AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.1.4

Power

Past-paper questions

Tier	**Higher**
Question groups	**161**
Available paper years	**2003–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.1.4 Power

Question 01

June 2003 | 3451H | Original Q15 | Legacy

15 (a) An electronic circuit in a freezer contains an alarm. This alarm will sound if the temperature inside the freezer rises above –15 °C. The alarm will also sound if the freezer door is left open for more than 45 seconds.

In the electronic circuit, name:

(i) the logic gate;

.....

(1 mark)

(ii) an input sensor which could detect the temperature rise;

.....

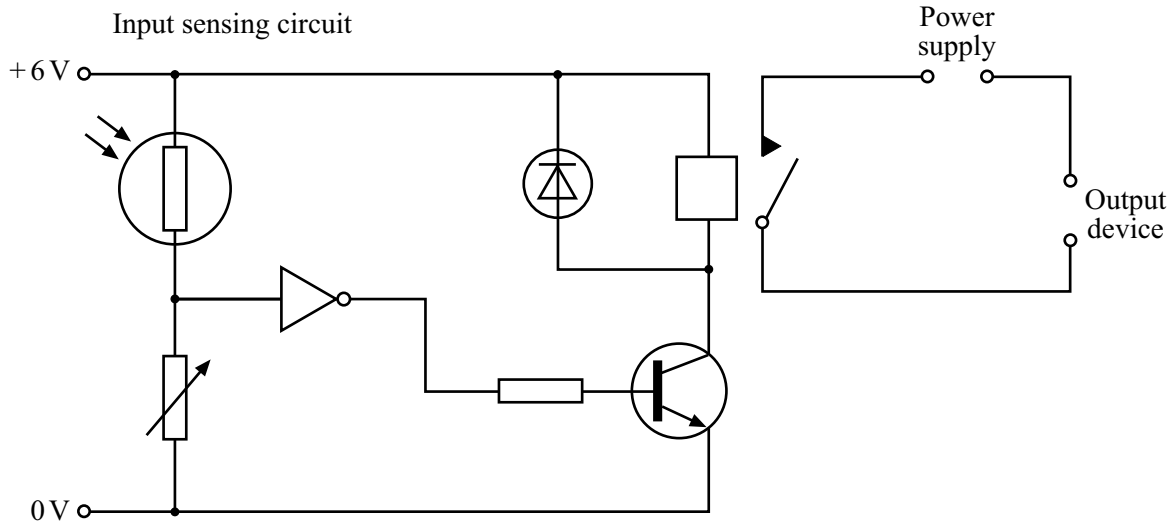
(1 mark)

(iii) a component which could act as a timer.

.....

(1 mark)

(b) The diagram shows a different system which could be used to switch on a security light, outside a house, at night. The diagram shows the input sensing circuit and the circuit for an output device.



4.1.1.4 Power

Question 01 · continued

MARGIN BLANK

(i) Complete the **five** spaces in these sentences to give the correct order for the events which occur.

As it gets dark, the resistance of the light dependent resistor (LDR) increases. The input to the logic gate will be ..... so the output will be ..... . Then the ..... will be switched on, the ..... will be switched on and the ..... will be switched on. *(5 marks)*

(ii) Explain why a diode is included in the circuit.

.....

.....

.....

.....

(2 marks)

(iii) Why is the diode reverse-biased?

.....

.....

(1 mark)

(iv) The system, in the diagram, can be modified to control a garden water fountain. This can be done by changing the output device to an electric pump.

The input sensing circuit could be modified so that the water fountain would operate only during the day.

Suggest **two** alternative ways in which the input sensing circuit could be modified so that it would have this result.

1 .....

.....

2 .....

.....

(2 marks)

13

4.1.1.4 Power

Question 02

June 2004 | 3451H | Original Q2 | Legacy

2 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

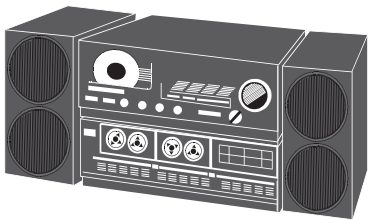
(1 mark)

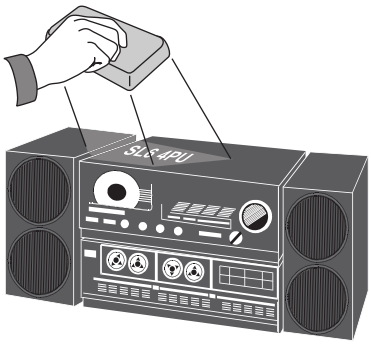
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.1.1.4 Power

Question 02 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred =.....kWh

(2 marks)

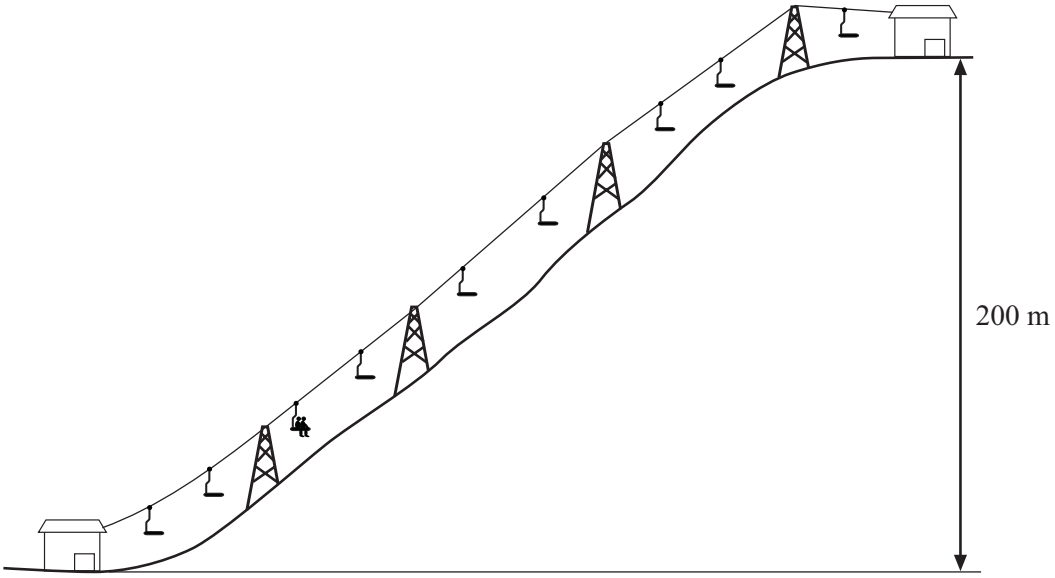
9

4.1.1.4 Power

Question 03

June 2004 | 3451H | Original Q6 | Legacy

6 (a) A chair lift carries two skiers, Greg and Jill, to the top of a ski slope. Greg weighs 700 N and Jill weighs 500 N.



(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

(ii) Calculate the work done to lift Greg and Jill through a vertical height of 200 m.
Show clearly how you work out your answer and give the unit.

.....

.....

.....

work done =.....

(3 marks)

4.1.1.4 Power

Question 03 · continued

MARGIN BLANK

(b) The chair takes 5 minutes to move from the bottom to the top of the ski slope.

Use the following equation to calculate the power required to lift Greg and Jill to the top of the ski slope. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....

.....

power = ...watts

(2 marks)

(c) The chair lift is driven by an electric motor.

(i) Why would the power output of the electric motor need to be larger than your answer to part (b)?

.....

.....

(1 mark)

(ii) Complete the following sentence.

When the ski lift is working ..... energy supplied to the motor is usefully transferred as gravitational ..... energy. *(1 mark)*

8

4.1.1.4 Power

Question 04

June 2004 | 3451H | Original Q10 | Legacy

10 (a) Nuclear power stations use the energy released by *nuclear fission* to generate electricity.

(i) Explain what is meant by *nuclear fission*.

.....

.....

.....

(2 marks)

(ii) How does nuclear fission lead to a chain reaction?

You may give your answer as a labelled diagram.

.....

.....

(1 mark)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is expensive. Why?

.....

.....

(1 mark)

(c) The table compares the energy released from 1 kg of coal and 1 kg of uranium.

Coal	29 MJ
Uranium	580 000 MJ

1 MJ = 1 000 000 joules

State **one** benefit to the environment of using a concentrated fuel like uranium to generate electricity rather than using the energy from coal.

.....

.....

(1 mark)

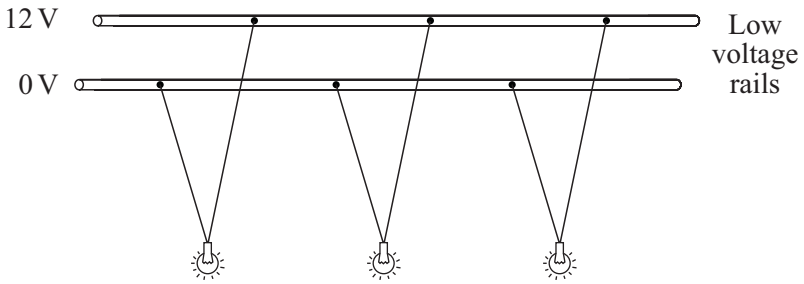
5

4.1.1.4 Power

Question 05

June 2004 | 3451H | Original Q13 | Legacy

13 (a) The diagram shows a 12 volt lighting system. Each lamp has a power of 32 watts.



(i) Write down the equation that links current, potential difference and power.

.....

(1 mark)

(ii) Calculate the input current to the lighting system. Show clearly how you work out your answer.

.....

.....

current =.....A

(2 marks)

(b) A transformer is used to reduce the 230 V a.c. mains to the 12 V supply required for the lighting system. The transformer has 1150 turns on its primary coil.

(i) Write down the equation which links the number of turns of each transformer coil to the voltage across each transformer coil.

.....

.....

(1 mark)

(ii) Calculate the number of turns on the secondary coil of the transformer. Show clearly how you work out your answer.

.....

.....

.....

number of turns on the secondary coil =.....

(2 marks)

6

4.1.1.4 Power

Question 06

June 2004 | 3462H3 | Original Q2 | Legacy

2 The diagram represents the electromagnetic spectrum.

Gamma rays	X-rays	Ultraviolet	Visible light	Infra red	Microwaves	Radio waves

(a) Name the type of electromagnetic radiation that is used:

(i) to sterilise surgical instruments;

.....

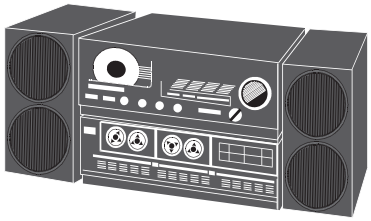
(1 mark)

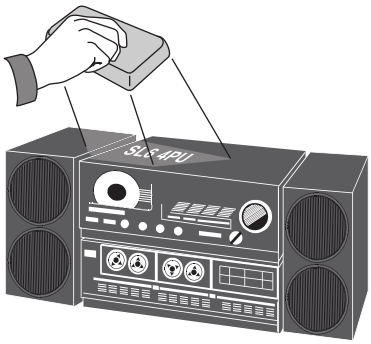
(ii) to send a signal to a TV from a remote control.

.....

(1 mark)

(b) Valuable items can be security marked using special ink. The ink can only be seen in ultraviolet radiation.





Explain what happens to make the ink visible.

.....

.....

.....

.....

(2 marks)

4.1.1.4 Power

Question 06 · continued

MARGIN BLANK

(c) Explain why skin cells need to be protected from ultraviolet radiation.

.....

.....

.....

.....

(2 marks)

(d) The following information is from an oven that combines a microwave and a grill.

Voltage	230 V
Microwave power	0.65 kW
Grill power	1.15 kW

(i) Name the **two** types of electromagnetic radiation that the oven can use to cook food.

..... and .....

(1 mark)

(ii) A joint of meat is cooked using both the microwave and the grill. Both are switched on at full power for half an hour.

Use the following equation to calculate the energy transferred, in kilowatt-hours, by the oven. Show clearly how you obtain your answer.

energy transferred = power × time

.....

.....

.....

energy transferred =.....kWh

(2 marks)

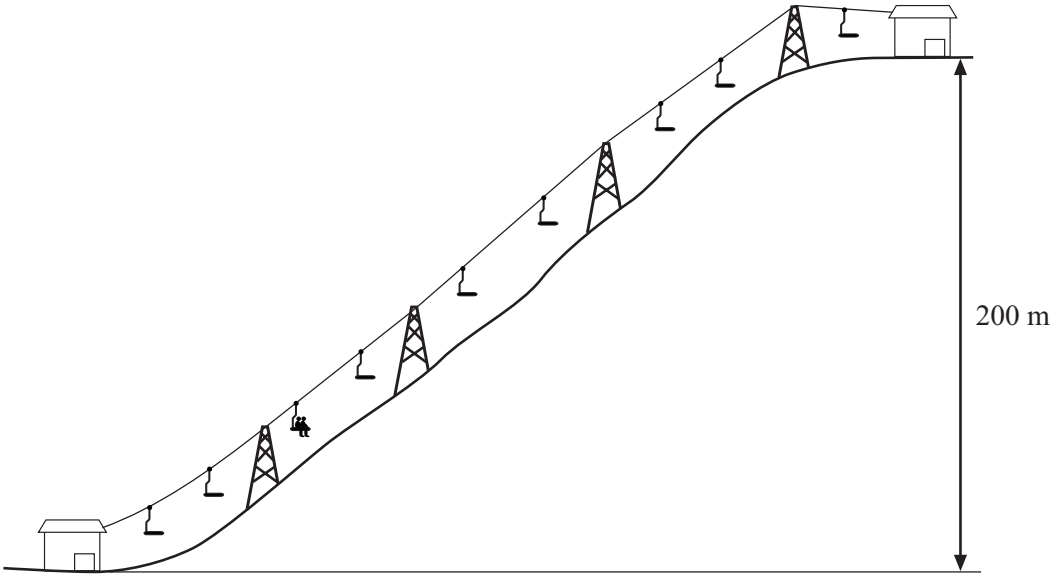
9

4.1.1.4 Power

Question 07

June 2004 | 3462H3 | Original Q6 | Legacy

6 (a) A chair lift carries two skiers, Greg and Jill, to the top of a ski slope. Greg weighs 700 N and Jill weighs 500 N.



(i) Write down the equation that links distance moved, force applied and work done.

.....

(1 mark)

(ii) Calculate the work done to lift Greg and Jill through a vertical height of 200 m.
Show clearly how you work out your answer and give the unit.

.....

.....

.....

work done =.....

(3 marks)

4.1.1.4 Power

Question 07 · continued

MARGIN BLANK

(b) The chair takes 5 minutes to move from the bottom to the top of the ski slope.

Use the following equation to calculate the power required to lift Greg and Jill to the top of the ski slope. Show clearly how you work out your answer.

$$\text{power} = \frac{\text{work done}}{\text{time taken}}$$

.....

.....

power = ...watts

(2 marks)

(c) The chair lift is driven by an electric motor.

(i) Why would the power output of the electric motor need to be larger than your answer to part (b)?

.....

.....

(1 mark)

(ii) Complete the following sentence.

When the ski lift is working ..... energy supplied to the motor is usefully transferred as gravitational ..... energy. *(1 mark)*

8

4.1.1.4 Power

Question 08

June 2004 | 3462H3 | Original Q8 | Legacy

8 (a) Nuclear power stations use the energy released by *nuclear fission* to generate electricity.

(i) Explain what is meant by *nuclear fission*.

.....

.....

.....

(2 marks)

(ii) How does nuclear fission lead to a chain reaction?

You may give your answer as a labelled diagram.

.....

.....

(1 mark)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is expensive. Why?

.....

.....

(1 mark)

(c) The table compares the energy released from 1 kg of coal and 1 kg of uranium.

Coal	29 MJ
Uranium	580 000 MJ

1 MJ = 1 000 000 joules

State **one** benefit to the environment of using a concentrated fuel like uranium to generate electricity rather than using the energy from coal.

.....

.....

(1 mark)

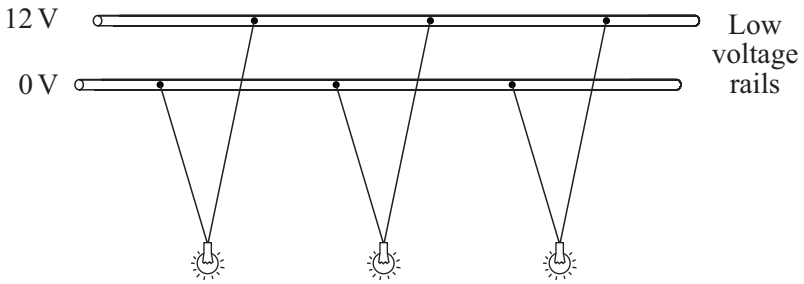
5

4.1.1.4 Power

Question 09

June 2004 | 3462H3 | Original Q11 | Legacy

11 (a) The diagram shows a 12 volt lighting system. Each lamp has a power of 32 watts.



(i) Write down the equation that links current, potential difference and power.

.....

(1 mark)

(ii) Calculate the input current to the lighting system. Show clearly how you work out your answer.

.....

.....

current =.....A

(2 marks)

(b) A transformer is used to reduce the 230 V a.c. mains to the 12 V supply required for the lighting system. The transformer has 1150 turns on its primary coil.

(i) Write down the equation which links the number of turns of each transformer coil to the voltage across each transformer coil.

.....

.....

(1 mark)

(ii) Calculate the number of turns on the secondary coil of the transformer. Show clearly how you work out your answer.

.....

.....

.....

number of turns on the secondary coil =.....

(2 marks)

6

4.1.1.4 Power

Question 10

June 2006 | 3451 | Original Q13 | Legacy

13 (a) Some people think that more electricity should be generated using nuclear fuels.

What reasons might they give for thinking this?

.....

.....

.....

.....

(2 marks)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is high. Why?

.....

.....

(1 mark)

(c) Electricity can be generated using energy from the wind.

(i) On average a wind turbine produces only 24 % of the power it is capable of producing. Why?

.....

.....

(1 mark)

(ii) There is no fuel cost for a wind turbine. However, generating electricity from a wind farm costs more than generating the same power from a coal-burning power station. Why?

.....

.....

.....

.....

(2 marks)

6

4.1.1.4 Power

Question 11

June 2006 | 3462 | Original Q11 | Legacy

11 (a) Some people think that more electricity should be generated using nuclear fuels.

What reasons might they give for thinking this?

.....

.....

.....

.....

(2 marks)

(b) Although nuclear fuels are relatively cheap the total cost of generating electricity using nuclear fuels is high. Why?

.....

.....

(1 mark)

(c) Electricity can be generated using energy from the wind.

(i) On average a wind turbine produces only 24 % of the power it is capable of producing. Why?

.....

.....

(1 mark)

(ii) There is no fuel cost for a wind turbine. However, generating electricity from a wind farm costs more than generating the same power from a coal-burning power station. Why?

.....

.....

.....

.....

(2 marks)

6

4.1.1.4 Power

Question 12

November 2006 | PHY1A | Original Q8 | Legacy

QUESTION EIGHT

Read this summary of a report on future energy supplies.

- By 2020, the UK should get 20 % of its electricity from wind power
- Thousands of wind turbines will need to be erected
- Very large wind turbines should be erected out at sea
- Fewer nuclear power stations will need to be built

8A Which one of the following statements describes an advantage of wind power over nuclear power?

1 Wind power does not make any dangerous waste.

2 Wind power puts less carbon dioxide into the atmosphere.

3 Wind power puts less sulfur dioxide into the atmosphere.

4 Wind turbines do not cause pollution in their manufacture.

8B Large wind turbines may be set up far out at sea because . . .

1 there is less air pollution than on land.

2 there is no danger to wildlife.

3 they cause less visual pollution than on land.

4 the wind speed is constant.

8C Why does a nuclear power station take up less space than a wind farm producing the same amount of energy?

1 The nuclear power station produces less electricity than a wind farm.

2 The energy in the wind is more spread out than the energy in nuclear fuels.

3 Nuclear power stations are usually built near the coast.

4 Nuclear power stations produce radioactive waste which must be contained.

4.1.1.4 Power

8D Which one of the following statements describes an advantage of nuclear power over wind power?

1 Electricity can be produced from nuclear power at any time and in any weather.

2 Fuel costs for nuclear power are very low.

3 Nuclear power does not cause atmospheric pollution.

4 Nuclear power does not damage river estuaries.

Turn over for the next question

4.1.1.4 Power

Question 13

November 2006 | PHY1A | Original Q9 | Legacy

QUESTION NINE

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

A village is many kilometres away from a supply of mains electricity. The sun shines for at least a few hours nearly every day. The villagers want a supply of electricity for a radio receiver. The table shows the costs of two different ways of providing the electricity over a 20-year period.

Way of providing electricity	Equipment cost	Cost of a set of batteries	Number of sets of batteries needed
Solar cells and rechargeable batteries	£75.00	£12.50	4
'Throwaway' batteries	Zero	£2.75	80

9A What are the total costs over the 20-year period of the different ways of providing electricity?

	Solar cells and rechargeable batteries	'Throwaway' batteries
1	£87.50	£220.00
2	£87.50	£231.00
3	£125.00	£220.00
4	£125.00	£231.00

9B One disadvantage of using solar cells and rechargeable batteries is that . . .

1 new batteries are needed more often.

2 the radio could not be used at night.

3 they are more expensive in the long run.

4 they cost more in the first place.

Question 13 · continued

9C Another battery of solar cells has a maximum output of 1 kW. The battery, when used in the UK, produces, on average, 10 % of its maximum output. The battery costs £ 4000 and has an expected life of 200 000 hours. The cells have no maintenance costs.

What is the cost of each kilowatt-hour of electricity produced by the battery of solar cells when used in the UK?

1 20 p

2 25 p

3 40 p

4 50 p

9D Electricity from solar cells is more expensive than electricity generated in power stations.

Which of the following would make the cost of electricity from solar cells cheaper?

1 A decrease in the cost of fuel for normal types of power station.

2 Developing solar cells that are smaller.

3 Developing other alternative energy technologies.

4 Reducing the cost of solar cells by mass production.

END OF TEST

4.1.1.4 Power

Question 14

January 2007 | PHY1H | Original Q6 | Legacy

6 There is an increasing demand for electricity and the reserve of fossil fuels is decreasing. A way to meet increasing demand for electricity is to build new nuclear power stations. Some people feel that no new nuclear power stations should be built because of the risks associated with nuclear fuels.

(a) Outline the arguments that a scientist working in the nuclear power industry could use to justify the building of more nuclear power stations in the future.

.....

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.....

(3 marks)

(b) Nuclear waste is a problem that must be dealt with. One possible solution would be to bury the waste deep underground.

Suggest **one** reason why some people are against burying nuclear waste.

.....

.....

(1 mark)

4.1.1.4 Power

Question 14 · continued

BLANK

(c) Electricity can also be generated using renewable energy sources.

Look at this information from a newspaper report.

- The energy from burning bio-fuels, such as woodchip and straw, can be used to generate electricity.
- Plants for bio-fuels use up carbon dioxide as they grow.
- Farmers get grants to grow plants for bio-fuels.
- Electricity generated from bio-fuels can be sold at a higher price than electricity generated from burning fossil fuels.
- Growing plants for bio-fuels offers new opportunities for rural communities.

Suggest why, apart from the declining reserves of fossil fuels, power companies should use more bio-fuels and less fossil fuels to generate electricity.

.....

.....

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.....

.....

.....

(3 marks)

7

4.1.1.4 Power

Question 15

March 2007 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

This statement was made during a recent television news programme.

> Environmentalists expressed concern today about possible increases in acid rain if the Government goes ahead with its plans for more power stations.
>
> "If the world needs more power stations, they should be wind farms, tidal barrages or geothermal," a spokesperson said.

5A The gas mainly responsible for producing acid rain is . . .

1 natural gas.

2 nitrogen.

3 oxygen.

4 sulfur dioxide.

5B The source of energy for geothermal power stations is . . .

1 combustion.

2 decay of radioactive elements.

3 movement of air.

4 movement of water.

5C Which is the main advantage of a tidal barrage over a wind farm?

1 More power is produced at times of high demand.

2 More power is produced in winter than in summer.

3 There are no environmental impacts.

4 The outputs for each day can be predicted.

4.1.1.4 Power

Question 15 · continued

5D 700 000 kilowatts of power are produced when 100 tonnes of coal are burned in one hour.

How quickly must the coal be burned to produce 7 000 000 kilowatts?

1 10 tonnes/hour

2 70 tonnes/hour

3 100 tonnes/hour

4 1000 tonnes/hour

Turn over for the next question

4.1.1.4 Power

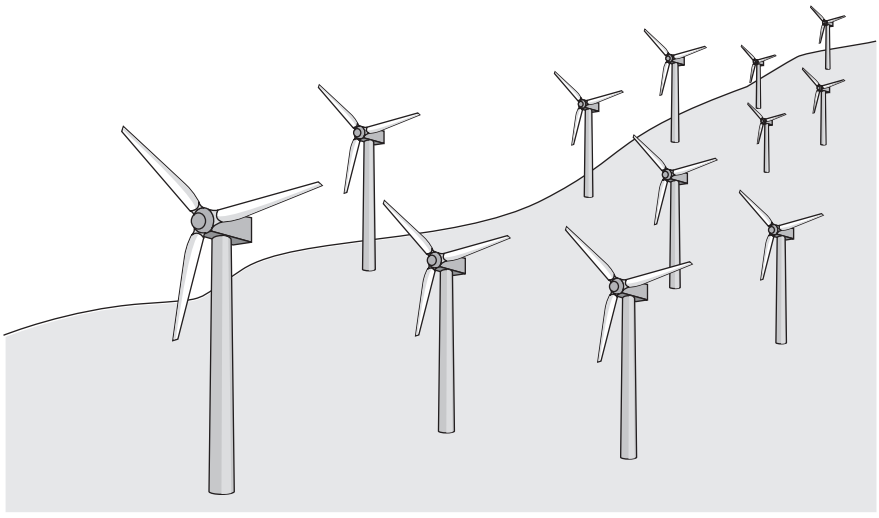
Question 16

March 2007 | PHY1A | Original Q6 | Legacy

QUESTION SIX

Wind turbines on Coldharbour site

The drawing shows part of a wind farm which will supply electricity to a small town.



6A Which type of energy is transformed from the wind to generate electricity?

1 elastic potential

2 gravitational potential

3 kinetic

4 sound

6B Where would you **least** expect to find a wind farm?

1 in a town

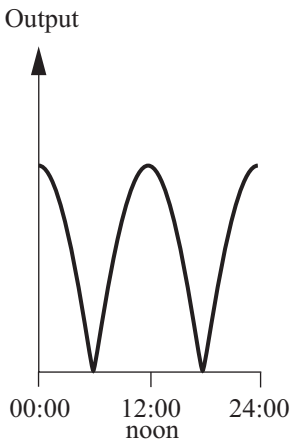
2 offshore – out at sea

3 on a coastal cliff

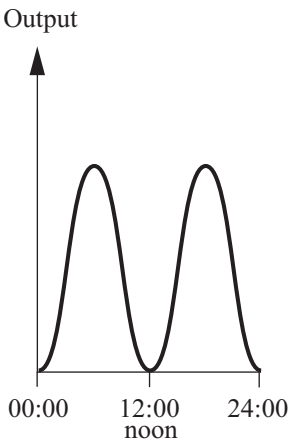
4 on the top of a hill

Question 16 · continued

6C Which graph is most likely to show the output from a wind farm over one day?



1



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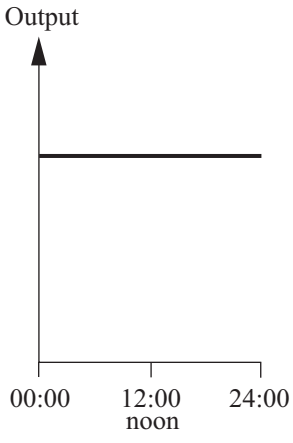

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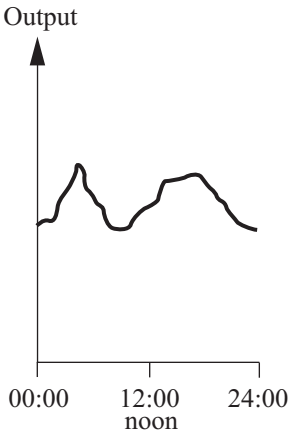


4

6D There are 10 000 homes in the town. The average electrical power input into each home is 0.5 kW. The average useful power output of the wind farm is 5 MW.

Why is this insufficient to meet the needs of the town?

1 0.5 kW × 10 000 is more than 5 MW.

2 5 MW is less than 0.5 kW × 10 000.

3 Supply and demand will often not coincide.

4 The wind farm wastes energy because it is noisy.

4.1.1.4 Power

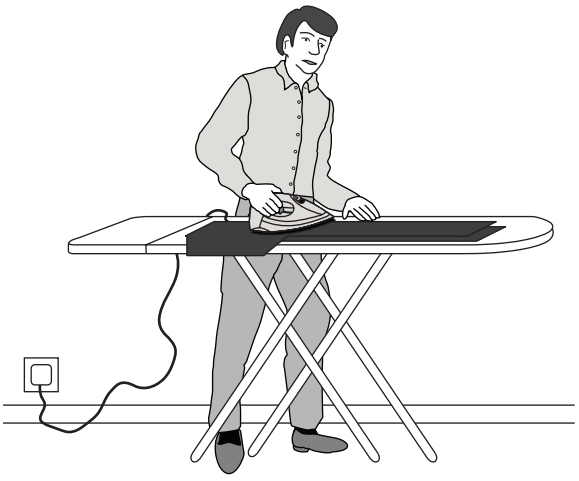
Question 17

March 2007 | PHY1A | Original Q7 | Legacy

QUESTION SEVEN

energy transferred (joule, J)	=	power (watt, W)	×	time (second, s)
energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)
total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

This question is about an electric iron. The power of the iron is 1.2 kW.



7A The base of the iron radiates energy.

It will radiate **least** energy when the base is . . .

1 at a high temperature and black.

2 at a high temperature and shiny.

3 at a low temperature and black.

4 at a low temperature and shiny.

4.1.1.4 Power

Question 17 · continued

7B What is the maximum quantity of energy, in joules, that can be transformed by the iron in one hour?

1 72 J

2 4320 J

3 72 000 J

4 4 320 000 J

7C When the iron is used for one hour, less than the calculated maximum amount of energy is transformed.

Why is this?

1 Some energy is provided by the person doing the ironing.

2 Some energy is transferred to the surroundings.

3 The ironing board is covered with an insulator.

4 The iron switches off at times to keep it at the correct temperature.

7D Electricity costs 10 p per kilowatt-hour. In one week, the iron uses electricity for a total of 90 minutes.

Calculate the cost of this electricity.

1 £ 0.15

2 £ 0.18

3 £ 0.90

4 £ 1.08

4.1.1.4 Power

Question 18

March 2007 | PHY1A | Original Q9 | Legacy

QUESTION NINE

The table gives the estimated costs, per kilowatt-hour, of generating electricity from four different energy sources.

Use the information in the table to help you to answer some of the questions.

Energy source	Building cost	Fuel cost	Operating cost	Decommissioning cost
Coal	2.0 p	0.6 p	0.9 p	0.1 p
Gas	2.3 p	1.4 p	0.3 p	0.1 p
Nuclear	4.2 p	0.4 p	0.7 p	2.5 p
Wind	4.8 p	zero	0.9 p	0.2 p

9A A power station must run continuously to meet a steady demand.

Ignoring the decommissioning and building costs, which power station would be economically best?

1 coal

2 gas

3 nuclear

4 wind

9B Which of the following is the correct order, cheapest first, for the **total** cost of producing each kWh of electricity?

1 coal, gas, wind, nuclear

2 gas, coal, nuclear, wind

3 nuclear, wind, gas, coal

4 wind, gas, coal, nuclear

Question 18 · continued

9C Which type of power station is the best for meeting short surges in demand for electricity?

1 coal

2 gas

3 nuclear

4 wind

9D Electricity produced from the wind costs more than electricity produced from fossil fuel power stations.

This is mainly because . . .

1 each wind turbine has a low output, so hundreds of them are needed to produce as much electricity as a fossil fuel power station.

2 wind turbines are usually erected on high ground and are unsightly, noisy and dependent on the weather conditions.

3 wind turbines have high decommissioning costs compared with fossil fuel power stations such as those using coal or oil.

4 wind turbines have high operating costs resulting from the high cost of maintaining a large number of them.

END OF TEST

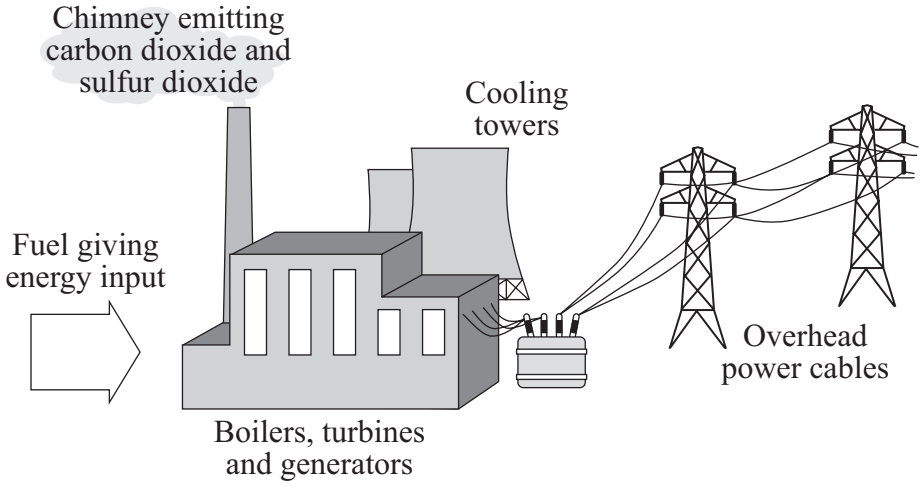
4.1.1.4 Power

Question 19

June 2007 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

The diagram shows a power station.



5A What type of power station is this?

1 coal-burning

2 gas-burning

3 geothermal

4 nuclear

5B Which part transforms kinetic energy into electrical energy?

1 boiler

2 cooling tower

3 generator

4 turbine

4.1.1.4 Power

Question 19 · continued

5C After steam has passed through the turbines, it is passed upwards through the cooling towers. Here, the steam condenses to form water vapour.

What types of pollution are caused by the cooling towers?

1 chemical and noise

2 noise and thermal

3 thermal and visual

4 visual and chemical

5D A fossil-fuel power station is going to be built in a part of the country that does not have a power station.

Which one of the following is **not** an advantage to the local economy?

1 Carbon dioxide from the power station can be used in local commercial greenhouses.

2 More jobs will be created.

3 The power station will be connected to the National Grid.

4 Waste heat can be used in nearby buildings.

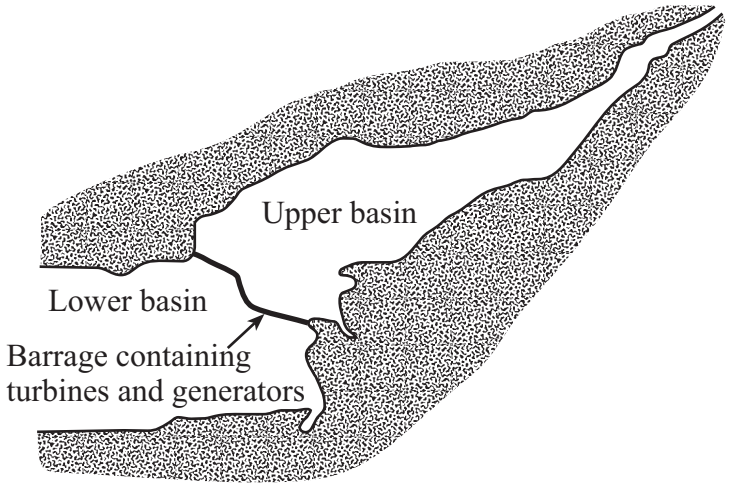
4.1.1.4 Power

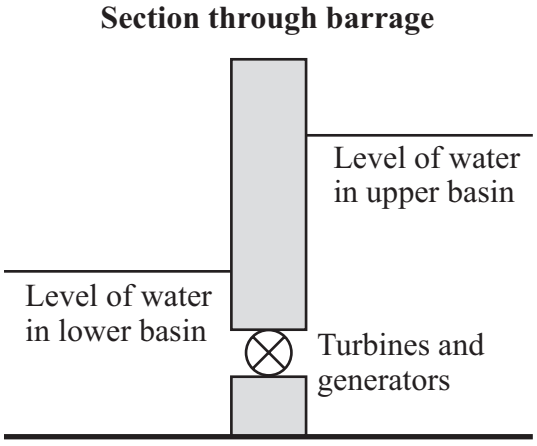
Question 20

June 2007 | PHY1A | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows a tidal barrage used to generate electricity. Before the barrage was built, the mudflats on the estuary were repeatedly covered with sea water as the tide came in and went out again.





7A As water moves from the lower basin into the upper basin, it gains mainly . . .

1 electrical energy.

2 gravitational potential energy.

3 sound energy.

4 thermal energy.

7B Which is the main energy transformation as water flows from the upper basin through the turbine?

1 electrical energy to gravitational potential energy

2 electrical energy to kinetic energy

3 gravitational potential energy to kinetic energy

4 kinetic energy to gravitational potential energy

4.1.1.4 Power

Question 20 · continued

7C Compared with a coal-fired power station with a similar generating capacity, a tidal barrage usually . . .

1 costs more to build.

2 has a more concentrated energy supply.

3 has higher fuel costs.

4 has a more constant energy output.

7D One disadvantage of this tidal barrage is that . . .

1 it cannot be used in summer.

2 it has high decommissioning costs.

3 its output depends on the weather.

4 large areas forming habitats for wildlife will be lost.

4.1.1.4 Power

Question 21

June 2007 | PHY1A | Original Q9 | Legacy

QUESTION NINE

The table shows the various costs, per kilowatt-hour, of electricity that is generated in four different ways.

Energy source	Capital cost	Running cost	Decommissioning cost
Nuclear	3.0 p	0.5 p	2.5 p
Gas	1.5 p	2.0 p	0.1 p
Coal	2.0 p	2.5 p	0.1 p
Wind	4.5 p	0.1 p	0.2 p

9A Considering only running cost, how much more does it cost to generate 1000 kilowatt-hours of electricity in a coal-fired power station than in a gas-fired power station?

1 £ 5

2 £ 15

3 £ 20

4 £ 25

9B It costs more to produce electricity from wind farms than from fuel-burning power stations.

This is mainly because wind generators . . .

1 have higher decommissioning costs.

2 have only very recently been developed.

3 have higher running costs.

4 use a dilute energy source.

4.1.1.4 Power

Question 21 · continued

9C In the UK, most new power stations are gas-fired.

This is because, compared with all the other ways of generating electricity shown in the table, . . .

1 they cause less atmospheric pollution.

2 they are cheaper to build and cheaper overall.

3 they have lower running costs.

4 they use a renewable energy source.

9D Which one of the four ways of generating electricity is most suited to meeting short surges in the demand for electricity at any time of the day?

1 coal

2 gas

3 nuclear

4 wind

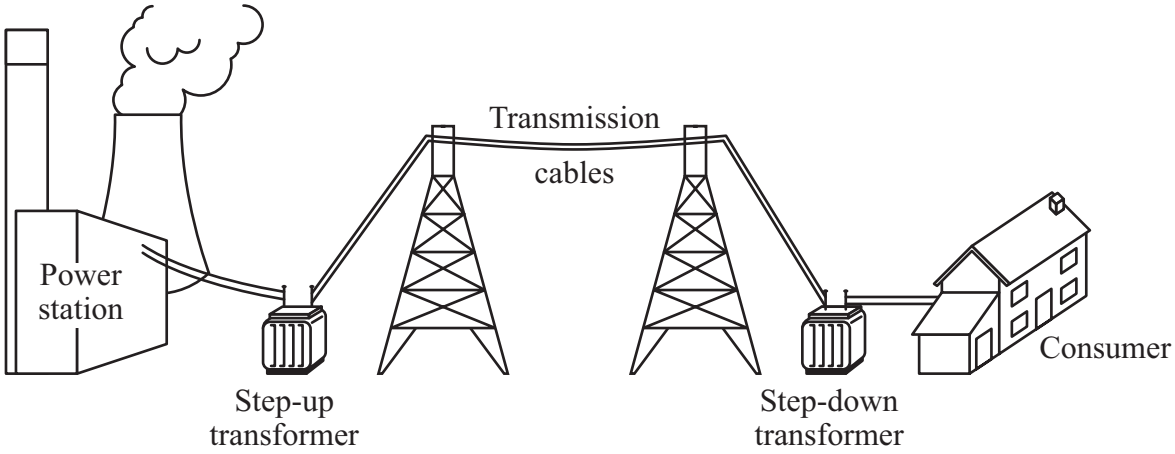
END OF TEST

4.1.1.4 Power

Question 22

June 2007 | PHY1H | Original Q3 | Legacy

3 The diagram shows how electricity is distributed from power stations to consumers.



(a) (i) What name is given to the network of cables and transformers that links power stations to consumers?

.....

(1 mark)

(ii) What does a step-up transformer do?

.....

(1 mark)

(iii) Explain why step-up transformers are used in the electricity distribution system.

.....

.....

.....

.....

(2 marks)

(b) Most of the world's electricity is generated in power stations that burn fossil fuels.

State **one** environmental problem that burning fossil fuels produces.

.....

.....

(1 mark)

4.1.1.4 Power

Question 22 · continued

BLANK

(c) Electricity can be generated using energy from the wind. A company wants to build a new wind farm. Not everyone thinks that this is a good idea.



(i) What arguments could the company give to persuade people that a wind farm is a good idea?

.....

.....

.....

.....

(2 marks)

(ii) What reasons may be given by the people who think that wind farms are **not** a good idea?

.....

.....

.....

.....

(2 marks)

9

4.1.1.4 Power

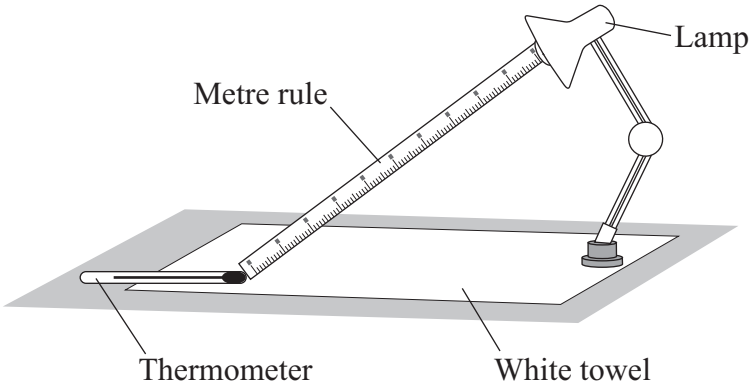
Question 23

November 2007 | PHY1A | Original Q3 | Legacy

QUESTION THREE

A student investigated the heat output from four different makes of lamp, **W**, **X**, **Y** and **Z**. Each lamp had the same power.

The diagram shows the apparatus she used.



- She recorded the initial temperature shown by the thermometer.
- She then switched on lamp **W**.
- Five minutes later, she recorded the final temperature shown by the thermometer.
- She repeated this procedure for lamps **X**, **Y** and **Z**.

The table shows her results.

Lamp	Initial temperature in °C	Final temperature in °C
W	17	27
X	18	26
Y	20	28
Z	22	29

4.1.1.4 Power

Question 23 · continued

3A What kind of variable was the make of lamp?

1 categoric

2 continuous

3 dependent

4 ordered

3B Which of these was **not** a control variable in this investigation?

1 make of lamp

2 distance of thermometer from lamp

3 length of time the lamp was switched on

4 the white towel

3C Which lamp caused the largest rise in temperature in the thermometer?

1 **W**

2 **X**

3 **Y**

4 **Z**

3D Which lamp seems to be the most efficient in producing light?

1 **W**

2 **X**

3 **Y**

4 **Z**

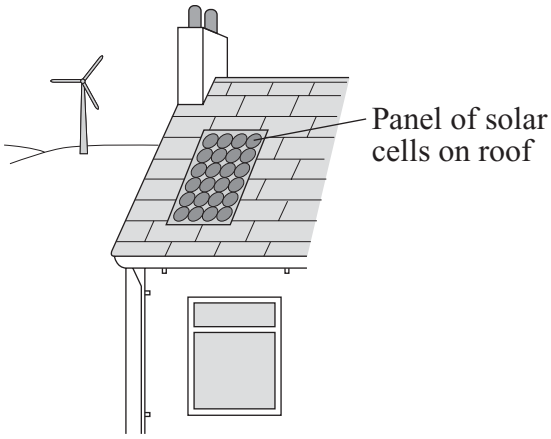
4.1.1.4 Power

Question 24

November 2007 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

A house on a Scottish island uses solar cells to produce some of the electricity needed for lights and for pumping water.



The panel of solar cells cost £300 and has a maximum output of 33 W.

On average, over 24 hours, it produces $\frac{1}{8}$ of its maximum output.

5A How many kilowatt-hours of electricity does the panel of solar cells produce, on average, each 24 hours?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 0.004125

2 0.099

3 0.792

4 356.4

5B The panel of solar cells has an expected life of 10 000 days.

What is the cost of the panel for each day of its life?

1 0.03 p

2 0.3 p

3 3.0 p

4 30 p

4.1.1.4 Power

Question 24 · continued

5C Most of the electricity for the house is produced by a wind generator.

The solar cells are also used . . .

1 because they produce electricity at such a low cost per kilowatt-hour.

2 because they may produce electricity at times when there is no wind.

3 because they will produce electricity all the time.

4 because they produce electricity at times when it is most likely to be needed.

5D Which of the following sentences about solar cells is true?

1 Electricity from solar cells is used to heat water in panels on house roofs.

2 Solar cells use a **non**-renewable energy source.

3 Solar cells will **not** work on cloudy days.

4 Solar cells transform light energy to electrical energy.

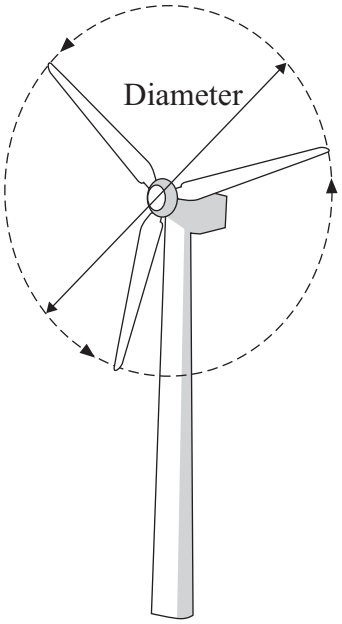
4.1.1.4 Power

Question 25

November 2007 | PHY1A | Original Q7 | Legacy

QUESTION SEVEN

The electrical power output from a wind turbine depends on the diameter of the turbine and on the wind speed.



Turbine diameter in metres	Electrical power output in watts for a wind speed of 6 metres per second
2	60
3	135
4	240
5	375
6	540

7A Which conclusion about the electrical power output is correct for this data?

1 It increases in direct proportion to the diameter.

2 It increases in inverse proportion to the diameter.

3 It increases in inverse proportion to the radius.

4 It increases in direct proportion to the square of the diameter.

4.1.1.4 Power

Question 25 · continued

7B The power output of a wind turbine . . .

1 is constant all the year round.

2 is greater in summer than winter.

3 varies on a monthly cycle.

4 varies throughout the year.

7C An advantage of wind turbines compared with a hydroelectric power station is that . . .

1 their dismantling cost is low.

2 there is no output of polluting gases during their construction.

3 they have no visual impact on their surroundings.

4 they work equally well in any location.

7D A disadvantage of wind turbines compared with a hydroelectric power station is that . . .

1 many hundreds are needed to produce the same power output.

2 their total atmospheric pollution in use is greater.

3 their total fuel costs are higher.

4 they use a non-renewable energy source.

4.1.1.4 Power

Question 26

November 2007 | PHY1A | Original Q8 | Legacy

QUESTION EIGHT

Transformers are used in the National Grid.

8A Two types of transformer are used in various parts of the National Grid.

Which row in the table shows the correct locations of the two types of transformer?

	Between generators and power lines	Between power lines and substation	Between substation and people's homes
1	step-down	step-down	step-up
2	step-down	step-up	step-up
3	step-up	step-down	step-down
4	step-up	step-up	step-down

8B Transformers alter the potential difference across the power lines and the current through the power lines. These changes affect the efficiency of the power lines.

Which row in the table is correct?

	Potential difference across power lines	Current through power lines	Efficiency of transmission
1	decreased	decreased	decreased
2	decreased	increased	increased
3	increased	decreased	increased
4	increased	increased	increased

4.1.1.4 Power

Question 26 · continued

8C The table shows the percentage of energy wasted as heat and sound by four different transformers.

Which transformer has the highest efficiency?

Transformer	Percentage of energy supplied to transformer which is wasted as sound	Percentage of energy supplied to transformer which is wasted as heat
1	1.1	7.4
2	1.2	4.7
3	1.3	5.4
4	1.4	6.9

8D The amount of electricity that a device transforms depends on the rate at which the device transforms energy and . . .

1 how long the device is switched on.

2 the current through the device.

3 the potential difference across the device.

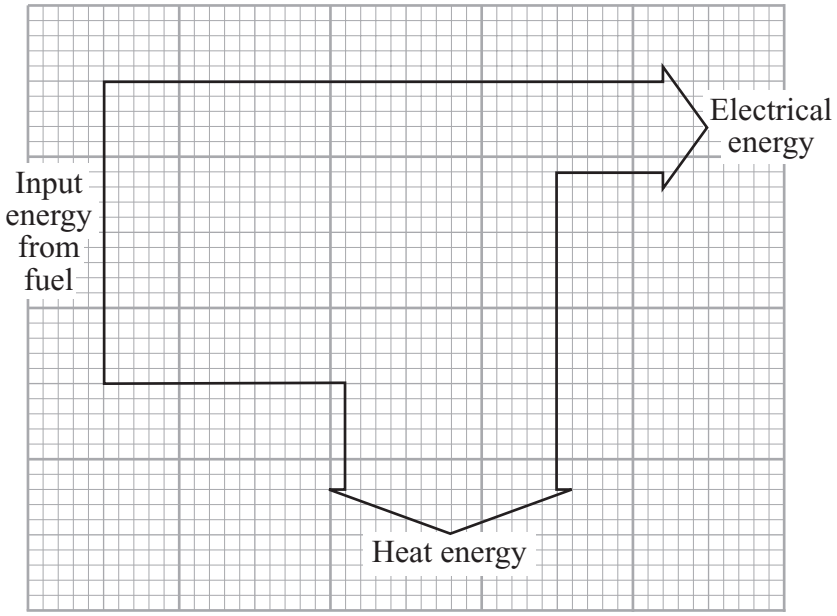
4 the power of the device.

4.1.1.4 Power

Question 27

January 2008 | PHY1H | Original Q1 | Legacy

1 (a) The diagram shows the energy transformations in a fuel burning power station.



(i) Name **one** fuel that is burned to provide the energy source for a power station.

.....

(1 mark)

(ii) Use the diagram and the equation in the box to calculate the efficiency of the power station.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2 marks)

(iii) Name the process by which a nuclear fuel provides the energy needed to generate electricity in a nuclear power station.

.....

(1 mark)

Question 1 continues on the next page

4.1.1.4 Power

Question 27 · continued

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(b) Electricity is distributed from power stations to consumers along the National Grid.

(i) Transformers are part of the National Grid. Transformers are *efficient* devices.

What is meant by a device being *efficient*?

.....

.....

(1 mark)

(ii) When electricity flows through a cable, some energy is transformed into heat.

Explain how the National Grid system reduces the amount of energy lost as heat.

.....

.....

.....

.....

(2 marks)

(c) Read this information taken from a recent newspaper article.

- Researchers have found that children living close to overhead power cables are more likely to develop leukaemia.
- The researchers studied two groups of children. One group had developed leukaemia, the other group was healthy.
- Although the researchers found a link, they are unable to explain why it happened. They say that the results may have happened by chance.
- Other factors that have not been investigated, such as the environment, the geographical area or the children's genes, could be important.
- A cancer research charity said that childhood leukaemia was most likely to be caused by factors that parents were unable to control.

(i) Why did the researchers study a group of healthy children?

.....

.....

(1 mark)

4.1.1.4 Power

Question 27 · continued

BLANK

(ii) The information does not say how many children were studied.

Why should this data have been included in the article?

.....

.....

(1 mark)

(iii) The researchers could not be certain that the overhead power cables were responsible for the increased chance of children developing leukaemia.

Explain why.

.....

.....

.....

.....

(2 marks)

(iv) The results of the research carried out by scientists may worry some people.

What do you think scientists should do?

Put a tick (✓) in the box next to your choice.

Scientists should publish their research findings straight away. ☐

Scientists should not publish their research findings until they have found out as many facts as possible. ☐

Give a reason for your choice.

.....

.....

(1 mark)

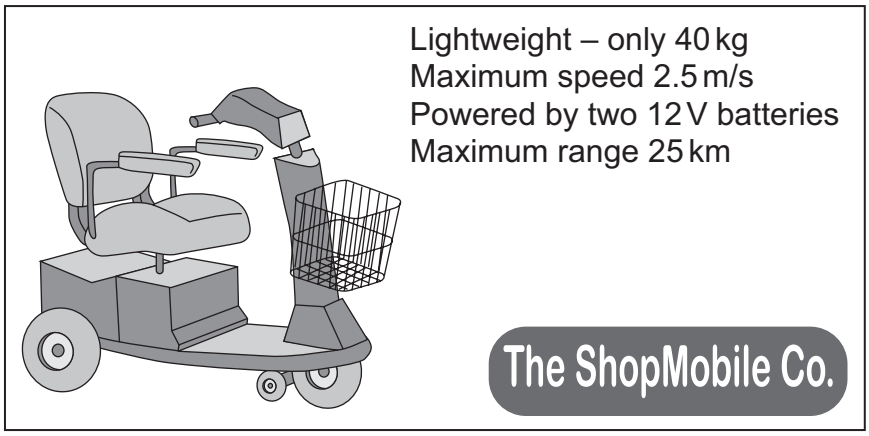
12

4.1.1.4 Power

Question 28

January 2008 | PHY2H | Original Q3 | Legacy

3 The picture shows an advert for an electric mobility scooter.



(a) The batteries are joined in series.

(i) What is the potential difference provided by the batteries to the motor?

.....

(1 mark)

(ii) The batteries supply a *direct current (d.c.)*.

What is a *direct current (d.c.)*?

.....

.....

(1 mark)

(b) At 2.5 m/s on flat ground, the motor takes a current of 3.0 A from the batteries.

(i) Explain why a bigger current is taken from the batteries when the scooter is going uphill at 2.5 m/s.

.....

.....

.....

.....

(2 marks)

4.1.1.4 Power

Question 28 · continued

BLANK

(ii) What effect does travelling uphill have on the range of the scooter?

.....

(1 mark)

(c) The mass of the scooter driver is 80 kg.

Use the equation in the box to calculate the kinetic energy of the scooter **and** driver when they are travelling at maximum speed.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2 marks)

(d) A battery which has run down is recharged in 8 hours. The average current delivered by the battery charger is 1.5 A.

Use the equation in the box to calculate the maximum charge stored by **both** batteries.

$$\text{charge} = \text{current} \times \text{time}$$

Show clearly how you work out your answer and give the unit.

.....

.....

Charge stored = ...

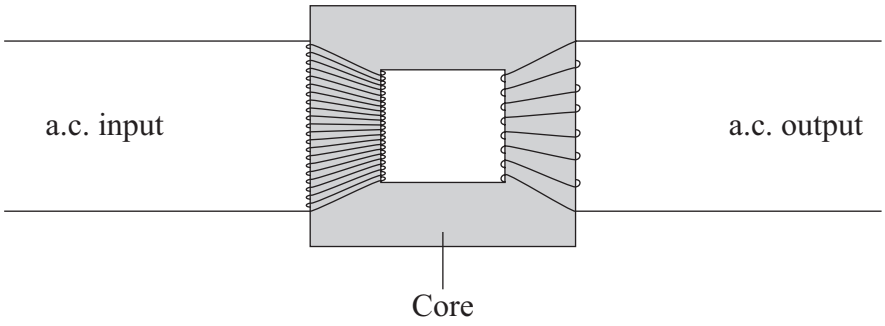
(3 marks)

10

4.1.1.4 Power

Question 29

6 (a) The diagram shows a transformer.



(i) Is the transformer in the diagram being used as a step-up transformer or as a step-down transformer?

Put a tick (✓) in the box next to your answer.

a step-up transformer ☐

a step-down transformer ☐

Explain your answer.

.....

.....

(1 mark)

(ii) Why is insulated wire, and not uninsulated wire, used to make the coils?

.....

.....

(1 mark)

(iii) Why is the core made of iron?

.....

.....

(1 mark)

4.1.1.4 Power

Question 29 · continued

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(b) A transformer has 500 turns on its primary coil and 7500 turns on its secondary coil. The potential difference across the primary coil is 150 volts.

Use the equation in the box to calculate the potential difference across the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

.....

.....

.....

Potential difference across the secondary coil = ... volts

(2 marks)

(c) Step-down transformers are used between power lines and people's houses.

Explain why.

.....

.....

.....

(2 marks)

(d) Before 1926, large towns had their own local power stations. After 1926, these power stations were connected to form the National Grid.

Explain the advantage of having a National Grid system.

.....

.....

.....

.....

(2 marks)

9

4.1.1.4 Power

Question 30

March 2008 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

A geothermal power station uses the energy in hot rocks to produce electricity.

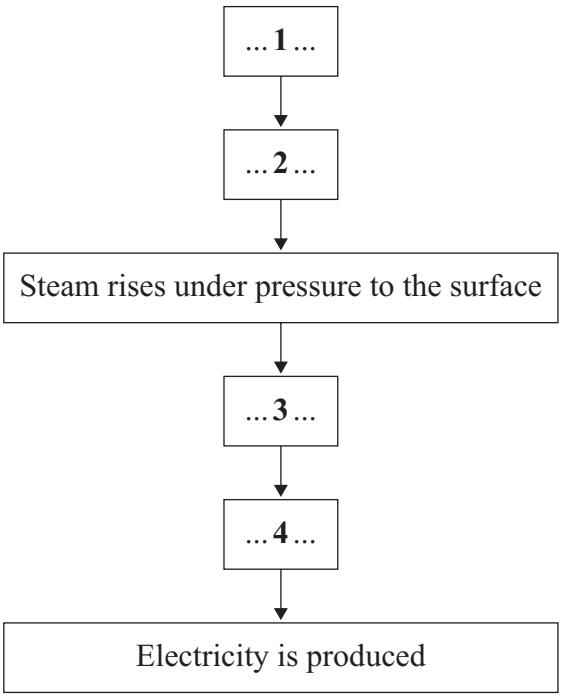
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart to explain how the power station works.

A cold water is pumped into the rocks

B steam drives turbines

C turbines drive generators

D water is heated by radioactive decay



4.1.1.4 Power

Question 31

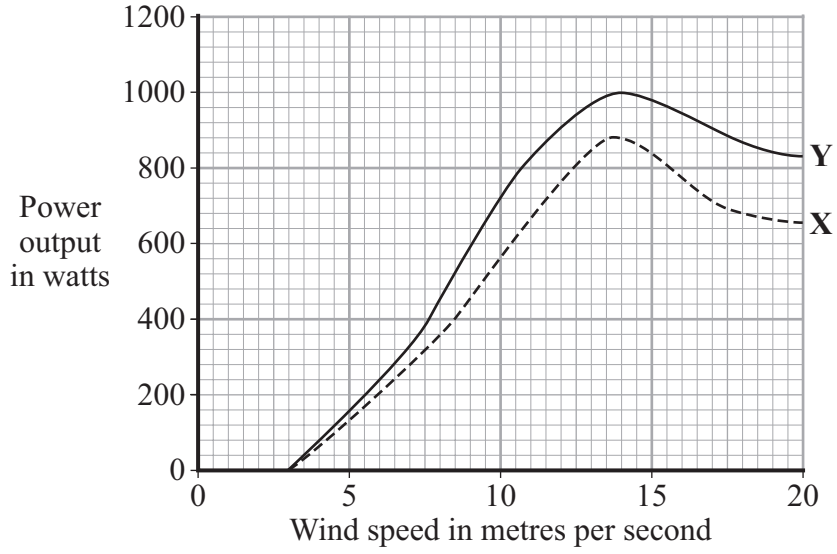
March 2008 | PHY1AP | Original Q4 | Legacy

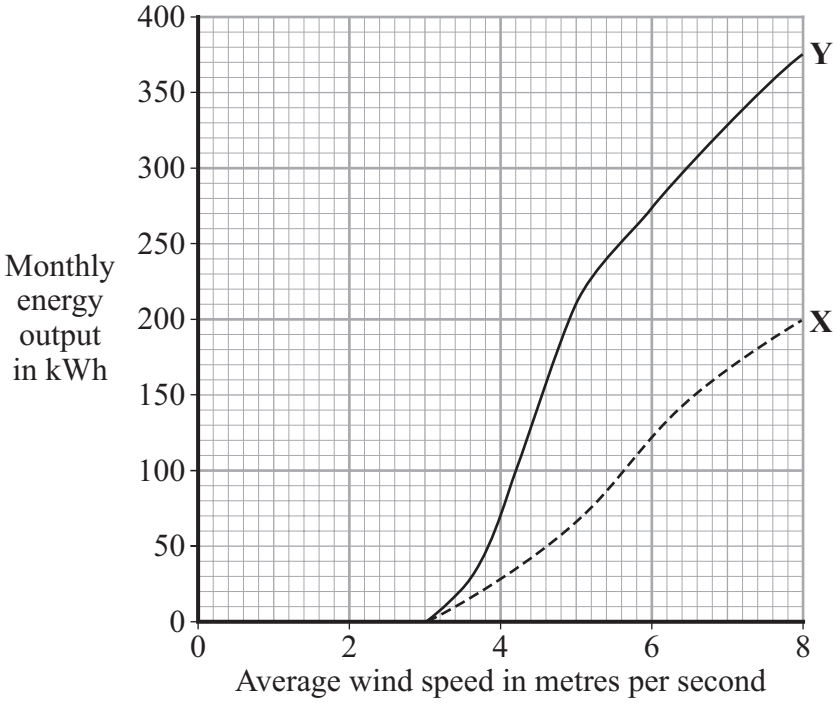
QUESTION FOUR

Many people are now installing wind turbines at their homes to produce electricity.

A customer has to decide which turbine to install.

The graphs show the performance of two models of wind turbine, **X** and **Y**.





4A How much greater is the maximum power produced by turbine **Y** than that produced by turbine **X**?

1 80 W

2 120 W

3 880 W

4 1000 W

4.1.1.4 Power

Question 31 · continued

4B Which one of the following statements about the relationship between average wind speed and monthly energy output by turbine **X** is true?

1 An increase in average wind speed always causes an increase in monthly energy output.

2 As average wind speed doubles, monthly energy output doubles.

3 Above a certain average wind speed, monthly energy output falls.

4 At average wind speeds below 2 m/s, a 10 % increase in wind speed has no effect on monthly energy output.

4C Turbine **X** can be bought and installed for £750; turbine **Y** can be bought and installed for £1500.

A person lives in an area where the maximum wind speed is 10 m/s and the average annual wind speed is 3.5 m/s. A salesman advises the person to buy turbine **Y** because it produces more power.

Is the advice given by the salesman the best advice?

1 Yes, because turbine **Y** always produces more power than turbine **X**.

2 Yes, because as wind speed increases above 3 m/s, power output increases more rapidly from turbine **Y** than from turbine **X**.

3 No, because there is very little difference between the monthly energy output of the two turbines where the person lives.

4 No, because turbine **Y** will never pay for itself.

4D A neighbour objects to planning permission being given for the turbine.

The most likely reason for this objection is that the neighbour thinks that . . .

1 the turbine may cause a decrease in property prices in the area.

2 the turbine is a health risk.

3 the turbine will cause air pollution.

4 having a turbine is a status symbol.

4.1.1.4 Power

Question 32

March 2008 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

This question is about the changes in the sources of energy used to generate electricity in the UK between 1960 and 2000.

The table gives information on the percentage of electrical energy produced from various energy sources.

Year	Coal %	Oil %	Natural gas %	Nuclear %	Hydroelectric power %	Other renewables %
1960	74.0	25.4	0	0	0.6	0
1980	36.7	37.0	21.6	4.1	0.6	0
2000	17.2	37.7	33.7	10.5	0.2	0.7

7A In 2000, what was the total percentage of energy produced by sources that did **not** put carbon dioxide into the atmosphere?

1 0.8

2 10.5

3 11.2

4 11.4

7B Which statement about the percentage of energy produced from coal is correct?

1 The percentage has gone down by about 30% every 20 years.

2 The percentage has remained steady throughout that period.

3 The percentage was approximately halved every 20 years.

4 The percentage is now about half of what it was in 1960.

7C The Government may decide to increase the percentage of electricity supplied by nuclear power stations.

Which one of the following is a valid argument against the use of nuclear power stations?

1 For maximum efficiency, they have to be in almost constant use.

2 They have high decommissioning costs.

3 They have high fuel costs.

4 They produce gases that pollute the atmosphere.

4.1.1.4 Power

7D A policy for the future that would result in the smallest contribution to possible global warming is one that made more use of . . .

1 coal, oil and natural gas.

2 oil, natural gas and nuclear energy.

3 natural gas, nuclear energy and hydroelectric power.

4 nuclear energy, hydroelectric power and other renewables.

Turn over for the next question

4.1.1.4 Power

Question 33

March 2008 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

Many scientists think that changes to the ice caps are affecting global warming.

As the ice melts, dark particles accumulate at the surface of the ice. This reduces the amount of sunlight reflected from the surface of the ice. The extra heat taken in by the ice causes the release of frozen methane. Methane is a potent greenhouse gas.

8A The reduction in the amount of sunlight reflected by the ice caps causes more heat to be transferred to the ice by . . .

1 conduction.

2 convection.

3 insulation.

4 radiation.

8B In addition to methane, the other potent greenhouse gas is . . .

1 carbon monoxide.

2 carbon dioxide.

3 ozone.

4 sulfur dioxide.

4.1.1.4 Power

Question 33 · continued

Changes to the ways in which electricity is generated could reduce global warming.

8C

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Centralised power stations are large power stations that supply electricity over a wide area.

A centralised power station wastes two-thirds of the energy supplied to it.

The efficiency of a centralised power station is . . .

1 0.23

2 0.33

3 0.50

4 0.67

8D Smaller local power stations use the heat that would normally be lost in cooling towers to warm surrounding homes and offices.

A large centralised power station and a group of four smaller local power stations both use the same mass of coal to generate electricity.

In comparison to the large centralised power station, the group of local power stations would . . .

1 produce less carbon dioxide.

2 have less impact on the environment.

3 produce more electricity.

4 transfer the same amount of useful energy.

4.1.1.4 Power

Question 34

June 2008 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The table shows data about some energy sources used to generate electricity in the UK in 2004.

The figures in the table take into account the construction of the power station.

Energy source	Percentage of UK electricity generation	Carbon dioxide produced per kWh in grams	Construction cost in £ million	Generating cost in pence per kWh	Typical generating capacity in MW
Coal	33	1000	560	2.6	1600
Gas	40	500	300	2.2	650
Nuclear	19	5	1500	3.5	900
falling water (Hydroelectric)	1	10–30	140	3.5	55
Wind	0.4	4.6	1.3	3.3	3

4A An electricity company sells its electricity at 10 pence per kilowatt-hour (kWh).

Which energy source would the company prefer to use to make the biggest profit on its generating cost?

1 coal

2 gas

3 nuclear

4 hydroelectric

4B Which energy source has the greatest effect on global warming for every kilowatt-hour (kWh) of electricity produced?

1 coal

2 gas

3 nuclear

4 wind

4.1.1.4 Power

Question 34 · continued

4C UK reserves of coal and gas are running out. Coal and gas can be provided from other countries.

Why might this be a good idea?

1 Transport costs for the fuel would be higher.

2 The UK would extend the life of its fossil fuel power stations.

3 The price of coal and gas would be out of the control of the UK.

4 The UK has the ability to develop hydroelectric and wind power stations.

4D The UK government wants to generate 10% of the country's electricity from renewable energy sources by 2010.

Which type of energy source that is renewable would you recommend in terms of generating cost?

1 gas

2 hydroelectric (falling water)

3 nuclear

4 wind

4.1.1.4 Power

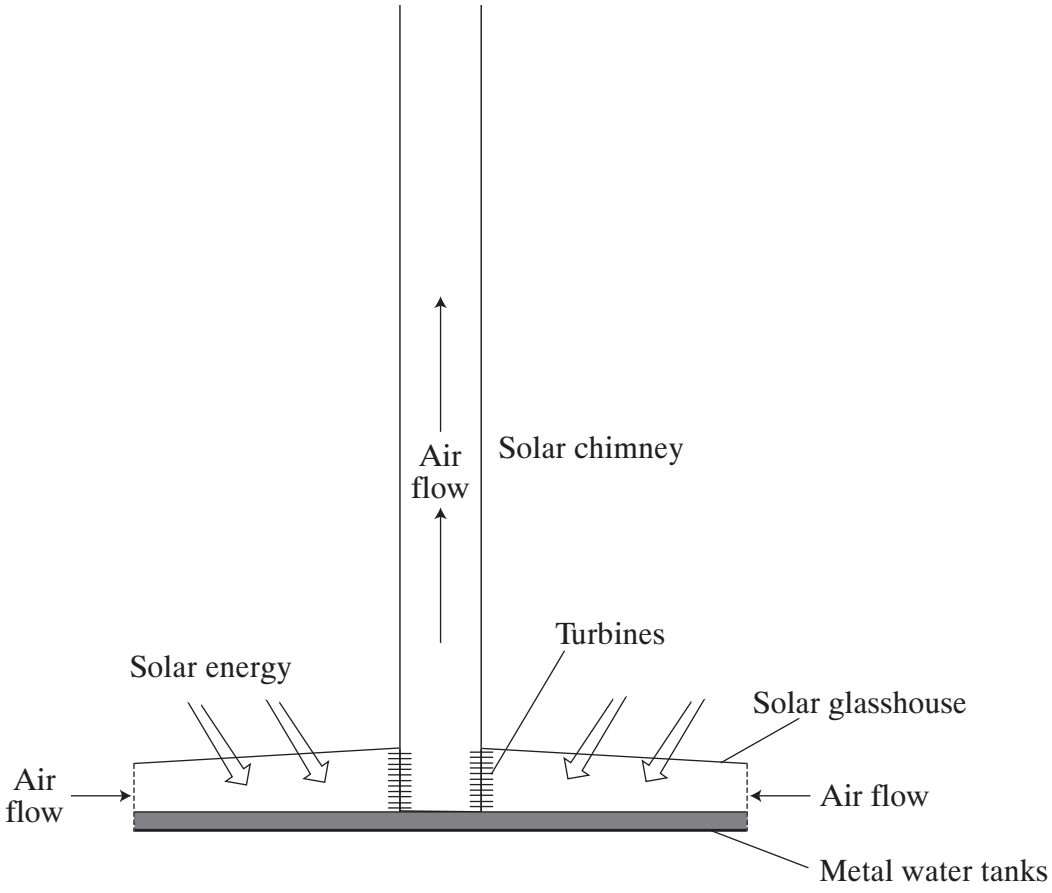
Question 35

June 2008 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows a giant solar chimney which is planned to generate electricity in Australia. It will be over 1000 m high and the base will be surrounded by a solar glasshouse with an area of 4 million m^2.

The average daylight solar input at the site is 0.25 kW/m^2.



7A Why will the air flow up the chimney?

1 It will be sucked up by radiation.

2 The air at the bottom is less dense than the cooler air at the top.

3 The air conducts heat from the bottom to the top.

4 The air conducts heat from the top to the bottom.

4.1.1.4 Power

Question 35 · continued

7B Why is it necessary for the solar glasshouse to be so large?

1 Noise from the turbines will be absorbed by the large volume of air.

2 Solar energy is dilute, so a large area is needed for high electricity output.

3 It is easier to support large sheets of glass.

4 There are no fuel costs, so capital costs are unimportant.

7C What is the likely purpose of the metal water tanks?

1 to ensure that the air in the glasshouse stays moist

2 to reduce the electrical output to safe levels

3 to reduce the level of noise from the turbines

4 to store heat to allow electrical generation at night

7D Australia expects to open a new coal-fired power station. Its power input will be 2250 MW.

How much more powerful is the input of the coal-fired power station compared with the input of the proposed solar chimney power station?

(1 MW = 1000 000 W; 1 kW = 1000 W)

1 0.44 times as powerful

2 2.25 times as powerful

3 4.40 times as powerful

4 22.50 times as powerful

4.1.1.4 Power

Question 36

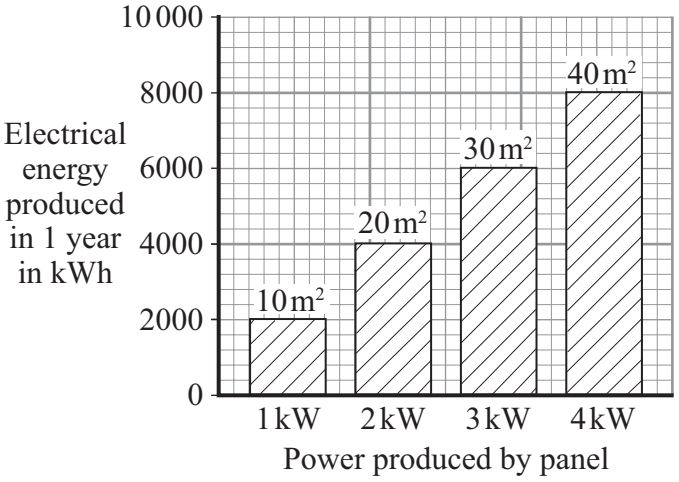
June 2008 | PHY1AP | Original Q8 | Legacy

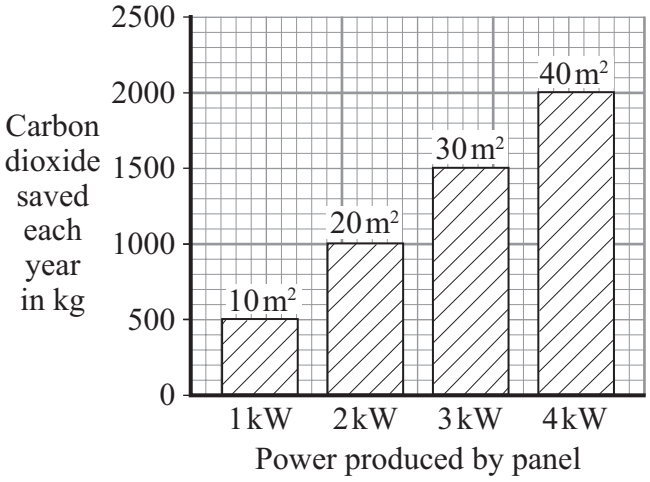
QUESTION EIGHT

The graphs in this question give information about solar cell panels used for producing electricity.

The graphs show:

- the area of the panels in m^2
- the power produced by the panels in kW
- the electrical energy produced each year by using the panels in kWh
- the mass of carbon dioxide saved each year by using the panels in kg.





8A Solar cells do not produce polluting gases.

How much carbon dioxide could be saved each year by using a 15 m^2 panel?

1 500 kg

2 750 kg

3 1 000 kg

4 1 750 kg

8B What area of panel would be needed to power a 2500 W heater?

1 20 m^2

2 25 m^2

3 30 m^2

4 35 m^2

4.1.1.4 Power

Question 36 · continued

8C Electricity supplied from the National Grid costs 8 p per kilowatt-hour.

A householder is considering installing solar cell panels. The household uses 4000 kWh of electricity each year. The cost of installing a solar cell panel is £6400 per kW.

What is the payback time?

1 4 years

2 8 years

3 40 years

4 400 years

8D Senegal is a poor, developing country. It has no large power stations. Small, local schemes for generating power are used.

Solar cell panels are used to generate electricity for pumping water from wells in remote locations.

The main reason for using solar cell panels in such locations is that . . .

1 low voltage from the solar cells is safer than high voltage power supplies.

2 solar cells are cheap to make.

3 solar cells provide a constant supply of electricity.

4 the location is a long distance from other electricity supplies.

4.1.1.4 Power

Question 37

June 2008 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

Electricity can be generated in various ways. Power stations use fossil fuels (coal, oil and gas) or nuclear fuels. No new nuclear power stations have been built in the UK for some years.

9A Which one of the following is a valid argument for using nuclear power stations?

1 For maximum efficiency, they have to be sited on the coast.

2 They have high decommissioning costs.

3 They use a renewable energy source.

4 They do **not** produce gases that pollute the atmosphere.

9B Some people argue that we should make more use of wind power instead of nuclear or fossil fuel power stations.

Which statement supports this view?

1 Fossil fuels and nuclear power stations are needed when the wind drops.

2 Large wind farms can be unsightly and noisy.

3 Wind farms have zero fuel costs.

4 Wind farms use large areas of land.

9C

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Using 1 tonne of uranium in a nuclear power station produces 160 000 000 kWh of energy.

How long could 1 tonne of uranium keep a 2000 MW nuclear power station running?

(1 MW = 1000 kW)

1 0.0125 hours

2 12.5 hours

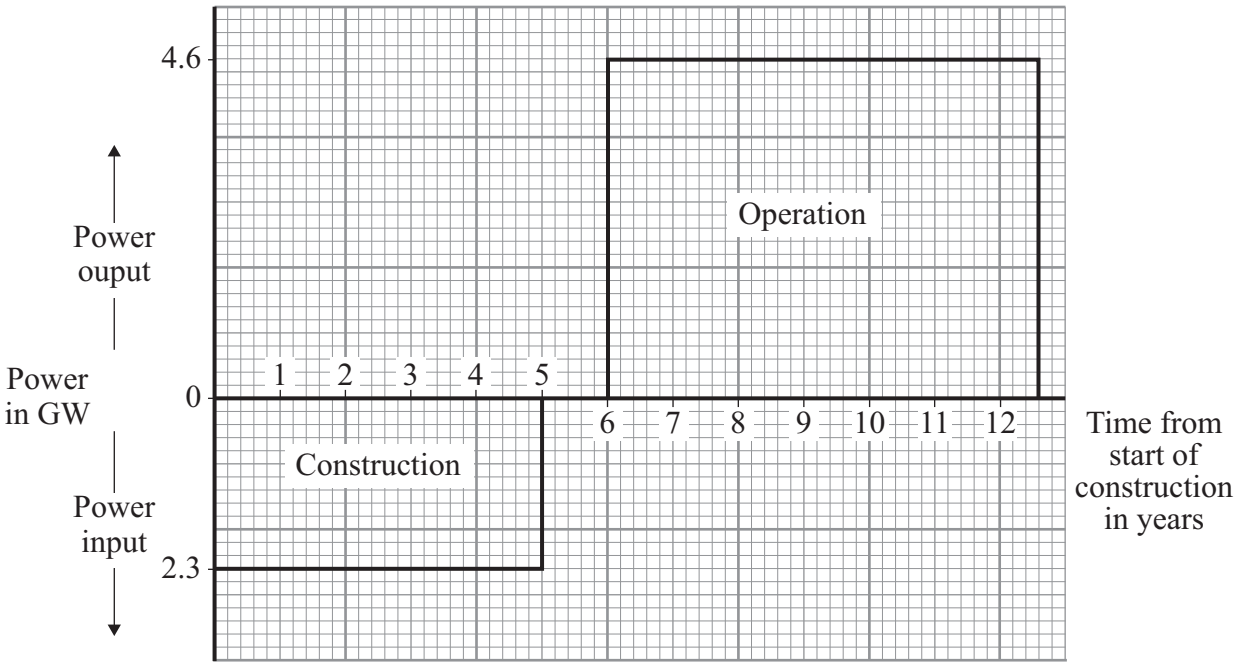
3 80 hours

4 80 000 hours

Question 37 · continued

9D Nuclear power stations take a long time to build. Power is used in their construction and initial fuel processing. This and the power produced by the station are shown in the graph.

The area under the graph represents the energy used or produced in GWh.



How many years from the start of construction will it be before the power station produces more energy than was used to build it?

1 2.5 years

2 7.5 years

3 8.0 years

4 8.5 years

END OF TEST

4.1.1.4 Power

Question 38

June 2008 | PHY1H | Original Q6 | Legacy

6 In 1986, a nuclear reactor exploded in a power station at Chernobyl in the Ukraine.

6 (a) The table gives information about some of the radioactive substances released into the air by the explosion.

Radioactive substance	Half-life	Type of radiation emitted
Iodine-131	8 days	beta and gamma
Caesium-134	2 years	beta
Caesium-137	30 years	beta

6 (a) (i) How is the structure of a caesium-134 atom different from the structure of a caesium-137 atom?

.....

(1 mark)

6 (a) (ii) What is a beta particle and from which part of an atom is a beta particle emitted?

.....

.....

(1 mark)

6 (a) (iii) Once a radioactive substance is dissolved in rainwater, it can enter the food chain.

Following the Chernobyl explosion, some milk supplies were found to be radioactive.

If one litre of milk contaminated with iodine-131 gives a count rate of 400 counts/second, how long will it take for the count rate to fall to 25 counts/second?

Show clearly how you work out your answer.

.....

.....

.....

Time taken = ... days

(2 marks)

4.1.1.4 Power

Question 38 · continued

for mark

6 (a) (iv) After 20 years, the caesium-137 emitted into the atmosphere is a more serious problem than the iodine-131.

Explain why.

.....

.....

.....

.....

.....

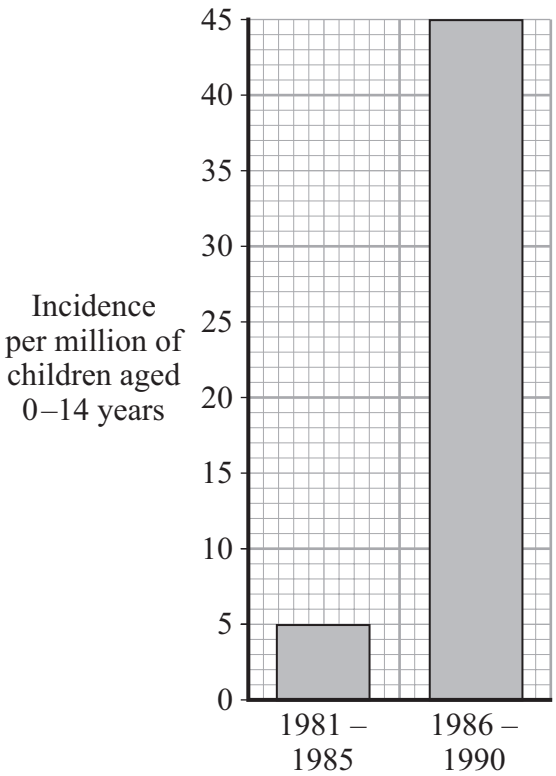
(2 marks)

Question 6 continues on the next page

Question 38 · continued

for mark

6 (b) The bar chart compares the incidence of thyroid cancer in Ukrainian children, aged 0–14 years, before and after the Chernobyl explosion.



Of the children that developed thyroid cancer, 64% lived in the areas most contaminated by the radiation.

Considering this data, can you be certain that a child who developed thyroid cancer between 1986 and 1990 did so because of the Chernobyl explosion?

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

4.1.1.4 Power

Question 38 · continued

for mark

6 (c) In 1991, some scientists compared the health of two groups of people: a *control* group and a group that had been exposed to the radiation from Chernobyl.

What people would have been in the *control* group?

.....

(1 mark)

6 (d) Although there are some risks associated with nuclear power stations, it is likely that new ones will be built.

Give **two** reasons to justify the use of nuclear power.

1 .....

.....

2 .....

.....

(2 marks)

11

4.1.1.4 Power

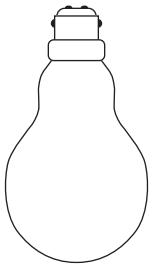
Question 39

November 2008 | PHY1AP | Original Q5 | Legacy

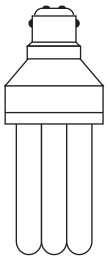
QUESTION FIVE

The diagram shows information about four types of electric lamp.

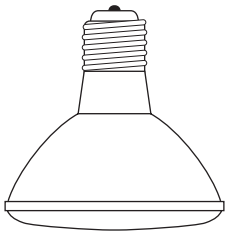
Each lamp produces the same amount of light energy in the same time.



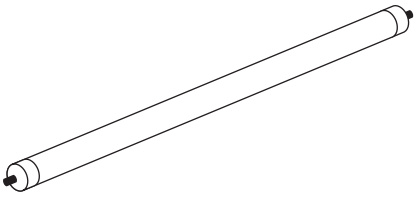
100 watt filament lamp
Average life = 1000 hours
Cost = £0.50



20 watt energy-saving lamp
Average life = 10 000 hours
Cost = £3.00



10 watt LED spotlight
Average life = 60 000 hours
Cost = £30.00



15 watt fluorescent tube
Average life = 5000 hours
Cost = £5.00

5A Which lamp is the most efficient?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

4.1.1.4 Power

Question 39 · continued

5B Which lamp would get the hottest when it is working?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

5C Which lamp would be the cheapest to run for 1000 hours?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

5D You want a lamp that will provide light for 60 000 hours. You realise that you may have to buy more than one lamp to last this long.

Which type of lamp would work out the cheapest to buy?

1 100 watt filament lamp

2 20 watt energy-saving lamp

3 10 watt LED spotlight

4 15 watt fluorescent tube

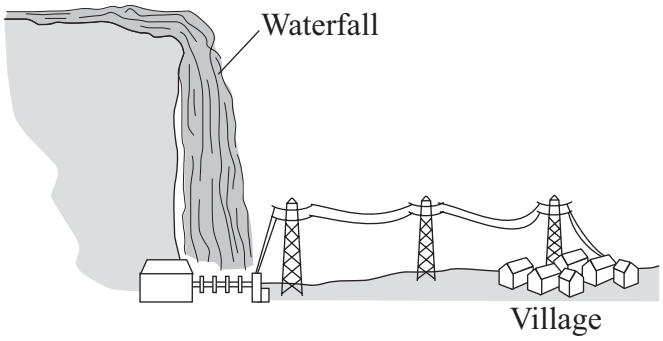
4.1.1.4 Power

Question 40

November 2008 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

The diagram shows a hydroelectric scheme.



A small mountain village lies near a waterfall.

The energy of the falling water is used to generate electricity for the village.

The table gives some information about the village and the electrical supply.

Efficiency of generating system	0.12
Energy of water entering turbines per second	10 000 kJ
Population of the village	1200
Average number of people per household	4
Average electrical demand per household	3.0 kW

6A The reason why the energy transformation is so inefficient is that . . .

1 the waterfall is not high enough.

2 water is a poor conductor of electricity.

3 heat is produced in the turbines.

4 maintenance costs are high.

4.1.1.4 Power

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

6B The electrical energy available to the village is . . .

1 833 kJ

2 1 200 kJ

3 83 300 kJ

4 120 000 kJ

6C The average power demand for the whole village is . . .

1 900 kW

2 3 600 kW

3 4 800 kW

4 14 400 kW

6D The total energy used by the village each day is, on average, 21 600 kWh. The daily maintenance cost of running the hydroelectric scheme is £1200.

What is the price, in pence per kWh, which must be charged to cover the daily maintenance costs?

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

1 2.8 p

2 5.6 p

3 11.2 p

4 22.4 p

4.1.1.4 Power

Question 41

November 2008 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

This question is about some of the different ways of generating electricity.

7A Some power stations in the UK burn coal to produce heat.

Which row in the table gives the correct order of operations in a coal-fired power station?

1	The turbine heats the boiler	The boiler produces steam	Steam drives the generator which produces electricity
2	The boiler produces steam	Steam turns the blades of the turbine	The turbine produces electricity
3	The boiler produces steam	Steam turns the blades of the turbine	The turbine drives the generator which produces electricity
4	The turbine heats the boiler	The boiler produces steam	Steam from the boiler makes electricity

7B Wind farms can be used to produce electricity.

A wind farm consists of a number of . . .

1 transformers connected to turbines.

2 turbines connected to generators.

3 generators only.

4 turbines only.

4.1.1.4 Power

7C The government wants more nuclear power stations to be built. Nuclear power stations have advantages and disadvantages.

Which of the following statements about nuclear power stations is correct under normal working conditions?

1 They use a renewable energy source, do not release harmful substances into the atmosphere and produce radioactive waste.

2 They use a renewable energy source, do not release harmful substances into the atmosphere and have a long start-up time.

3 They do not release harmful substances into the atmosphere, have a relatively short start-up time and produce radioactive waste.

4 They do not release harmful substances into the atmosphere, have a relatively long start-up time and produce radioactive waste.

7D Solar cells can be used to produce electricity on a large scale in places like Australia and California. At present, they are not used on a large scale in the UK.

Which of the following statements about solar cells used to produce electricity on a large scale is correct?

1 They can be used where the Sun shines every day and they need only a small area of land.

2 They can harness a vast amount of energy from the Sun each day and they need only a small area of land.

3 They need a large area of land because the energy from the Sun is dilute.

4 They need a large area of land because the solar cells are very efficient.

4.1.1.4 Power

Question 42

November 2008 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

Australia's carbon emissions are among the highest in the developed world at 540 million tonnes per year.

Australia is to build the world's most advanced solar power station. It will use thousands of mirrors to concentrate the Sun's energy onto solar cells. This power station will produce enough electricity for 45 000 households.

8A The main advantage of the solar power scheme over coal-fired power stations is that . . .

1 it will not produce radioactive waste.

2 it will not produce noise pollution.

3 it will not produce greenhouse gas emissions.

4 it will not destroy wildlife habitats.

8B A fossil fuel power station producing enough electricity for 45 000 households produces 390 000 tonnes of carbon emissions per year.
How many tonnes of carbon emissions are produced each year on average per household by this electricity production?

1 8.7

2 83.3

3 722.2

4 1384.6

8C Australia plans to build a series of advanced solar power stations to reduce carbon emissions by 10 million tonnes per year.

The number of solar power stations needed would be about . . .

1 10

2 25

3 50

4 100

4.1.1.4 Power

8D California has a solar power station that is larger than the advanced solar power station planned for Australia. However, the Californian power station uses similar technology to a coal-fired power station instead of using solar cells.

In the Californian power station, solar energy is transformed directly into . . .

1 movement (kinetic energy) in a turbine.

2 movement (kinetic energy) in a generator.

3 heat to produce steam which drives a turbine.

4 heat which drives a turbine.

Turn over for the next question

4.1.1.4 Power

Question 43

November 2008 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

This question is about using electricity in the home.

9A When electricity is transmitted from a power station, it is stepped up from 25 kV to 300 kV.

This is done by a . . .

1 generator to decrease the current and make it safer.

2 generator to increase the current and make the electricity travel faster.

3 transformer to increase the current and reduce energy losses.

4 transformer to reduce the current and reduce energy losses.

The table shows the power ratings of four electrical appliances.

Fan heater	2 kW
Oven	3 kW
Kettle	2 kW
Microwave oven	0.75 kW

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

$$\text{energy transferred (kilowatt-hour, kWh)} = \text{power (kilowatt, kW)} \times \text{time (hour, h)}$$

$$\text{total cost} = \text{number of kilowatt-hours} \times \text{cost per kilowatt-hour}$$

The cost of electrical energy is 10 p per kilowatt-hour.

Question 43 · continued

9B The kettle is used for a total of 30 minutes a day. It has an efficiency of 0.9

What is the cost of the energy wasted by the kettle each day?

1 0.6 p

2 1.0 p

3 6.0 p

4 9.0 p

9C The fan heater has a heating element and a motor to turn the blades of the fan. The power rating of the heater is 1800 W. To cool a room in the summer, only the fan is used.

How much would it cost to use the fan to cool a room for 5 hours?

1 0.1 p

2 1.0 p

3 10.0 p

4 100.0 p

9D A bowl of cauliflower cheese is cooked in a microwave oven for 6 minutes on half power.

How much does it cost to cook the cauliflower cheese?

1 0.375 p

2 0.750 p

3 1.500 p

4 2.250 p

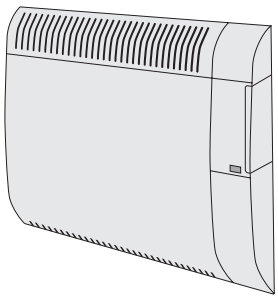
END OF TEST

4.1.1.4 Power

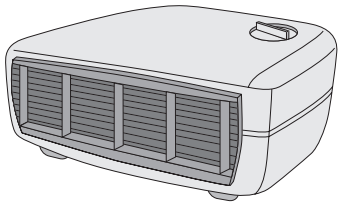
Question 44

January 2009 | PHY1H | Original Q2 | Legacy

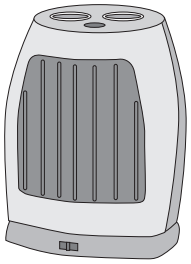
2 The pictures show three different types of electric heater.



400 W oil-filled panel heater (wall mounted)
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



3 kW fan heater
- 2 heat settings
- Power indicator light
- Cool air fan setting



1800 W ceramic heater
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out

2 (a) The ceramic heater is run on full power for 5 hours.

Use the following equation to calculate, in kilowatt-hours, the amount of energy transferred from the mains to the heater.

energy transferred = power × time

Show clearly how you work out your answer.

.....

.....

Energy transferred = ... kilowatt-hours

(2 marks)

2 (b) Which heater will be the most expensive to run on its highest heat setting?

.....

(1 mark)

4.1.1.4 Power

Question 44 · continued

for mark

2 (c) A heater is needed for a small office.

Comparing each type of heater with the other two, give **one** advantage of using each type of heater in the office.

oil-filled panel heater .....

.....

fan heater .....

.....

ceramic heater .....

.....

(3 marks)

6

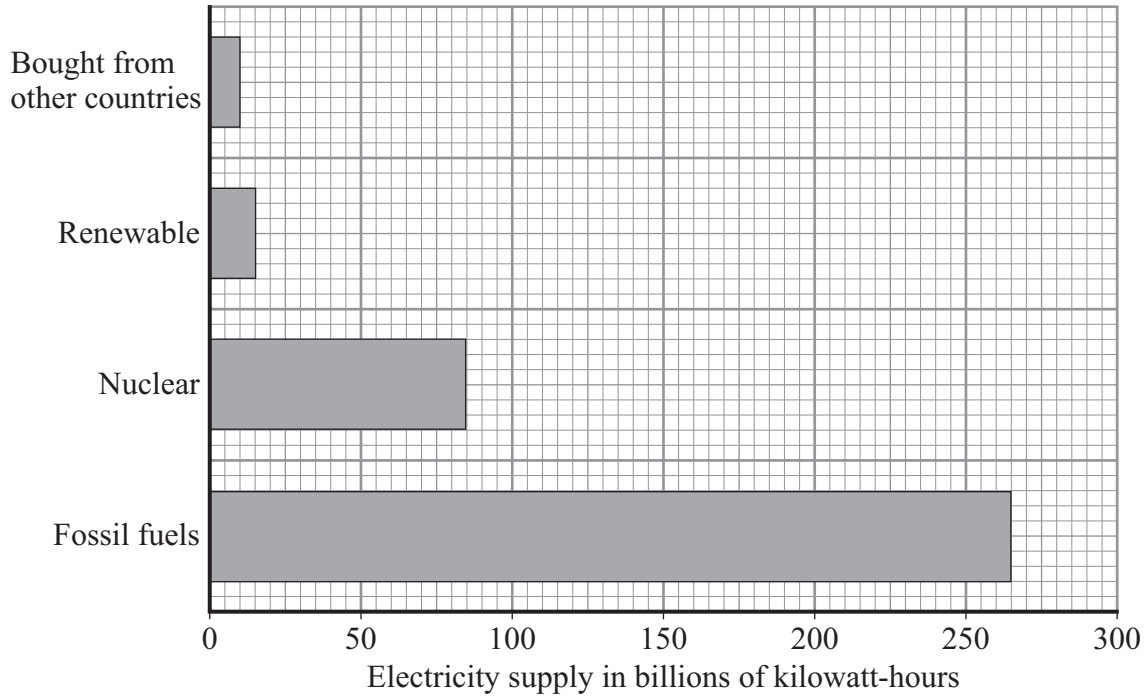
Turn over for the next question

4.1.1.4 Power

Question 45

January 2009 | PHY1H | Original Q3 | Legacy

3 The bar chart shows how the UK's electricity demands in 2007 were met.



3 (a) What proportion of electricity was generated using renewable energy sources?

Show clearly how you work out your answer.

.....

.....

.....

.....

(2 marks)

4.1.1.4 Power

Question 45 · continued

for mark

3 (b) By 2020, most of the UK's nuclear reactors and one-third of coal-fired power stations are due to close, yet the demand for electricity is expected to increase.

Four students, **A**, **B**, **C** and **D**, were asked how a demand of 380 billion kilowatt-hours could be met. They made the suggestions given in the table.

Student	Fossil fuels	Nuclear	Renewable	Bought from other countries
A	200	100	40	40
B	80	240	40	20
C	160	80	100	40
D	280	0	100	0

3 (b) (i) Which student has made the suggestion most likely to result in the lowest carbon dioxide emissions?

.....

Give a reason for your answer.

.....

.....

(2 marks)

3 (b) (ii) Suggest **one** realistic way in which a householder could help to reduce the annual electricity demand.

.....

.....

(1 mark)

Question 3 continues on the next page

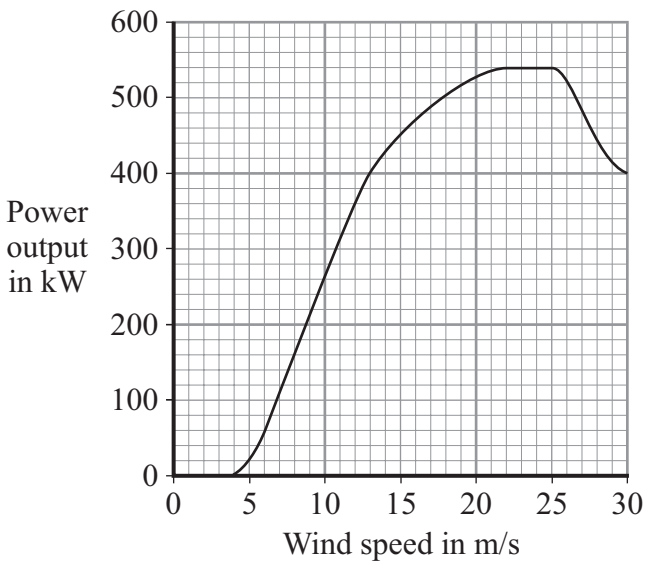
4.1.1.4 Power

Question 45 · continued

for mark

3 (c) To increase the amount of electricity generated using renewable energy resources would probably involve erecting many new wind turbines.

The graph shows the power curve of a wind turbine.



3 (c) (i) Describe, in detail, how the power output of the turbine varies with the wind speed.

.....

.....

.....

.....

.....

.....

(3 marks)

3 (c) (ii) Give **one** disadvantage of using wind turbines to generate a high proportion of the electricity required in the UK.

.....

.....

(1 mark)

9

4.1.1.4 Power

Question 46

January 2009 | PHY1H | Original Q4 | Legacy

4 Most elements have some *isotopes* which are *radioactive*.

4 (a) What is meant by the terms:

4 (a) (i) *isotopes*

.....

.....

(1 mark)

4 (a) (ii) *radioactive*?

.....

.....

(1 mark)

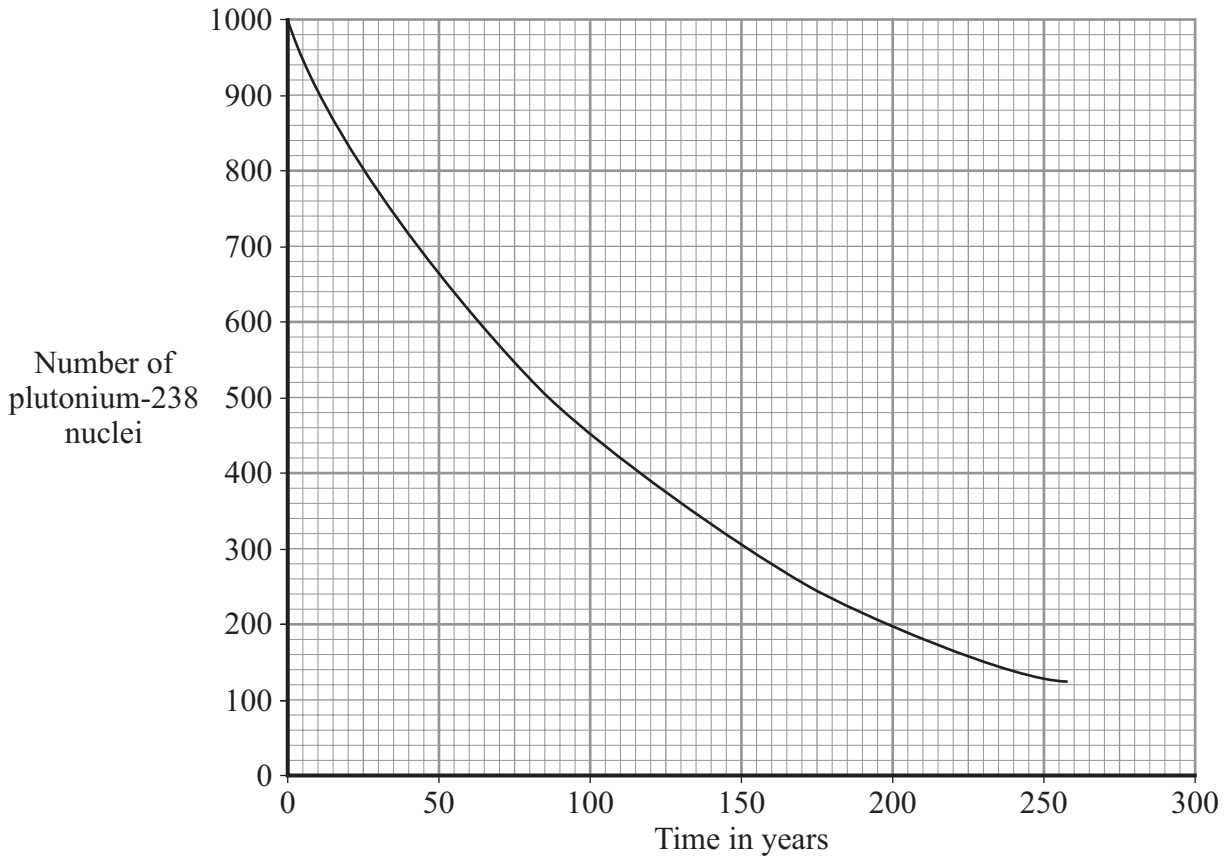
Question 4 continues on the next page

4.1.1.4 Power

Question 46 · continued

for mark

4 (b) The graph shows how the number of nuclei in a sample of the radioactive isotope plutonium-238 changes with time.



Use the graph to find the half-life of plutonium-238.

Show clearly on the graph how you obtain your answer.

Half-life = ... years

(2 marks)

4 (c) The Cassini spacecraft launched in 1997 took seven years to reach Saturn.
The electricity to power the instruments on board the spacecraft is generated using the heat produced from the decay of plutonium-238.

4 (c) (i) Plutonium-238 decays by emitting alpha particles.

What is an alpha particle?

.....

(1 mark)

4.1.1.4 Power

Question 46 · continued

for mark

4 (c) (ii) During the 11 years that Cassini will orbit Saturn, the output from the generators will decrease.

Explain why.

.....

.....

.....

.....

(2 marks)

4 (d) Plutonium-238 is highly dangerous. A tiny amount taken into the body is enough to kill a human.

4 (d) (i) Plutonium-238 is unlikely to cause any harm if it is outside the body but is likely to kill if it is inside the body.

Explain why.

.....

.....

.....

.....

(2 marks)

4 (d) (ii) In 1964, a satellite powered by plutonium-238 was destroyed, causing the release of radioactive material into the atmosphere.

Suggest why some environmental groups protested about the launch of Cassini.

.....

.....

(1 mark)

10

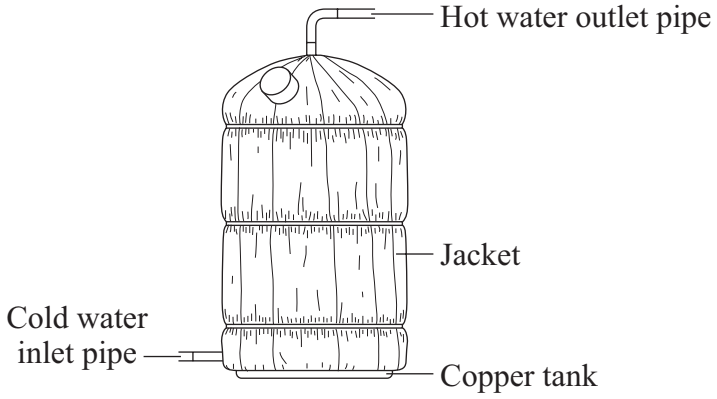
4.1.1.4 Power

Question 47

March 2009 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows a hot water cylinder. The cylinder contains an electric heater.



4A A jacket is wrapped round the cylinder to keep the water warm. The jacket contains trapped air.

Trapped air reduces heat loss by . . .

1 conduction only.

2 conduction and radiation.

3 conduction and convection.

4 conduction, convection and radiation.

4B If a jacket is not fitted, it would be best to have a shiny surface for the cylinder rather than a dark matt one.

This is because dark matt surfaces are . . .

1 good conductors.

2 poor conductors.

3 good radiators.

4 poor radiators.

4.1.1.4 Power

Question 47 · continued

4C The heater has a power of 3000 W. The heater is switched on for 6 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

How many kilowatt-hours of energy does the heater use?

1 0.5

2 18

3 500

4 18 000

4D A household receives an electricity bill every 3 months. The total amount of electrical energy used during one 3-month period was 2000 kWh. Electricity costs 10 p per kWh.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

How much was the bill?

1 £200

2 £600

3 £20 000

4 £60 000

4.1.1.4 Power

Question 48

March 2009 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

This question is about energy sources.

6A Look at this list of energy sources for power stations.

Biomass **Coal** **Falling water (hydroelectric)** **Nuclear**

Hydroelectric is the odd one out because it is . . .

1 the only renewable energy source.

2 the only non-renewable energy source.

3 the only energy source that is not used to produce steam.

4 the only energy source that is used to produce steam.

6B Which one of the following lists contains only **one** energy source that costs nothing?

1 biomass, gas, solar, tidal

2 geothermal, hydroelectric, wave, wind

3 coal, hydroelectric, solar, wave

4 coal, gas, nuclear, wind

6C Which of the sequences shows what happens in a fossil fuel power station?

1 electricity → generator → steam → turbine

2 steam → generator → turbine → electricity

3 steam → turbine → generator → electricity

4 electricity → generator → steam → generator

4.1.1.4 Power

Question 48 · continued

6D At present, gas-fired power stations emit fewer harmful gases than coal-fired power stations. Britain's gas reserves are running out. Gas for power stations is imported from Europe. The government has decided to build a new coal-fired power station.

What is the most likely reason for this?

1 Britain's coal reserves will never run out.

2 It is easier to transport coal than gas.

3 Britain would not have to rely so much on imported gas.

4 The government intends to stop all fossil fuel use by 2020.

Turn over for the next question

4.1.1.4 Power

Question 49

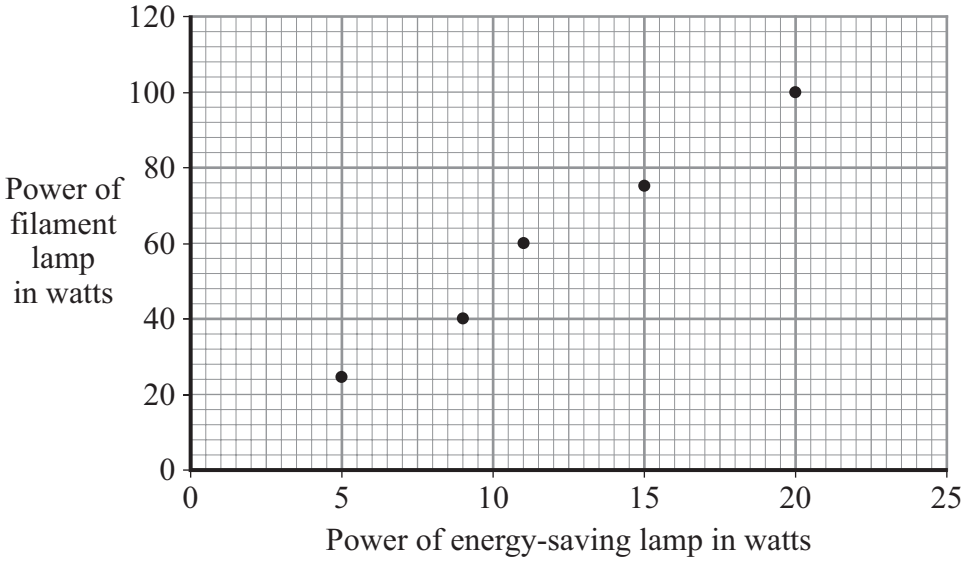
March 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

A householder bought an energy-saving lamp. She found the following table printed on its packaging.

Power of energy-saving lamp in W	Equivalent power of filament lamp in W
5	25
9	40
11	60
15	75
20	100

The graph shows the data.



9A To see if the power of the filament lamp is directly proportional to the power of the energy-saving lamp, you should . . .

1 draw a line of best fit.

2 draw a straight line of best fit and see whether it passes through (0,0).

3 plot more points and see whether a straight line is produced.

4 produce a bar chart and see whether there is a positive relationship.

Question 49 · continued

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

9B A 25 W lamp transforms 25 joules of electrical energy each second.

The efficiency of a 25 W energy-saving lamp is 0.6

How much energy does it waste each second?

1 10.0 J

2 15.0 J

3 41.2 J

4 62.5 J

9C The efficiency of a 100 W filament lamp is 0.15

From the data in the table on page 30, what is the approximate efficiency of the 20 W energy-saving lamp?

1 0.03

2 0.15

3 0.30

4 0.75

9D The government has recommended that the sale of filament lamps should be stopped.

Why is this?

1 to give shops new products to sell

2 to use less fuel for generating electricity

3 to make electricity cheaper to buy

4 to give householders brighter lamps

END OF TEST

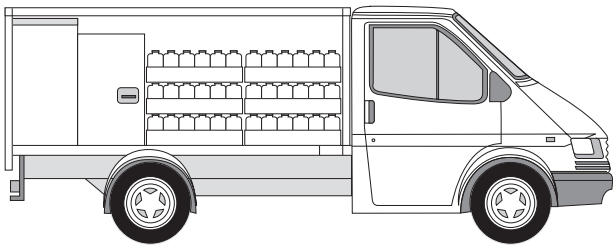
4.1.1.4 Power

Question 50

June 2009 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows an electrically powered milk float.



In a milk float, batteries drive an electric motor.
A milk float travels 40 km a day.
The batteries are recharged overnight.

4A When the milk float is travelling along the road, the batteries transform . . .

1 electrical energy to kinetic energy.

2 kinetic energy to chemical energy.

3 chemical energy to electrical energy.

4 kinetic energy to electrical energy.

4B When charging the batteries, the battery charger transfers 1.5 kW of power for 5 hours.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

The energy transferred to the batteries is . . .

1 0.3 kWh

2 3.3 kWh

3 7.5 kWh

4 75 kWh

4.1.1.4 Power

Question 50 · continued

4C During a day, the electric motor usefully transfers 1600 kJ. The energy supplied to the electric motor is 4000 kJ.

What is the efficiency of the motor?

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

1 0.4

2 2.5

3 2400

4 5600

4D The milk float is said to be more 'environmentally friendly' than a petrol-driven vehicle.

This is because . . .

1 the batteries store energy.

2 it produces no harmful waste gases.

3 the batteries can be recharged many times.

4 the top speed is only 20 km/h.

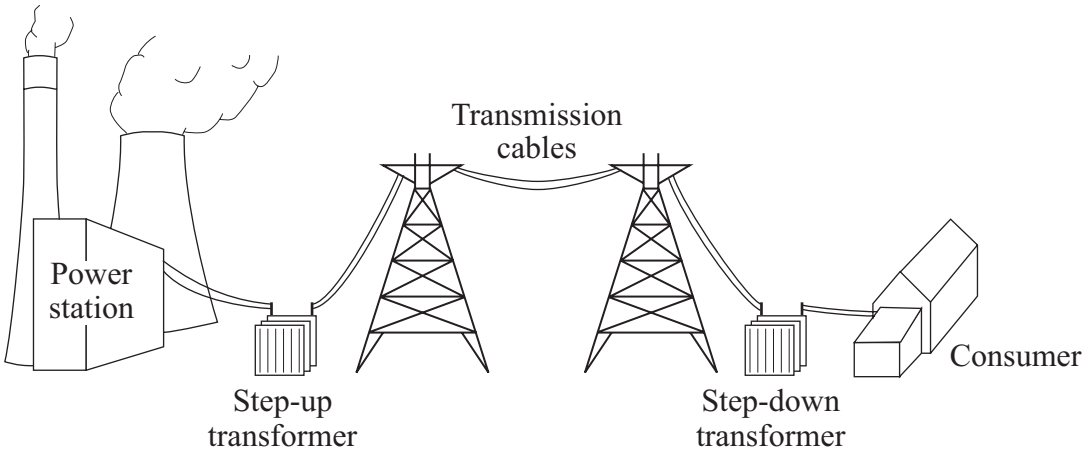
4.1.1.4 Power

Question 51

June 2009 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows how electricity is distributed from a coal-fired power station to consumers.



5A Which row in the table shows what happens at the step-up transformer?

	Current	Voltage
1	decreased	decreased
2	decreased	increased
3	increased	decreased
4	increased	increased

5B The purpose of the step-up transformer is to . . .

1 allow the electricity to travel further.

2 increase the speed of the electricity through the cables.

3 reduce energy losses from the cables.

4 reduce vibrations in the cables.

4.1.1.4 Power

Question 51 · continued

5C Which one of the following power stations has the shortest start-up time?

1 coal

2 gas

3 nuclear

4 oil

5D Which of these fuels undergoes nuclear fission to produce heat in a power station?

1 coal

2 gas

3 oil

4 uranium

Turn over for the next question

4.1.1.4 Power

Question 52

June 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The table compares data for two types of lamp.

	Filament lamp	Compact fluorescent lamp (CFL)
Cost	80p	£3.00
Efficiency	0.2	0.8
Expected life	1000 hours	8000 hours

7A People may decide **not** to buy CFLs because CFLs are . . .

1 more expensive to buy.

2 more efficient.

3 cheaper to run.

4 longer lasting.

7B A filament lamp with a power rating of 100 W gives 2000 units of light.

What power rating would a CFL need to provide 2000 units of light?

1 8000 W

2 20 W

3 25 W

4 25 kW

4.1.1.4 Power

Question 52 · continued

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15 p per kWh

7C What will be the cost of using a 100 W filament lamp during its expected life?

1 £1.50

2 £15.00

3 £150.00

4 £1500.00

7D In its lifetime, a security light is used for 15 000 hours.

How much would you expect to spend on buying CFLs for the security light in that time?

1 £5.63

2 £6.00

3 £12.00

4 £45.00

4.1.1.4 Power

Question 53

June 2009 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

This question is about the energy available from various fuels.

The table shows the amount of energy that 1 kg of different fuels can produce when the fuel energy is transformed.

Fuel	Energy available in MJ per kg
Uranium	70 million
Hydrogen	115
Gas	50
Oil	45
Coal	20
Wood	15

1 MJ = 1 million joules

8A What mass of coal, in kg, would provide the same amount of energy as 1 kg of uranium?

1 0.29

2 3.5

3 0.29 million

4 3.5 million

8B Which three fuels are non-renewable?

1 coal, gas and wood

2 coal, gas and uranium

3 gas, oil and wood

4 gas, uranium and wood

4.1.1.4 Power

Question 53 · continued

8C Coal is burned at a rate of 100 kg per second in a power station. The overall efficiency of the power station is 0.3.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

What is the energy output per second, in MJ, of this power station?

1 600

2 1400

3 1500

4 6700

8D A factory gets all of its energy by burning oil.

Only half of the energy from burning oil is transformed into useful energy.

For a working day, the energy required to run the factory is 10 800 MJ.

What is the mass of oil, in kg, needed each day?

1 24

2 48

3 240

4 480

4.1.1.4 Power

Question 54

June 2009 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Mobile phones make use of microwaves.

Microwave ovens use microwaves of a similar wavelength. These microwaves are absorbed by the water molecules in food.

Human and animal body tissues contain a lot of water molecules. Some people are worried that using mobile phones for long periods of time could lead to some form of brain damage.

Scientists have investigated this worry by exposing laboratory mice to mobile phone radiation and monitoring the mice for signs of brain abnormality.

6A Electromagnetic waves travel at a speed of 300 000 km/s. Some microwaves have a wavelength of 10 cm.

What is the frequency of these microwaves?

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

1 30 000 000 Hz

2 300 000 000 Hz

3 3 000 000 000 Hz

4 30 000 000 000 Hz

6B Electromagnetic waves that ionise may cause cancer. The higher the frequency of a wave, the more ionising the radiation.

Which type of radiation is most likely to cause cancer?

1 microwaves

2 infra red

3 ultraviolet

4 X-rays

4.1.1.4 Power

Question 54 · continued

6C The power output of a microwave oven is at least 500 W.

The power output of mobile phones is limited to 2 W.

What is the most likely reason why this power limit was introduced?

1 to reduce interference between phones

2 to reduce heating effects on the brain

3 to allow phones to use the GPS (Global Positioning System)

4 to allow phones to use a digital signal

6D The tests on mice showed no evidence of brain abnormalities in the mice.

From this, the public can conclude that . . .

1 the results are not accurate because the tests were not carried out on humans.

2 as there is no evidence of danger to mice, there is probably no danger to humans.

3 as there is no evidence of danger to mice, there is no danger to humans.

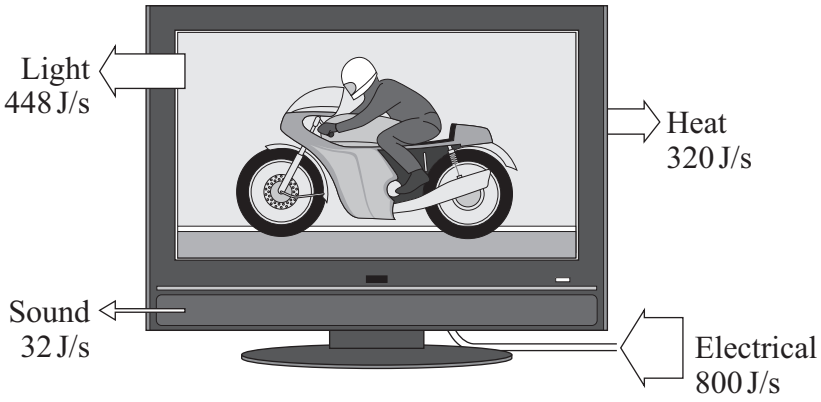
4 the tests were not sensitive enough to record any evidence.

4.1.1.4 Power

Question 55

June 2009 | PHY1H | Original Q3 | Legacy

3 (a) The diagram shows the energy transformations produced by a TV.



3 (a) (i) Use the information in the diagram and the equation in the box to calculate the efficiency of the TV.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2 marks)

3 (a) (ii) What eventually happens to the useful energy transferred by the TV?

.....

.....

(1 mark)

Question 3 continues on the next page

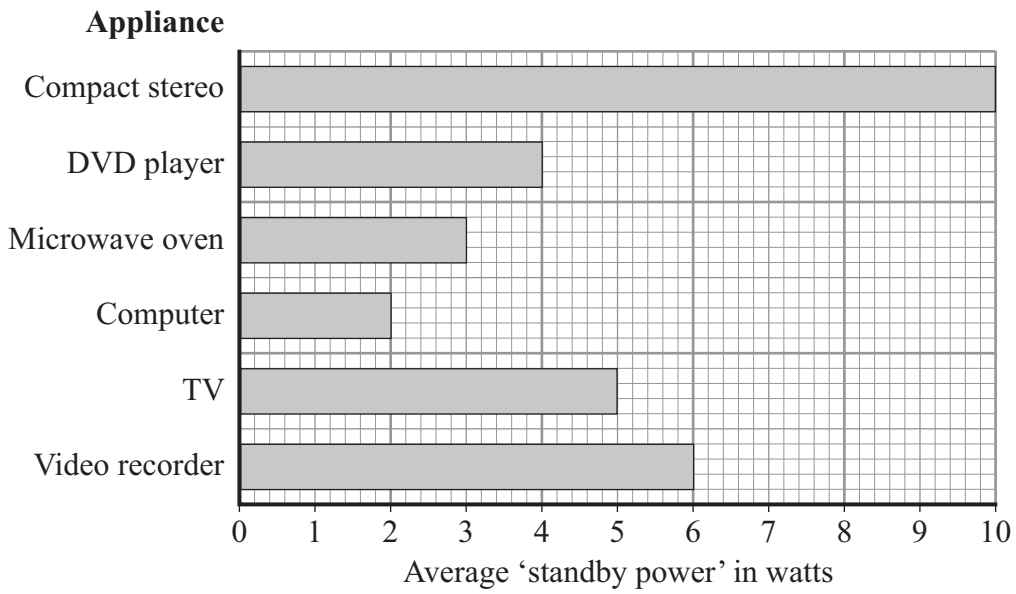
4.1.1.4 Power

Question 55 · continued

for mark

3 (b) Electrical appliances left on standby use energy.

The bar chart shows the power for the appliances that one family leaves on standby when they go on holiday.



The family is on holiday for a total of 175 hours.

3 (b) (i) Use the information in the bar chart and the equation in the box to calculate the energy wasted by leaving the compact stereo on standby while the family is on holiday.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Show clearly how you work out your answer.

.....

.....

Energy wasted = ... kilowatt-hours

(2 marks)

4.1.1.4 Power

Question 55 · continued

for mark

3 (b) (ii) Electricity costs 12 p per kilowatt-hour.

Use the equation in the box to calculate the cost of leaving the compact stereo on standby while the family is on holiday.

total cost = number of kilowatt-hours × cost per kilowatt-hours

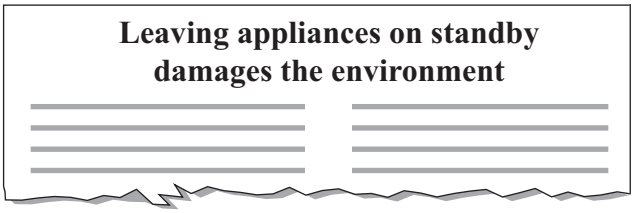
Show clearly how you work out your answer.

.....

Cost = ... p

(1 mark)

3 (c) A headline from a recent newspaper article is shown below.



Explain why leaving appliances on standby damages the environment.

.....

.....

.....

.....

(2 marks)

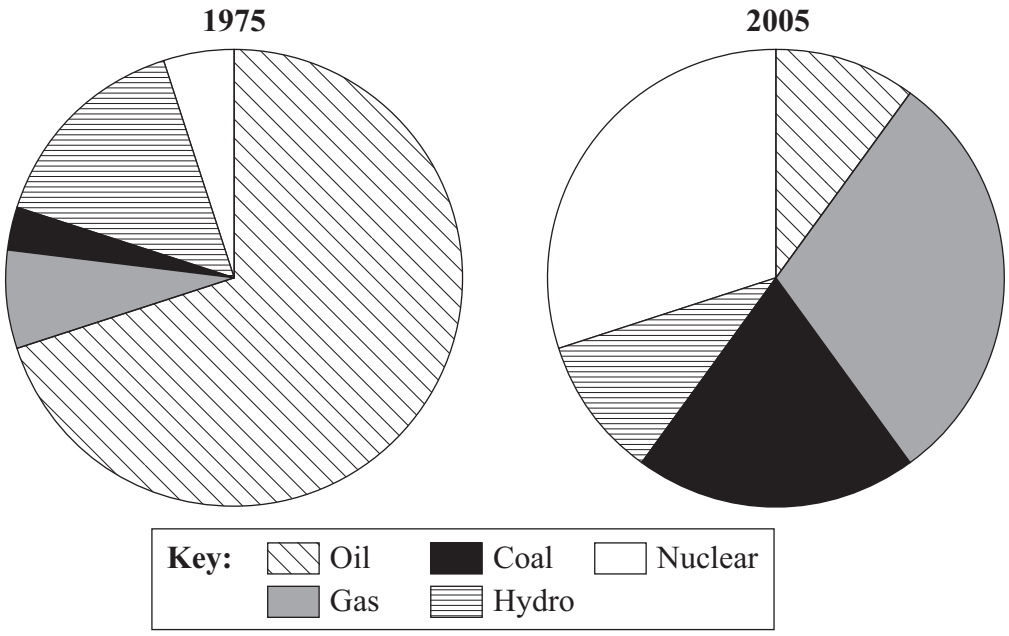
8

4.1.1.4 Power

Question 56

June 2009 | PHY1H | Original Q4 | Legacy

4 The pie charts show the relative proportions of electricity generated in Japan from different energy sources in 1975 and 2005.



4 (a) Describe the main differences in the energy sources used in 2005 compared with 1975.

.....

.....

(1 mark)

4 (b) In the UK, nuclear fuels are used to generate about 21% of the total electricity supply.

4 (b) (i) What is the name of the process by which a nuclear fuel produces heat?

.....

(1 mark)

4 (b) (ii) Explain how the heat released from a nuclear fuel is used to generate electricity in power stations.

.....

.....

.....

.....

(2 marks)

4.1.1.4 Power

Question 56 · continued

for mark

4 (b) (iii) Some people have suggested that more nuclear power stations should be built in the UK.

Give **two** reasons to support this suggestion.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) (iv) Nuclear power stations create dangerous waste.

Why is the waste from a nuclear power station dangerous?

.....

.....

(1 mark)

4 (c) A headline from a newspaper article is shown below.

Police arrest 38 people during a climate change protest outside Britain's largest coal-burning power station

Explain the possible link between *climate change* and *coal-burning power stations*.

.....

.....

.....

.....

(2 marks)

9

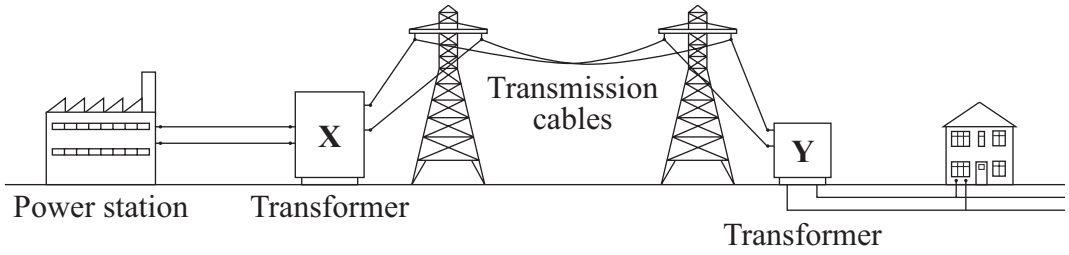
4.1.1.4 Power

Question 57

November 2009 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

Power stations produce electricity and the National Grid distributes it to our homes and to factories.



5A Electricity is transferred along the transmission cables at high voltage so that . . .

1 fewer pylons need to be used.

2 less energy is lost in the cables.

3 the current in the cables is also high.

4 thicker cables can be used.

5B The two transformers, **X** and **Y**, are needed to . . .

1 change heat to electrical energy at **X** and electrical energy to heat at **Y**.

2 change the current at **X** to a higher value and the current at **Y** to a lower value.

3 change the voltage at **X** from ac to dc and the voltage at **Y** from dc to ac.

4 change the voltage at **X** to a higher value and the voltage at **Y** to a lower value.

5C Power stations use gas, coal, oil or uranium as the fuel.

Which of these fuels does **not** produce carbon dioxide when it is used?

1 coal

2 gas

3 oil

4 uranium

4.1.1.4 Power

Question 57 · continued

5D A hydroelectric power station does not release carbon dioxide into the atmosphere.

Which row in the table gives a correct advantage and a correct disadvantage of hydroelectric power stations?

	Advantage	Disadvantage
1	Valleys are flooded to form large lakes.	The building costs are very high.
2	There are no fuel costs.	They take a long time to start up.
3	They can be started up quickly.	Habitats are flooded to make large lakes.
4	No wildlife habitats are destroyed during construction.	Valleys are flooded to produce large lakes.

Turn over for the next question

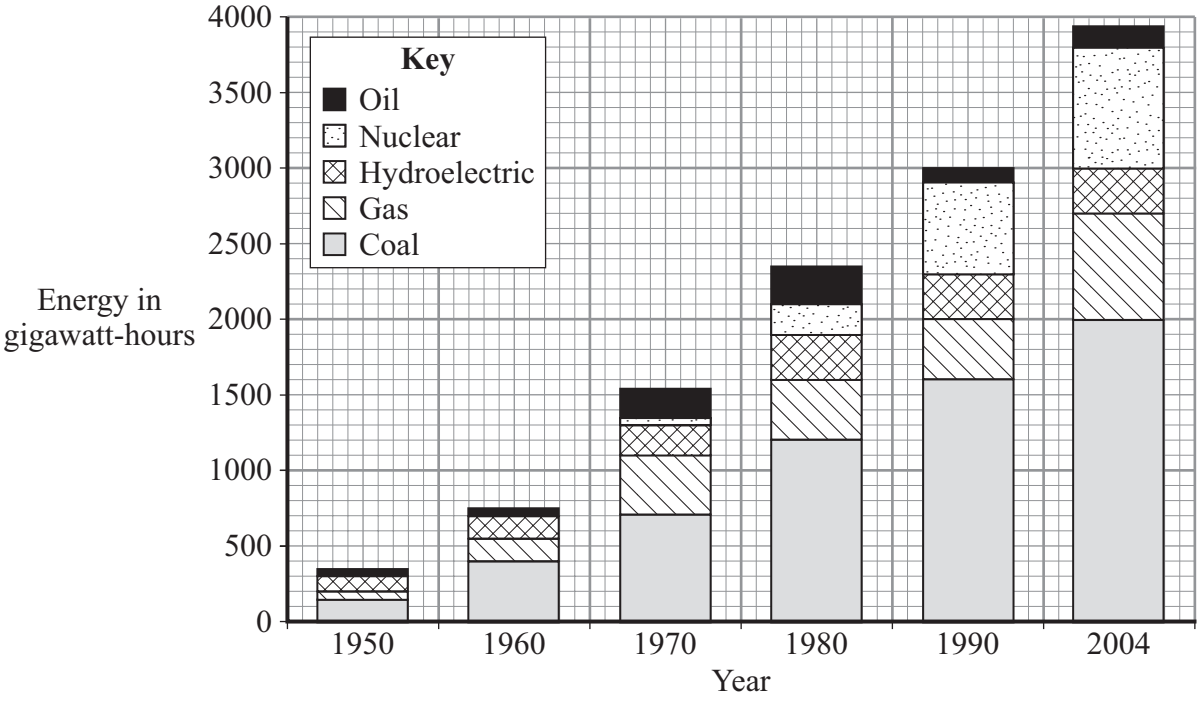
4.1.1.4 Power

Question 58

November 2009 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

The bar chart shows the generation of electricity, in gigawatt-hours for a certain country, from five different energy sources between 1950 and 2004.



6A Of the following energy sources, which one produced the greatest amount of electricity in 1980?

1 gas

2 hydroelectric

3 nuclear

4 oil

6B In 1990, which of the following energy sources was producing approximately 600 gigawatt-hours of electricity?

1 coal

2 gas

3 hydroelectric

4 nuclear

4.1.1.4 Power

Question 58 · continued

6C Which of the following useful energy transformations takes place in power stations using coal, oil, gas and uranium?

1 kinetic to chemical

2 chemical to heat

3 electrical to kinetic

4 heat to kinetic

6D In 2004, over 50% of the electricity was generated using coal as the fuel. The government of the country is committed to reducing carbon dioxide emissions.

Which row in the table shows how the energy sources used for generating electricity may change in the next 10 years?

	Increased use	Decreased use
1	coal and gas	hydroelectric and nuclear
2	wave and wind	coal and gas
3	gas and nuclear	coal and wind
4	tidal and wave	nuclear and wind

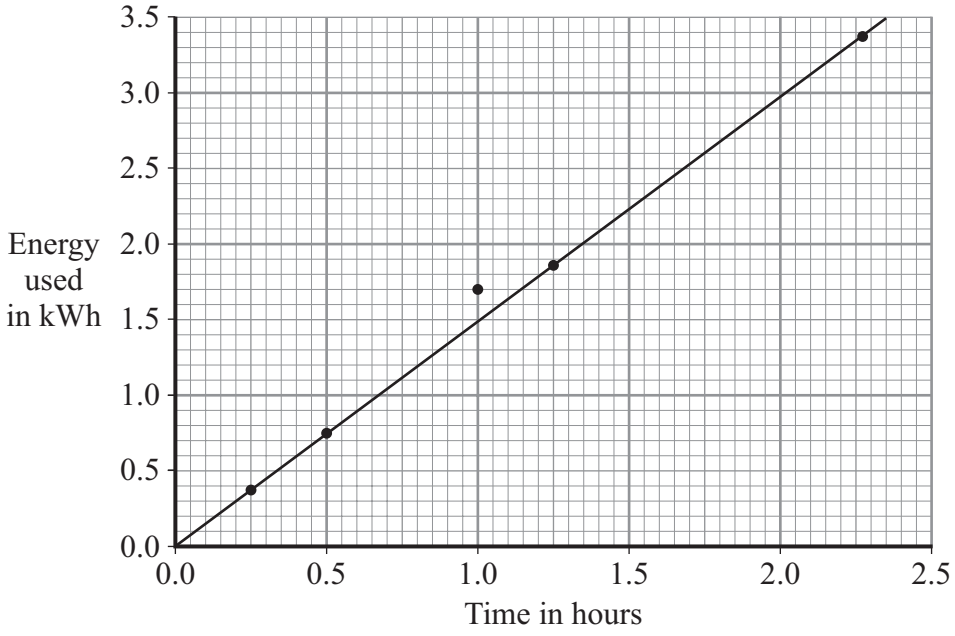
4.1.1.4 Power

Question 59

November 2009 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The graph shows the amount of energy used by an electric fire plotted against the length of time it is switched on.



8A The unit of energy on the graph is the kilowatt-hour (kWh).

Energy is usually measured in . . .

1 joules.

2 joules per second.

3 watts.

4 watts per second.

8B The point on the graph at the time of one hour could be anomalous.

This means that the value of the energy . . .

1 was measured with too little precision.

2 was measured with too much precision.

3 does not fit the general pattern.

4 is subject to a systematic error.

4.1.1.4 Power

Question 59 · continued

8C The graph shows that . . .

1 the energy used decreases with time.

2 the energy used is directly proportional to the time.

3 the energy used is inversely proportional to the time.

4 the energy used halves when the time is doubled.

8D What is the power of the electric fire?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 1.5 W

2 6.7 W

3 1500 W

4 6700 W

4.1.1.4 Power

Question 60

November 2009 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

A notice in an office says:

Leaving your computer on standby overnight uses as much energy as microwaving six dinners

Switch it OFF

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

total cost = number of kilowatt-hours × cost per kilowatt-hour

Electricity costs 12 p per kilowatt-hour.

9A The instructions on a frozen cottage pie say: 'Cook in an 850 W microwave oven for 6 minutes'.

Approximately how much would it cost to cook 6 cottage pies, if they are cooked one at a time?

1 6 p

2 £1.02

3 £3.66

4 £36.72

9B A computer monitor in an office has a power rating of 300 W. Normal office hours are 9 am to 5 pm.

A sensible estimate of the energy wasted if it is left on overnight at full power is . . .

1 4.8 kWh

2 7.2 kWh

3 4800 kWh

4 7200 kWh

Question 60 · continued

9C The 300 W computer monitor can be switched to standby. The standby power is 3 W.

How much money is saved each hour by switching the monitor from full power to standby?

1 less than 1 p

2 3.6 p

3 33 p

4 36 p

9D It is estimated that in Britain 15 million televisions are left on standby for 20 hours per day. The European Parliament has passed a law to help to reduce this problem.

Suggest which of the following would have been included in the law.

1 decrease the price of televisions

2 make it compulsory for television owners to switch off their television sets when not in use

3 set a 1 W limit on standby power for all televisions

4 set a 1 W limit on standby power for all new televisions

END OF TEST

4.1.1.4 Power

Question 61

January 2010 | PHY1H | Original Q5 | Legacy

5 Over the next 15 years, some of the older nuclear power stations will be closed down, and the process of *decommissioning* will start. In the same period, several countries plan to build a number of new nuclear power stations.

5 (a) (i) What does it mean to *decommission* a nuclear power station?

.....

.....

(1 mark)

5 (a) (ii) How does *decommissioning* affect the overall cost of electricity generated using nuclear fuels?

.....

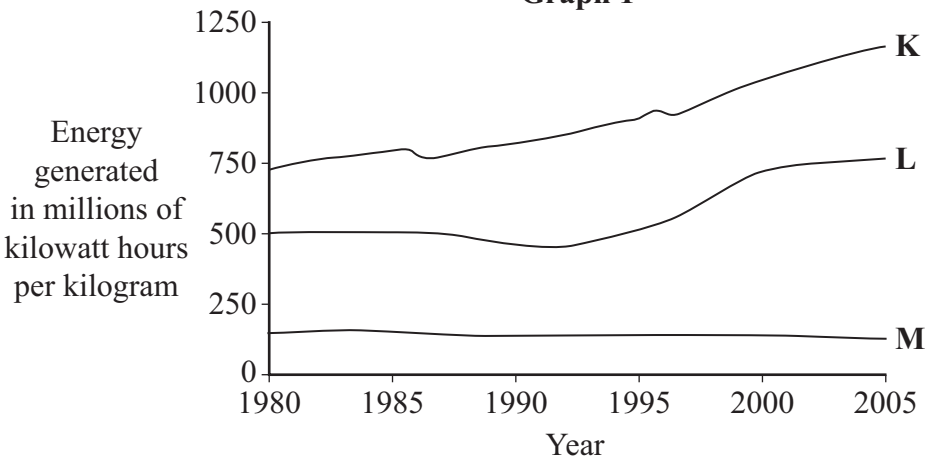
.....

(1 mark)

5 (b) Uranium is a fuel used in nuclear power stations to generate electricity.

Graph 1 compares how the electricity generated from one kilogram of nuclear fuel changed between 1980 and 2005 in three different types of nuclear power station.

Graph 1



5 (b) (i) Compare the efficiency of the three types of power station, **K**, **L** and **M**, between 1980 and 2005.

.....

.....

.....

.....

(2 marks)

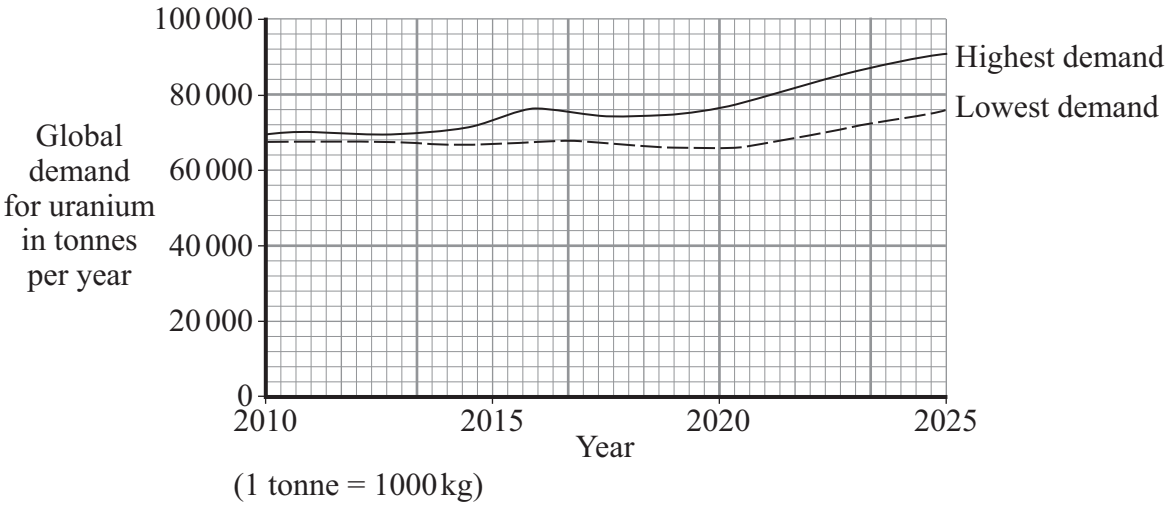
4.1.1.4 Power

Question 61 · continued

for mark

Graph 2 shows two different predictions for the global growth in uranium demand over the next 15 years.

Graph 2



(1 tonne = 1000 kg)

5 (b) (ii) Suggest reasons why it is **not** possible to predict accurately how much uranium will be needed in 2025.

.....

.....

.....

.....

(2 marks)

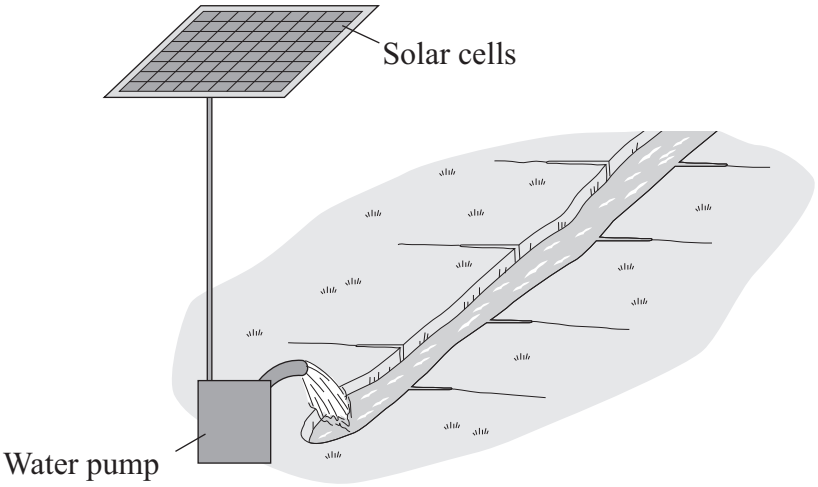
6

4.1.1.4 Power

Question 62

January 2010 | PHY1H | Original Q7 | Legacy

7 The farmers in a village in India use solar powered water pumps to irrigate the fields.



On average, a one square metre panel of solar cells receives 5 kWh of energy from the Sun each day.
The solar cells have an efficiency of 0.15

7 (a) (i) Use the following equation to calculate the electrical energy available from a one square metre panel of solar cells.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Electrical energy = ... kWh
(2 marks)

7 (a) (ii) On average, each solar water pump uses 1.5 kWh of energy each day.

Calculate the area of solar cells required by one solar water pump.

Area = ... square metres
(1 mark)

4.1.1.4 Power

Question 62 · continued

for mark

7 (b) Give **one** reason why the area of solar cells needed will probably be greater than the answer to part (a)(ii).

.....

.....

(1 mark)

4

4.1.1.4 Power

Question 63

2 (a) The process of nuclear fusion results in the release of energy.

2 (a) (i) Describe the process of nuclear fusion.

.....

.....

.....

.....

(2 marks)

2 (a) (ii) Where does nuclear fusion happen naturally?

.....

(1 mark)

2 (b) For many years, scientists have tried to produce a controlled nuclear fusion reaction that lasts long enough to be useful. However, the experimental fusion reactors use more energy than they produce.

2 (b) (i) From the information given, suggest **one** reason why nuclear fusion reactors are not used to produce energy in a nuclear power station.

.....

.....

(1 mark)

2 (b) (ii) Suggest **one** reason why scientists continue to try to develop a practical nuclear fusion reactor.

.....

.....

(1 mark)

4.1.1.4 Power

Question 63 · continued

for mark

2 (c) In 1989, two scientists claimed in a daily newspaper that they had produced nuclear fusion reactions in normal laboratory conditions. The process became known as 'cold fusion'. Other scientists thought that the evidence produced to support 'cold fusion' was unreliable.

2 (c) (i) Suggest **one** reason why other scientists thought that the evidence to support 'cold fusion' was unreliable.

.....

.....

(1 mark)

2 (c) (ii) In 2007, the results of a new 'cold fusion' research project were published in a respected scientific journal. This journal includes scientists such as Albert Einstein amongst its past authors.

Suggest why people may be more likely to believe an article published in a respected scientific journal than one published in a daily newspaper.

.....

.....

.....

(1 mark)

7

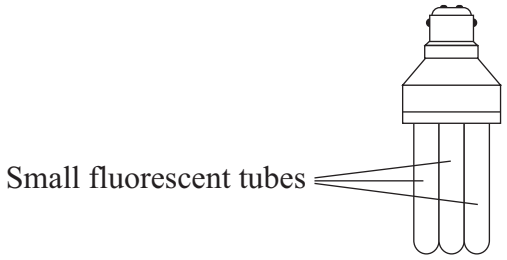
4.1.1.4 Power

Question 64

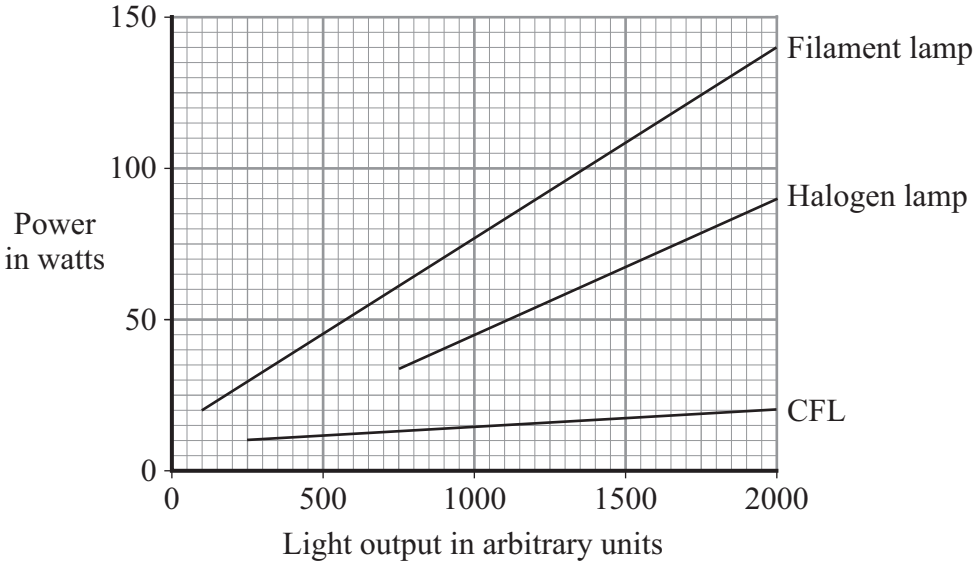
March 2010 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The diagram shows a compact fluorescent lamp (CFL).



The graph shows the electrical power of a CFL compared with a filament lamp and a halogen lamp.



4A How much power does a halogen lamp need in order to give an output of 1000 units of light?

1 40 watts

2 45 watts

3 50 watts

4 55 watts

4.1.1.4 Power

Question 64 · continued

4B How many more watts of power would a filament lamp need, compared with a halogen lamp, to produce 2000 units of light?

1 40

2 50

3 70

4 120

4C What happens to the extra energy that the filament lamp uses compared with the halogen lamp?

The extra energy . . .

1 is stored in the filament of the lamp.

2 is transferred as heat to the surroundings.

3 is used to produce a chemical reaction in the lamp.

4 returns to the electricity supply.

4D In some countries, governments are making it compulsory to use CFLs rather than filament lamps.

What is the reason for this?

1 CFLs are more powerful than filament lamps.

2 CFLs can give out much more light than filament lamps.

3 CFLs can heat the room as well as light it.

4 CFLs save energy because they are more efficient.

4.1.1.4 Power

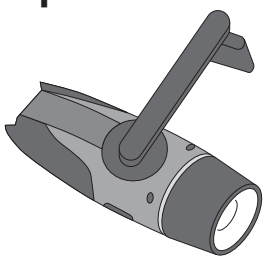
Question 65

March 2010 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

Read this advertisement for a wind-up torch.

Wind-up Torch



£19.99

This torch is always ready to go. Simply wind the handle for just 1 minute and this will power your torch for up to 2 hours of use.

The torch also has a mobile phone connection that will power mobile phones for up to 7 minutes of talk-time for every 1 minute of winding.

You won't have to scrabble around in the dark looking for your torch. The 1 minute of winding also powers a standby light for up to 2 months.

The wind-up torch is strong, splash-proof and eco-friendly.

6A The wind-up torch and a power station both generate electricity.

Which feature of the power station process is the equivalent of the torch's winding handle?

1 boiler

2 generator

3 steam

4 turbine

4.1.1.4 Power

Question 65 · continued

6B The source of energy for the operator of the torch's winding handle is food.

Which of these forms of energy is **not** involved in the chain of useful energy transformations for the torch as it is wound up?

1 chemical

2 electrical

3 kinetic

4 thermal

6C What feature of the wind-up torch enables the advertisement to claim that it is eco-friendly?

1 It can be used to power mobile phones.

2 It has a standby light.

3 It is splash-proof.

4 It produces no waste products when in use.

6D A dog owner uses a conventional torch every night. The torch she uses is powered by 4 batteries. She has to replace the batteries every 3 months. The batteries cost 75p each.

If she bought this wind-up torch, how long would the pay-back time be?

1 between 6 months and 1 year

2 between 1 year and 1.5 years

3 between 1.5 years and 2 years

4 between 2 years and 2.5 years

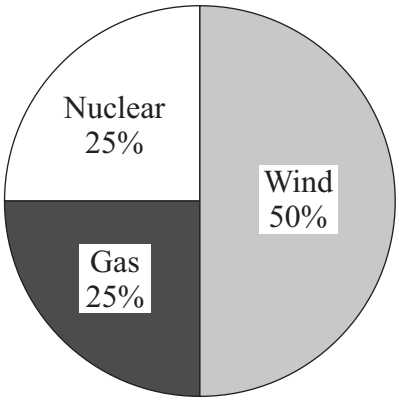
4.1.1.4 Power

Question 66

March 2010 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

An electricity company claims to generate its electricity from environmentally friendly energy sources. Its sources are shown below.



The table shows the cost of generating one kilowatt-hour of electricity using each energy source.

Energy source	Cost in pence per kilowatt-hour
Gas	2.2
Nuclear	2.2
Wind	3.6

8A The average cost per kilowatt-hour for the electricity company is . . .

1 2.5p

2 2.7p

3 2.9p

4 3.1p

8B How much of the company's electricity is produced by sources that do not release polluting gases?

1 25%

2 50%

3 75%

4 100%

4.1.1.4 Power

Question 66 · continued

8C Pumped storage hydroelectric power stations have two reservoirs of water. One reservoir is at a high level, the other at a low level. Water can be released from the high reservoir to flow through turbines to the low reservoir. The turbines drive electrical generators. At night, when demand for electricity is low, water is pumped back to the high reservoir.

The electricity company buys a pumped storage hydroelectric power station.

When is the company likely to use this power station to generate electricity?

1 when the demand for electricity is low

2 when there is a sudden increase in demand for electricity

3 when the wind is blowing at a steady speed

4 when a constant increase in generating capacity is needed

8D The government wants 20% of all electricity to be generated from renewable sources by 2020. It is considering building more wind farms, tidal and wave-powered generators and nuclear power stations.

Why would a scientist consider this statement to be wrong?

1 Coal will continue to be available for another 200 years.

2 Nuclear energy should not be included as a renewable source.

3 The decision should be made by scientists, not politicians.

4 These renewable energy sources are not reliable.

4.1.1.4 Power

Question 67

March 2010 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

In the south of Spain, there is an electricity generator which is powered by the Sun.

- Mirrors reflect the Sun's radiation onto a container of water at the top of a tower.
- The water is changed to steam.
- The steam is used to turn a generator.

9A The main source of energy for this generator is . . .

1 infra red.

2 light.

3 microwave.

4 ultraviolet.

9B Which row in the table gives a correct advantage and disadvantage for this generator?

	Advantage	Disadvantage
1	It cannot be used continuously over a 24-hour period.	It has low running costs.
2	It has low running costs.	It produces atmospheric pollution.
3	It produces no atmospheric pollution.	It uses non-renewable energy.
4	It uses renewable energy.	It cannot be used continuously over a 24-hour period.

9C The electricity is transferred to a nearby city using overhead cables.

At the power station, a transformer is used to . . .

1 increase the current, decrease the power and reduce energy losses.

2 increase the energy, increase the power and reduce energy losses.

3 increase the power, decrease the current and reduce energy losses.

4 increase the voltage, decrease the current and reduce energy losses.

4.1.1.4 Power

Question 67 · continued

The maximum output of the generator is 11 000 000 watts.

9D A typical household needs 2 kW of electrical power.

If the solar generator is working at 60 % of its maximum output, the number of typical households that could be supplied is . . .

1 3 300

2 198 000

3 3 300 000

4 198 000 000

END OF TEST

4.1.1.4 Power

Question 68

March 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

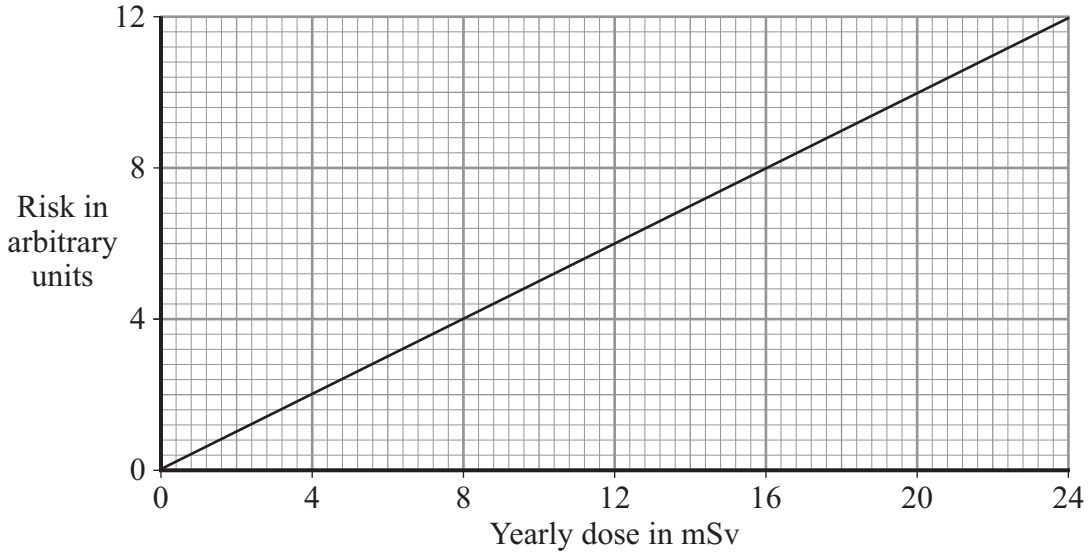
Workers in industries that use radioactive materials have the amount of radiation they receive carefully monitored. The amount of radiation received is called the dose. The industries set dose limits.

The table shows the maximum yearly dose that is allowed for three groups of people. The higher the dose of radiation received, the greater the risk of developing cancer.

Description	Yearly dose limit in millisieverts (mSv)
Member of the public	1
Worker under 18 years	6
Pregnant adult worker	4

A millisievert is a unit of radiation dose.

5A The graph shows how the risk changes with the yearly dose.



The graph shows that the risk . . .

1 does not depend on the yearly dose.

2 is 2 arbitrary units for a member of the public.

3 is inversely proportional to the yearly dose.

4 is directly proportional to the yearly dose.

4.1.1.4 Power

Question 68 · continued

5B The yearly dose limit for an adult worker is five times that of a pregnant adult worker.

What is the risk (in arbitrary units) for an adult worker?

1 3

2 10

3 15

4 20

5C Nuclear power stations produce radiation.

Which one of the following does **not** reduce the risk to power station workers?

1 building power stations far from centres of population

2 giving the workers protective clothing

3 monitoring the dose each worker receives to ensure that radiation limits are not exceeded

4 shielding the workers from the source of radiation

5D Workers may be subjected to alpha, beta or gamma radiation.

Outside the body, alpha is less dangerous to workers than beta because alpha radiation . . .

1 cannot penetrate the skin.

2 is deflected by electric fields.

3 is much less strongly ionising.

4 has a much longer range.

4.1.1.4 Power

Question 69

June 2010 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

The UK government has decided that filament lamps must be replaced by energy-saving lamps. Some people want to continue using filament lamps. Below are some of the arguments for using each type of lamp.

Filament lamps	Energy-saving lamps
• Filament lamps cost only 42 p; energy-saving lamps are more expensive. • Filament lamps reach full brightness almost immediately; energy-saving lamps take a long time to warm up. • The extra heat given out from a filament lamp helps to warm the room.	• An 11 watt energy-saving lamp gives as much light as a 60 watt filament lamp. • Energy-saving lamps produce very little waste energy; filament lamps have an efficiency of only 0.1. • Energy-saving lamps are cheaper to use. • Energy-saving lamps last about 7 times longer than filament lamps.

4A Filament lamps are less efficient than energy-saving lamps.

This means that they . . .

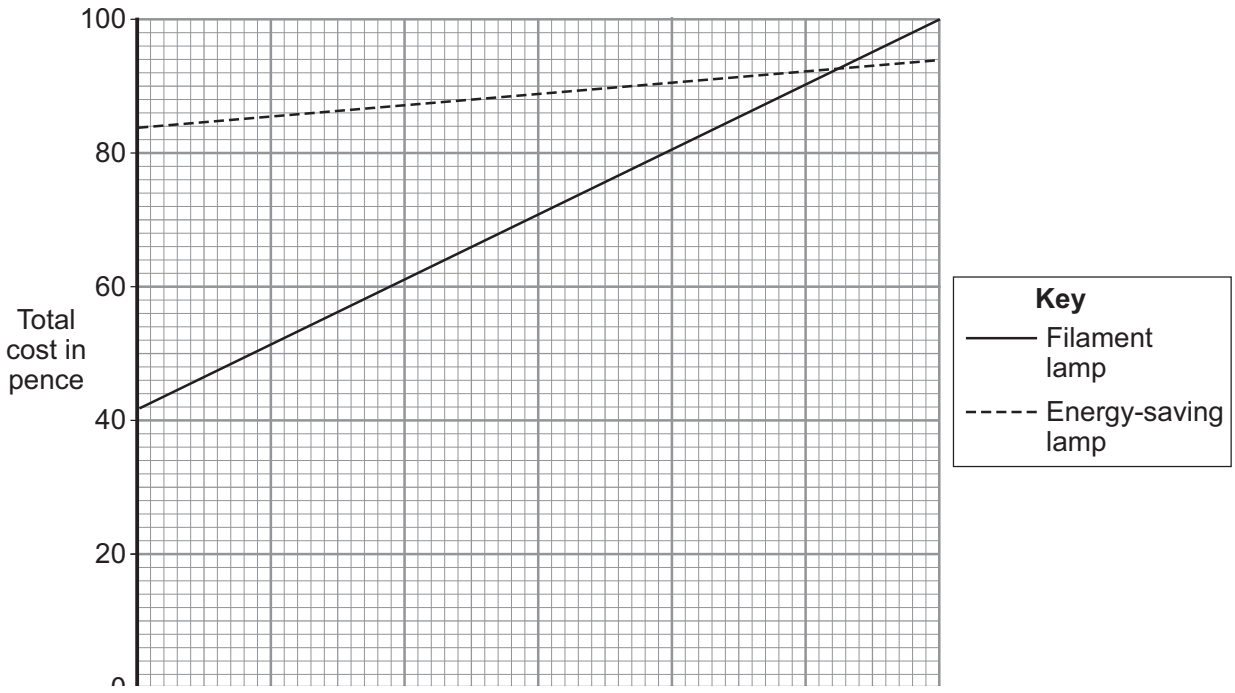
1 cost less.

2 do not last as long.

3 have a larger input power for the same light output.

4 reach full brightness straight away.

The graph shows the total cost of buying and using each type of lamp.



4.1.1.4 Power

Question 69 · continued

4B The graph shows that the cost of buying an energy-saving lamp compared with buying a filament lamp is . . .

1 half as much.

2 twice as much.

3 the same.

4 four times as much.

4C An energy-saving lamp becomes more economical than a filament lamp after . . .

1 86 hours of use.

2 93 hours of use.

3 103 hours of use.

4 105 hours of use.

4D Supporters of filament lamps believe that the 'waste' heat from each lamp is used to heat their houses. They believe that this saves on their heating costs. They say that the total energy used to **light and heat** their houses would not be reduced by using energy-saving lamps.

To find out if they are correct, it is necessary to compare the costs . . .

1 in a small house using filament lamps and in a large house using energy-saving lamps.

2 in a small house using energy-saving lamps and in a large house using filament lamps.

3 using two identical houses with filament lamps in one and energy-saving lamps in the other.

4 using some filament lamps and some energy-saving lamps in the same house.

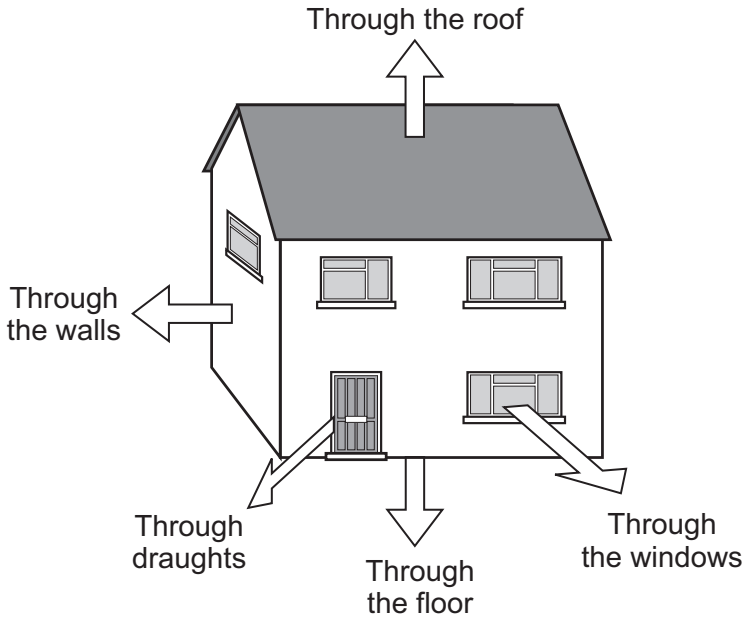
4.1.1.4 Power

Question 70

June 2010 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows the ways in which energy can be lost from a house.



5A This house is losing heat at a rate of 30 kW.

What power must be supplied by the central heating system to maintain a steady temperature?

1 less than 30 kW

2 30 kW

3 60 kW

4 more than 60 kW

5B One day, the central heating boiler uses 10 kWh of energy.

The efficiency of the central heating boiler is 0.9

How much of the energy from the fuel is usefully transferred?

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

1 1 kWh

2 9 kWh

3 10 kWh

4 11kWh

4.1.1.4 Power

Question 70 · continued

5C What happens to the energy that is **not** usefully transferred?

1 It is stored in the boiler until needed.

2 It is turned mainly into sound energy.

3 It warms the air surrounding the house.

4 It leaves the house in the form of light energy.

5D In the UK, the government has ruled that central heating boilers must have an efficiency of at least 0.9

Why might the government wish to raise this figure above 0.9?

Because . . .

1 householders would have to pay more for their energy supplies.

2 it would help to conserve energy supplies.

3 it would help to protect the ozone layer.

4 more polluting gases would be produced.

4.1.1.4 Power

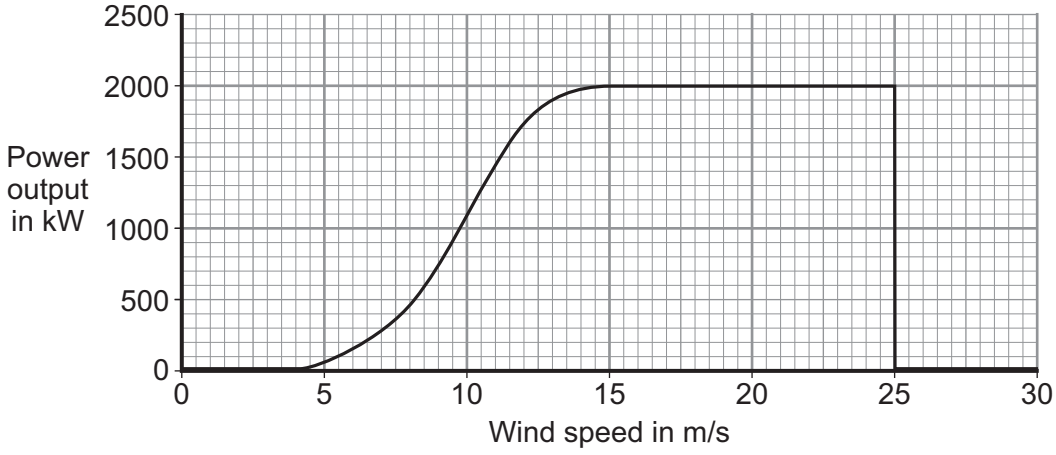
Question 71

June 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

A wind turbine can be used to produce electricity.

The graph shows how the power output of a particular turbine varies with wind speed.



The turbine is designed to operate best at a minimum wind speed of 15 m/s. This is called the rated wind speed.

7A How much energy would be transferred if the turbine operated at its rated wind speed for 2 hours?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 2 kWh

2 4 kWh

3 2000 kWh

4 4000 kWh

7B The turbine will work only when the wind speed is above a value called the cut-in wind speed. The turbine shuts down when the wind speed reaches a certain value.

Which row in the table gives the correct wind speeds?

	Cut-in wind speed	Shut-down wind speed
1	4 m/s	15 m/s
2	9 m/s	20 m/s
3	4 m/s	25 m/s
4	13 m/s	25 m/s

4.1.1.4 Power

Question 71 · continued

7C What happens to the energy of the wind at speeds lower than the cut-in speed and higher than the shut-down speed?

1 It will all be transformed into heat.

2 It will all be transformed into sound.

3 It will be stored in the turbine for future use.

4 It will stay as kinetic energy of moving air.

7D The efficiency of this turbine is 0.7

How many kilowatt-hours of wind energy would be needed to produce 10 kilowatt-hours of electrical energy?

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

1 7.0

2 9.3

3 10.7

4 14.3

4.1.1.4 Power

Question 72

June 2010 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

Worldwide, the demand for electrical energy is rising rapidly. Many countries are building new coal-fired power stations to help meet the demand.

The UK government is committed to reducing carbon emissions.

The government wants to generate 20% of the country's electricity from renewable sources by 2020.

8A What can UK electricity generating companies do to help achieve the government's aims?

1 close some coal, gas and oil-fired power stations

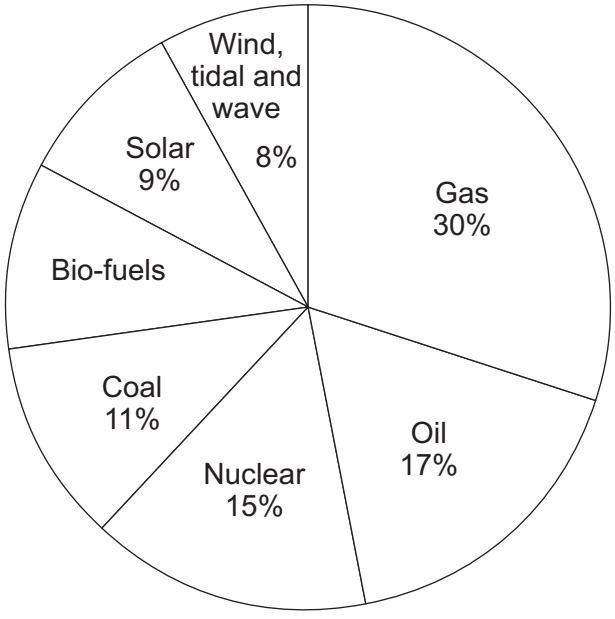
2 build more nuclear power stations

3 build more tidal and wave power stations

4 build more wind and nuclear power stations

By 2050, the ways in which electricity is generated in the UK will be very different from today's methods.

8B The pie chart shows the predicted percentages of different sources of energy that will be used to generate electricity in 2050.



What percentage of this energy will be provided by renewable sources?

1 17

2 27

3 42

4 58

4.1.1.4 Power

Question 72 · continued

8C It is predicted that by 2050, many more power stations will use uranium as a fuel.

What is the main process by which uranium produces heat in a power station?

1 decay

2 fission

3 fusion

4 radiation

8D In 2008, 1500 wind turbines produced 1600 MW of power in the UK. It is predicted that by the year 2050, there will be 12 000 wind turbines providing a total of 60 000 MW.

The average output per wind turbine is predicted to increase by the year 2050.

The increase from the 2008 value would be . . .

1 1.1 MW

2 3.9 MW

3 5.0 MW

4 6.1 MW

4.1.1.4 Power

Question 73

June 2010 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

In a recent speech, a politician called for a European energy policy that gives sustainable, affordable and secure energy resources. The issues in the policy are given in the table.

	Policy issue
L	Break the dependency on fossil fuels, which are damaging the atmosphere
M	Guarantee realistic and stable costs to customers
N	Free citizens from dependence on unreliable energy suppliers

9A Which row in the table below describes correctly the issues in the energy policy?

	L	M	N
1	economic	environmental	political
2	environmental	economic	political
3	environmental	environmental	economic
4	economic	economic	environmental

9B The politician also stated that the electricity would be transferred by energy-efficient cables.

The cables would be *energy-efficient* so that . . .

1 energy would be created along the cables.

2 energy would be transformed along the cables.

3 energy loss in the cables would be kept to a minimum.

4 energy would be destroyed along the cables.

9C Part of the policy is to transfer electricity from renewable sources along a 'Super Grid'. This *Super Grid* could use transformers to achieve energy efficiency.

Just before the electricity entered the *Super Grid*, the transformer would . . .

1 decrease the voltage and decrease the current.

2 decrease the voltage and increase the current.

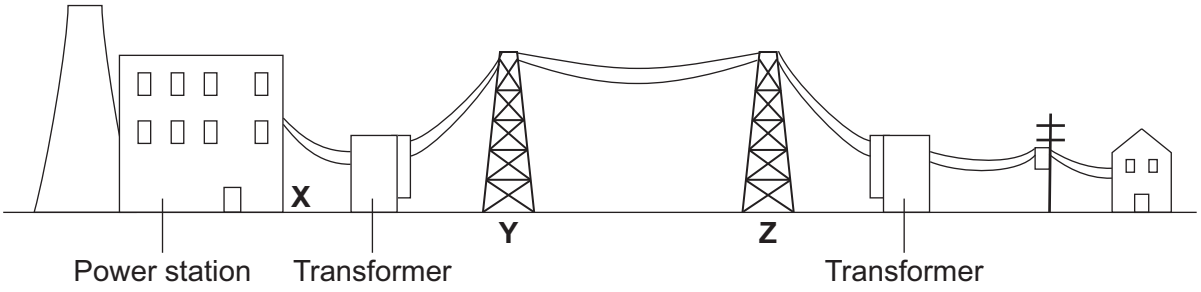
3 increase the voltage and decrease the current.

4 increase the voltage and increase the current.

4.1.1.4 Power

Question 73 · continued

9D In the UK, electricity is transferred by the National Grid.



Which row in the table could give the correct voltages at **X**, **Y** and **Z**?

	X	Y	Z
1	25 kV	400 kV	25 kV
2	25 kV	400 kV	400 kV
3	400 kV	25 kV	25 kV
4	400 kV	400 kV	25 kV

END OF TEST

4.1.1.4 Power

Question 74

June 2010 | PHY1BP | Original Q6 | Legacy

QUESTION SIX

Radio and television programmes are transmitted through the air over long distances.

The information is carried by electromagnetic waves.

6A Compared with light waves, radio waves . . .

1 have a shorter wavelength and a higher speed.

2 have a lower frequency and the same speed.

3 have a longer wavelength and a lower speed.

4 have a higher frequency and the same speed.

6B A radio programme is broadcast on a wavelength of 1500 metres. The speed of the wave is 300 000 000 m/s.

wave speed (metre/second, m/s)	=	frequency (hertz, Hz)	×	wavelength (metre, m)

The frequency of these waves is . . .

1 200 Hz

2 200 kHz

3 450 000 Hz

4 450 000 kHz

6C Over the next few years, all television signals will be changed from analogue to digital.

One advantage to television broadcasters of using digital signals instead of analogue signals is that . . .

1 they are easier to generate.

2 they are less prone to interference.

3 they can travel faster.

4 they can travel further.

4.1.1.4 Power

Question 74 · continued

6D Some people are worried about the effects of living close to a powerful radio transmitter.

Close to one transmitter, it was found that the number of children with leukaemia was slightly higher than normal. Leukaemia is a type of cancer of the blood.

What conclusion could you make from this observation?

1 Radio waves cause leukaemia.

2 There may be a connection between radio waves and leukaemia.

3 Adults are less likely than children to develop leukaemia.

4 Children should not be allowed to live near a radio transmitter.

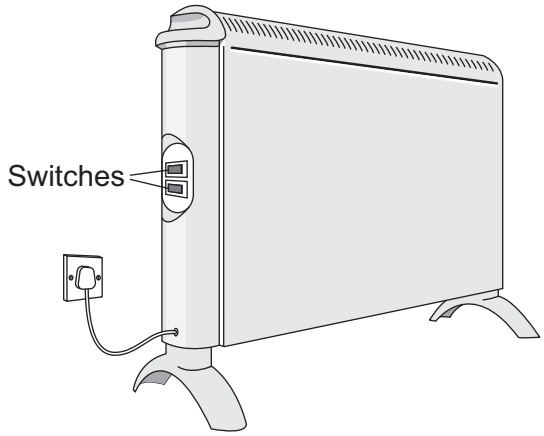
Turn over for the next question

4.1.1.4 Power

Question 75

June 2010 | PHY1H | Original Q3 | Legacy

3 (a) The diagram shows two switches on a room heater. The heater has three power settings. The power produced by two of the settings is given in the table.



Setting	Power in watts
Low	700
Medium	1400
High	

3 (a) (i) When both switches are on, the heater works at the high power setting.

What is the power of the heater, in kilowatts, when it is switched to the **high** power setting?

.....

Power = ... kilowatts
(1 mark)

3 (a) (ii) The heater is used on the **high** power setting. It is switched on for $1\frac{1}{2}$ hours.

Use the equation in the box to work out the energy transferred from the mains to the heater in $1\frac{1}{2}$ hours.

energy transferred = power × time

Show clearly how you work out your answer and give the unit.

.....

.....

.....

Energy transferred = ...
(3 marks)

4.1.1.4 Power

Question 75 · continued

3 (a) (iii) This type of heater is a very efficient device.

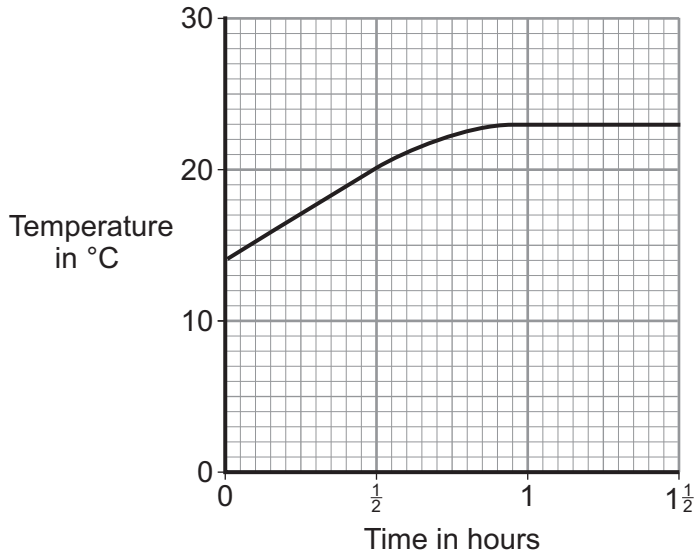
What is meant by a device being very efficient?

.....

.....

(1 mark)

3 (b) The graph shows how the temperature of a room changes during the $1\frac{1}{2}$ hours that the heater is used.



After 1 hour, the temperature of the room has become constant, even though the heater is still switched on.

Explain why.

.....

.....

.....

.....

(2 marks)

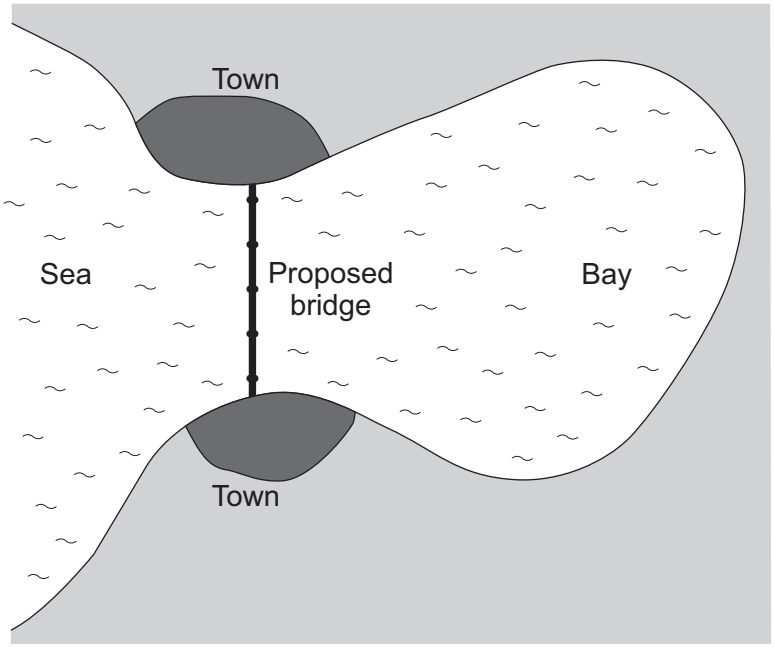
7

4.1.1.4 Power

Question 76

June 2010 | PHY1H | Original Q5 | Legacy

5 The map shows the positions of two towns on either side of a very large coastal bay in England. The map also shows where a bridge may be built to link the towns. The road journey from one town to the other is about 60 kilometres at present.



5 (a) It is estimated that building turbines and generators inside the legs of the bridge would produce enough electricity for both towns. In addition, enough electricity would be generated to run electric buses over the bridge between the two towns.

5 (a) (i) If the bridge is built, what form of renewable energy will be used to generate the electricity?

.....

(1 mark)

5 (a) (ii) Most people living in the area are in favour of the proposed bridge.

Suggest **three** reasons why people would be in favour of building the bridge and the associated electricity generating scheme.

Reason 1 .....

.....

Reason 2 .....

.....

Reason 3 .....

.....

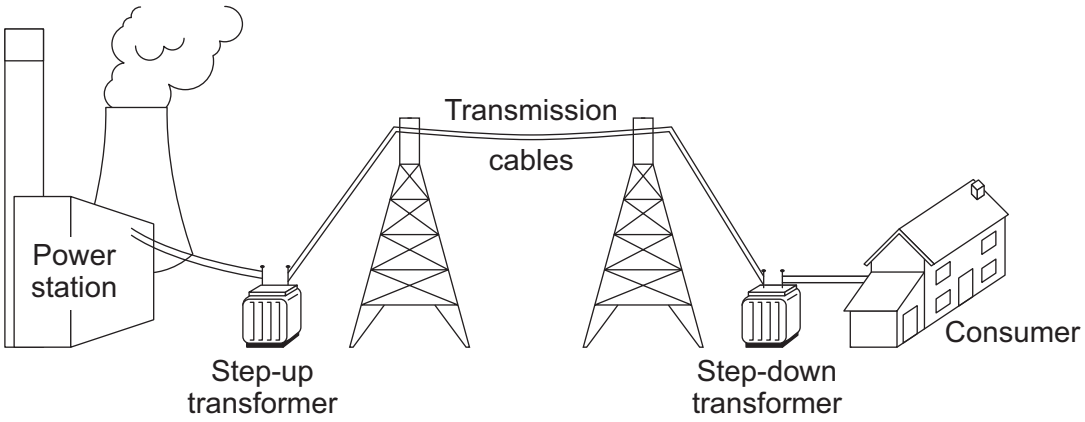
(3 marks)

4.1.1.4 Power

Question 76 · continued

5 (b) Even with the proposed bridge, the two towns will need to stay connected to the National Grid.

The diagram shows part of the National Grid.



5 (b) (i) Give **one** reason why the towns need to stay connected to the National Grid.

.....

.....

(1 mark)

5 (b) (ii) Explain how the step-up transformer increases the efficiency of the National Grid.

.....

.....

.....

.....

(2 marks)

7

4.1.1.4 Power

Question 77

June 2010 | PHY3H | Original Q2 | Legacy

2 (a) Read this passage from a health leaflet.

> Most children can hear the full range of sounds which can be detected by the human ear. But as people get older, they cannot hear the higher frequencies.

2 (a) (i) Complete this statement.

Most children can detect sounds in the frequency range

..... Hz to ..... Hz.

(1 mark)

2 (a) (ii) What word is used to describe sound with a frequency so high that it cannot be heard by humans?

.....

(1 mark)

2 (b) Read this cutting from a newspaper.

> A shopkeeper has fitted a special loudspeaker outside his store.
> "We used to have gangs of young people out there," he said, "but now, when I switch on the special loudspeaker, they hate the sound and go away."
> Older people are not bothered by the sound because the frequency is too high for them to hear it.

Some people support the use of the special loudspeaker but other people do not.

Give **one** reason against its use.

.....

.....

(1 mark)

2 (c) Machines are often very noisy. They transfer energy, and some of the energy is transformed into sound.

What is the cause of the sound?

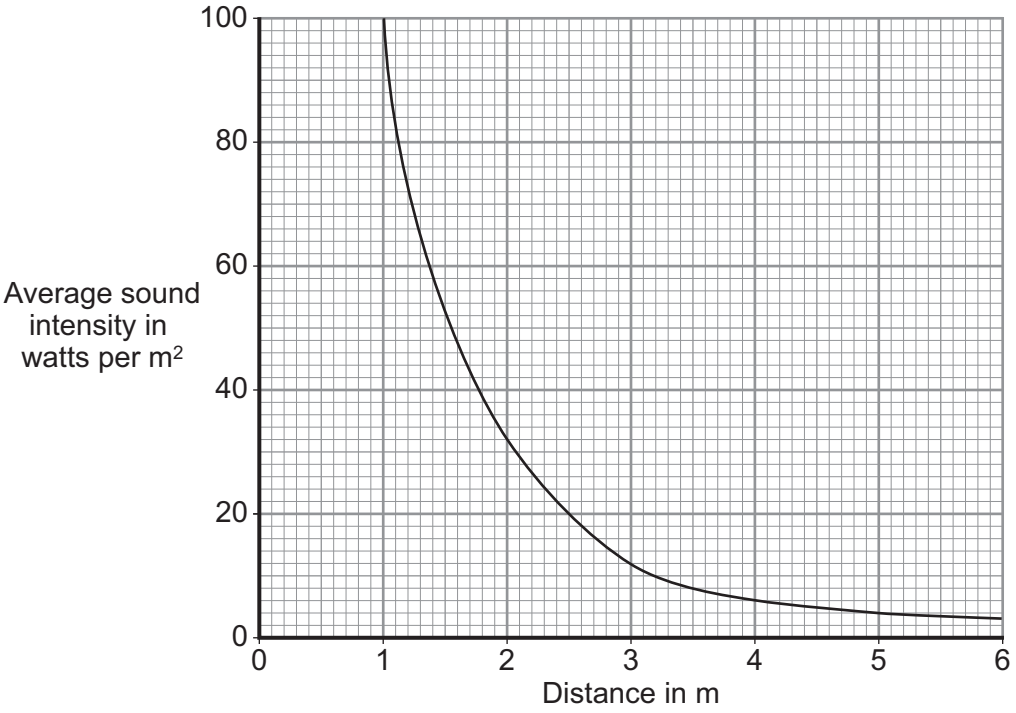
.....

(1 mark)

4.1.1.4 Power

Question 77 · continued

2 (d) Sound from a machine may damage the hearing of people who work close by. A safety officer measures the sound intensity at different distances from a noisy machine. The average results are shown on the graph.



2 (d) (i) Describe the pattern shown by the graph.

Use one or more examples from the graph to support your description.

.....

.....

.....

.....

(2 marks)

2 (d) (ii) Average results were plotted.

Explain why taking results several times and then calculating average values is more reliable than taking only a single result.

.....

.....

.....

.....

(2 marks)

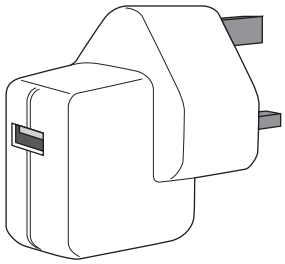
8

4.1.1.4 Power

Question 78

June 2010 | PHY3H | Original Q3 | Legacy

3 The diagram shows a USB power adapter which plugs into a 230 V a.c. mains socket.



The adapter contains a small step-down transformer.

3 (a) The core of the transformer is made of laminated soft iron.

Why is iron used?

.....

.....

(1 mark)

3 (b) The coils of the transformers are made of insulated copper wire.

Why is the wire insulated?

.....

.....

(1 mark)

4.1.1.4 Power

Question 78 · continued

3 (c) There are 500 turns on one coil of the transformer and 20 000 turns on the other coil.

Use the equation in the box to calculate the p.d. across the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer and give the unit.

.....

.....

.....

p.d. across the secondary = ...

(3 marks)

5

Turn over for the next question

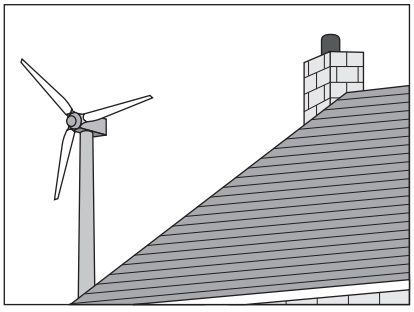
4.1.1.4 Power

Question 79

November 2010 | PHY1AP | Original Q4 | Legacy

QUESTION FOUR

A householder is thinking about buying and installing a wind turbine on his roof.
The turbine costs £3000 to buy and install.



4A The householder estimates that the wind turbine would generate electricity worth an average of £1.50 each day.

What would be the pay-back time?

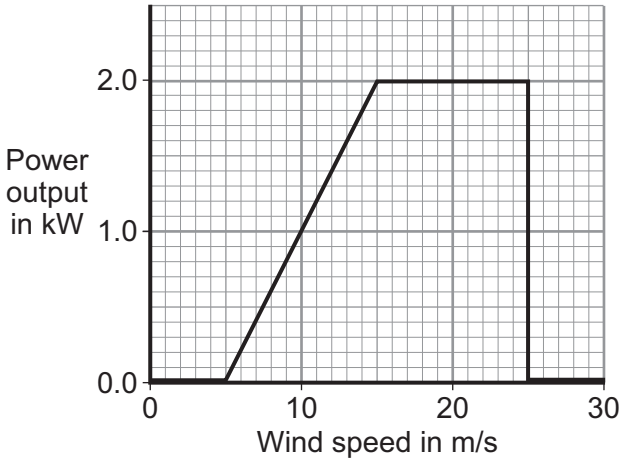
1 1000 days

2 2000 days

3 3000 days

4 4000 days

The graph shows how the power produced by the wind turbine changes with the wind speed.
The wind turbine shuts down at high wind speeds.



4B The maximum power output occurs when the wind speed reaches . . .

1 5 m/s

2 10 m/s

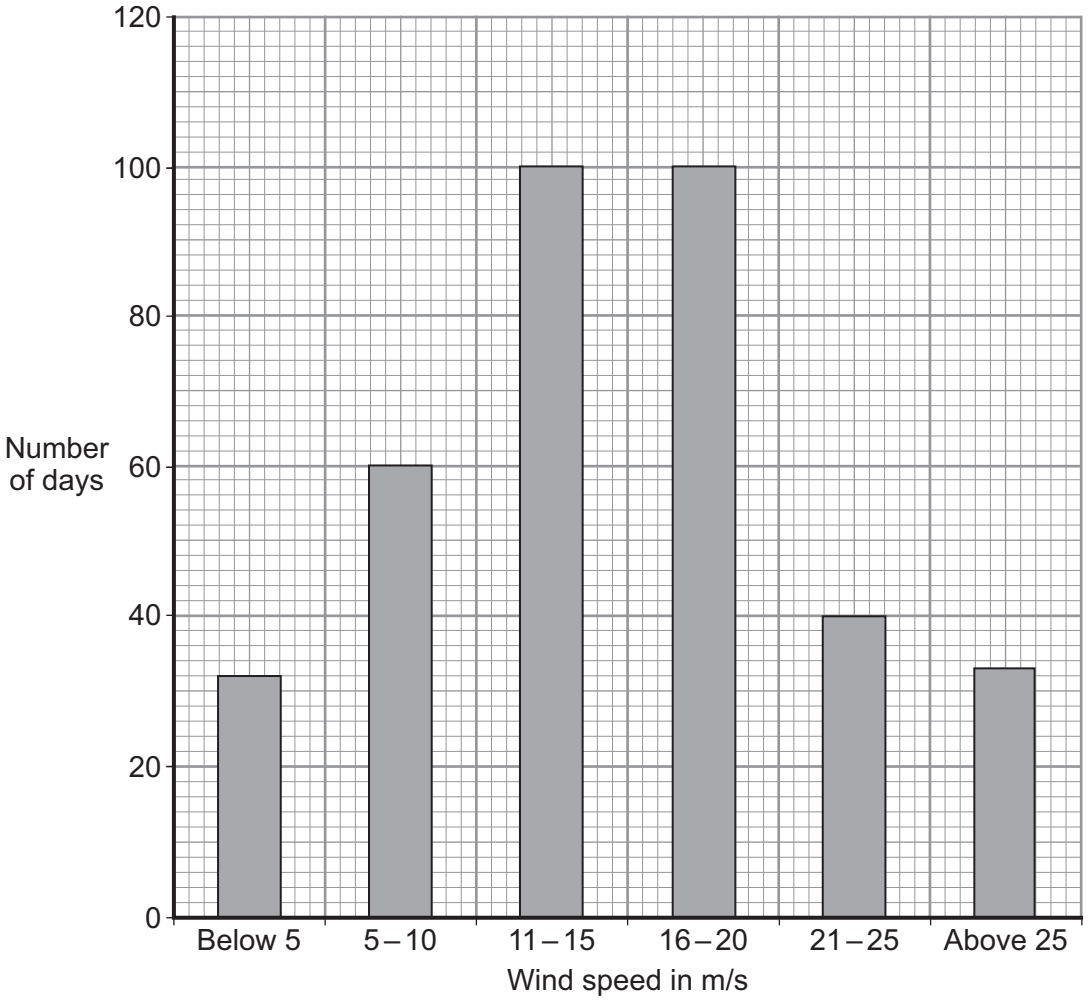
3 15 m/s

4 20 m/s

4.1.1.4 Power

Question 79 · continued

4C The bar chart shows the wind speed at the house and the number of days in the year on which the wind has that speed.



For how many days in the year could the householder get some energy from the wind turbine?

1 160

2 260

3 300

4 330

4D The householder decides not to buy the wind turbine.

The most likely reason for his decision is that the wind turbine . . .

1 has fuel costs that are too high.

2 produces no greenhouse gases.

3 uses a non-renewable energy source.

4 uses an unreliable energy source.

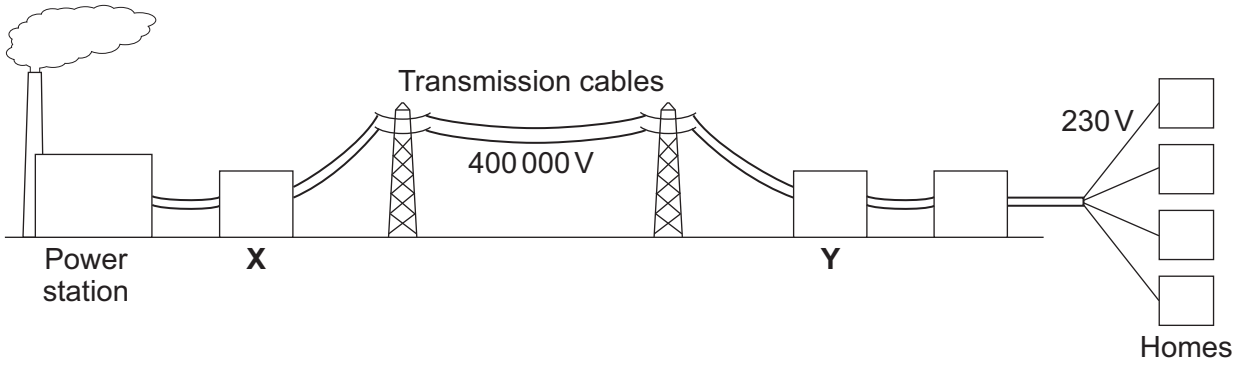
4.1.1.4 Power

Question 80

November 2010 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The diagram shows a power station connected to the National Grid. The National Grid distributes the electrical energy to homes.



7A Which row in the table correctly describes the transformers **X** and **Y**?

	X	Y
1	step-down	step-down
2	step-down	step-up
3	step-up	step-down
4	step-up	step-up

7B Why is the voltage (potential difference) across the transmission cables of the National Grid very high?

1 so that the electricity travels faster

2 so that the electric current is large

3 to make the transmission of electricity safe

4 to reduce energy loss from the cables

7C A transformer changes both the voltage and the current.

Which row in the table correctly describes the changes of current in transformers **X** and **Y**?

	X	Y
1	decrease	decrease
2	decrease	increase
3	increase	decrease
4	increase	increase

4.1.1.4 Power

Question 80 · continued

7D In the power station, the boiler has an efficiency of 0.75. The turbine and generator system have an efficiency of 0.80.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

For every 1000 J of energy supplied to the boiler, what is the useful output energy from the turbine and generator system?

1 600 J

2 750 J

3 800 J

4 1670 J

Turn over for the next question

4.1.1.4 Power

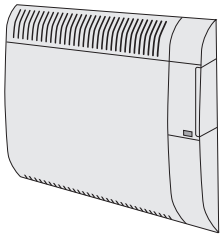
Question 81

November 2010 | PHY1AP | Original Q9 | Legacy

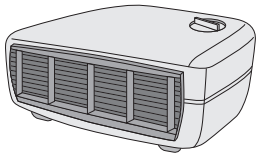
QUESTION NINE

The pictures show three different types of electric heater.

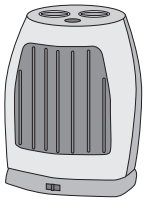
400 W oil-filled panel heater
- 3 heat settings
- Efficient background heat
- Safety overheat cut-out



3 kW fan heater
- 2 heat settings
- Power indicator light
- Cool air fan setting



1800 W ceramic heater
- 2 heat settings
- 8 hour timer
- Power indicator light
- Safety overheat cut-out



9A Two 400 W oil-filled panel heaters are both switched on in an office.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

How much energy, in kWh, is transferred from the mains to the heaters in 12 hours?

1 4.8

2 9.6

3 2400

4 4800

9B The cost of using the ceramic heater during one week was £6.00. During this week, the heater transferred 40 kWh.

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

What was the cost per kWh of the electricity?

1 1.50p

2 6.67p

3 £0.15

4 £6.67

4.1.1.4 Power

Question 81 · continued

9C When the fan heater is working at less than full power, 2 kilojoules of energy are usefully transferred every second. The efficiency of the fan heater at this power is 0.95.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

How many joules of electrical energy are supplied to the fan heater each second?

1 0.000475

2 0.475

3 2.1

4 2105

9D The fan heater cannot be 100% efficient.

Why is this?

1 The fan heater is the most powerful of the four heaters.

2 The fan heater does not have a safety overheat cut-out.

3 The fan heater makes a noise.

4 The fan heater's case becomes warm during use.

END OF TEST

4.1.1.4 Power

Question 82

November 2010 | PHY1BP | Original Q9 | Legacy

QUESTION NINE

Four hundred years ago, Galileo pointed his small, primitive telescope at the night sky.

His telescope had lenses to focus light from the stars.

Today, much larger optical telescopes use large curved mirrors to focus light. The largest single-piece mirror has a diameter of 8.4 m. If the diameter was made any larger, the mirror would deform under its own weight. Very large telescopes use smaller mirrors linked together.

The table gives the effective diameters of the mirrors in several large optical telescopes.

Telescope	Keck	Giant Magellan Telescope (GMT)	Thirty Metre Telescope(TMT)	Very Large Telescope (VLT)
Effective diameter of mirror in metres	10.0	27.0	30.0	32.8

9A The TMT has nine times the light-collecting power of the Keck telescope mirror.

This is because the light-collecting power of a telescope is . . .

1 directly proportional to the diameter of the mirror.

2 inversely proportional to the diameter of the mirror.

3 directly proportional to the square of the diameter of the mirror.

4 inversely proportional to the square of the diameter of the mirror.

9B The VLT is located in a desert high in the mountains of South America.

The VLT produces sharp images because . . .

1 the VLT is nearer to the stars than optical telescopes at sea level.

2 light rays are more easily reflected higher in the atmosphere.

3 the night sky in the desert is clear and dark.

4 at the top of a mountain the telescope weighs less.

4.1.1.4 Power

9C Some telescopes are put into orbit round the Earth.

This is so that the telescopes . . .

1 can detect only visible light.

2 can detect only the electromagnetic waves that the Earth's atmosphere absorbs.

3 can detect visible light and sound waves.

4 can detect electromagnetic waves that do not reach the Earth's surface.

9D The smaller the diameter of a telescope, the higher the frequency of the waves that it can detect.

Pulsars are objects in space that emit radio waves. Pulsars were discovered using radio telescopes based on Earth.

The telescope that first detected the radiation from a pulsar had a diameter . . .

1 about the same size as the diameter of an optical telescope because the frequencies it detects are about the same.

2 smaller than the diameter of an optical telescope because the frequencies it detects are lower.

3 larger than the diameter of an optical telescope because the frequencies it detects are higher.

4 larger than the diameter of an optical telescope because the frequencies it detects are lower.

END OF TEST

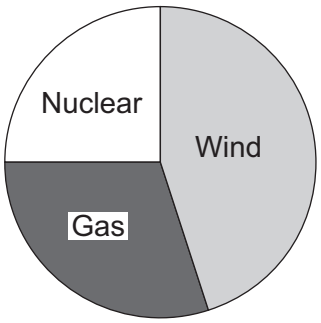
4.1.1.4 Power

Question 83

January 2011 | PHY1H | Original Q3 | Legacy

3 (a) An electricity company claims to generate all of its electricity from environmentally friendly energy sources.

The energy sources used by the company are shown in the pie chart.



Do you think that the claim made by the company is correct?

Draw a ring around your answer.

Yes **No** **Maybe**

Explain the reasons for your answer.

.....

.....

.....

.....

(2 marks)

3 (b) The government is committed to increasing the amount of electricity generated from renewable sources. A newspaper reported that:

More wind farms, wave powered generators, solar generators and nuclear power stations would need to be built

Why is the statement made in the newspaper incorrect?

.....

.....

(1 mark)

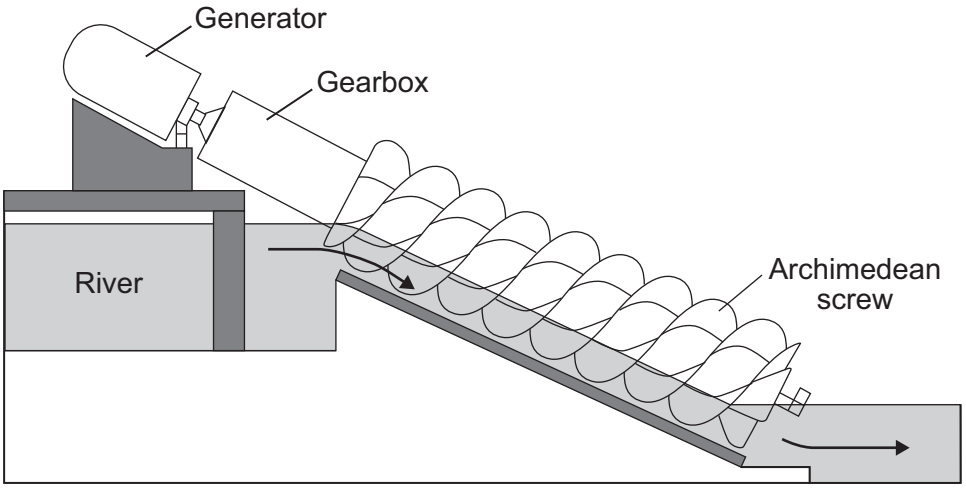
3

4.1.1.4 Power

Question 84

January 2011 | PHY1H | Original Q4 | Legacy

4 The diagram shows a small-scale, *micro-hydroelectricity* generator which uses the energy of falling river water to generate electricity. The water causes a device, called an Archimedean screw, to rotate.
The Archimedean screw is linked to the generator by a gearbox.



4 (a) Each second, the *micro-hydroelectricity* generator transforms 80 000 joules of gravitational potential energy into 60 000 joules of electrical energy.

4 (a) (i) Fill in the missing word to complete the energy transformation diagram.

Gravitational potential energy of the falling water	→	..... energy of the Archimedean screw	→	Electrical energy generated

(1 mark)

4 (a) (ii) Use the equation in the box to calculate the efficiency of the *micro-hydroelectricity* generator.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2 marks)

4.1.1.4 Power

Question 84 · continued

4 (b) The power output from a conventional large-scale hydroelectric power station is 100 000 times more than the power output from a micro-hydroelectric system.

Give **one** disadvantage of a conventional large-scale hydroelectric power station compared to the micro-hydroelectric system.

.....

.....

(1 mark)

4 (c) The electricity generated by a micro-hydroelectric system is transferred via a transformer directly to local homes. The electricity generated by a conventional large-scale hydroelectric power station is transferred to the National Grid, which distributes the electricity to homes anywhere in the country.

4 (c) (i) What is the National Grid?

.....

.....

(1 mark)

4 (c) (ii) Explain why transferring the electricity directly to local homes is more efficient than using the National Grid to distribute the electricity.

.....

.....

.....

.....

(2 marks)

7

4.1.1.4 Power

Question 85

January 2011 | PHY1H | Original Q6 | Legacy

6 (a) The table gives information about some ways of reducing the energy consumption in a house.

Method of reducing energy consumption	Installation cost in £	Annual saving on energy bills in £
Cavity wall insulation	250	115
Jacket for hot water tank	12	35
Upgraded central heating controls	310	80

Show that over 5 years, the most cost-effective method of reducing energy consumption is to install cavity wall insulation.

.....

.....

.....

.....

(2 marks)

6 (b) Any device that transforms energy will waste energy.

Why must the total energy input to such a device always equal the total energy output from the device?

.....

.....

(1 mark)

4.1.1.4 Power

Question 85 · continued

6 (c) A holiday cottage has a pre-payment electricity meter. The electricity is charged at the rate of 20 p per kWh. A £2 coin is put into the meter and a 2.5 kW fire switched on.

Use the equations in the box to work out how many hours it will be before £2 runs out. Assume that no other electrical device is switched on.

energy transferred = power × time
total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

.....

.....

Time = ... hours

(2 marks)

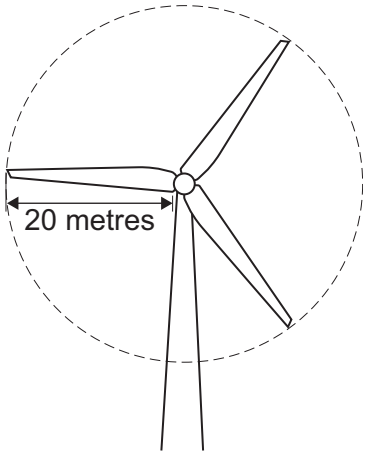
5

4.1.1.4 Power

Question 86

January 2011 | PHY2H | Original Q4 | Legacy

4 The diagram shows a wind turbine.



4 (a) The blades of the turbine are 20 metres long. On average, 15 000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

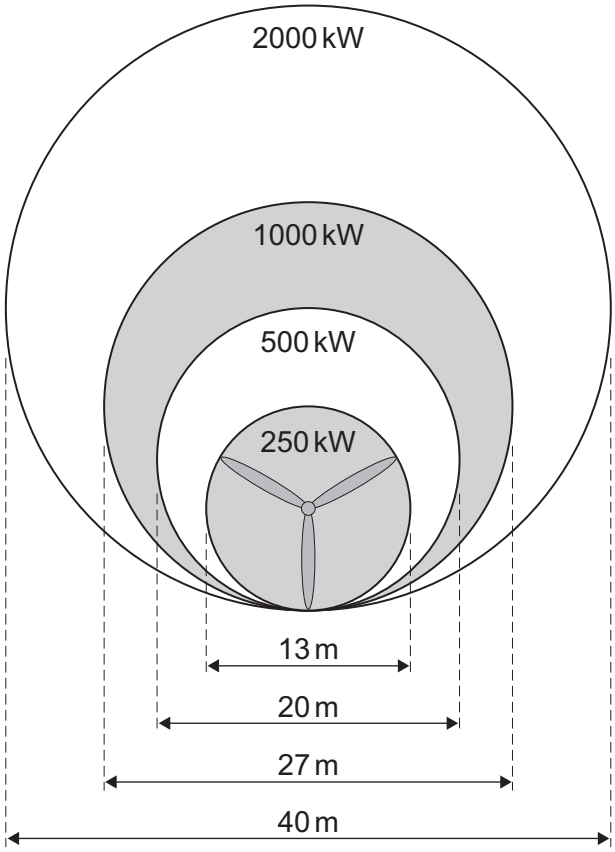
Kinetic energy = ... J

(2 marks)

4.1.1.4 Power

Question 86 · continued

4 (b) Part of the kinetic energy of the wind is transformed into electrical energy.
The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.



Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

.....

.....

(1 mark)

3

4.1.1.4 Power

Question 87

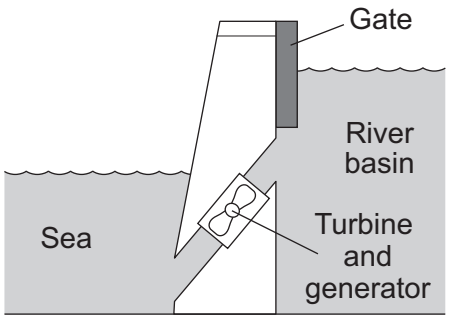
March 2011 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

It is estimated that the total energy available from the world's tides could provide about 5 % of the electricity generated worldwide.

One method of using the energy of tides is to build a barrage across a river.

The diagram shows a tidal barrage.



Tide going out

- As the tide rises, the gate is opened to let seawater into the river basin.
- At high tide the gate is closed, trapping water in the river basin.
- As the tide goes out, the gate is opened and water flows through the turbine.

3A Which energy transformations take place as the water flows from the river basin through the turbine and the generator to the sea?

1 gravitational potential to electrical to kinetic

2 gravitational potential to kinetic to electrical

3 kinetic to electrical to gravitational potential

4 kinetic to gravitational potential to electrical

4.1.1.4 Power

Question 87 · continued

3B From the information above, one of the advantages of a tidal barrage over a wind farm is that it . . .

1 can be built anywhere.

2 generates electricity all the time.

3 has low building costs.

4 uses a predictable energy source.

3C Environmentalists claim that one of the **disadvantages** of tidal power stations is that they . . .

1 cause noise pollution.

2 destroy the habitat of wading birds.

3 produce gases that pollute the atmosphere.

4 produce radioactive waste.

3D A cheaper way to use tidal energy is to use underwater currents to drive turbines. This is the same idea as a wind farm, but it works under water.

One report states that electricity generated by underwater currents would be four times as expensive as electricity generated by a wind farm.

The cost of electricity, from cheapest to most expensive, would be . . .

1 tidal barrage, underwater current, wind farm.

2 underwater current, wind farm, tidal barrage.

3 wind farm, tidal barrage, underwater current.

4 wind farm, underwater current, tidal barrage.

4.1.1.4 Power

Question 88

March 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

A 'hybrid' car can run on petrol stored in a tank or on electricity stored in a rechargeable battery.

5A When the battery is completely 'flat', it has no energy stored in it. The battery of car **X** is connected to the mains electrical supply and receives energy at a rate of 2000 W. It takes 6 hours to fully charge the battery.

How much electrical energy is needed to fully charge the battery of car **X**?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

1 3 kWh

2 12 kWh

3 333 kWh

4 12 000 kWh

5B A different hybrid car, **Y**, needs a different amount of electrical energy to charge its battery. The total cost of this electrical energy is £3.

Mains electricity costs 15 pence per kWh.

How much electrical energy is needed to fully charge the battery of car **Y**?

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

1 0.2 kWh

2 12 kWh

3 20 kWh

4 45 kWh

5C When the battery of car **Y** is fully charged, it can travel 100 km using the energy stored in its battery. Travelling the same distance using its petrol engine would require five times as much energy.

What does this tell you about the efficiency of the two methods of propelling car **Y**?

1 The electric motor is more efficient than the petrol engine.

2 The petrol engine is more efficient than the electric motor.

3 The petrol engine and the electric motor have the same efficiency.

4 It is impossible to compare the efficiency.

4.1.1.4 Power

Question 88 · continued

5D Some cars are all electric and have no petrol engine fitted.

Which statement about these cars is true?

1 They are not responsible for producing any atmospheric pollution.

2 They produce more atmospheric pollution than petrol-engine cars.

3 They produce no atmospheric pollution while being driven.

4 They produce no atmospheric pollution but a lot of noise pollution.

Turn over for the next question

4.1.1.4 Power

Question 89

March 2011 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The table is taken from an advert for low-energy lamps.

Save up to 80 % of your electricity bill by switching to low-energy lamps		
Filament lamp	**Equivalent low-energy lamp**	**Power saving**
60 W	12 W	80 %
60 W	15 W	
100 W	20 W	80 %
100 W	24 W	76 %

7A A householder changes from using a 60 W filament lamp to using a 15 W low-energy lamp.

What is the percentage power saving made?

1 20 %

2 45 %

3 75 %

4 80 %

A 20 W low-energy lamp provides the same amount of light each second as a 100 W filament lamp.

7B The efficiency of a 100 W filament lamp is 0.15.

What is the efficiency of the 20 W low-energy lamp?

1 0.03

2 0.15

3 0.30

4 0.75

4.1.1.4 Power

Question 89 · continued

7C How much money is saved over 200 hours by replacing a 100 W filament lamp with a 20 W low-energy lamp?

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15p per kWh

1 48p

2 60p

3 £2.40

4 £3.00

7D A householder is considering changing all her filament lamps for low-energy lamps. However, she says that the table in the advert does not contain enough information for her to know how much money she will save.

She needs to know . . .

1 how much each lamp costs and how long it lasts.

2 how long each lamp lasts and how much electricity costs per kWh.

3 how much electricity costs per kWh and how much each lamp costs.

4 how much each lamp costs, how long each lamp lasts and how much electricity costs per kWh.

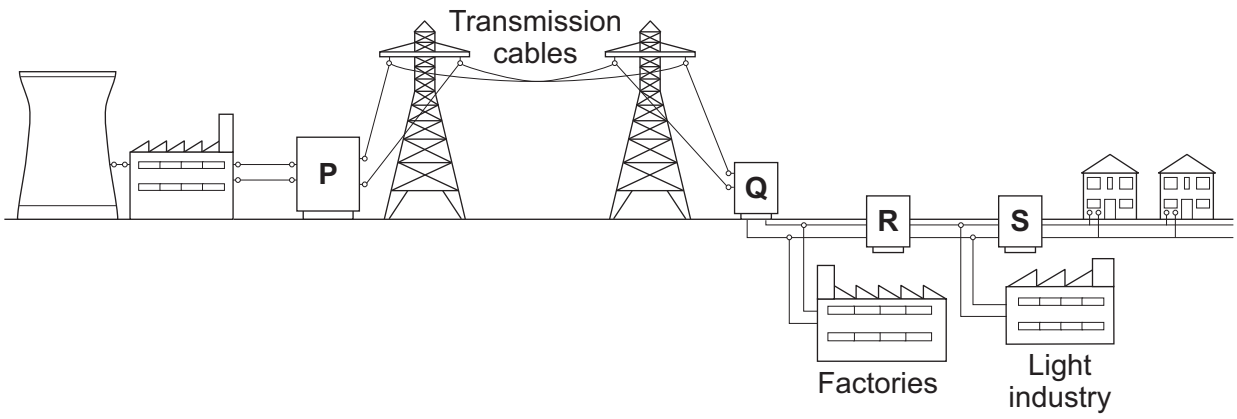
4.1.1.4 Power

Question 90

March 2011 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The diagram shows a power station supplying electricity to the National Grid. There are four transformers in the system, labelled **P**, **Q**, **R** and **S**.



8A Which row in the table correctly describes each transformer?

	P	Q	R	S
1	step up	step down	step down	step down
2	step down	step up	step up	step up
3	step up	step down	step up	step down
4	step up	step up	step down	step down

8B The voltage across the overhead transmission cables is very high.

The best explanation for this is that . . .

1 it allows thinner cables to be used and the energy loss from the cables is reduced.

2 the energy loss from the cables is reduced and it allows the distance between pylons to be reduced.

3 the distance between the pylons can be reduced and thicker cables can be used.

4 it allows the current to travel more slowly and thicker cables can be used.

Question 90 · continued

8C Changing the voltage between the power station and the transmission cables using transformer **P** also changes the current flowing and the efficiency of distribution.

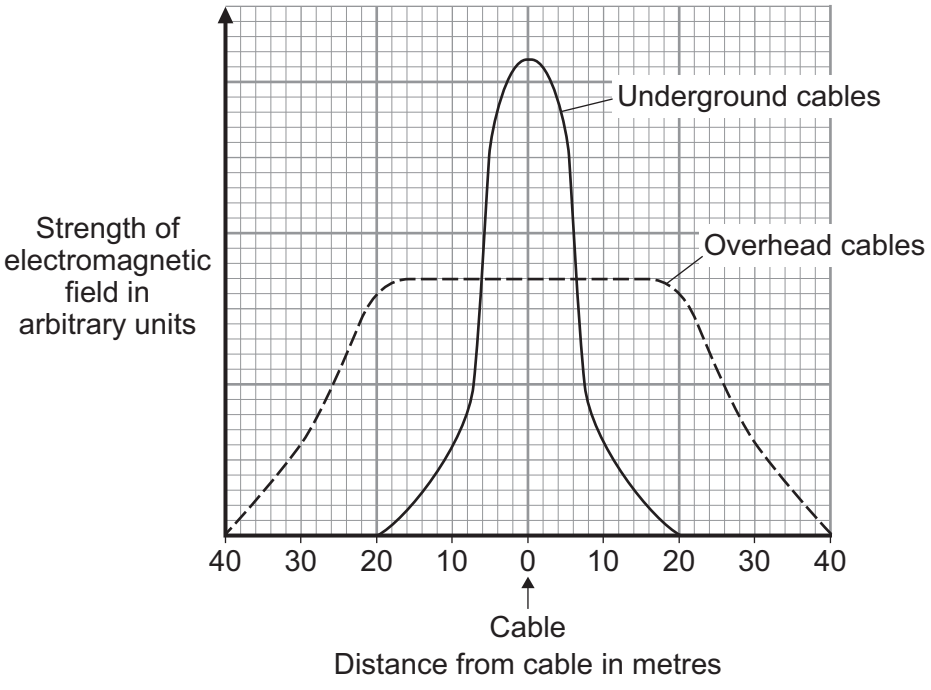
Which row of the table correctly shows these changes?

	Voltage	Current	Efficiency
1	increases	increases	increases
2	decreases	decreases	increases
3	decreases	decreases	decreases
4	increases	decreases	increases

8D Transmission cables can either be suspended from pylons above ground or they can be buried underground.

An electromagnetic field is produced when an electric current flows through a cable. Some people think that these fields can cause a health risk.

The graph shows how the strength of the electromagnetic field varies with distance from the cable for both overhead cables and underground cables.



Which of the following conclusions could be made from the graph?

1 When you are within 5 metres of the cable, the possible risk to health is bigger with an underground cable.

2 The possible health risk from overhead cables falls to zero when you are 20 metres away.

3 The biggest possible health risk from overhead cables occurs when you are 40 metres away.

4 Between 10 and 40 metres away, the biggest possible health risk is from underground cables.

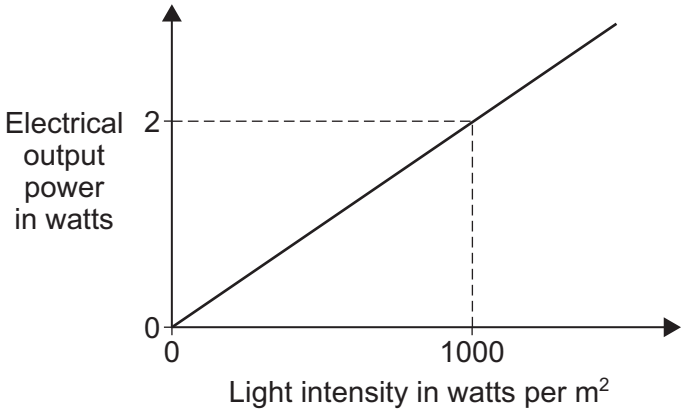
4.1.1.4 Power

Question 91

March 2011 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

The diagram shows the electrical output power of a typical solar cell as the light intensity on it changes. The solar cell has a surface area of 100 cm^2.



9A The graph shows that . . .

1 the output power is directly proportional to the light intensity.

2 the output power decreases as the light intensity increases.

3 as the light intensity decreases the output power increases.

4 the output power is not affected by the light intensity.

9B The output power of the solar cell is directly proportional to the area of the cell exposed to light.

A similar solar cell has an area of 50 cm^2. The light intensity was 1000 watts per $metre^2$.

What is the output power of this solar cell?

1 0 watts

2 1 watt

3 2 watts

4 4 watts

4.1.1.4 Power

Question 91 · continued

A satellite in space uses solar energy as its power source.
The satellite needs 3 kJ of energy per second.
One square metre of solar cells on the satellite produces 250 joules of energy per second.

9C What area of solar cells is needed to power the satellite?

1 12 m^2

2 83 m^2

3 300 m^2

4 400 m^2

9D The efficiency of the solar cells is 0.2

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Considering the total energy requirement of the satellite, how much solar energy falls on the solar cells each second?

1 15 J

2 600 J

3 15 kJ

4 600 kJ

END OF TEST

4.1.1.4 Power

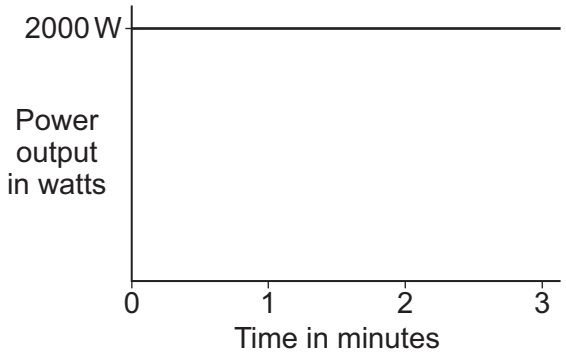
Question 92

June 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

An electric kettle has a power rating of 2000 W. It can boil 1 litre of water in 3 minutes.

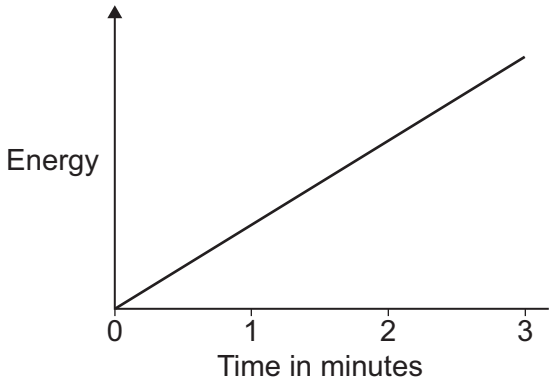
The graph shows how the power output of the kettle varies with time.



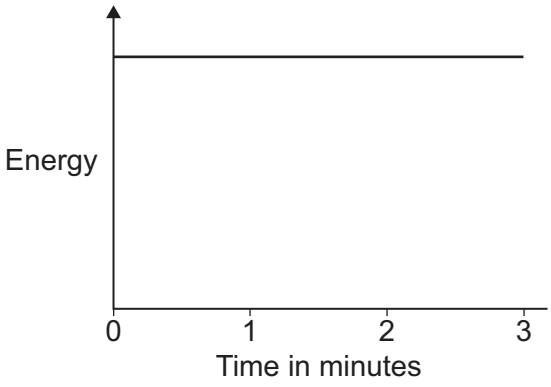
energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

5A Which graph shows how the energy transferred by the kettle varies with time?

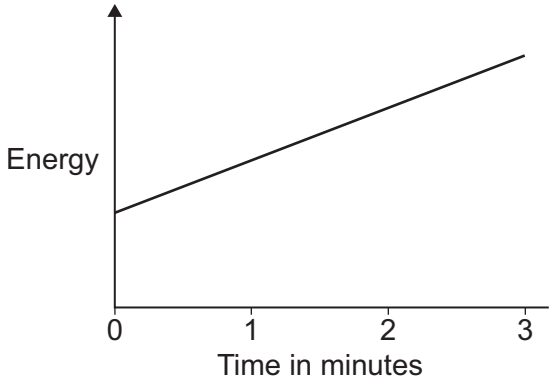
1



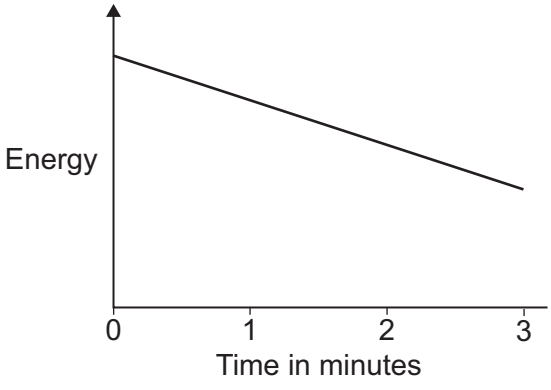
2



3



4



4.1.1.4 Power

Question 92 · continued

5B The energy transferred to boil the water is . . .

1 0.1 kWh

2 0.5 kWh

3 0.6 kWh

4 0.8 kWh

5C The 2000 W kettle is replaced by a 1000 W kettle. This second kettle is used to boil 1 litre of water.

Which row in the table shows what happens when a 1000 W kettle is used instead of a 2000 W kettle?

	Energy used to boil the water	Time taken to boil the water
1	stays the same	increases
2	stays the same	decreases
3	increases	stays the same
4	decreases	increases

5D It costs £7.50 to use the 1000 W kettle for 3 months. During this time, 50 kWh of electrical energy are transferred by the kettle.

total cost = number of kilowatt-hours × cost per kilowatt-hour

What is the cost per kilowatt-hour of electrical energy?

1 3.75 p

2 7.00 p

3 11.25 p

4 15.00 p

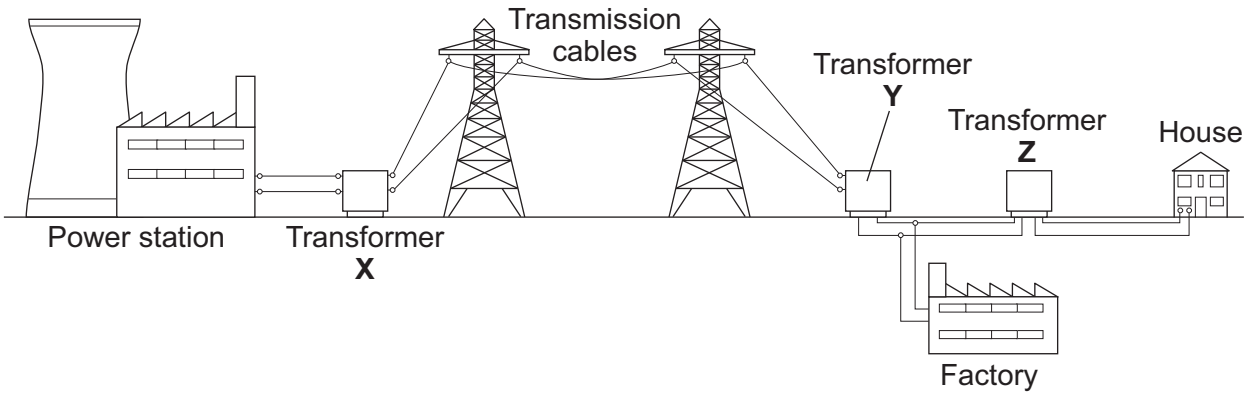
4.1.1.4 Power

Question 93

June 2011 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Transformers are used in the National Grid.



7A Both step-up transformers and step-down transformers are used in the National Grid.

Which row in the table shows the correct types of transformer?

	Transformer X	Transformer Y	Transformer Z
1	step-up	step-down	step-up
2	step-up	step-up	step-up
3	step-up	step-down	step-down
4	step-up	step-up	step-down

7B Transformer **X** changes the voltage between the power station and the transmission cables. It also changes the current. These changes affect the efficiency of the transmission cables.

Which row in the table correctly describes the changes produced by transformer **X**?

	Voltage	Current	Efficiency of transmission
1	decreased	decreased	decreased
2	decreased	increased	increased
3	increased	decreased	increased
4	increased	increased	increased

4.1.1.4 Power

Question 93 · continued

7C The table shows the percentage of energy wasted as heat and sound by four different transformers.

Which transformer has the highest efficiency?

Transformer	Percentage of energy supplied to transformer which is wasted as sound	Percentage of energy supplied to transformer which is wasted as heat
1	1.1	7.4
2	1.2	4.7
3	1.3	5.4
4	1.4	6.9

7D The amount of electricity that a device uses depends on the rate at which the device transforms energy and . . .

1 how long the device is switched on.

2 the current through the device.

3 the potential difference across the device.

4 the power of the device.

4.1.1.4 Power

Question 94

June 2011 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The sources of energy used to generate electricity in the UK have changed over the years. The table gives information on the percentages of electrical energy consumed in the UK produced from various energy sources.

Year \ Energy source	Coal	Oil	Gas	Nuclear	Hydroelectric	Other renewables
1965	65.0	28.4	5.0	1.0	0.6	0.0
1985	33.7	35.0	23.6	7.0	0.7	0.0
2005	33.0	1.0	40.0	19.0	1.0	3.5

8A In 1965, what was the percentage of electrical energy produced from sources that released polluting gases into the atmosphere?

1 1.6

2 65.0

3 93.4

4 98.4

8B The UK government wants to build more nuclear power stations.

Which row in the table gives a valid reason for, and a valid reason against, building more nuclear power stations?

	For	Against
1	Nuclear power stations have a long start-up time.	Nuclear power stations produce radioactive waste.
2	The energy available from 1 kg of nuclear fuel is much bigger than from other fuels.	Nuclear power stations have high decommissioning costs.
3	Nuclear power stations have low decommissioning costs.	Nuclear power stations produce radioactive waste.
4	The energy source is renewable.	The energy available from 1 kg of nuclear fuel is much smaller than from other fuels.

4.1.1.4 Power

Question 94 · continued

8C The figures for 2005 do not add up to 100 %.

This is likely to be because about 2.5 % . . .

1 of the energy was lost in the National Grid transmission cables.

2 of the electricity was exported to other countries.

3 of the electricity was imported from other countries.

4 of the energy was generated by wind farms.

8D Governments would like householders to replace older electrical appliances with new ones that are more efficient.

This would result in . . .

1 more electricity being generated from renewable sources and lower greenhouse gas emissions.

2 less electricity being generated from renewable sources and higher greenhouse gas emissions.

3 less energy being used and lower greenhouse gas emissions.

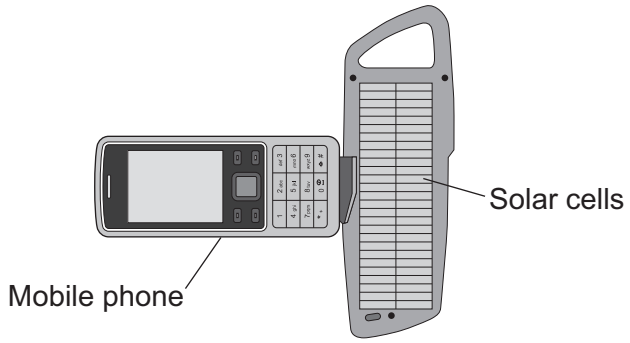
4 more energy being used and higher greenhouse gas emissions.

4.1.1.4 Power

Question 95

June 2011 | PHY1H | Original Q4 | Legacy

4 (a) The diagram shows a solar powered device being used to recharge a mobile phone.



On average, the solar cells produce 0.6 joules of electrical energy each second.
The solar cells have an efficiency of 0.15.

4 (a) (i) Use the following equation to calculate the average energy input each second to the device.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Average energy input each second = ... J/s

(2 marks)

4 (a) (ii) Draw a labelled Sankey diagram for the solar cells.
The diagram does **not** need to be drawn to scale.

(1 mark)

4.1.1.4 Power

Question 95 · continued

4 (a) (iii) Energy from the Sun is stored by a rechargeable battery inside the device.

Suggest **one** factor that would affect the time it takes to fully charge the battery.

Give a reason for your answer.

.....

.....

.....

.....

(2 marks)

4 (b) Scientists have developed a new type of solar cell with an efficiency of over 40 %. The efficiency of the solar cell was confirmed independently by other scientists.

Suggest why it was important to confirm the efficiency independently.

.....

.....

(1 mark)

4 (c) The electricity used in homes in the UK is normally generated in a fossil fuel power station.

Outline some of the advantages of using solar cells to generate this electricity.

.....

.....

.....

.....

(2 marks)

8

4.1.1.4 Power

Question 96

June 2011 | PHY3H | Original Q3 | Legacy

3 Jupiter is the largest planet in the solar system. It has over sixty moons. The four largest moons were observed by Galileo using his telescope over four hundred years ago.

The table displays some of the data on these four largest moons which is now known to scientists.

Name	Distance from Jupiter in kilometres	Time to orbit Jupiter in days	Diameter in kilometres	Mass in quintillion tonnes
Callisto	1 883 000	16.9	4806	108
Europa	671 000	3.6	3130	48
Ganymede	1 070 000	7.2	5268	148
Io	422 000	1.8	3630	89

1 quintillion tonne = 1 000 000 000 000 000 000 tonnes

3 (a) A centripetal force acts on each of these moons.

State clearly what provides the centripetal force.

.....

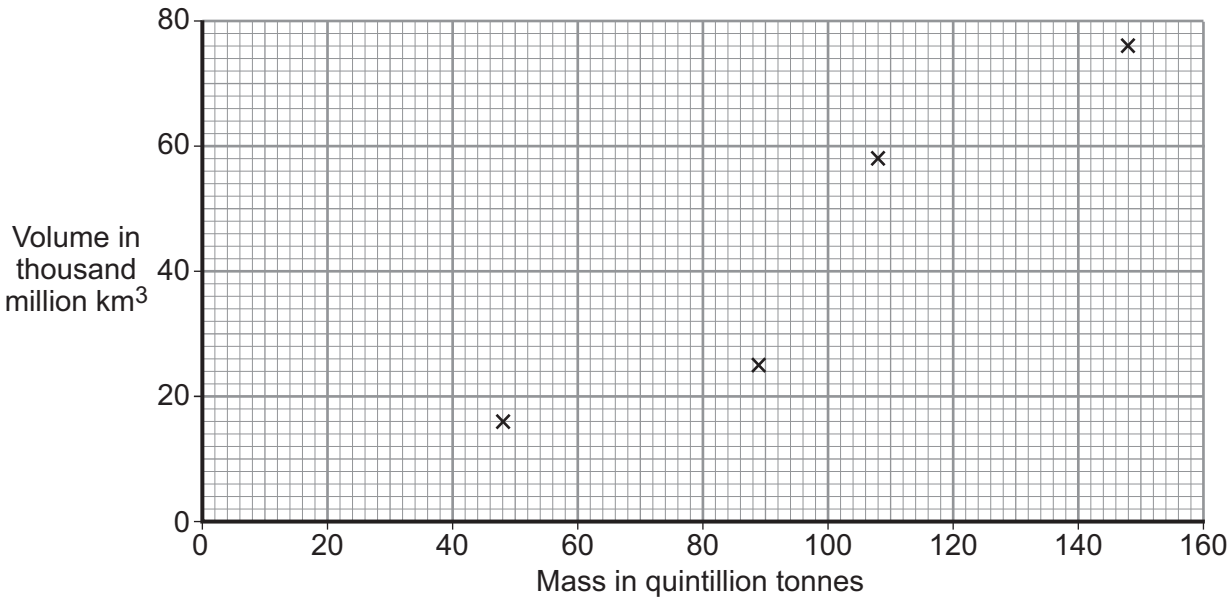
.....

(1 mark)

4.1.1.4 Power

Question 96 · continued

3 (b) The graph shows the volume against mass for these large moons.



Use the graph to estimate the volume of a moon with a mass of 20 quintillion tonnes.

Show clearly on the graph how you used it to get to your estimate.

Estimated volume of moon = ... thousand million km^3

(2 marks)

3 (c) For these large moons, what is the relationship, if any, between the moon's *distance* from Jupiter and the *time* it takes for the moon to orbit Jupiter?

.....

.....

(1 mark)

3 (d) One reason why astronomers now have more data on the moons of Jupiter is that present-day astronomers have telescopes which are much more powerful than Galileo's telescope.

Give **one** other reason.

.....

.....

(1 mark)

5

4.1.1.4 Power

Question 97

June 2011 | PHY3H | Original Q7 | Legacy

7 (a) In the National Grid, very large step-up transformers link power stations to the transmission cables.

A transformer used for this purpose has 800 turns on its primary coil and 12 800 turns on its secondary coil. The p.d. (potential difference) across its primary coil is 25 kV.

Use the equation in the box to calculate the p.d. across its secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer **and** give the unit.

.....

.....

p.d. across secondary coil = ...

(3 marks)

7 (b) The primary and secondary coils of a transformer are made of insulated wire.

Why is this insulation necessary?

.....

.....

(1 mark)

7 (c) Describe what happens when an alternating potential difference is applied across the primary coil of a transformer.

.....

.....

.....

.....

.....

.....

(3 marks)

7

4.1.1.4 Power

Question 98

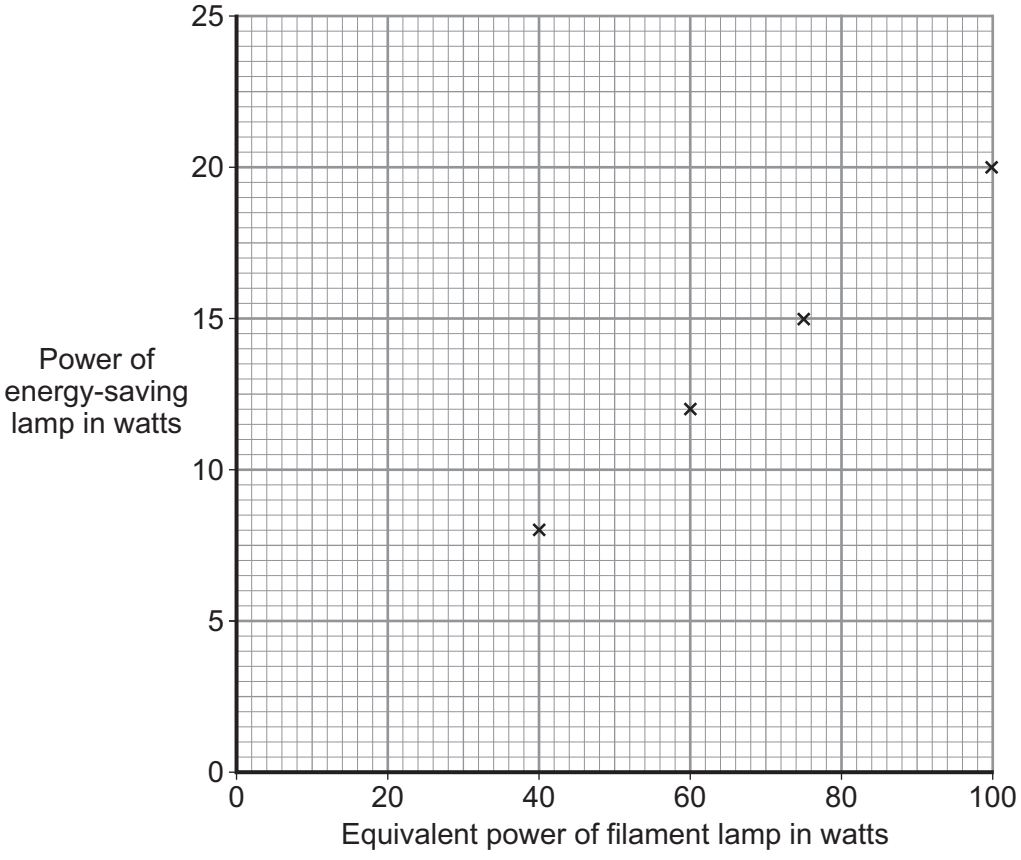
November 2011 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

A householder bought an energy-saving lamp. The following table was printed on the box.

Power of energy-saving lamp in W	Equivalent power of filament lamp in W
8	40
12	60
15	75
20	100

5A The graph shows the data given in the table.



To see if the power of the filament lamp is directly proportional to the power of the energy-saving lamp, you should . . .

1 draw a line of best fit and see if it passes through (0,0).

2 change the watts to kilowatts.

3 produce a bar chart.

4 use a different scale.

4.1.1.4 Power

Question 98 · continued

5B Assume that the power of the filament lamp is directly proportional to the power of the energy-saving lamp.

What is the power of an energy-saving lamp that is equivalent to a 150 W filament lamp?

1 8 W

2 18 W

3 30 W

4 35 W

5C The efficiency of a 100 W filament lamp is 0.15.

What is the efficiency of a 20 W energy-saving lamp?

1 0.03

2 0.15

3 0.30

4 0.75

5D The government has decided to stop the sale of filament lamps. This is to save on the amount of fuel needed for making electricity.

Most energy-saving lamps contain toxic chemicals. Safety campaigners say that energy-saving lamps must be disposed of carefully.

Which row in the table correctly describes the types of issue given above that concern the government and safety campaigners?

	The Government	Safety campaigners
1	environmental	economic
2	economic	environmental
3	ethical	social
4	social	ethical

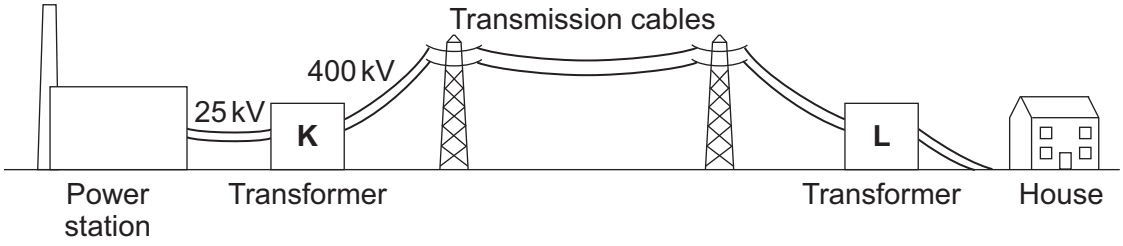
4.1.1.4 Power

Question 99

November 2011 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

Electricity is transmitted around the country through the National Grid.



6A The voltage from the power station is stepped up from 25 kV to 400 kV in transformer **K** so that . . .

1 the current decreases.

2 the current increases.

3 the current travels faster.

4 the current travels more slowly.

6B Increasing the voltage also . . .

1 increases energy losses from the cables.

2 makes the National Grid more efficient.

3 makes the National Grid safer.

4 means a step-down transformer is not needed.

6C Which row of the table shows what happens in transformer **L**?

	Current	Voltage
1	decreases	decreases
2	decreases	increases
3	increases	decreases
4	increases	increases

4.1.1.4 Power

6D The amount of electrical energy that a device transfers depends on . . .

1 the current flowing through the device only.

2 for how long the device is switched on only.

3 the power of the device only.

4 the power of the device and for how long it is switched on.

Turn over for the next question

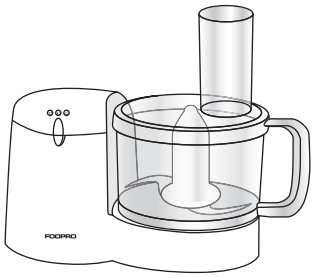
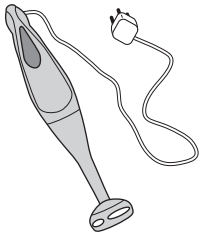
4.1.1.4 Power

Question 100

November 2011 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

A food mixer and a hand-held blender can both be used for making soup. The ingredients are cooked and then processed to produce a smooth soup. Processing is done by metal blades spinning in the soup.

	Food mixer	Hand-held blender
		
Power rating	500 W	300 W
Volume of soup	300–500 cm^3	Up to 2000 cm^3
Feature	Lid	No lid

7A Which one of the following describes advantages of using the hand-held blender rather than the food mixer for making soup?

1 The hand-held blender can mix smaller volumes of soup and does not splash.

2 The hand-held blender uses more power and may splash hot soup on the user.

3 The hand-held blender can mix larger volumes of soup and does not splash.

4 The hand-held blender uses less power and can mix larger volumes of soup.

7B How much more does it cost to use the food mixer for 1 hour rather than the hand-held blender?

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

total cost	=	number of kilowatt-hours	×	cost per kilowatt-hour

Electricity costs 15 p per kilowatt-hour

1 3 p

2 4.5 p

3 7.5 p

4 30 p

4.1.1.4 Power

Question 100 · continued

7C As the soup is being processed, it cools down.

Which soup will probably cool down the quickest?

1 the soup processed by the food mixer, because it has a lid that stops convection

2 the soup processed by the food mixer, because the container is made of plastic

3 the soup processed by the hand-held blender, because there is no lid to stop convection

4 the soup processed by the hand-held blender, because the soup is not as hot

7D The processed soup is put into a saucepan and reheated.

Heat is transferred through the soup because the soup at the bottom of the saucepan . . .

1 contracts, becomes less dense and falls.

2 expands, becomes more dense and falls.

3 contracts, becomes more dense and rises.

4 expands, becomes less dense and rises.

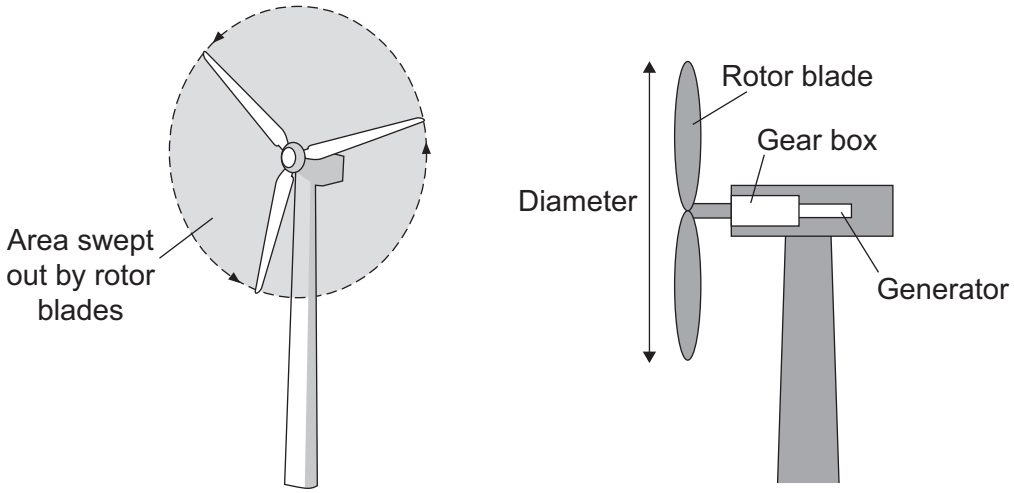
4.1.1.4 Power

Question 101

November 2011 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

A wind turbine is an electrical generator. The rotor blades are connected to the generator through a gear box.



8A Which is the correct energy transformation for the wind turbine generator?

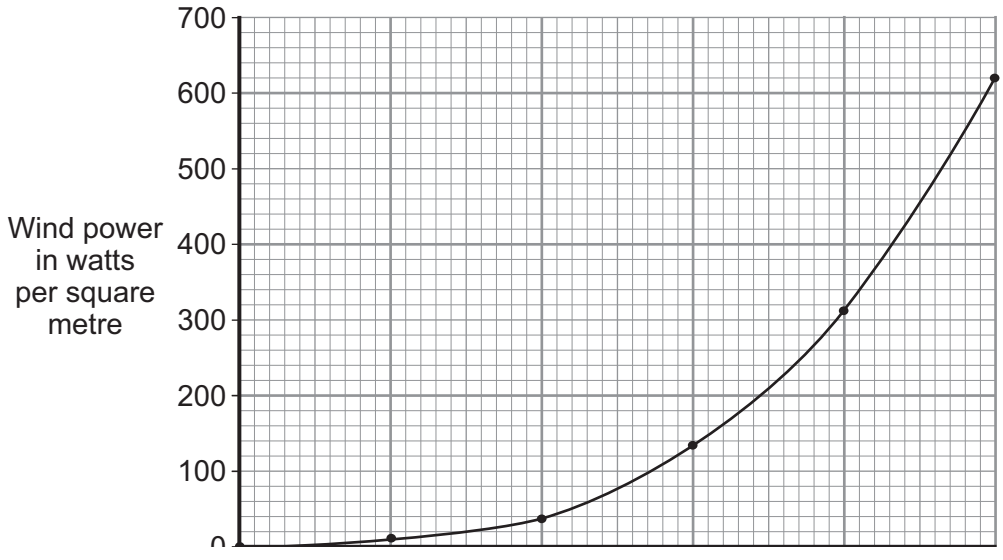
1 potential → electrical, thermal and sound

2 potential → kinetic, electrical and thermal

3 kinetic → electrical, thermal and sound

4 kinetic → chemical, electrical and thermal

8B The graph shows the power developed by the wind at different wind speeds. The power is measured in watts per square metre of area swept out by the rotor blades.



4.1.1.4 Power

Question 101 · continued

What wind power is developed by a wind speed of 5.5 metres per second when the rotor blades sweep out an area of 5 square metres?

1 20 W

2 27.5 W

3 100 W

4 500 W

8C The table shows how the power output of a wind turbine changes with the diameter of the rotor blade.

Rotor blade diameter in metres (m)	Power output in kilowatts (kW)
1	0.4
2	1.6
3	3.6
4	6.4
6	14.4
8	25.6
10	40.0

Which of the following statements is correct?

1 decrease the rotor blade diameter and the power output increases

2 double the rotor blade diameter and the power output doubles

3 double the rotor blade diameter and the power output trebles

4 double the rotor blade diameter and the power output quadruples

8D A small wind turbine on the roof of a house has an average power output of 1 kW. The average demand for a household is 10 kW.

Large wind farms can produce an average power output of 5 MW.

One of the **disadvantages** of using wind farms to provide all the electricity for a large city is that . . .

1 wind farms develop far too much power for a large city.

2 large numbers of turbines are needed, taking up a lot of land.

3 large numbers of turbines will produce a lot of carbon dioxide.

4 wind farms produce a lot of noise that is very harmful to birds.

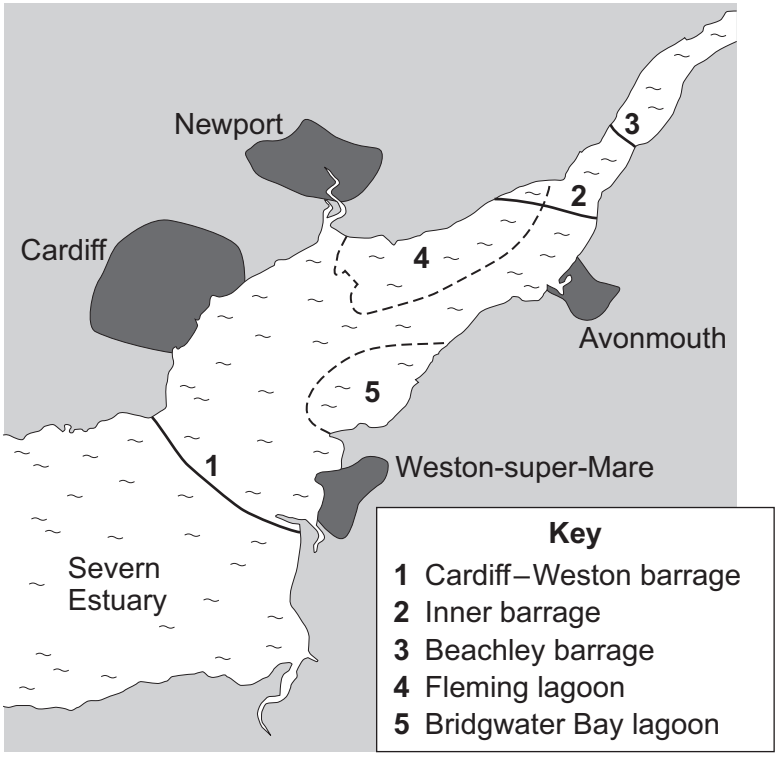
4.1.1.4 Power

Question 102

November 2011 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

The UK government is considering five schemes for generating electricity from the tides in the Severn estuary. Three of the schemes involve building a barrage across the estuary. The barrage would contain turbines and generators. The other two schemes would be lagoons, which enclose large areas of water, rather than having a barrier across the estuary.



9A The table gives some information about the five schemes.

	Estimated building cost in billions of £	Maximum power produced in millions of watts (MW)	Annual carbon dioxide emission savings in millions of tonnes
Cardiff–Weston barrage	21.0	8.64	7.2
Inner barrage	3.2	1.05	1.2
Beachley barrage	2.3	0.62	0.7
Fleming lagoon	4.5	1.36	1.0
Bridgwater Bay lagoon	3.8	1.36	1.1

Question 102 · continued

From the information in the table, which of the following statements is correct?

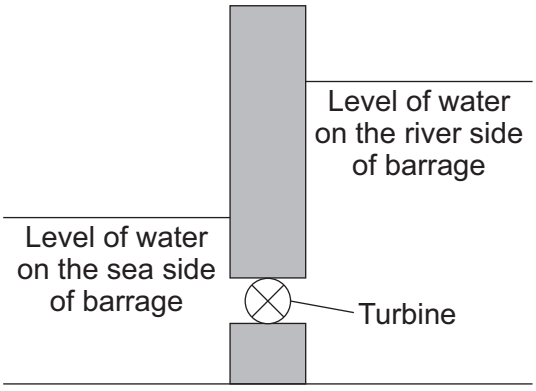
1 The Bridgwater Bay lagoon would produce the cheapest electricity and would be the cheapest to build.

2 The Beachley barrage would be the cheapest to build and would be the best at reducing global warming.

3 The Cardiff–Weston barrage would be the most expensive to build, would produce the most energy and would be the best at reducing global warming.

4 The Fleming lagoon would be the most expensive to build, would produce the most energy and would be the best at reducing global warming.

9B The diagram shows a section through a barrage.



As the tide comes in, water is trapped behind the barrage. Later, water is released to flow back through the turbine.

What is the main energy transformation as water is released to flow through the turbine?

1 electrical energy to gravitational potential energy

2 electrical energy to kinetic energy

3 gravitational potential energy to kinetic energy

4 kinetic energy to gravitational potential energy

Question 9 continues on the next page

Question 102 · continued

9C There are many arguments for and against the Cardiff–Weston barrage scheme.

Which row in the table of statements for and against the scheme gives two correct **environmental** issues?

	For the scheme	Against the scheme
1	It will increase the number of ships using Cardiff docks.	It will provide only a small percentage of the UK's electricity.
2	It will provide up to 1500 extra jobs.	It will cost many billions of pounds to build.
3	It will reduce the total harmful emissions from UK power stations.	It will destroy wildlife habitats and block fish migration routes.
4	It will reduce the amount of salt in the water in the Severn estuary.	It will attract more tourists to the area.

9D The UK uses about 360 terawatt-hours (TWh) of electricity each year. A barrage across the Severn estuary is expected to generate 18 TWh of electricity each year.

1 terawatt-hour is a very large unit of energy

What percentage of the UK's electricity would the barrage generate each year?

1 2 %

2 5 %

3 20 %

4 80 %

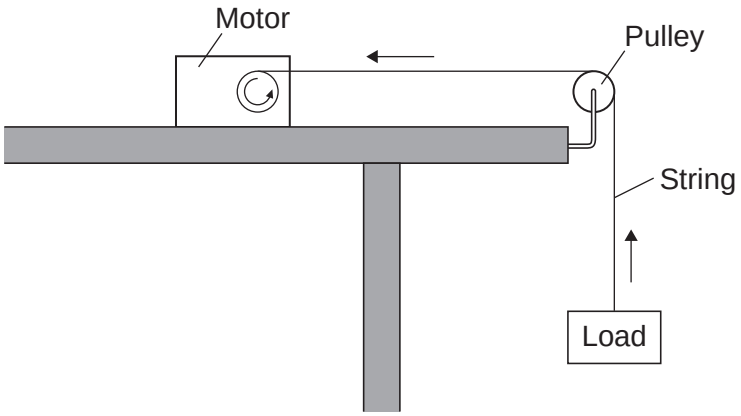
END OF TEST

4.1.1.4 Power

Question 103

June 2012 | PH1HP | Original Q2 | Legacy

2 A student uses an electric motor to lift a load.



In the motor, the electrical energy is transferred into other types of energy. Some of this energy is useful and the rest of the energy is wasted.

2 (a) (i) Name the useful energy output from the electric motor.

.....

(1 mark)

2 (a) (ii) What eventually happens to the wasted energy?

.....

.....

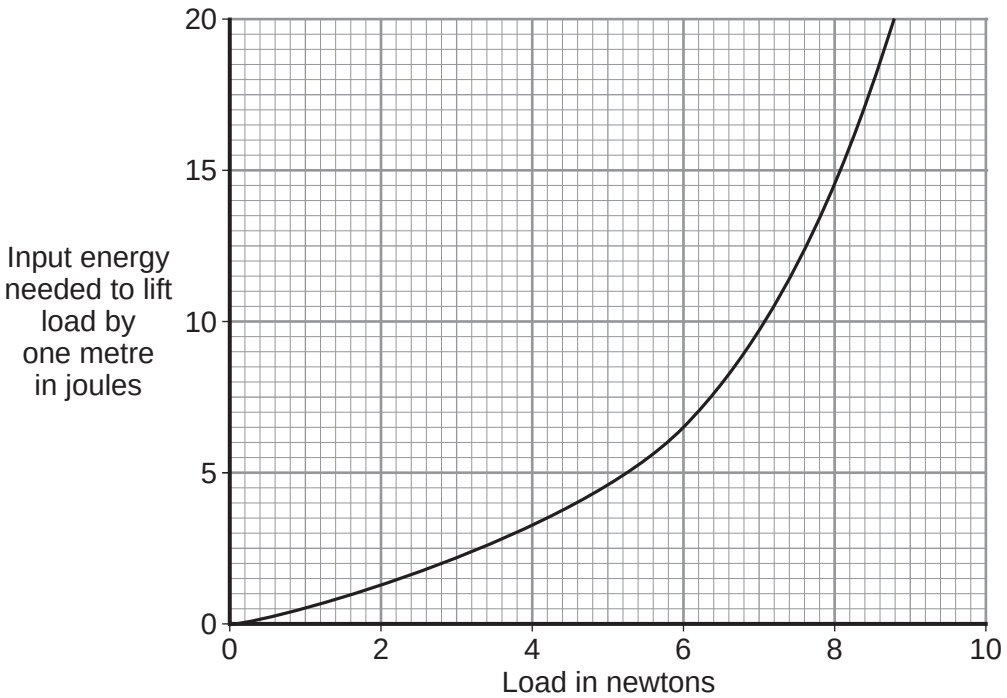
(1 mark)

Question 2 continues on the next page

4.1.1.4 Power

Question 103 · continued

2 (b) The graph shows the input energy the motor needs to lift different loads by one metre.



What can you conclude from the graph about the relationship between the load lifted and the input energy needed?

.....

.....

.....

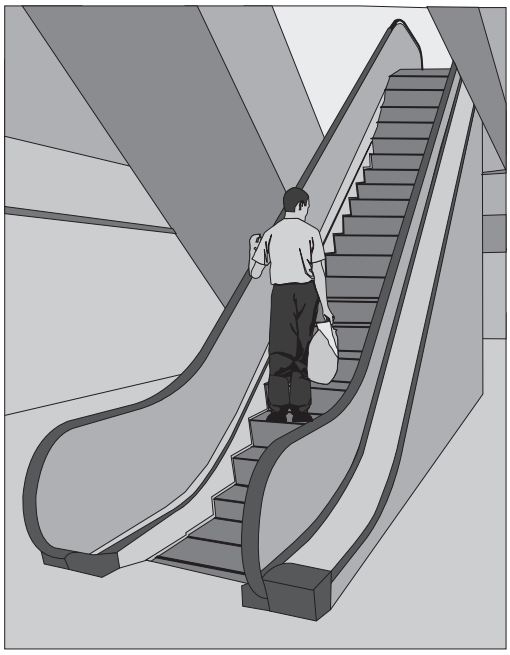
.....

(2 marks)

4.1.1.4 Power

Question 103 · continued

2 (c) A shop uses escalators to lift customers to different floor levels. The escalators use electric motors. When the shop is not busy some escalators are turned off.
A sign tells the customers that the escalators are turned off to save energy.



2 (c) (i) Each escalator has one motor with an average power of 4000 W. The motor is turned on for an average of 8 hours each day, 6 days each week. Electricity costs 15 pence per kilowatt-hour.

Calculate the cost of the electricity used in an average week to run **one** escalator.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

.....

Cost = ... pence
(3 marks)

2 (c) (ii) Give **one** environmental advantage to turning off electrical appliances when they are not being used.

.....

.....
(1 mark)

8

4.1.1.4 Power

Question 104

June 2012 | PH1HP | Original Q3 | Legacy

3 (a) Geothermal energy and the energy of falling water are two resources used to generate electricity.

3 (a) (i) What is geothermal energy?

.....

.....

(1 mark)

3 (a) (ii) Hydroelectric systems generate electricity using the energy of falling water.

A pumped storage hydroelectric system can also be used as a way of storing energy for future use.

Explain how.

.....

.....

.....

.....

.....

.....

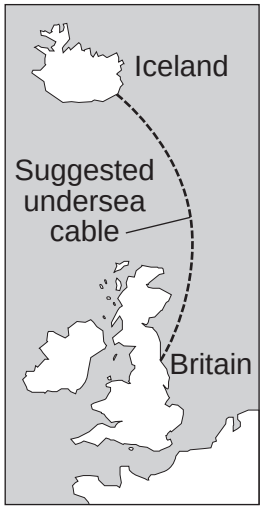
(2 marks)

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate*.

Read the following extract from a newspaper.

Britain may be switched on by Iceland

Iceland is the only country in the world generating all of its electricity from a combination of geothermal and hydroelectric power stations. However, Iceland is using only a small fraction of its energy resources. It is estimated that using only these resources, the amount of electricity generated could be increased by up to four times.



To help supply the future demand for electricity in Britain, there are plans to build thousands of new offshore wind turbines. It has also been suggested that the National Grid in Britain could be linked to the electricity generating systems in Iceland. This would involve laying a 700 mile undersea electricity cable between Iceland and Britain.

4.1.1.4 Power

Question 104 · continued

Discuss the advantages and disadvantages of the plan to build thousands of offshore wind turbines around Britain **and** the suggested electricity power link between Britain and Iceland.

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(6 marks)

9

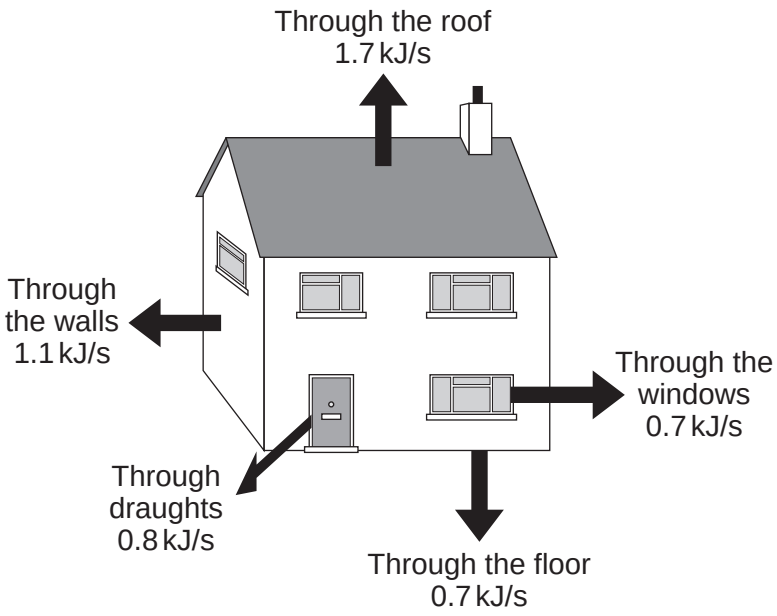
4.1.1.4 Power

Question 105

January 2013 | PH1HP | Original Q1 | Legacy

1 **Diagram 1** shows the energy transferred per second from a badly insulated house on a cold day in winter.

Diagram 1



1 (a) (i) When the inside of the house is at a constant temperature, the energy transferred from the heating system to the inside of the house equals the energy transferred from the house to the outside.

Calculate, in kilowatts, the power of the heating system used to keep the inside of the house in **Diagram 1** at a constant temperature.

1 kilowatt (kW) = 1 kilojoule per second (kJ/s)

.....

Power of the heating system = ... kW

(1 mark)

4.1.1.4 Power

Question 105 · continued

1 (a) (ii) In the winter, the heating system is switched on for a total of 7 hours each day.

Calculate, in kilowatt-hours, the energy transferred each day from the heating system to the inside of the house.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred each day = ... kWh

(2 marks)

1 (a) (iii) Energy costs 15 p per kilowatt-hour.

Calculate the cost of heating the house for one day.

.....

Cost = ...

(1 mark)

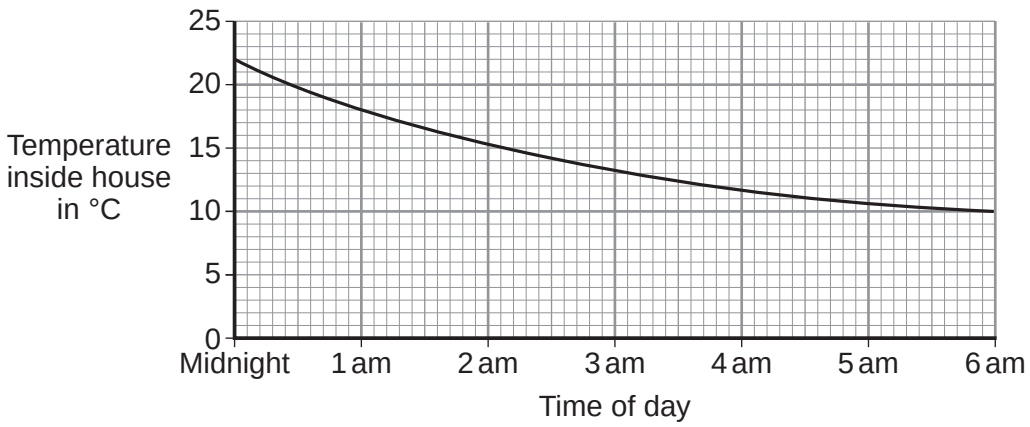
Question 1 continues on the next page

4.1.1.4 Power

Question 105 · continued

1 (a) (iv) The heating system is switched off at midnight.

The graph shows how the temperature inside the house changes after the heating system has been switched off.



Draw a ring around the correct answer in the box to complete the sentence.

Between midnight and 6 am the rate of energy transfer from

the house

decreases.
decreases then stays constant.
increases.

Give the reason for your answer.

.....

.....

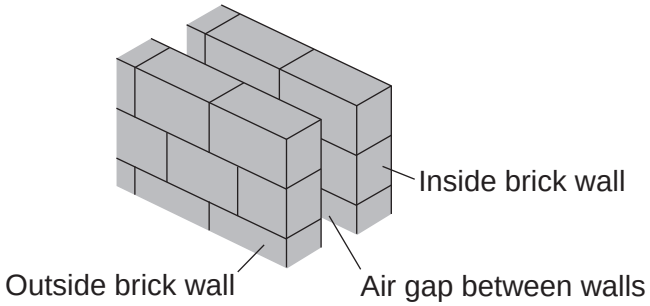
(2 marks)

4.1.1.4 Power

Question 105 · continued

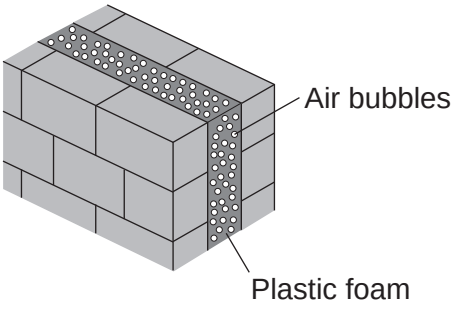
1 (b) **Diagram 2** shows how the walls of the house are constructed.
Diagram 3 shows how the insulation of the house could be improved by filling the air gap between the two brick walls with plastic foam.

Diagram 2



U-value of the wall = 0.7

Diagram 3



U-value of the wall = 0.3

1 (b) (i) The plastic foam reduces energy transfer by convection.

Explain why.

.....

.....

.....

.....

(2 marks)

1 (b) (ii) Filling the air gap with plastic foam reduces the U-value of the wall.

What is meant by the term *U-value*?

.....

.....

(1 mark)

Question 1 continues on the next page

4.1.1.4 Power

Question 105 · continued

1 (c) A homeowner has part of the outside wall of her house removed and replaced with double-glazed glass doors.

U-value of the wall = 0.3
U-value of glass doors = 1.8

Explain the effect of replacing part of the outside wall with glass doors on the rate of energy transfer from the house.

.....

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.....

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(2 marks)

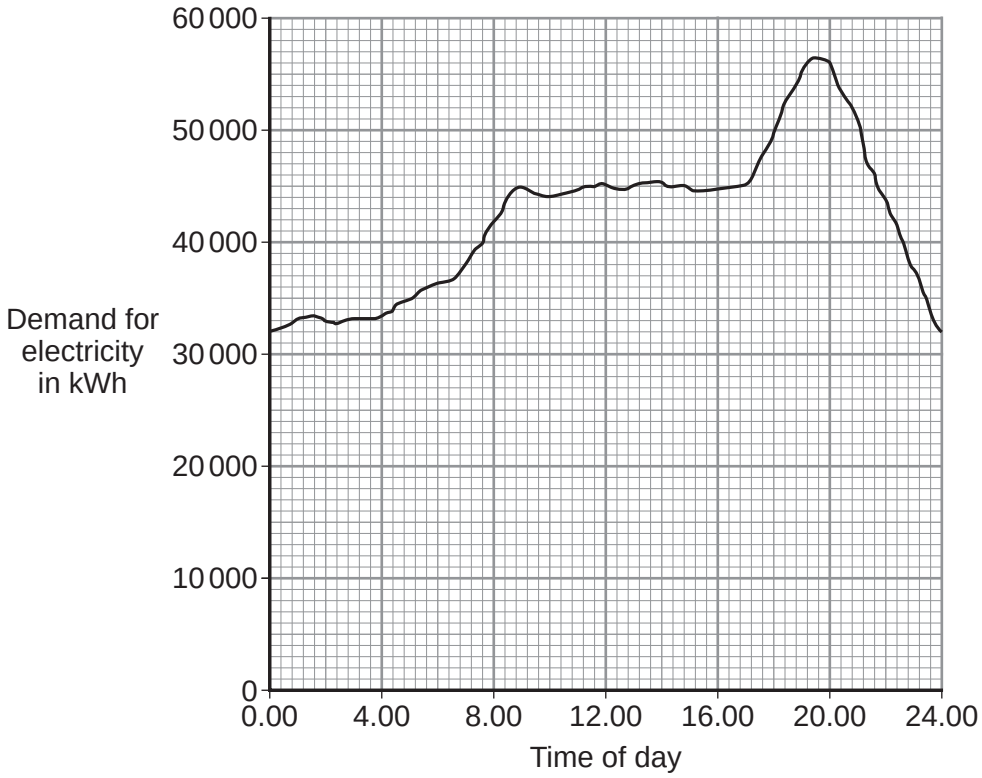
11

4.1.1.4 Power

Question 106

January 2013 | PH1HP | Original Q3 | Legacy

3 (a) The graph shows how the demand for electricity in the UK changes during one 24-hour period.



The table gives the start-up times for two types of power station.

Type of power station	Start-up time
Gas	A few minutes
Nuclear	Several days

How would these two types of power station be used to meet the demand for electricity during this 24-hour period?

.....

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.....

.....

(3 marks)

4.1.1.4 Power

Question 106 · continued

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

A farmer plans to generate all the electricity needed on her farm, using either a biogas generator or a small wind turbine.

The biogas generator would burn methane gas. The methane gas would come from rotting the animal waste produced on the farm. When burnt, methane produces carbon dioxide.

The biogas generator would cost £18 000 to buy and install. The wind turbine would cost £25 000 to buy and install.

The average power output from the wind turbine would be the same as the continuous output from the biogas generator.

Evaluate the advantages and disadvantages of the two methods of generating electricity.

Conclude, with a reason, which system would be better for the farmer to buy and install.

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(6 marks)

9

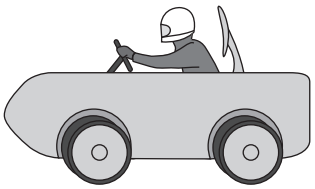
4.1.1.4 Power

Question 107

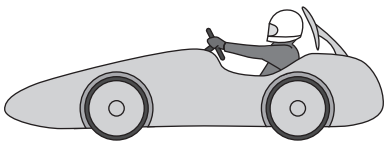
January 2013 | PH2HP | Original Q5 | Legacy

5 (a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.

First design **X**



Final design **Y**



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

.....

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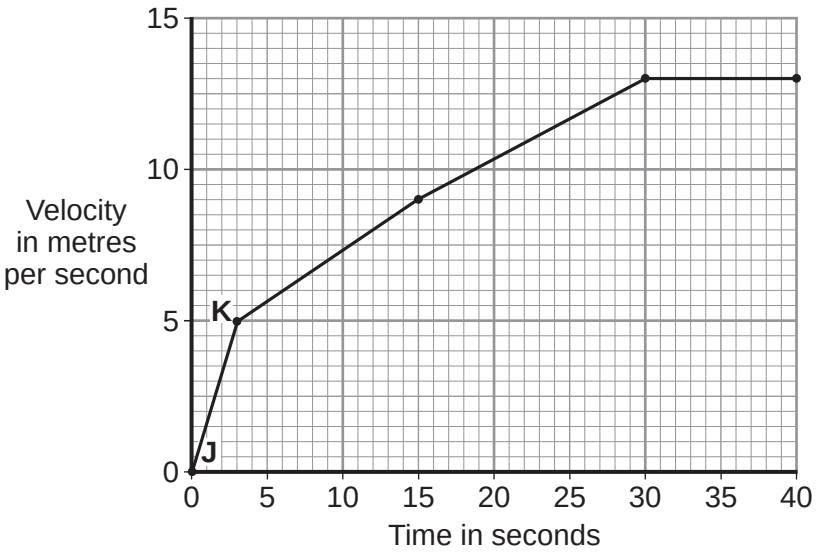
.....

(3 marks)

5 (b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.



4.1.1.4 Power

Question 107 · continued

5 (b) (i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

Give your answer to **two** significant figures.

.....

.....

.....

Acceleration = ... m/s^2

(2 marks)

5 (b) (ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

.....

.....

.....

Distance = ... m

(2 marks)

5 (b) (iii) What causes most of the resistive forces acting on the go-kart?

.....

(1 mark)

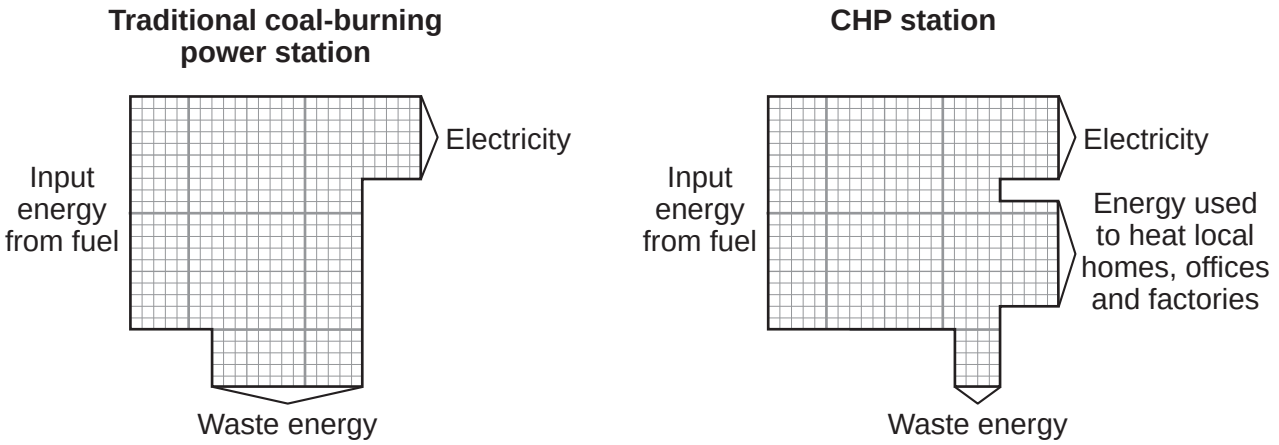
8

4.1.1.4 Power

Question 108

June 2013 | PH1HP | Original Q1 | Legacy

1 The Sankey diagrams show the energy transfers in a traditional coal-burning power station and a combined heat and power (CHP) station.



1 (a) What effect does the waste energy from a power station have on the surroundings?

.....

.....

(1 mark)

1 (b) Calculate the efficiency of the CHP station.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Efficiency = ...

(2 marks)

4.1.1.4 Power

Question 108 · continued

1 (c) Why is a CHP station more efficient than a traditional coal-burning power station?

.....

.....

.....

.....

(2 marks)

1 (d) A CHP station is usually used to meet the demand for electricity within the local area. The electricity is not transmitted and distributed through the National Grid.

1 (d) (i) What is the National Grid?

Tick (✓) **one** box.

A system of cables and pylons. ☐

A system of cables and transformers. ☐

A system of cables, transformers and power stations. ☐

(1 mark)

1 (d) (ii) Using the electricity locally and not transmitting it through the National Grid increases the overall efficiency of a CHP station by 7%.

Give **one** reason why.

.....

.....

(1 mark)

7

4.1.1.4 Power

Question 109

June 2013 | PH1HP | Original Q6 | Legacy

6 (a) In the UK, over 70% of the electricity is generated in power stations that burn fossil fuels.

6 (a) (i) Explain **one** effect that burning fossil fuels has on the environment.

.....

.....

.....

.....

(2 marks)

6 (a) (ii) Give **one** way the effect on the environment described in part **(a)(i)** could be reduced.

Assume the amount of fossil fuels burnt stays the same.

.....

.....

(1 mark)

6 (b) Electricity can also be generated in a pumped storage hydroelectric power station.

An advantage of pumped storage hydroelectric power stations is the short start-up time they have.

6 (b) (i) What is the importance of the short start-up time?

.....

.....

(1 mark)

6 (b) (ii) Give **one** other advantage of a pumped storage hydroelectric power station.

.....

.....

(1 mark)

4.1.1.4 Power

Question 109 · continued

6 (c) Read the extract below from a newspaper article.

> In the future it may not be possible to have constant electricity. Families will have to get used to using power when it is available.

6 (c) (i) In the UK, the proportion of electricity generated using wind turbines is due to increase a lot. Some opponents of wind turbines think this increase will cause big fluctuations in the electricity supply.

Suggest **one** reason why this may be true.

.....

.....

(1 mark)

6 (c) (ii) Between 2002 and 2008 the amount of electricity used for lighting in homes in the UK decreased.

Suggest **one** reason why.

.....

.....

(1 mark)

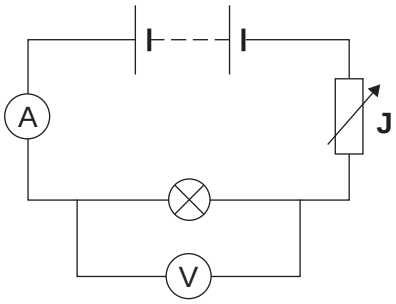
7

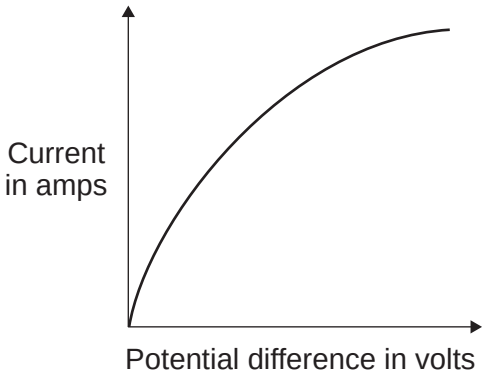
4.1.1.4 Power

Question 110

June 2013 | PH2HP | Original Q2 | Legacy

2 (a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.





2 (a) (i) Why is the component labelled '**J**' included in the circuit?

.....

.....

(1 mark)

2 (a) (ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

.....

.....

(1 mark)

2 (a) (iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

Calculate the power of the bulb when it is at full brightness and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Power = ...

(3 marks)

4.1.1.4 Power

Question 110 · continued

2 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The table gives data about two types of light bulb people may use in their homes.

Type of light bulb	Energy efficiency	Cost of one light bulb	Average lifetime in hours
Halogen	10%	£1.95	2 000
Light Emitting Diode (LED)	32%	£11.70	36 000

Both types of light bulb produce the same amount of light.

Evaluate, in terms of cost and energy efficiency, the use of the two types of light bulb.

To gain full marks you must compare both types of light bulb and conclude which light bulb would be the best to use.

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(6 marks)

11

4.1.1.4 Power

Question 111

June 2013 | PH2HP | Original Q3 | Legacy

3 (a) Nuclear power stations generate about 14% of the world's electricity.

3 (a) (i) Uranium-235 is used as a fuel in some nuclear reactors.

Name **one** other substance used as a fuel in some nuclear reactors.

.....

(1 mark)

3 (a) (ii) Energy is released from nuclear fuels by the process of nuclear fission.
This energy is used to generate electricity.

Describe how this energy is used to generate electricity.

Do **not** explain the nuclear fission process.

.....

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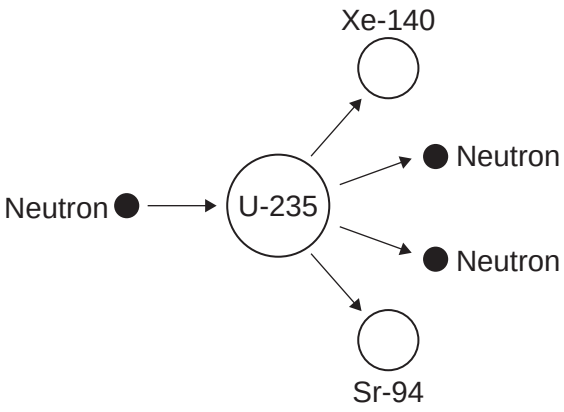
(3 marks)

3 (b) The diagram shows the nuclear fission process for an atom of uranium-235.

Complete the diagram to show how the fission process starts a chain reaction.

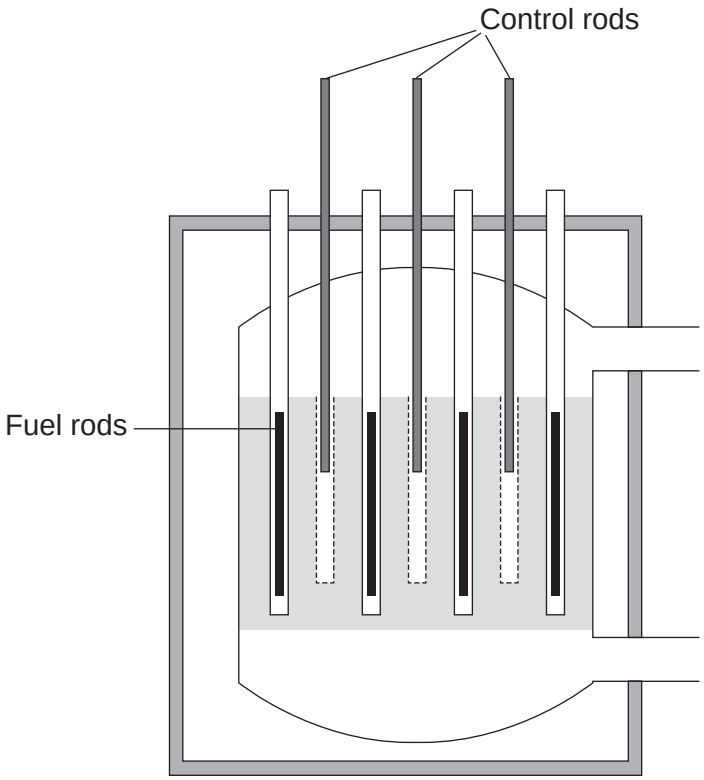


(2 marks)

4.1.1.4 Power

Question 111 · continued

3 (c) The diagram shows the cross-section through a nuclear reactor.



The control rods, made from boron, are used to control the chain reaction. Boron atoms absorb neutrons without undergoing nuclear fission.

Why does lowering the control rods reduce the amount of energy released each second from the nuclear fuel?

.....

.....

.....

.....

(2 marks)

8

4.1.1.4 Power

Question 112

June 2013 | PH2HP | Original Q5 | Legacy

5 In 2011 an earthquake caused severe damage to a nuclear power station in Japan. The damage led to the release of large amounts of radioactive iodine-131($^{131}_{53}I$) into the atmosphere.

5 (a) The table gives some information about an atom of iodine-131($^{131}_{53}I$).

Complete the table.

mass number	131
number of protons	53
number of neutrons	

(1 mark)

5 (b) Complete the sentence.

The number of protons in an atom is called the proton number or

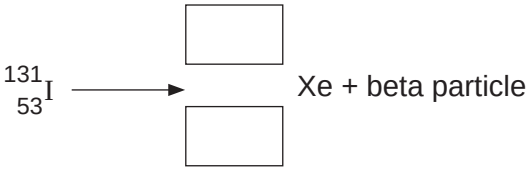
the ..... number.

(1 mark)

5 (c) An atom of iodine-131 decays into an atom of xenon (Xe) by emitting a beta particle.

5 (c) (i) The decay of iodine-131 can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.



(2 marks)

Question 5 continues on the next page

4.1.1.4 Power

Question 112 · continued

5 (c) (ii) A sample of rainwater contaminated with iodine-131 gives a count rate of 1200 counts per second.

Calculate how many days it will take for the count rate from the sample of rainwater to fall to 75 counts per second.

Half-life of iodine-131 = 8 days

Show clearly how you work out your answer.

.....

.....

..... days
(2 marks)

5 (c) (iii) If people drink water contaminated with iodine-131, the iodine-131 builds up in the thyroid gland. This continues until the thyroid is saturated with iodine-131 and cannot absorb any more. The radiation emitted from the iodine-131 could cause cancer of the thyroid.

In Japan, people likely to be drinking water contaminated with iodine-131 were advised to take tablets containing a non-radioactive isotope of iodine.

Suggest why this advice was given.

.....

.....

.....

.....
(2 marks)

8

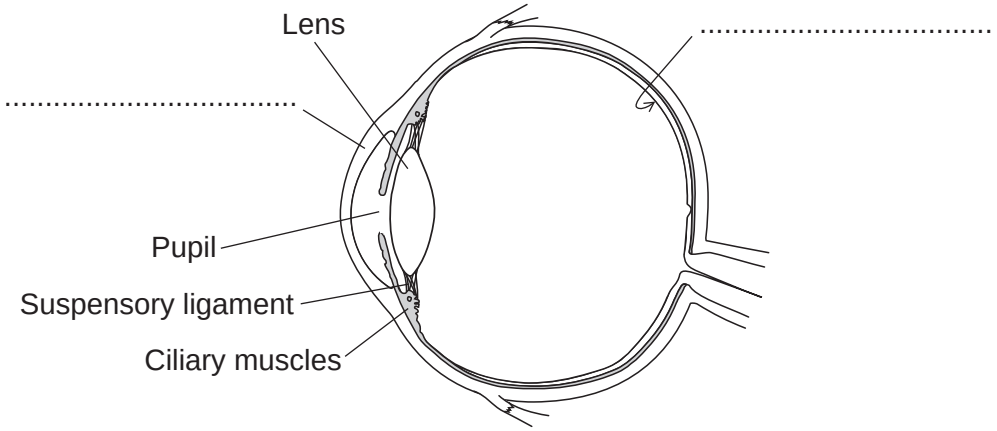
4.1.1.4 Power

Question 113

June 2013 | PH3HP | Original Q1 | Legacy

1 (a) The diagram shows parts of the human eye.

Complete the missing labels.



(2 marks)

1 (b) Each part of the human eye has a function.

Complete the table below.

Part of the human eye	Function of the part
.....	Changes size to make sure the correct amount of light enters the eye.
Ciliary muscles	....
Lens	....

(3 marks)

4.1.1.4 Power

Question 113 · continued

1 (c) The human eye can focus on near objects. The closest distance the eye can bring into sharp focus is called the near point.

A student measured the near point of four people of different ages. The table shows her data.

Age of human in years	Near point in millimetres
10	200
25	250
40	400
55	700

What can you conclude from the data in the table above?

.....

.....

.....

.....

(2 marks)

1 (d) Suggest how the data obtained by the student could be improved.

.....

.....

(1 mark)

1 (e) Spectacles are worn to correct vision. One of the lenses in a pair of spectacles has a focal length of 40 centimetres.

Calculate the power of the lens.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Power of lens = ... dioptres

(2 marks)

10

4.1.1.4 Power

Question 114

June 2014 | PH1HP | Original Q1 | Legacy

1 Electricity can be generated using various energy sources.

1 (a) Give **one** advantage and **one** disadvantage of using nuclear power stations rather than gas-fired power stations to generate electricity.

[2 marks]

Advantage .....

.....

Disadvantage .....

.....

1 (b) (i) A single wind turbine has a maximum power output of 2 000 000 W.

The wind turbine operated continuously at maximum power for 6 hours.

Calculate the energy output in kilowatt-hours of the wind turbine.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Energy output = ... kWh

1 (b) (ii) Why, on average, do wind turbines operate at maximum power output for only 30% of the time?

[1 mark]

.....

.....

1 (c) An on-shore wind farm is made up of many individual wind turbines.

They are connected to the National Grid using underground power cables.

Give **one** advantage of using underground power cables rather than overhead power cables.

[1 mark]

.....

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6

4.1.1.4 Power

Question 115

June 2014 | PH1HP | Original Q5 | Legacy

5 (a) Iceland is a country that generates nearly all of its electricity from renewable sources.

In 2013, about 80% of Iceland's electricity was generated using hydroelectric power stations (HEP).

Describe how electricity is generated in a hydroelectric power station. Include the useful energy transfers taking place.

[4 marks]

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4.1.1.4 Power

Question 115 · continued

5 (b) The UK produces most of its electricity from fossil fuels.

Many people in the UK leave their televisions in 'stand by' mode when not in use, instead of switching them off.

It is better for the environment if people switch off their televisions, instead of leaving them in 'stand by' mode.

Explain why.

[3 marks]

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5 (c) A scientist wrote in a newspaper:

'Appliances that do not automatically switch off when they are not being used should be banned.'

Suggest why scientists alone cannot make the decision to ban these appliances.

[1 mark]

.....

.....

8

4.1.1.4 Power

Question 116

June 2014 | PH1HP | Original Q8 | Legacy

8 **Table 2** shows information about different light bulbs.

The bulbs all have the same brightness.

Table 2

Type of bulb	Input power in watts	Efficiency
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

8 (a) (i) Calculate the useful power output of the CFL bulb.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Useful power output = ... watts

8 (a) (ii) Use your answer to part **(a)(i)** to calculate the waste energy produced each second by a CFL bulb.

[1 mark]

.....

Waste energy per second = ... joules

Question 8 continues on the next page

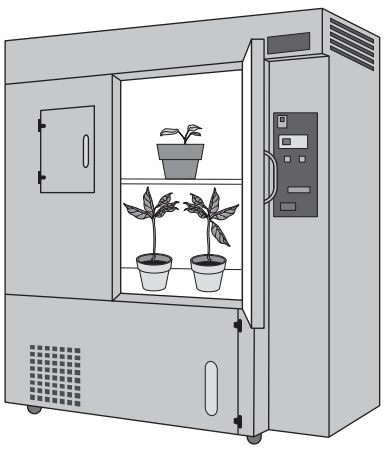
4.1.1.4 Power

Question 116 · continued

8 (b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

Figure 9 shows a growth cabinet.

Figure 9



In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

[4 marks]

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4.1.1.4 Power

Question 116 · continued

8 (b) (ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

[1 mark]

.....

Give a reason for your answer.

.....

.....

8 (c) **Table 3** gives further information about both a halogen bulb and an LED bulb.

Table 3

Type of bulb	Cost to buy	Lifetime in hours	Operating cost over the lifetime of one bulb
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than an LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

[4 marks]

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12

4.1.1.4 Power

Question 117

June 2014 | PH2HP | Original Q6 | Legacy

6 (a) There are many isotopes of the element molybdenum (Mo).

What do the nuclei of different molybdenum isotopes have in common?

[1 mark]

.....

6 (b) The isotope molybdenum-99 is produced inside some nuclear power stations from the nuclear fission of uranium-235.

6 (b) (i) What happens during the process of nuclear fission?

[1 mark]

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.....

6 (b) (ii) Inside which part of a nuclear power station would molybdenum be produced?

[1 mark]

.....

6 (c) When the nucleus of a molybdenum-99 atom decays, it emits radiation and changes into a nucleus of technetium-99.

$$^{99}_{42}\text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + \text{Radiation}$$

What type of radiation is emitted by molybdenum-99?

[2 marks]

.....

Give a reason for your answer.

.....

.....

Question 6 continues on the next page

4.1.1.4 Power

Question 117 · continued

6 (d) Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term ‘half-life’?

[1 mark]

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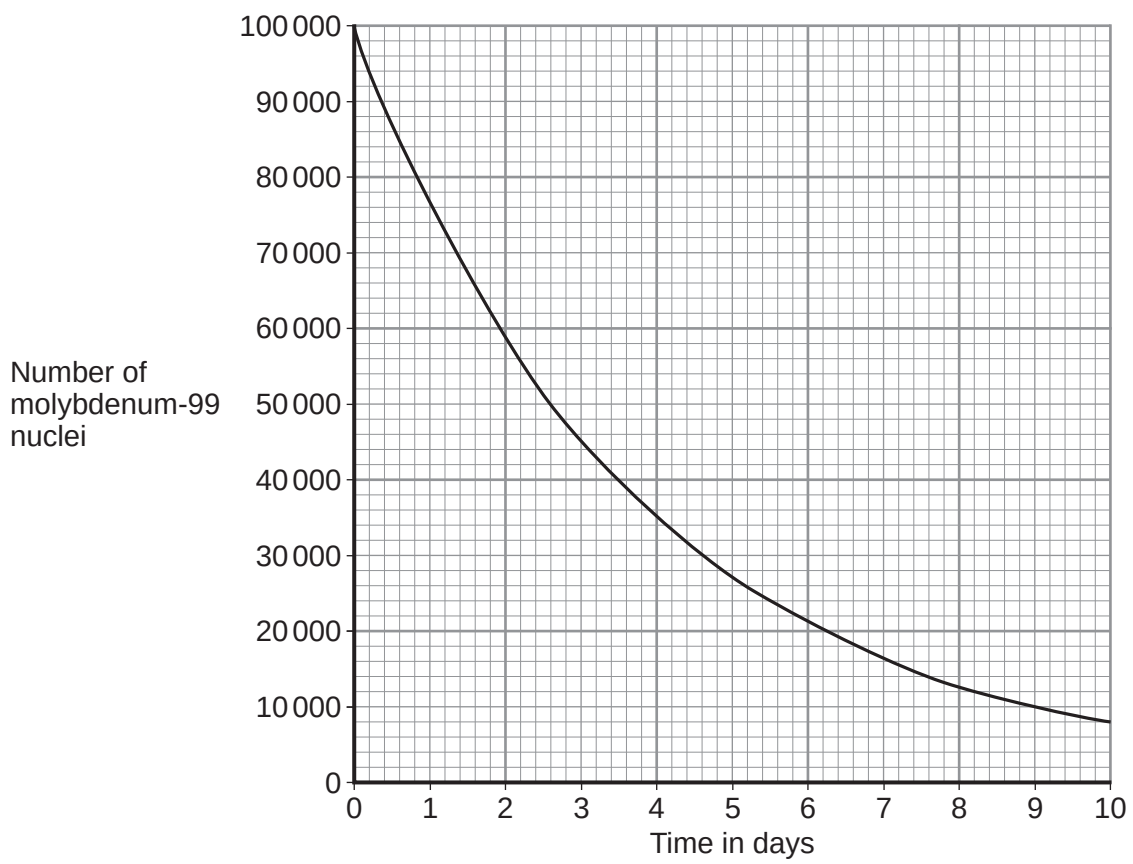
.....

6 (e) Technetium-99 is used by doctors as a medical tracer. In hospitals it is produced inside a technetium generator by the decay of molybdenum-99 nuclei.

6 (e) (i) **Figure 7** shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.

Figure 7



4.1.1.4 Power

Question 117 · continued

A technetium generator will continue to produce sufficient technetium-99 until 80% of the original molybdenum nuclei have decayed.

After how many days will a source of molybdenum-99 inside a technetium-99 generator need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

[2 marks]

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.....

.....

Number of days = ...

6 (e) (ii) Medical tracers are injected into a patient's body; this involves some risk to the patient's health.

Explain the risk to the patient of using a radioactive substance as a medical tracer.

[2 marks]

.....

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6 (e) (iii) Even though there may be a risk, doctors frequently use radioactive substances for medical diagnosis and treatments.

Suggest why.

[1 mark]

.....

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11

4.1.1.4 Power

Question 118

June 2015 | PH1HP | Original Q1 | Legacy

1 **Figure 1** shows a man using a leaf blower to move leaves.

Figure 1



The leaf blower is powered by an electric motor connected to a battery.

1 (a) Energy transfers take place when the leaf blower is being used.

Complete the following sentences.

[3 marks]

The battery stores ..... energy which is transferred into electrical energy.

The electric motor transfers electrical energy usefully into ..... energy.

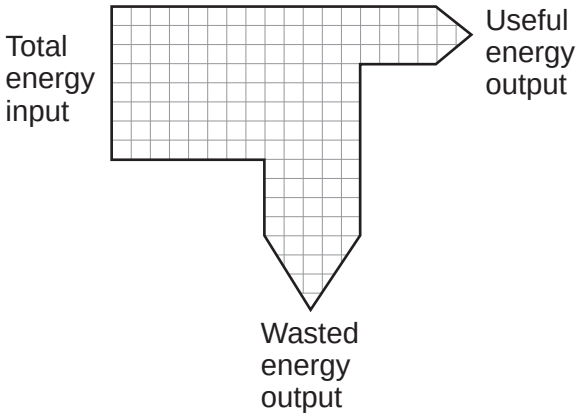
The motor wastes energy as ..... and as energy that heats the surroundings.

4.1.1.4 Power

Question 118 · continued

1 (b) **Figure 2** shows a Sankey diagram for the leaf blower.

Figure 2



Use **Figure 2** to calculate the efficiency of the leaf blower.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Efficiency = ...

5

4.1.1.4 Power

Question 119

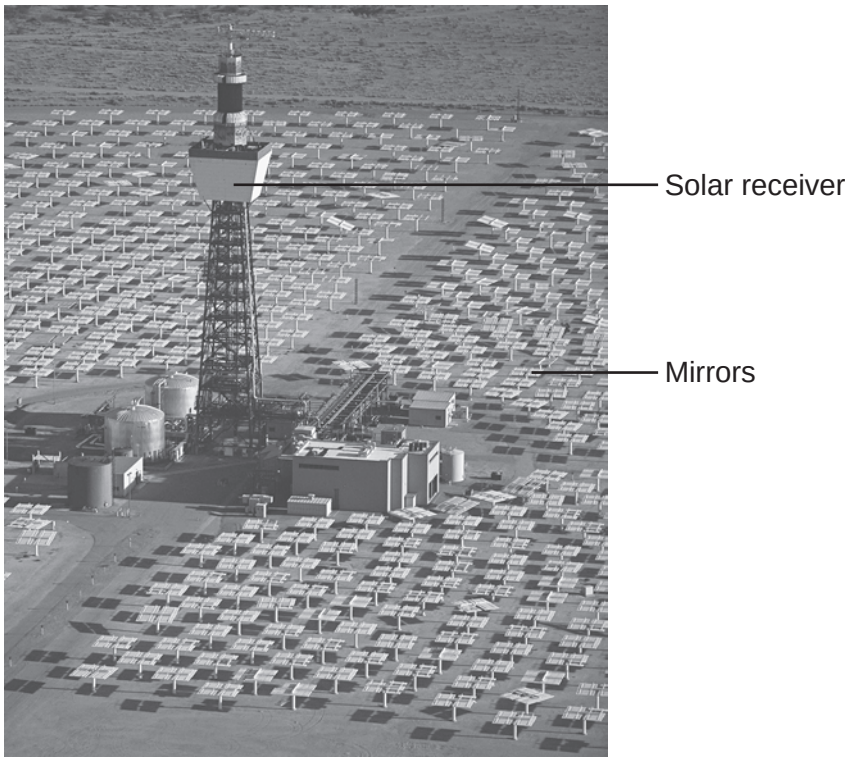
June 2015 | PH1HP | Original Q5 | Legacy

5 **Figure 5** shows a solar thermal power station that has been built in a hot desert.

The power station uses energy from the Sun to heat water to generate electricity.

Energy from the Sun is reflected towards a solar receiver using many mirrors.

Figure 5



5 (a) (i) Which part of the electromagnetic spectrum provides most of the energy to heat the water in a solar thermal power station?

[1 mark]

.....

4.1.1.4 Power

Question 119 · continued

June 2015 | PH1HP | Original Q5 | Legacy

5 (a) (ii) Describe how heated water is used to generate electricity by this solar thermal power station.
The process is the same as in a fossil fuel power station.

[3 marks]

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5 (b) A new type of solar power station, called a solar storage power station, is able to store energy from the Sun by heating molten chemical salts.
The stored energy can be used to generate electricity at night.

5 (b) (i) It is important that the molten chemical salts have a high specific heat capacity.
Suggest **one** reason why.

[1 mark]

.....

.....

5 (b) (ii) The solar storage power station can store a maximum of 2 200 000 kWh of energy.
The solar storage power station can supply a town with a maximum electrical power of 140 000 kW.

Calculate for how many hours the energy stored by the solar storage power station can supply the town with electrical power.

Give your answer to 2 significant figures.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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.....

Time = ... hours

Question 5 continues on the next page

4.1.1.4 Power

Question 119 · continued

5 (b) (iii) **Table 3** gives information about the place where the solar storage power station has been built.

Table 3

Season	Mean number of daylight hours	Mean power received from the Sun per square metre in kW
Spring	11.5	0.90
Summer	13.5	1.10
Autumn	12.0	0.95
Winter	10.5	0.71

The solar storage power station does not operate at the maximum possible electrical output every day of the year.

Suggest why.

[2 marks]

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.....

5 (c) Power stations do not work at maximum possible electrical output all the time.
The 'capacity factor' of a power station is calculated using the equation:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

4.1.1.4 Power

Question 119 · continued

Table 4 shows capacity factors for different types of power station.

Table 4

Type of power station	Renewable energy source	Capacity factor
Coal	No	0.41
Natural gas	No	0.48
Nuclear	No	0.66
Solar thermal	Yes	0.33
Tidal	Yes	0.26
Wind turbine	Yes	0.30

5 (c) (i) Compare the capacity factors of the renewable power stations with those of the non-renewable power stations in **Table 4**.
Explain the reason for the difference between the capacity factors.

[3 marks]

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5 (c) (ii) The capacity factor of a solar storage power station is higher than for all other renewable power stations.
Suggest **one** reason why.

[1 mark]

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14

4.1.1.4 Power

Question 120

June 2015 | PH2HP | Original Q3 | Legacy

3 Many countries use nuclear power stations to generate electricity.
Nuclear power stations use the process of nuclear fission to release energy.

3 (a) (i) What is nuclear fission?

[1 mark]

.....

.....

3 (a) (ii) Plutonium-239 is one substance used as a fuel in a nuclear reactor. For nuclear fission to happen, the nucleus must absorb a particle.

What type of particle must be absorbed?

[1 mark]

.....

3 (b) Nuclear **fusion** also releases energy.
Nuclear fusion happens at very high temperatures. A high temperature is needed to overcome the repulsion force between the nuclei.

3 (b) (i) Why is there a repulsion force between the nuclei of atoms?

[1 mark]

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.....

3 (b) (ii) Where does nuclear fusion happen naturally?

[1 mark]

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4.1.1.4 Power

Question 120 · continued

3 (c) In 1991, scientists produced the first controlled release of energy from an experimental nuclear **fusion** reactor. This was achieved by fusing the hydrogen isotopes, deuterium and tritium.

Deuterium is naturally occurring and can easily be extracted from seawater. Tritium can be produced from lithium. Lithium is also found in seawater.

Table 2 gives the energy released from 1 kg of fusion fuel and from 1 kg of fission fuel.

Table 2

Type of fuel	Energy released from 1 kg of fuel in joules
Fusion fuel	3.4×10^{14}
Fission fuel	8.8×10^{13}

3 (c) (i) Suggest **two** advantages of the fuel used in a fusion reactor compared with plutonium and the other substances used as fuel in a fission reactor.

[2 marks]

1 .....

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2 .....

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3 (c) (ii) Some scientists think that by the year 2050 a nuclear fusion power station capable of generating electricity on a large scale will have been developed.

Suggest **one** important consequence of developing nuclear fusion power stations to generate electricity.

[1 mark]

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Question 3 continues on the next page

4.1.1.4 Power

Question 120 · continued

3 (d) Tritium is radioactive.

After 36 years, only 10 g of tritium remains from an original sample of 80 g.

Calculate the half-life of tritium.

Show clearly how you work out your answer.

[2 marks]

.....

.....

Half-life = ... years

9

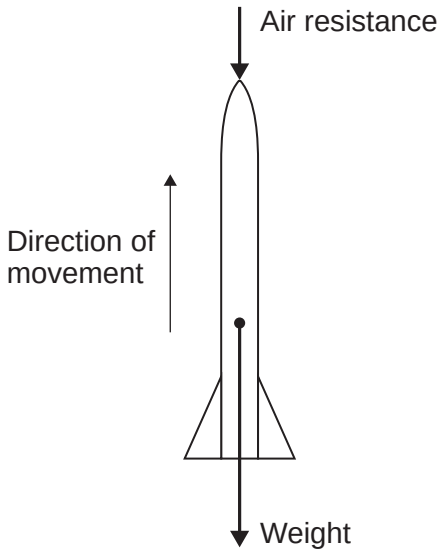
4.1.1.4 Power

Question 121

June 2015 | PH2HP | Original Q6 | Legacy

6 (a) **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 7



6 (a) (i) How does the velocity of the rocket change as the rocket moves **upwards**?

[2 marks]

.....

Give a reason for your answer.

.....

.....

6 (a) (ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

[1 mark]

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4.1.1.4 Power

Question 121 · continued

6 (b) The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

6 (b) (i) Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Kinetic energy = ... J

6 (b) (ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

6 (b) (iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Maximum height = ... m

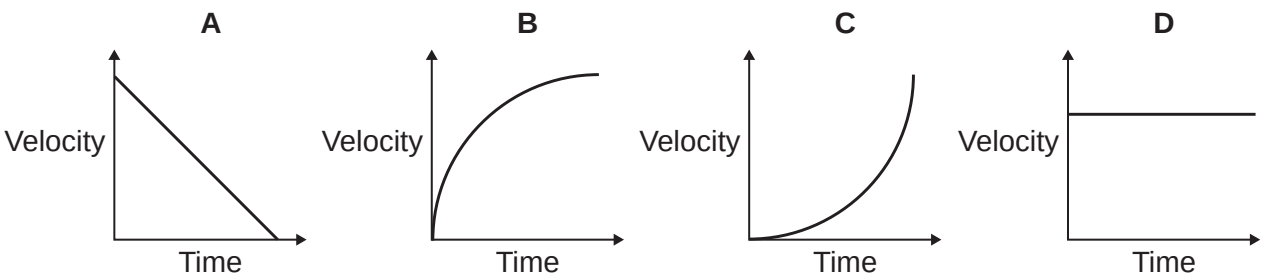
Question 6 continues on the next page

4.1.1.4 Power

Question 121 · continued

6 (b) (iv) **Figure 8** shows four velocity–time graphs.

Figure 8



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

[1 mark]

Write the correct answer in the box.

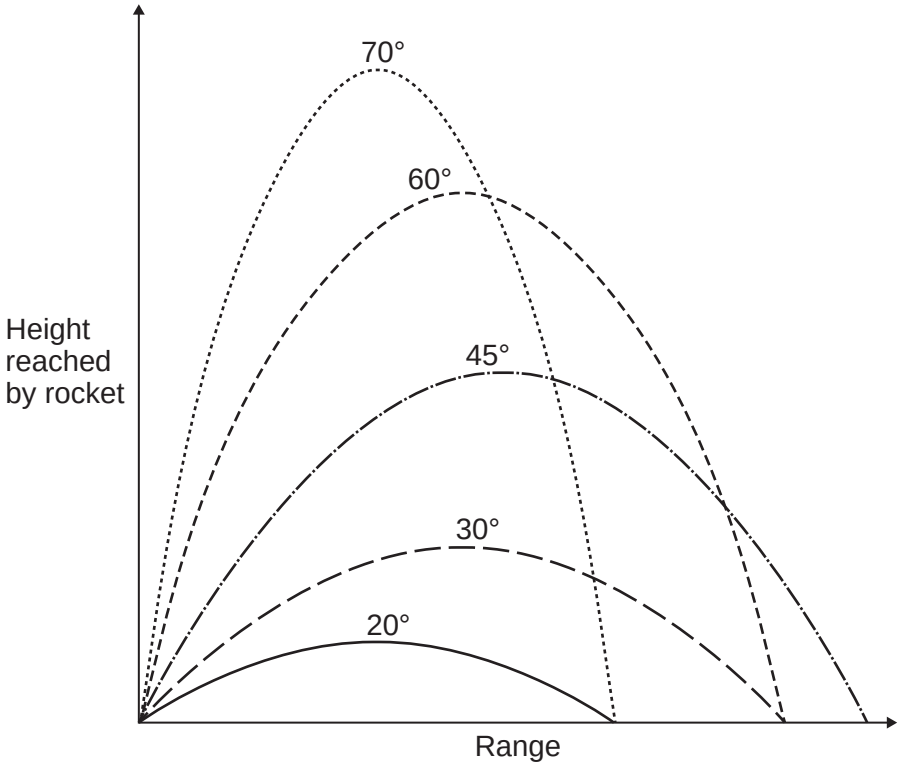
4.1.1.4 Power

Question 121 · continued

6 (c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 9 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 9



What pattern links the angle at which the rocket is launched and the range of the rocket?

[2 marks]

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11

4.1.1.4 Power

Question 122

June 2016 | PH1HP | Original Q2 | Legacy

2 A small community of people live in an area in the mountains.
The houses are not connected to the National Grid.

The people plan to buy an electricity generating system that uses either the wind or the flowing water in a nearby river.

Figure 2 shows where these people live.

Figure 2



2 (a) It would not be economical to connect the houses to the National Grid.
Give **one** reason why.

[1 mark]

_____

_____

_____

_____

2 (b) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Information about the two electricity generation systems is given in **Figure 3**.

Figure 3

The wind turbine costs £50 000 to buy and install. The hydroelectric generator costs £20 000 to buy and install. The average power output from the wind turbine is 10 kW. The hydroelectric generator will produce a constant power output of 8 kW.

4.1.1.4 Power

Question 122 · continued

Compare the advantages and disadvantages of the two methods of generating electricity.

Use your knowledge of energy sources as well as information from **Figure 3**.

[6 marks]

Extra space

7

4.1.1.4 Power

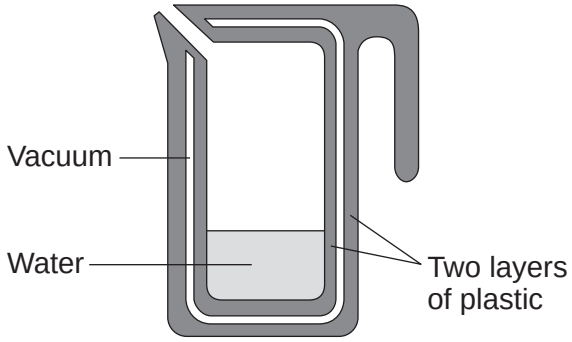
Question 123

June 2016 | PH1HP | Original Q5 | Legacy

5 A new design for a kettle is made from two layers of plastic separated by a vacuum. After the water in the kettle has boiled, the water stays hot for at least 2 hours.

The new kettle is shown in **Figure 5**.

Figure 5



5 (a) Explain why the vacuum reduces energy transfer to the surroundings.

[2 marks]

4.1.1.4 Power

Question 123 · continued

5 (b) The energy transferred from the water in the kettle to the surroundings in 2 hours is 46 200 J.

The mass of water in the kettle is 0.50 kg.

The specific heat capacity of water is 4200 J/kg °C.

The initial temperature of the water is 100 °C.

5 (b) (i) Calculate the temperature of the water in the kettle after 2 hours.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Temperature after 2 hours = _____ °C

5 (b) (ii) Calculate the average power output from the water in the kettle to the surroundings in 2 hours.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Average power output = _____ W

7

4.1.1.4 Power

Question 124

6 All European Union countries are expected to generate 20% of their electricity using renewable energy sources by 2020.

The estimated cost of generating electricity in the year 2020 using different energy sources is shown in **Table 1**.

Table 1

Energy source	Estimated cost (in the year 2020) in pence per kWh
Nuclear	7.8
Solar	25.3
Tidal	18.8
Wind	10.0

France generated 542 billion kWh of electricity using nuclear power stations in 2011. France used 478 billion kWh of electricity and sold the rest of the electricity to other countries in 2011.

6 (a) France may continue generating large amounts of electricity using nuclear power stations instead of using renewable energy resources.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

4.1.1.4 Power

Question 124 · continued

6 (b) Give **two** disadvantages of generating electricity using nuclear power stations.

[2 marks]

1 _____

_____

2 _____

_____

6 (c) A panel of solar cells has an efficiency of 0.15.

The total power input to the panel of solar cells is 3.2 kW.

Calculate the useful power output of this panel of solar cells in kW.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

_____

Useful power output = _____ kW

Question 6 continues on the next page

4.1.1.4 Power

Question 124 · continued

6 (d) **Table 2** shows the manufacturing cost and efficiency of different types of panels of solar cells.

Table 2

Type of Solar Panel	Cost to manufacture a 1 m^2 solar panel in £	Efficiency in %
A	40.00	20
B	22.50	15
C	5.00	10

Some scientists think that having a low manufacturing cost is more important than improving the efficiency of solar cells.

Use information from **Table 2** to suggest why.

[2 marks]

8

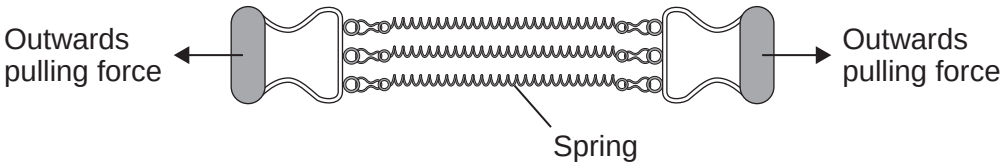
4.1.1.4 Power

Question 125

June 2016 | PH2HP | Original Q5 | Legacy

5 **Figure 11** shows an exercise device called a chest expander. The three springs are identical.

Figure 11



A person pulls outwards on the handles and does work to stretch the springs.

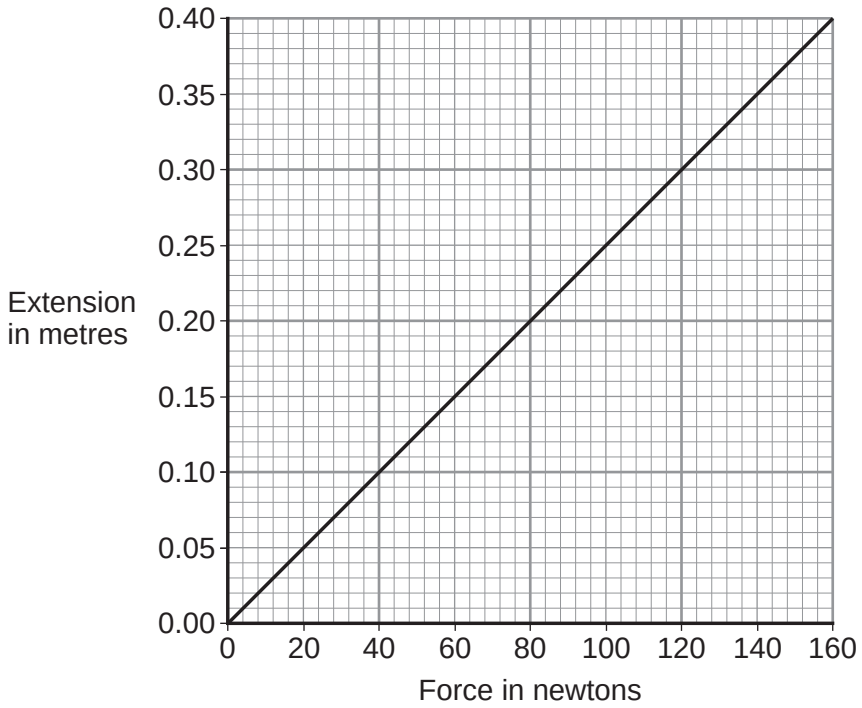
5 (a) Complete the following sentence.

[1 mark]

When the springs are stretched _____ _____ energy is stored in the springs.

5 (b) **Figure 12** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 12



4.1.1.4 Power

Question 125 · continued

5 (b) (i) How can you tell, from **Figure 12**, that the limit of proportionality of the spring has not been exceeded?

[1 mark]

_____

_____

5 (b) (ii) Use data from **Figure 12** to calculate the spring constant of the spring.
Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Spring constant = _____ Unit _____

5 (b) (iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 12** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

[2 marks]

_____

_____

Total force = _____ N

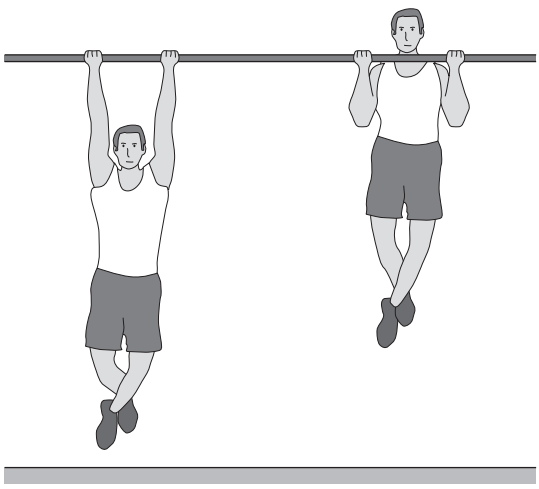
Question 5 continues on the next page

4.1.1.4 Power

Question 125 · continued

5 (c) The student in **Figure 13** is doing an exercise called a chin-up.

Figure 13



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

Use the correct equations from the Physics Equations Sheet.

[3 marks]

Power = _____ W

10

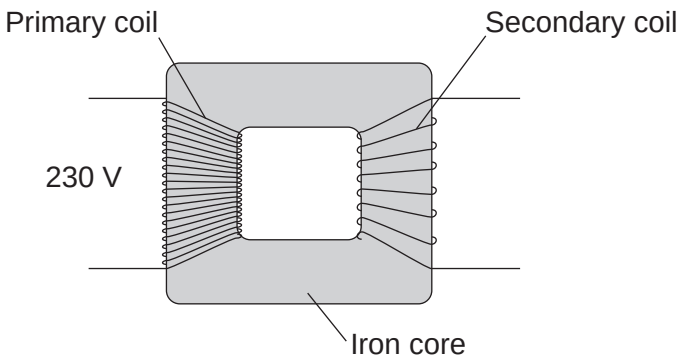
4.1.1.4 Power

Question 126

June 2016 | PH3HP | Original Q2 | Legacy

2 **Figure 2** shows the structure of a traditional transformer.

Figure 2



2 (a) There is an alternating current in the primary coil of the transformer.

State what is produced in the iron core.

[2 marks]

_____

_____

2 (b) A transformer has only **one** turn of wire on the secondary coil.
The potential difference across the secondary coil is 11.5 V
The potential difference across the primary coil is 230 V

Calculate the number of turns on the primary coil.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

_____

Number of turns on the primary coil = _____

Question 2 continues on the next page

Question 126 · continued

2 (c) In most transformers, the power output is less than the power input.

State why.

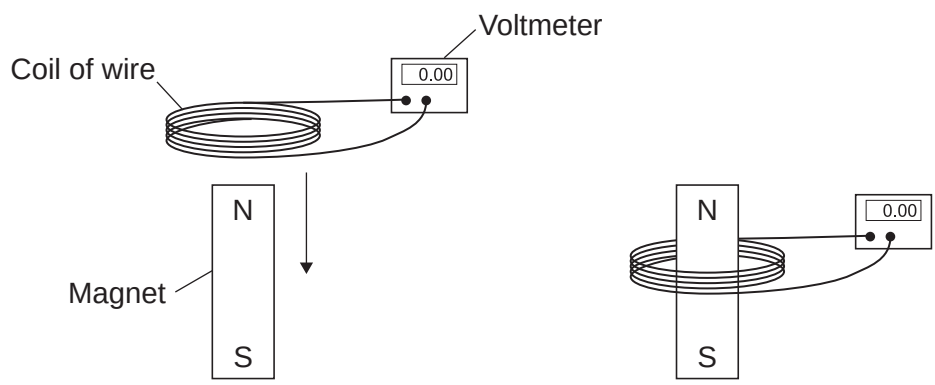
[1 mark]

_____

_____

2 (d) Two students investigated how magnets can be used to produce a potential difference. The students held a coil of wire above a magnet. The students quickly lowered the coil so that the magnet was inside the coil, as shown in **Figure 3**.

Figure 3



The students recorded the maximum potential difference for coils with different numbers of turns of wire. The results are shown in **Table 1**.

Table 1

Number of turns of wire in the coil	Maximum potential difference in volts	
	Results from student 1	Results from student 2
5	0.09	0.08
10	0.20	0.15
15	0.31	0.25
20	0.39	0.33
25	0.51	0.39

4.1.1.4 Power

Question 126 · continued

2 (d) (i) State the resolution of the voltmeter.

Give **one** reason why the resolution of the voltmeter is suitable for this investigation.

[2 marks]

Resolution _____

Reason _____

_____

2 (d) (ii) The two students used exactly the same equipment to carry out their investigations. Both students recorded their results correctly.

Give the reason why student 2 got different results from student 1.

[1 mark]

_____

_____

2 (d) (iii) The students decided that even though the results were different, there was no need to repeat the investigation.

How do the results show that the investigation is reproducible?

[1 mark]

_____

_____

2 (d) (iv) State the name of the process which causes the potential difference to be produced in this investigation.

[1 mark]

_____

2 (e) A transformer has been developed that can be used with many different devices.

Suggest **one** advantage of having a transformer that can be used with many different devices.

[1 mark]

_____

_____

11

4.1.1.4 Power

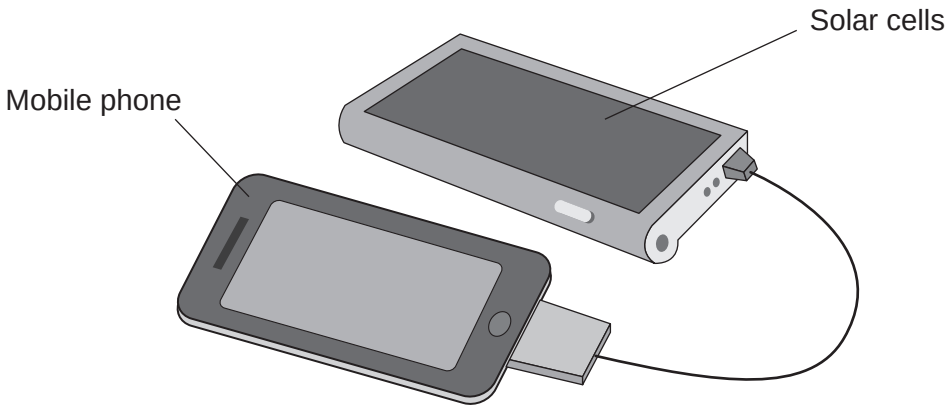
Question 127

June 2017 | PH1HP | Original Q6 | Legacy

6 **Figure 6** shows a mobile phone battery being charged using solar cells.

The useful power output of the solar cells is 2.5 W

Figure 6



6 (a) The efficiency of the solar cells is 40%.

Calculate the total power input to the solar cells.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Total power input = _____ W

6 (b) The mobile phone battery can store 36 kJ of energy and was initially uncharged.

Calculate the minimum time, in hours, it would take to fully charge the mobile phone battery using these solar cells.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Time = _____ hours

4.1.1.4 Power

Question 127 · continued

6 (c) Explain why the power **output** of the solar cells may be lower than 2.5 W

[2 marks]

6 (d) Explain why the time taken to recharge this mobile phone battery using these solar cells depends on whether the phone is switched on or off.

[2 marks]

9

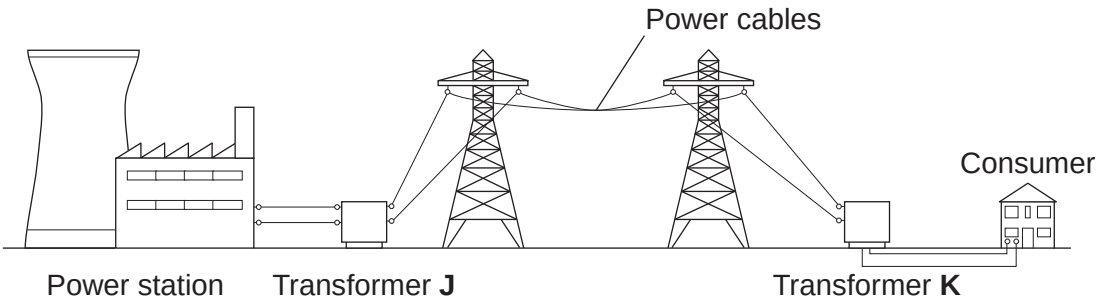
4.1.1.4 Power

Question 128

June 2017 | PH1HP | Original Q7 | Legacy

7 **Figure 7** shows how the National Grid connects power stations to consumers.

Figure 7



7 (a) Explain the role of the two transformers, **J** and **K**, in the power transmission process and the reasons for their use.

[4 marks]

4.1.1.4 Power

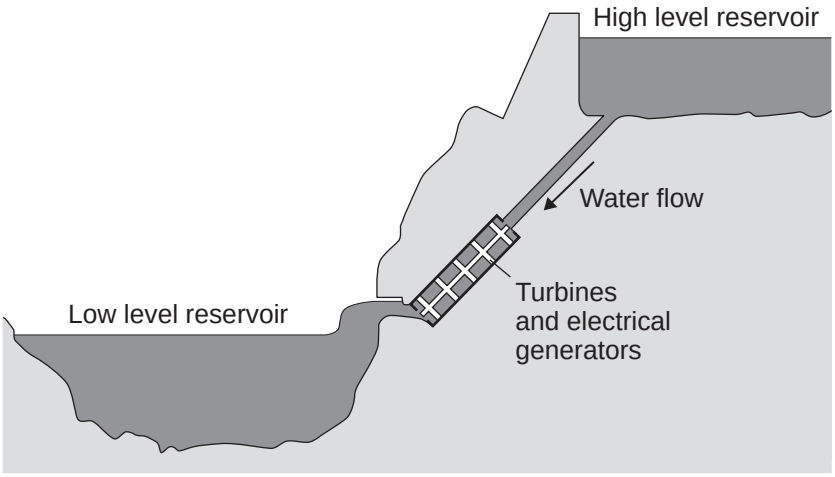
Question 128 · continued

7 (b) In a pumped storage power station, water flows from a high level reservoir to a low level reservoir turning turbines and generating electricity.

Pumped storage power stations do not supply electricity to the National Grid at all times of the day.

Figure 8 shows a pumped storage power station.

Figure 8



7 (b) (i) Explain how pumped storage power stations store energy for later use.

[4 marks]

7 (b) (ii) Explain why pumped storage power stations are able to meet sudden large demands for electricity.

[2 marks]

10

4.1.1.4 Power

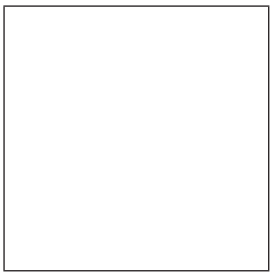
Question 129

June 2017 | PH2HP | Original Q5 | Legacy

5 The lighting in a home may be provided by LED bulbs, filament bulbs or halogen bulbs.

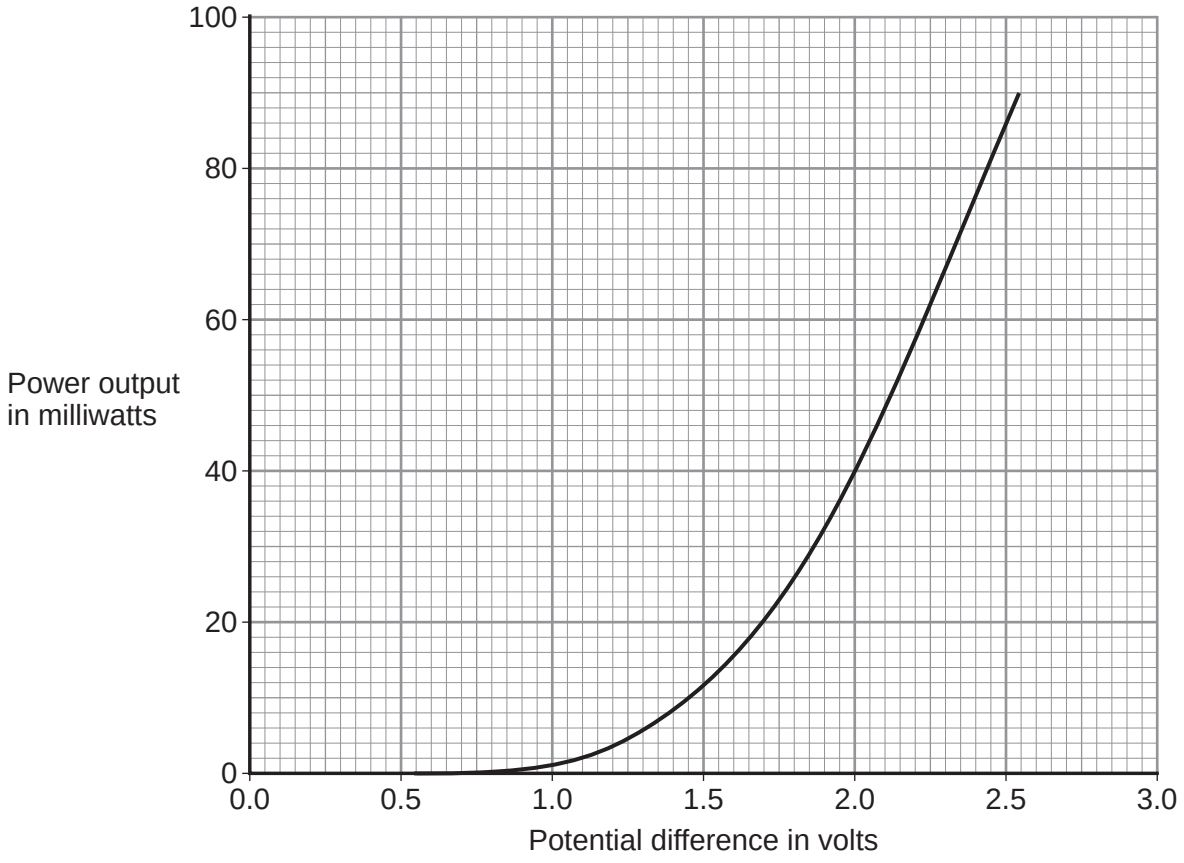
5 (a) (i) In the box below, draw the circuit symbol for an LED.

[1 mark]



5 (a) (ii) **Figure 6** shows how the power output from one type of LED varies with the potential difference across the LED.

Figure 6



1 milliwatt = 0.001 W

4.1.1.4 Power

Question 129 · continued

The LED is connected in series with a battery and resistor.
The potential difference across the LED is 2.0 V

Use data from **Figure 6** to calculate the energy transferred by the LED in 5 minutes.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Energy transferred = _____ J

5 (b) The resistance of a filament bulb increases as the temperature of the filament increases.

Explain, in terms of the electrons and ions inside the filament, why the resistance increases.

[2 marks]

5 (c) Why are LED bulbs cheaper to use than filament bulbs or halogen bulbs that produce the same brightness of light?

[1 mark]

7

4.1.1.4 Power

Question 130

June 2018 | 8463/1H | Original Q4

0 4 **Figure 5** shows a cyclist riding along a straight, level road at a constant speed.

Figure 5



0 4 . 1 Complete the sentences.

[2 marks]

As the cyclist rides along the road, the _____ energy store in the cyclist's body decreases.

The speed of the cyclist is constant when the work done by the cyclist is _____ the work done against air resistance.

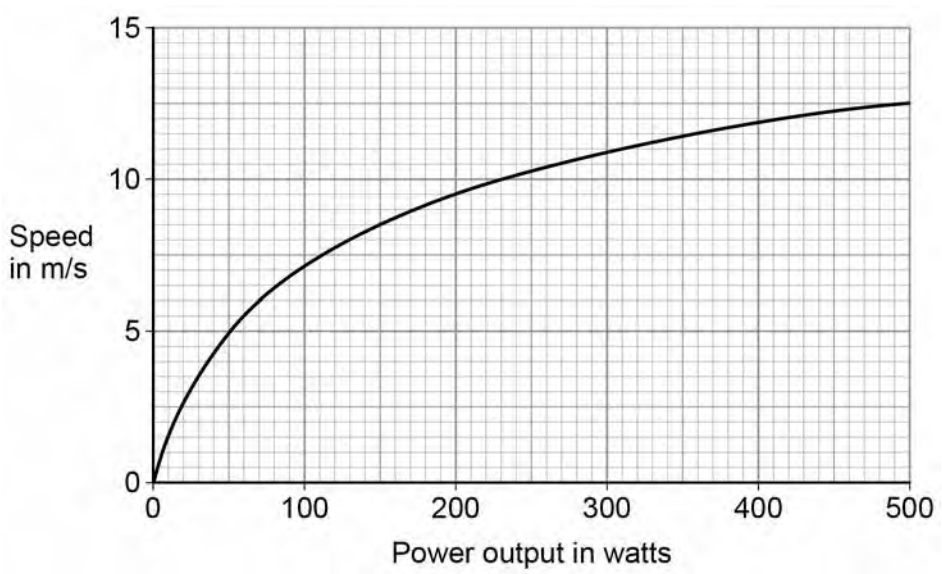
Question 4 continues on the next page

4.1.1.4 Power

Question 130 · continued

Figure 6 shows how the speed changes as the power output of the cyclist changes.

Figure 6



0 4 . 2 Write down the equation that links power, time and work done.

[1 mark]

0 4 . 3 Calculate the work done by the cyclist when his power output is 200 W for 1800 seconds.

[3 marks]

Work done = _____ J

4.1.1.4 Power

Question 130 · continued

0 4 . 4 Calculate the percentage increase in speed of the cyclist when the power output changes from 200 W to 300 W.

[2 marks]

Percentage increase in speed = _____

0 4 . 5 The maximum speed this cyclist can travel on a level road is 14 m/s.

How does cycling uphill affect the maximum speed of this cyclist?

Explain your answer.

[3 marks]

11

4.1.1.4 Power

Question 131

June 2018 | 8463/1H | Original Q5

0 5 . 1 Complete the sentence. Choose answers from the box.

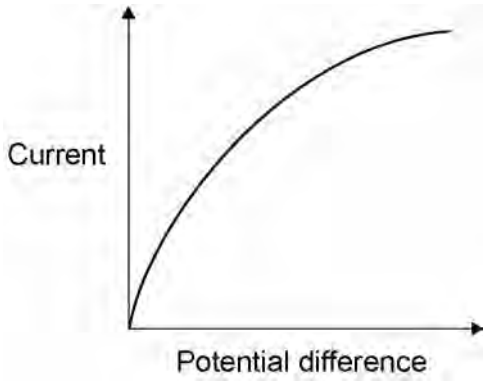
[2 marks]

charge	**potential difference**	**power**	**temperature**	**time**

The current through an ohmic conductor is directly proportional to the _____ across the component, provided that the _____ remains constant.

0 5 . 2 **Figure 7** shows a current – potential difference graph for a filament lamp.

Figure 7



Explain how the resistance of a filament lamp changes as the potential difference across it increases.

[3 marks]

4.1.1.4 Power

Question 131 · continued

0 5 . 3 Many householders are replacing their filament lamps with LED lamps which are more energy efficient.

What does more energy efficient mean?

[1 mark]

Question 5 continues on the next page

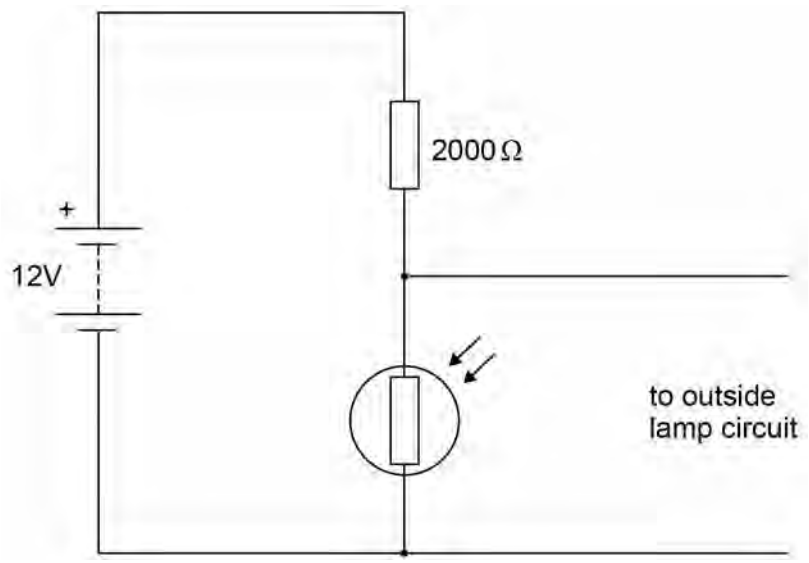
4.1.1.4 Power

Question 131 · continued

A Light Dependent Resistor (LDR) is used to turn on an outside lamp when it gets dark.

Part of the circuit is shown in **Figure 8**.

Figure 8



0 5 . 4 The light intensity decreases.

What happens to the potential difference across the LDR and the current in the LDR?

[2 marks]

Potential difference _____

Current _____

0 5 . 5 What is the resistance of the LDR when the potential difference across it is 4 V?

Give a reason for your answer.

[2 marks]

Resistance = _____ Ω

Reason _____

_____

_____

4.1.1.4 Power

Question 131 · continued

0 5 . 6 Calculate the current through the LDR when the resistance of the LDR is 5000 Ω.

Give your answer to 2 significant figures.

[4 marks]

Current = _____ A

14

Turn over for the next question

4.1.1.4 Power

Question 132

June 2018 | 8463/1H | Original Q9

0 9 **Figure 15** shows a coffee machine. The coffee machine uses an electric element to heat water.

Figure 15



0 9 . 1 The coffee machine has a metal case.

Why would it be dangerous for the live wire of the electric cable to touch the metal case?

[1 mark]

0 9 . 2 The power output of the coffee machine is 2.53 kW.

The mains potential difference is 230 V.

Calculate the current in the coffee machine.

[3 marks]

Current = _____ A

4.1.1.4 Power

Question 132 · continued

0 9 . 3 The coffee machine heats water from 20 °C to 90 °C.

The power output of the coffee machine is 2.53 kW.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the mass of water that the coffee machine can heat in 14 seconds.

[5 marks]

Mass = _____ kg

9

4.1.1.4 Power

Question 133

June 2018 | 8463/1H | Original Q10

1 0 **Figure 16** shows a wind turbine.

Figure 16



1 0 . 1 At a particular wind speed, a volume of 2.3×10^4 m^3 of air passes the blades each second.

The density of air is 1.2 kg/m^3.

Calculate the mass of air passing the blades per second.

[3 marks]

Mass of air per second = _____ kg

1 0 . 2 The power output of the turbine is directly proportional to the kinetic energy of the air passing the blades each second.

Describe the effect on the power output when the wind speed is halved.

[3 marks]

4.1.1.4 Power

Question 133 · continued

10.3 At a different wind speed, the wind turbine has a power output of 388 kW.

The mass of air passing the wind turbine each second is 13 800 kg.

Calculate the speed of the air passing the blades each second.

Assume that the process is 100% efficient.

[3 marks]

Speed of air = _____ m/s

9

4.1.1.4 Power

Question 134

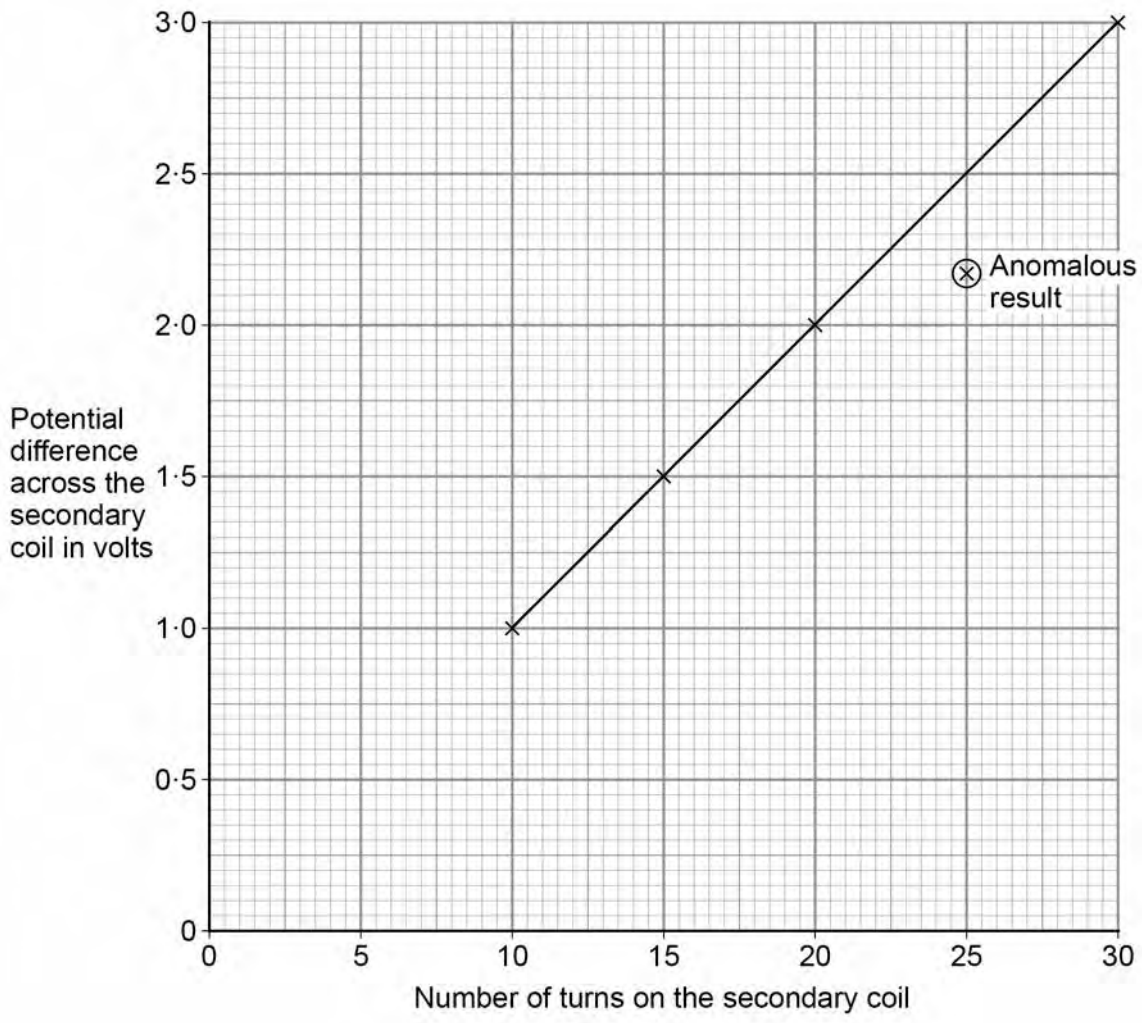
June 2018 | 8463/2H | Original Q7

0 7 A student used a simple transformer to investigate how the number of turns on the secondary coil affects the potential difference (p.d.) across the secondary coil.

The student kept the p.d. across the primary coil fixed at 2V.

Figure 12 shows the results collected by the student.

Figure 12



0 7 . 1 **Figure 12** contains one anomalous result.

Suggest **one** possible reason why this anomalous result occurred.

[1 mark]

4.1.1.4 Power

Question 134 · continued

0 7 . 2 The transformer changes from being a step-down to a step-up transformer.

How can you tell from **Figure 12** that this happens?

[1 mark]

Question 7 continues on the next page

4.1.1.4 Power

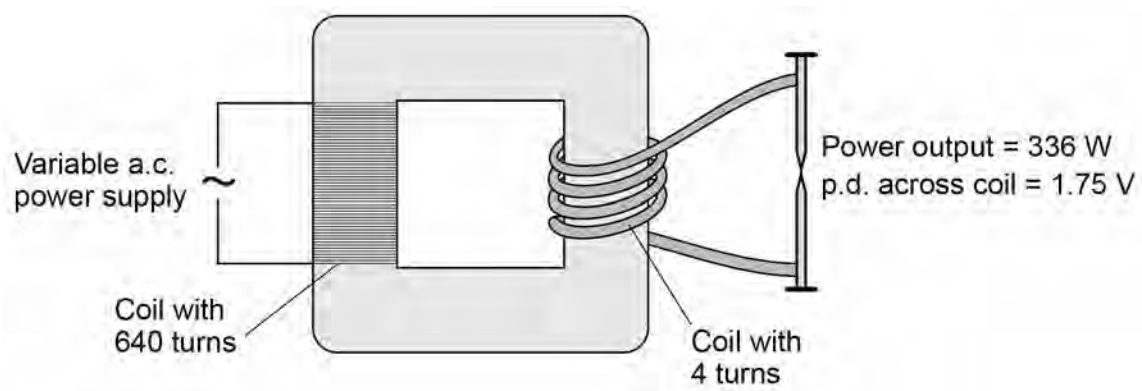
Question 134 · continued

June 2018 | 8463/2H | Original Q7

A spot-welder is a device that uses a transformer to produce a large current to join sheets of metal together.

Figure 13 shows a transformer demonstrating how a large current can heat and join two nails together.

Figure 13



0 7 . 3 How does the amount of infrared radiation emitted by the nails change when the power supply is switched on?

[1 mark]

0 7 . 4 Calculate the current from the power supply needed to provide a power output of 336 W.

Use the data in **Figure 13**.

The transformer is 100% efficient.

[5 marks]

Current = _____ A

8

4.1.1.4 Power

Question 135

June 2019 | 8463/1H | Original Q1

0 1 Light bulbs are labelled with a power input.

0 1 . 1 What does power input mean?

[1 mark]

Tick (✓) **one** box.

- The charge transferred each second by the bulb. ☐
- The current through the bulb. ☐
- The energy transferred each second to the bulb. ☐
- The potential difference across the bulb. ☐

0 1 . 2 Write down the equation which links current, potential difference and power.

[1 mark]

_____

0 1 . 3 A light bulb has a power input of 40 W

The mains potential difference is 230 V

Calculate the current in the light bulb.

[3 marks]

_____

_____

_____

Current = _____ A

4.1.1.4 Power

Question 135 · continued

Table 1 shows information about three different light bulbs.

Table 1

Light bulb	Total power input in watts	Useful power output in watts	Efficiency
P	6.0	5.4	0.90
Q	40	2.0	0.05
R	9.0	**X**	0.30

0 1 . 4 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 1 . 5 Calculate the value of **X** in **Table 1**.

[3 marks]

X = _____ W

0 1 . 6 In addition to power input, light bulbs should also be labelled with the rate at which they emit visible light.

Suggest why.

[2 marks]

11

4.1.1.4 Power

Question 136

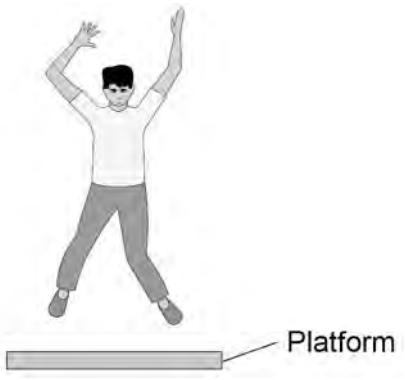
June 2019 | 8463/1H | Original Q3

0 3 A scientist investigated how the maximum muscle power of humans varies with age and gender.

The scientist asked volunteers to stand on a platform and to jump as high as they could.

Figure 4 shows a volunteer taking part in the experiment.

Figure 4



An electronic timer measured the time that the volunteer was in the air.

0 3 . 1 The muscle power in watts per kg is calculated using the following equation:

$$\text{muscle power} = \frac{9.8 \times \text{jump height}}{\text{time}}$$

One volunteer has a muscle power of 41 W/kg

He was in the air for 0.12 s

Calculate his jump height.

[3 marks]

Jump height = _____ m

4.1.1.4 Power

Question 136 · continued

0 3 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

0 3 . 3 One volunteer had a kinetic energy of 270 J and a speed of 3.0 m/s at the moment he left the ground.

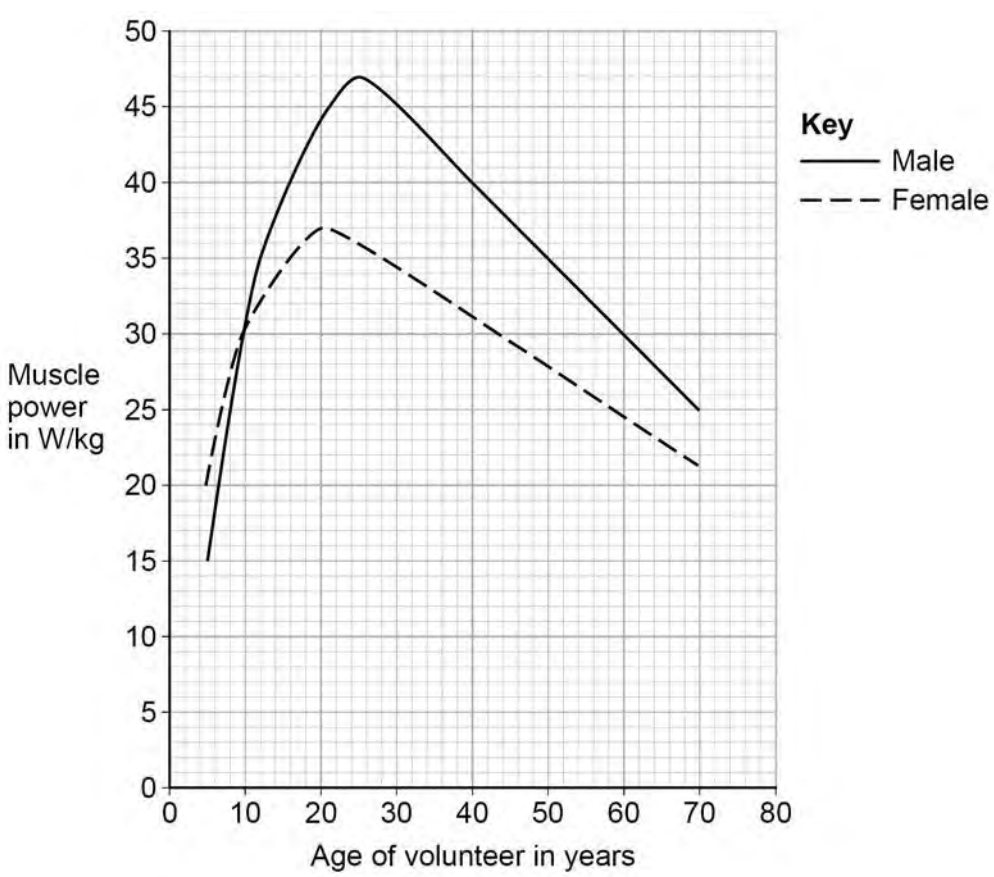
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 5 shows the scientist's results.

Figure 5



4.1.1.4 Power

Question 136 · continued

0 3 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 5** in your answer.

[4 marks]

0 3 . 5 The muscle power of each volunteer was measured five times.

The highest muscle power reading was recorded instead of calculating an average.

Suggest **one** reason why.

[1 mark]

12

4.1.1.4 Power

Question 137

June 2019 | 8463/1H | Original Q4

0 4 Electric cars have motors that are powered by a battery.

Diesel cars have engines that are powered by diesel fuel.

Table 2 compares one type of electric car with one type of diesel car.

Table 2

Power source	Energy density in MJ / kg	Mass of power source in kg	Total mass of car in kg	Time to recharge battery or refill fuel tank in minutes
Battery	0.95	280	1600	40
Diesel fuel	45	51	1500	3

0 4 . 1 The electric car has a range of 400 km with a fully charged battery.

The diesel car has a range of 1120 km with a full tank of diesel.

Explain the difference in the time needed to complete a 500 km journey using the electric car compared with the diesel car.

Assume both cars travel at the same speed.

[2 marks]

4.1.1.4 Power

Question 137 · continued

0 4 . 2 Energy density is the amount of energy stored per kilogram of the energy source.

Show why the diesel car has a greater range than the electric car.

Use data from **Table 2**.

Assume the efficiency of the two cars is the same.

Include calculations in your answer.

[3 marks]

Question 4 continues on the next page

4.1.1.4 Power

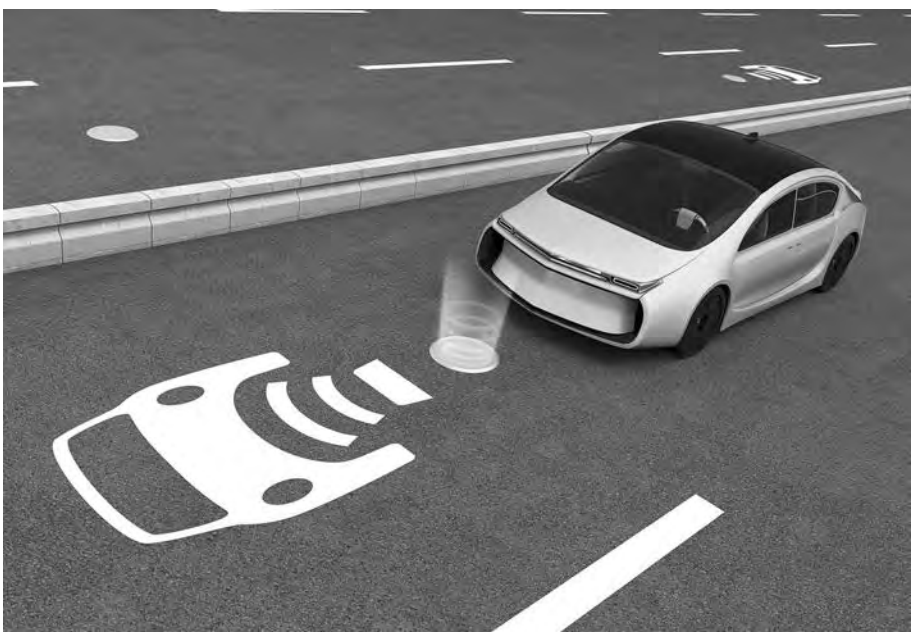
Question 137 · continued

Engineers have developed a way of charging electric cars while they are driving along the road.

Coils of wire buried under the road transfer energy to the car's battery as the car is passing over the coils.

Figure 6 shows a charging lane on a motorway.

Figure 6



0 4 . 3 Suggest **two** advantages of using this method to charge electric cars compared with plugging them into the mains electricity supply.

[2 marks]

1 _____

_____

_____

_____

2 _____

_____

_____

_____

4.1.1.4 Power

Question 137 · continued

0 4 . 4 When electric cars are not being driven, energy stored in their batteries could be used to meet sudden peaks in electricity demand.

Suggest how.

[2 marks]

9

4.1.1.4 Power

Question 138

June 2019 | 8463/1H | Original Q6

0 6 **Figure 7** shows a person using an electric lawn mower.

Figure 7



0 6 . 1 The lawn mower is connected to the mains electricity supply.

What is the frequency of the mains electricity supply in the UK?

[2 marks]

Frequency = _____ Unit _____

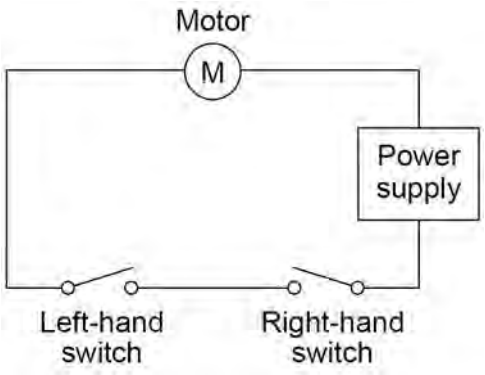
4.1.1.4 Power

Question 138 · continued

The lawn mower has a switch on each side of the handle.

Figure 8 shows the circuit diagram for the lawn mower.

Figure 8



0 6 . 2 The motor in the lawn mower can only be turned on when the person using it holds the handle of the lawn mower with both hands.

Explain why.

[2 marks]

0 6 . 3 The power input to the motor is 1.8 kW

The resistance of the motor is 32 Ω

Calculate the current in the motor.

[3 marks]

Current = _____ A

4.1.1.4 Power

Question 138 · continued

0 6 . 4 The useful power output from the motor is 1.5 kW

Calculate the time it takes for the motor to transfer 450 000 J of useful energy.

[3 marks]

Time = _____ seconds

1

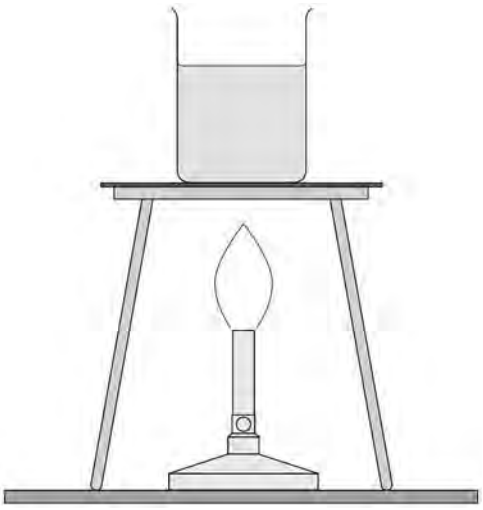
4.1.1.4 Power

Question 139

June 2019 | 8463/1H | Original Q11

1 1 **Figure 14** shows a Bunsen burner heating some water in a beaker. Eventually the water changes into steam.

Figure 14



1 1 . 1 Explain how the internal energy of the water changes as it is heated from 20 °C to 25 °C

[2 marks]

1 1 . 2 How is the particle model used to explain the difference in density between a liquid and a gas?

[1 mark]

Tick (✓) **one** box.

- Particles in a gas have less kinetic energy than particles in a liquid. ☐
- Particles in a gas have more potential energy than particles in a liquid. ☐
- Particles in a liquid are further apart than particles in a gas. ☐
- Particles in a liquid are larger than particles in a gas. ☐

4.1.1.4 Power

Question 139 · continued

1 1 . 3 A student measured the mass of boiling water that was turned into steam in five minutes.

Explain how the student could use this information to estimate the power output of the Bunsen burner in watts.

[4 marks]

7

4.1.1.4 Power

Question 140

November 2020 | 8463/1H | Original Q2

0 2 **Figure 3** shows an LED torch.

Figure 3

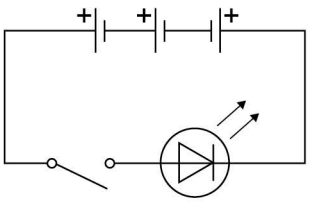


0 2 . 1 The torch contains one LED, one switch and three cells.

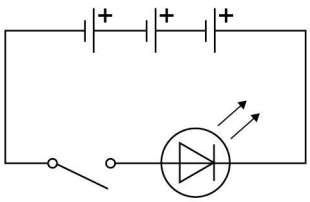
Which diagram shows the correct circuit for the torch?

[1 mark]

Tick (✓) **one** box.



☐



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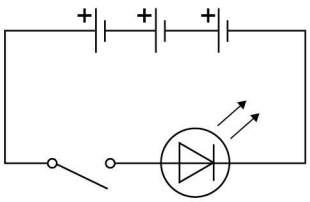


☐

4.1.1.4 Power

Question 140 · continued

0 2 . 2 Write down the equation which links charge flow (Q), current (I) and time (t).

[1 mark]

0 2 . 3 The torch worked for 14 400 seconds before the cells needed replacing.

The current in the LED was 50 mA.

Calculate the total charge flow through the cells.

[3 marks]

Total charge flow = _____ C

0 2 . 4 When replaced, the cells were put into the torch the wrong way around.

Explain why the torch did not work.

[2 marks]

Question 2 continues on the next page

4.1.1.4 Power

Question 140 · continued

0 2 . 5 Write down the equation which links efficiency, total power input and useful power output.

[1 mark]

0 2 . 6 The total power input to the LED was 0.24 W.

The efficiency of the LED was 0.75

Calculate the useful power output of the LED.

[3 marks]

Useful power output = _____ W

11

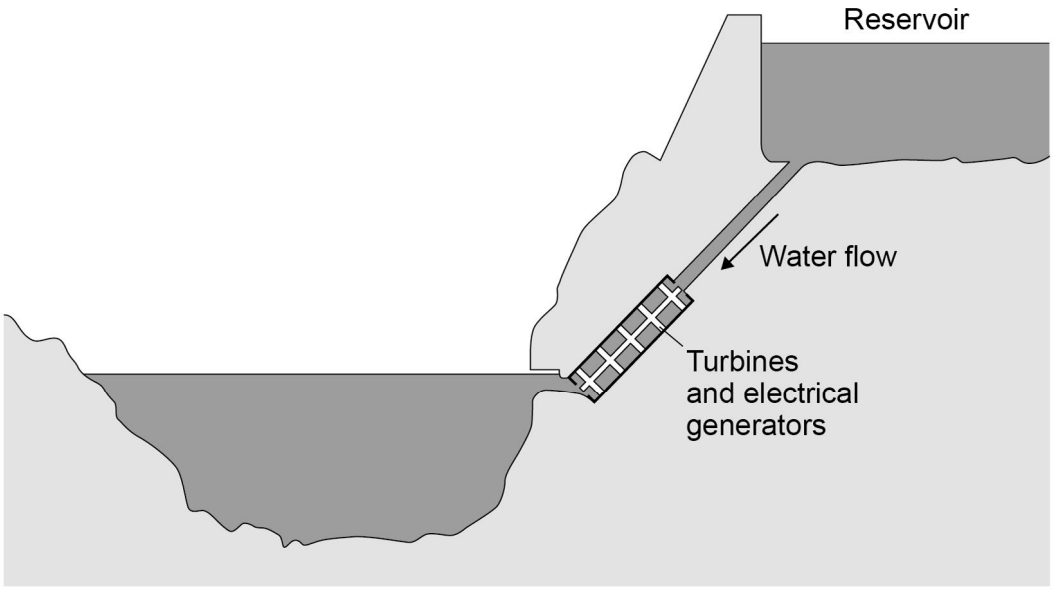
4.1.1.4 Power

Question 141

November 2020 | 8463/1H | Original Q3

0 3 **Figure 4** shows a hydroelectric power station.

Figure 4



Electricity is generated when water from the reservoir flows through the turbines.

0 3 . 1 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 3 . 2 The reservoir stores 6 500 000 m^3 of water.

The density of the water is 998 kg/m^3.

Calculate the mass of water in the reservoir.

Give your answer in standard form.

[4 marks]

Mass (in standard form) = _____ kg

4.1.1.4 Power

Question 141 · continued

0 3 . 3 Write down the equation which links energy transferred (E), power (P) and time (t).

[1 mark]

0 3 . 4 The electrical generators can provide 1.5×10^9 W of power for a maximum of 5 hours.

Calculate the maximum energy that can be transferred by the electrical generators.

[3 marks]

Energy transferred = _____ J

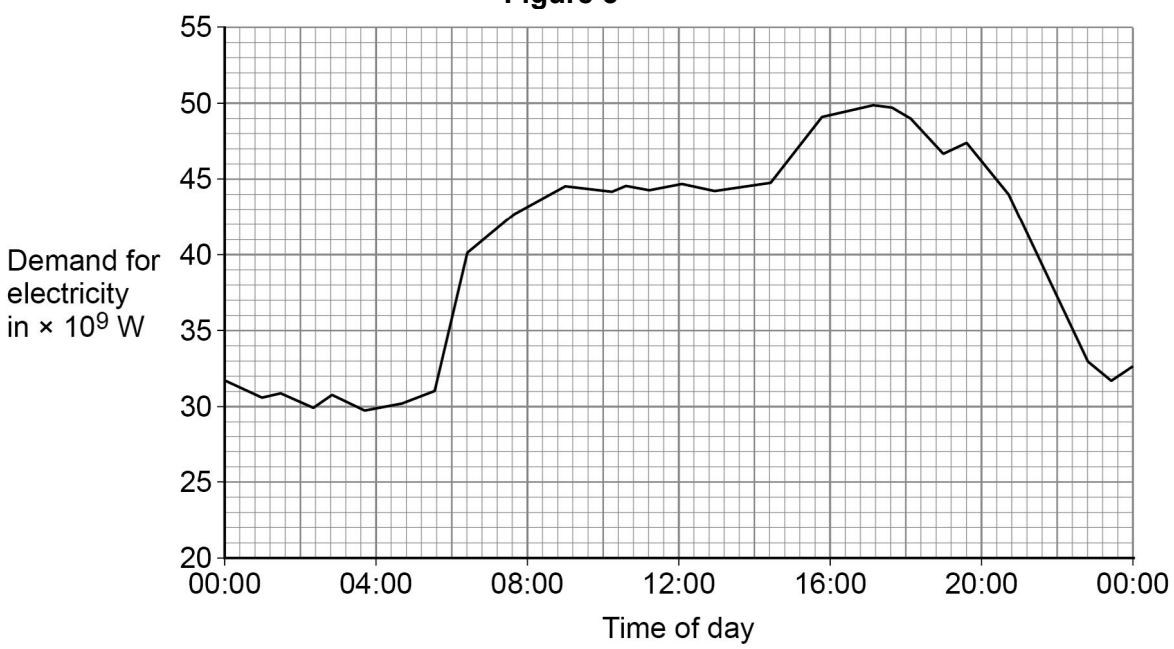
Question 3 continues on the next page

4.1.1.4 Power

Question 141 · continued

0 3 . 5 **Figure 5** shows how the UK demand for electricity increases and decreases during one day.

Figure 5



The hydroelectric power station in **Figure 4** can provide 1.5×10^9 W of power for a maximum of 5 hours.

Give **two** reasons why this hydroelectric power station is not able to meet the increase in demand shown between 04:00 and 16:00 in **Figure 5**.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

11

4.1.1.4 Power

Question 142

November 2020 | 8463/1H | Original Q5

0 5 Radioactive waste from nuclear power stations is a man-made source of background radiation.

0 5 . 1 Give **one** other man-made source of background radiation.

[1 mark]

Nuclear power stations use the energy released by nuclear fission to generate electricity.

0 5 . 2 Give the name of **one** nuclear fuel.

[1 mark]

0 5 . 3 Nuclear fission releases energy.

Describe the process of nuclear fission inside a nuclear reactor.

[4 marks]

4.1.1.4 Power

Question 142 · continued

0 5 . 4 A new type of power station is being developed that will generate electricity using nuclear fusion.

Explain how the process of nuclear fusion leads to the release of energy.

[2 marks]

0 5 . 5 Nuclear fusion power stations will produce radioactive waste. This waste will have a much shorter half-life than the radioactive waste from a nuclear fission power station.

Explain the advantage of the radioactive waste having a shorter half-life.

[2 marks]

10

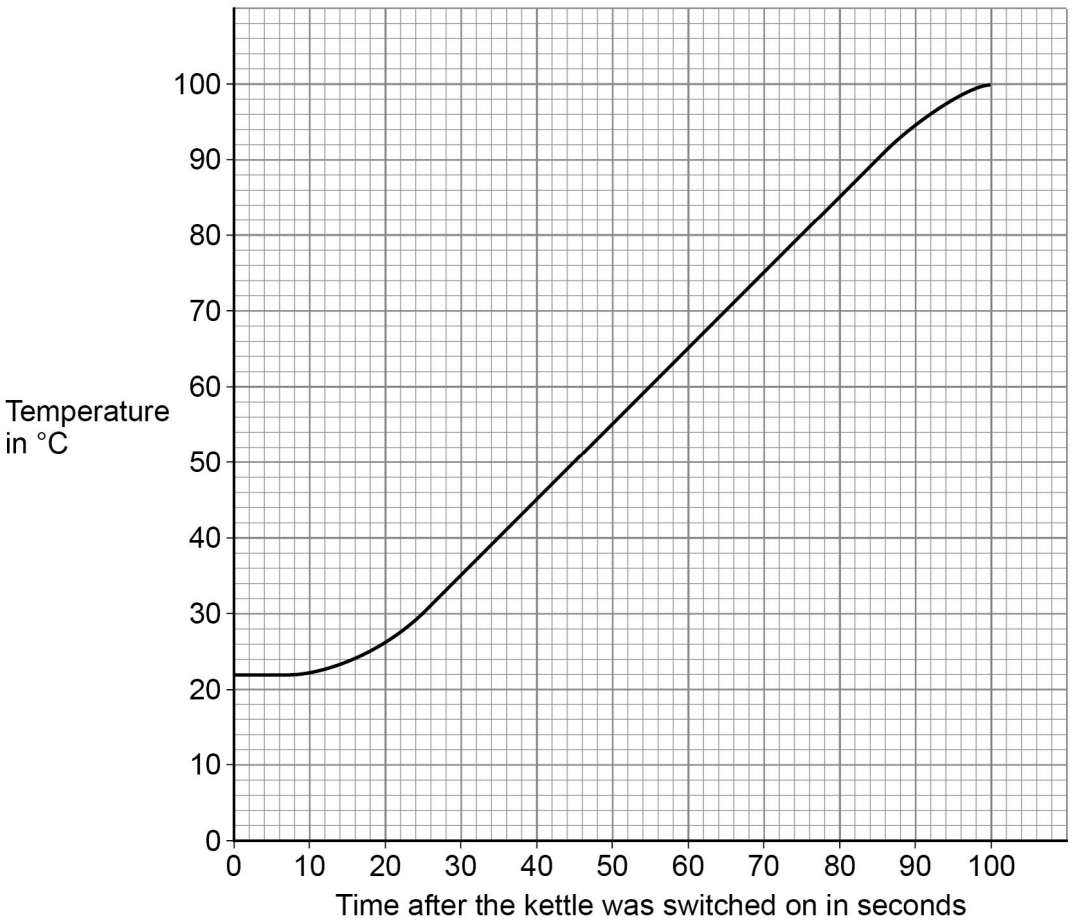
4.1.1.4 Power

Question 143

0 7 An electric kettle was switched on.

Figure 10 shows how the temperature of the water inside the kettle changed.

Figure 10



0 7 . 1 When the kettle was switched on the temperature of the water did **not** immediately start to increase.

Suggest **one** reason why.

[1 mark]

4.1.1.4 Power

Question 143 · continued

0 7 . 2 The energy transferred to the water in 100 seconds was 155 000 J.

specific heat capacity of water = 4200 J/kg °C

Determine the mass of water in the kettle.

Use **Figure 10**.

Give your answer to 2 significant figures.

[5 marks]

Mass of water (2 significant figures) = _____ kg

0 7 . 3 The straight section of the line in **Figure 10** can be used to calculate the useful power output of the kettle.

Explain how.

[3 marks]

9

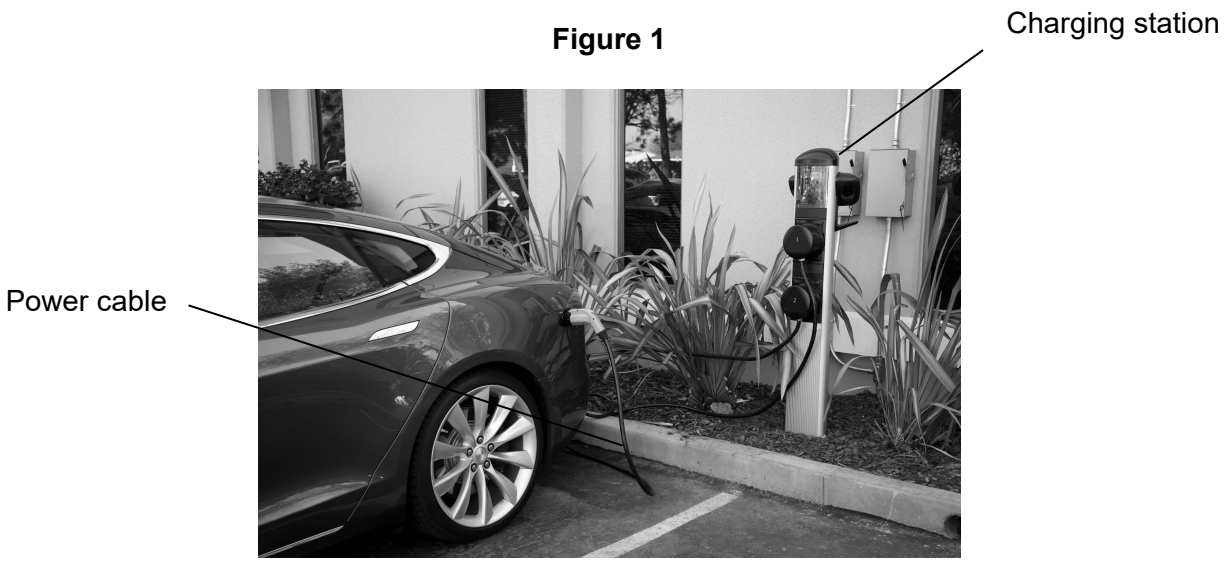
4.1.1.4 Power

Question 144

November 2021 | 8463/1H | Original Q1

0 1 **Figure 1** shows an electric car being recharged.

Figure 1



0 1 . 1 The charging station applies a direct potential difference across the battery of the car.

What does 'direct potential difference' mean?

[1 mark]

Question 1 continues on the next page

4.1.1.4 Power

Question 144 · continued

0 1 . 2 Which equation links energy transferred (E), power (P) and time (t)?

[1 mark]

Tick (✓) **one** box.

energy transferred = $\frac{\text{power}}{\text{time}}$ ☐

energy transferred = $\frac{\text{time}}{\text{power}}$ ☐

energy transferred = power × time ☐

energy transferred = power^2 × time ☐

0 1 . 3 The battery in the electric car can store 162 000 000 J of energy.

The charging station has a power output of 7200 W.

Calculate the time taken to fully recharge the battery from zero.

[3 marks]

Time taken = _____ s

4.1.1.4 Power

Question 144 · continued

0 1 . 4 Which equation links current (I), potential difference (V) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$I = V \times R$ ☐

$I = V^2 \times R$ ☐

$R = I \times V$ ☐

$V = I \times R$ ☐

0 1 . 5 The potential difference across the battery is 480 V.

There is a current of 15 A in the circuit connecting the battery to the motor of the electric car.

Calculate the resistance of the motor.

[3 marks]

Resistance = _____ Ω

Question 1 continues on the next page

4.1.1.4 Power

Question 144 · continued

0 1 . 6 Different charging systems use different electrical currents.

- Charging system **A** has a current of 13 A.
- Charging system **B** has a current of 26 A.
- The potential difference of both charging systems is 230 V.

How does the time taken to recharge a battery using charging system **A** compare with the time taken using charging system **B**?

[1 mark]

Tick (✓) **one** box.

Time taken using system **A** is half the time of system **B** ☐

Time taken using system **A** is the same as system **B** ☐

Time taken using system **A** is double the time of system **B** ☐

10

4.1.1.4 Power

Question 145

November 2021 | 8463/1H | Original Q2

0 2 Energy from the Sun is released by nuclear fusion.

0 2 . 1 Complete the sentences.

[2 marks]

Nuclear fusion is the joining together of _____.

During nuclear fusion the total mass of the particles _____.

0 2 . 2 Nuclear fusion of deuterium is difficult to achieve on Earth because of the high temperature needed.

Electricity is used to increase the temperature of 4.0 g of deuterium by 50 000 000 °C.

specific heat capacity of deuterium = 5200 J/kg °C

Calculate the energy needed to increase the temperature of the deuterium by 50 000 000 °C.

Use the Physics Equation Sheet.

[3 marks]

Energy = _____ J

4.1.1.4 Power

Question 145 · continued

0 2 . 3 The idea of obtaining power from nuclear fusion was investigated using models.

The models were tested before starting to build the first commercial nuclear fusion power station.

Suggest **two** reasons why models were tested.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 2 . 4 Generating electricity using nuclear fusion will have fewer environmental effects than generating electricity using fossil fuels.

Explain **one** environmental effect of generating electricity using fossil fuels.

[2 marks]

_____

_____

_____

_____

_____

9

4.1.1.4 Power

Question 146

November 2021 | 8463/1H | Original Q5

0 5 . 1 During one year, 1.25×10^{18} J of energy was transferred from the National Grid.

number of seconds in 1 year = 3.16×10^{7}

Calculate the mean energy transferred from the National Grid each second.

Give your answer to 3 significant figures.

[2 marks]

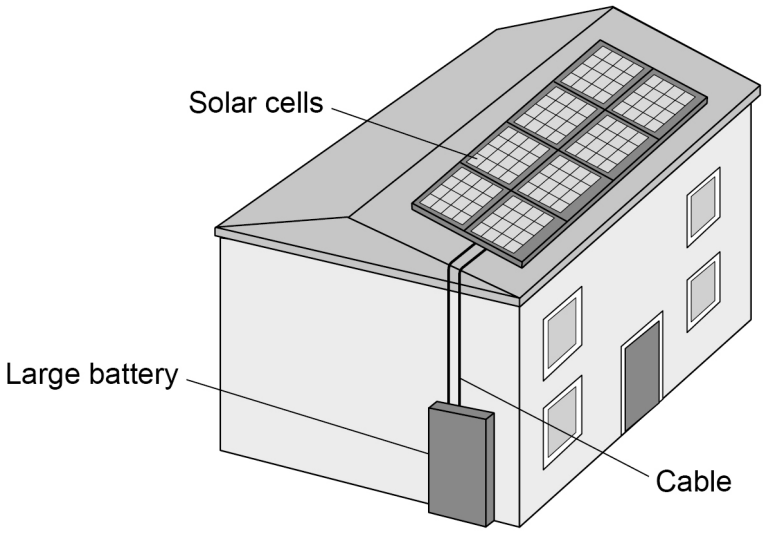
Energy each second (3 significant figures) = _____ J

Figure 5 shows a house with a solar power system.

The solar cells generate electricity.

When the electricity generated by the solar cells is not needed, the energy is stored in a large battery.

Figure 5



4.1.1.4 Power

Question 146 · continued

0 5 . 2 The charge flow through the cable between the solar cells and the battery in 24 hours was 27 000 coulombs.

Calculate the mean current in the cable.

[4 marks]

Mean current = _____ A

0 5 . 3 At one time, the total power input to the solar cells was 7.8 kW.

The efficiency of the solar cells was 0.15

Calculate the useful power output of the solar cells.

[3 marks]

Useful power output = _____ W

Question 5 continues on the next page

4.1.1.4 Power

Question 146 · continued

0 5 . 4 It is unlikely that **all** of the electricity that the UK needs can be generated by solar power systems.

Explain why.

[2 marks]

11

4.1.1.4 Power

Question 147

November 2021 | 8463/1H | Original Q11

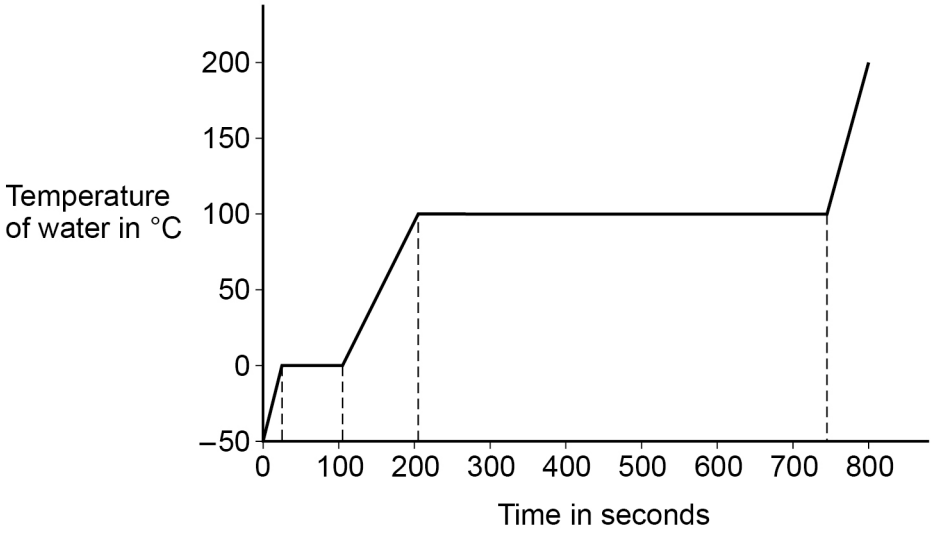
1 1 A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

Figure 17 shows the student's results.

The power output of the heater was constant.

Figure 17



1 1 . 1 The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how **Figure 17** shows this.

[2 marks]

4.1.1.4 Power

Question 147 · continued

11.2 The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how **Figure 17** shows this.

[2 marks]

11.3 A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in **Figure 17** would have been different.

[2 marks]

1

2

Question 11 continues on the next page

4.1.1.4 Power

Question 147 · continued

11.4 When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

[5 marks]

Specific latent heat of vaporisation = _____

Unit _____

11

4.1.1.4 Power

Question 148

June 2022 | 8463/1H | Original Q1

0 1 **Figure 1** shows a large wind farm off the coast of the UK.

Figure 1



The mean power output of the wind farm is 696 MW, which is enough power for 580 000 homes.

0 1 . 1 Calculate the mean power needed for 1 home.

Give your answer in watts.

[2 marks]

Mean power needed for 1 home = _____ W

4.1.1.4 Power

Question 148 · continued

0 1 . 2 On one day the demand for electricity in the UK was 34 000 MW.

Suggest **two** reasons why wind power was not able to meet this demand.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 1 . 3 Some of the energy from the wind used to rotate a wind turbine is wasted.

An engineer oils the mechanical parts of a wind turbine.

Explain how oiling would affect the efficiency of the wind turbine.

[3 marks]

_____

_____

_____

_____

_____

0 1 . 4 In most homes in the UK there are many different electrical devices.

Explain why people should be encouraged to use energy efficient electrical devices.

[2 marks]

_____

_____

_____

_____

_____

9

4.1.1.4 Power

Question 149

June 2022 | 8463/1H | Original Q3

0 3 An engineering company has invented pavement tiles that generate electricity as people walk on them.

Figure 3 shows someone walking on the pavement tiles.

Figure 3



Use the Physics Equations Sheet to answer questions **03.1** and **03.2**.

0 3 . 1 What equation links current (I), potential difference (V) and power (P)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{V}{I}$ ☐

$P = V \times I$ ☐

$I = P \times V$ ☐

$V = I^2 \times P$ ☐

4.1.1.4 Power

Question 149 · continued

0 3 . 2 When a person walks on a tile, a potential difference of 40 V is induced across the tile.

The power output of the tile is 4.4 W.

Calculate the current in the tile.

[3 marks]

Current = _____ A

Question 3 continues on the next page

4.1.1.4 Power

Question 149 · continued

Use the Physics Equations Sheet to answer questions **03.3** and **03.4**.

0 3 . 3 What equation links efficiency, total power input and useful power output?

[1 mark]

Tick (✓) **one** box.

Efficiency = $\frac{\text{useful power output}}{\text{total power input}}$ ☐

Efficiency = $\frac{\text{total power input}}{\text{useful power output}}$ ☐

Efficiency = useful power output × total power input ☐

0 3 . 4 The tiles are used to power LED lights in the pavement.

An LED light has a total power input of 4.0 W.

The efficiency of the LED light is 0.85

Calculate the useful power output of the LED light.

[3 marks]

Useful power output = _____ W

8

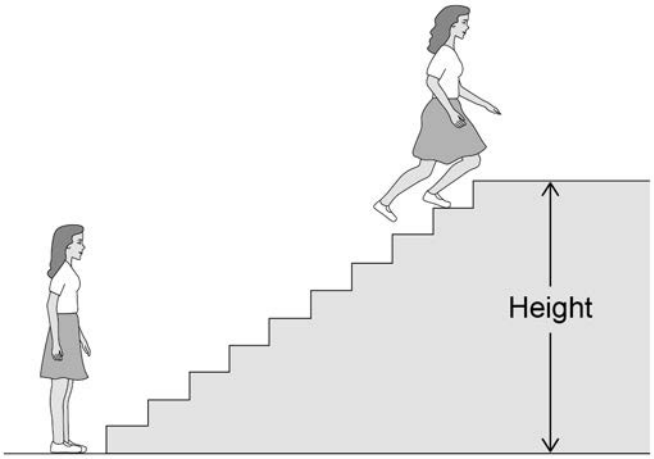
4.1.1.4 Power

Question 150

June 2022 | 8463/1H | Original Q9

0 9 **Figure 10** shows a girl doing an experiment to determine her power output by running to the top of some stairs.

Figure 10



0 9 . 1 The mass of the girl was 60.0 kg.

The height of the stairs was 175 cm.

The girl ran to the top of the stairs in 1.40 s.

gravitational field strength = 9.8 N/kg

Calculate the power output of the girl.

Use the Physics Equations Sheet.

[5 marks]

Power = _____ W

4.1.1.4 Power

Question 150 · continued

0 9 . 2 The **total** power output of the girl was greater than the answer to question **09.1**.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 3 A boy took more than 1.40 s to run up the same stairs.

The power output of the boy was the same as the power output of the girl.

What conclusion can be made about the boy's mass?

[1 mark]

Tick (✓) **one** box.

The boy's mass was greater than the girl's mass. ☐

The boy's mass was lower than the girl's mass. ☐

The boy's mass was the same as the girl's mass. ☐

8

4.1.1.4 Power

Question 151

June 2022 | 8463/1H | Original Q11

1 1 **Figure 12** shows some hair straighteners.

Hair straighteners contain heating elements.

Figure 12



1 1 . 1 When the hair straighteners reach normal operating temperature, an LED turns on.

Draw the circuit symbol for an LED in the box.

[1 mark]

4.1.1.4 Power

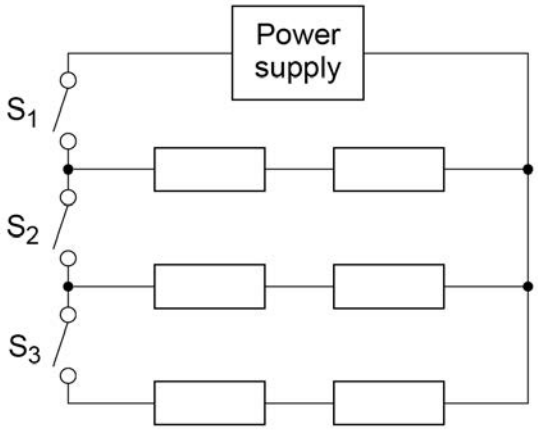
Question 151 · continued

Figure 13 shows the circuit diagram for the hair straighteners.

Each resistor represents a heating element.

The power output of the hair straighteners can be changed by closing different switches.

Figure 13



11.2 Why do the hair straighteners **not** turn on when only switch S_2 is closed?

[1 mark]

Question 11 continues on the next page

4.1.1.4 Power

Question 151 · continued

1 1 . 3 The hair straighteners have a maximum power output of 120 W.

The energy transferred to the hair straighteners to reach normal operating temperature is 3.6 kJ.

Calculate the time taken for the hair straighteners to reach normal operating temperature when operating at maximum power.

Use the Physics Equations Sheet.

[4 marks]

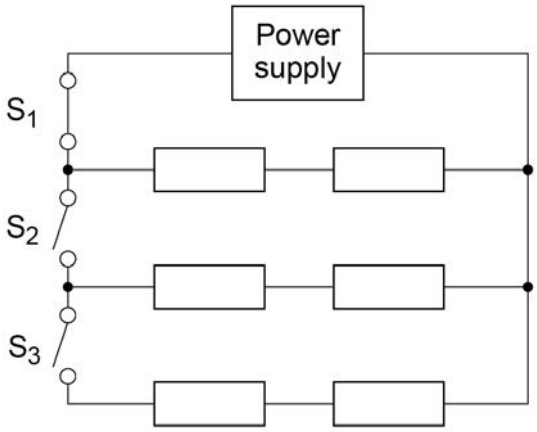
Time = _____ seconds

4.1.1.4 Power

Question 151 · continued

1 1 . 4 **Figure 14** shows the hair straighteners circuit with switch S_1 closed.

Figure 14



Switch S_2 and switch S_3 are then closed at the same time.

Explain what happens to the power output of the power supply.

[3 marks]

9

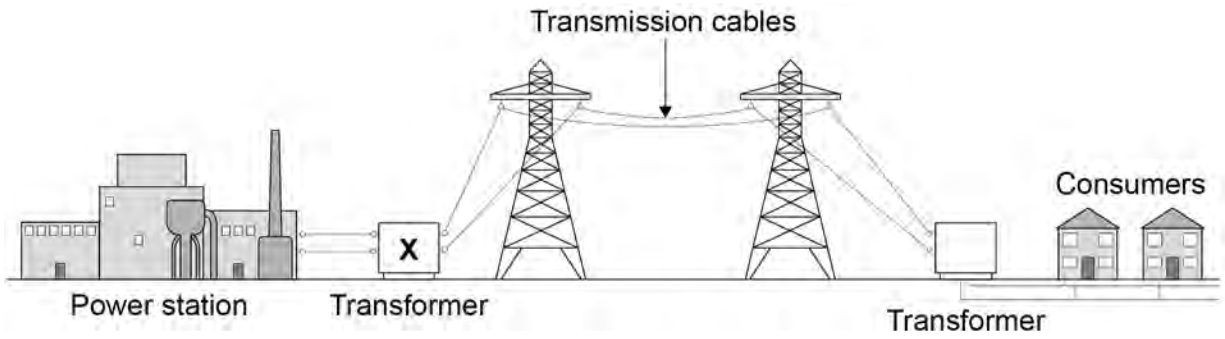
4.1.1.4 Power

Question 152

June 2023 | 8463/1H | Original Q1

0 1 **Figure 1** shows how the National Grid connects a power station to consumers.

Figure 1



0 1 . 1 Complete the sentences.

[2 marks]

Transformer **X** causes the potential difference to _____ .

Transformer **X** causes the current to _____ .

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Which equation links current (I), power (P) and resistance (R)?

[1 mark]

Tick (✓) **one** box.

$P = \frac{I}{R}$ ☐

$P = \frac{I}{R^2}$ ☐

$P = I^2 R$ ☐

$P = IR$ ☐

4.1.1.4 Power

Question 152 · continued

0 1 . 3 A transmission cable has a power loss of 1.60×10^9 W.

The current in the cable is 2000 A.

Calculate the resistance of the cable.

[3 marks]

Resistance = _____ Ω

Use the Physics Equations Sheet to answer questions **01.4** and **01.5**.

0 1 . 4 Write down the equation which links efficiency, total energy input and useful energy output.

[1 mark]

0 1 . 5 The total energy input to the National Grid from one power station is 34.2 GJ.

The National Grid has an efficiency of 0.992

Calculate the useful energy output from this power station to consumers in GJ.

[3 marks]

Useful energy output = _____ GJ

10

4.1.1.4 Power

Question 153

June 2023 | 8463/1H | Original Q4

0 4 A remote village in the UK uses a hydroelectric generator to provide electricity.

0 4 . 1 In one day, 2 500 000 kg of water passes through the hydroelectric generator.

The change in gravitational potential energy of the water is 367.5 MJ.

gravitational field strength = 9.8 N/kg

Calculate the mean change in vertical height of the water as it moves through the hydroelectric generator.

Use the Physics Equations Sheet.

[4 marks]

Mean change in vertical height = _____ m

4.1.1.4 Power

Question 153 · continued

0 4 . 2 The generator transfers 3.0 kW of electrical power.

Calculate the time taken for the generator to transfer 2.16×10^7 J of energy.

Use the Physics Equations Sheet.

Give your answer in standard form.

[5 marks]

Time taken (in standard form) = _____ s

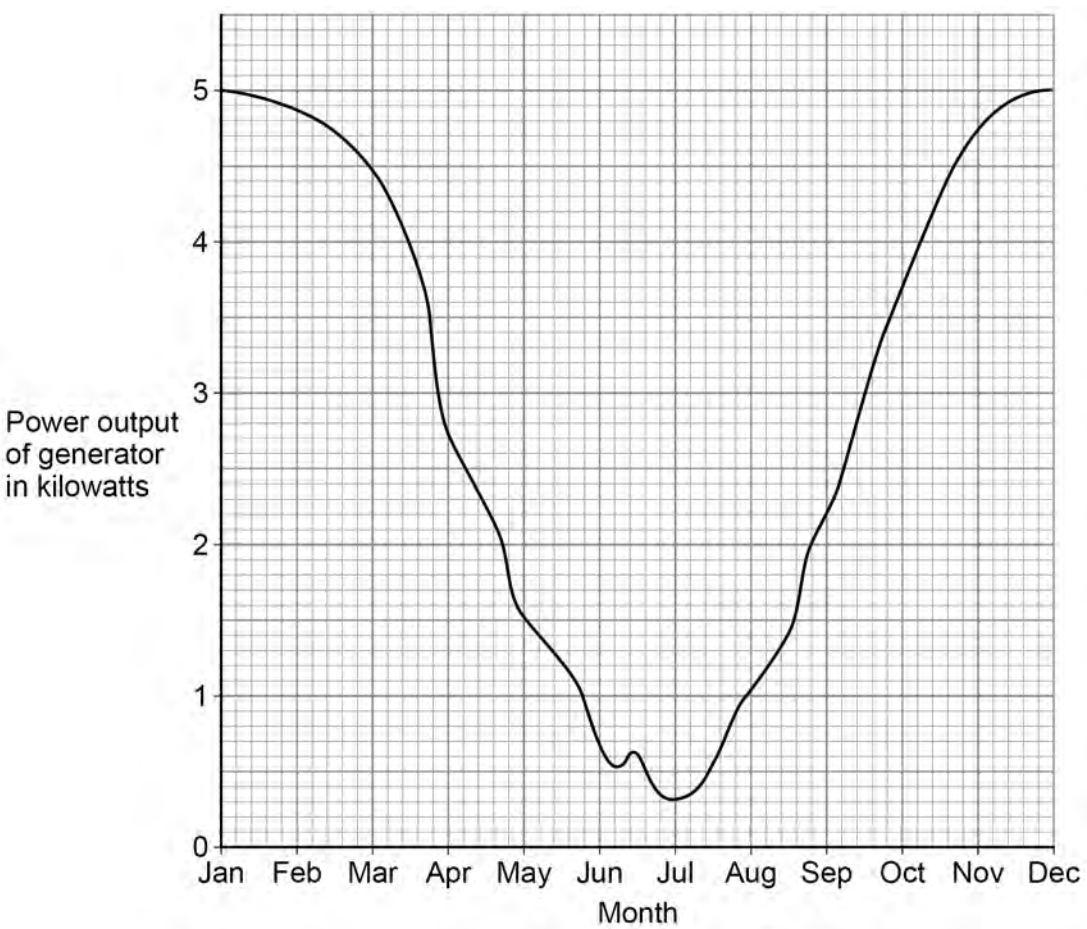
Question 4 continues on the next page

4.1.1.4 Power

Question 153 · continued

0 4 . 3 **Figure 5** shows how the power output of the generator varied during one year.

Figure 5



A solar power system is installed in the remote village in addition to the hydroelectric generator.

Explain why this improves the reliability of the electricity supply to the village.

Use information from **Figure 5**.

[2 marks]

11

4.1.1.4 Power

Question 154

June 2023 | 8463/1H | Original Q5

0 5 Some isotopes emit nuclear radiation.

0 5 . 1 Carbon-14 and carbon-12 are isotopes of carbon.

Compare the structure of an atom of carbon-14 with the structure of an atom of carbon-12.

[3 marks]

0 5 . 2 Carbon-14 is a radioactive isotope.

Carbon-14 has a half-life of 5700 years.

What does 'a half-life of 5700 years' mean?

[1 mark]

Question 5 continues on the next page

Question 154 · continued

Table 1 gives the half-life of some other radioactive isotopes.

Table 1

Isotope	Half-life in seconds
Nitrogen-18	0.62
Nitrogen-17	4.17
Fluorine-17	64.37
Fluorine-18	6584.34

0 5 . 3 A sample of fluorine-17 has an activity that is one quarter of its original activity.

Calculate the age of the sample of fluorine-17.

[2 marks]

Age = _____ s

0 5 . 4 All of the isotopes in **Table 1** emit beta radiation.

Explain which isotope would cause the biggest risk to a person's health based only on the half-life of each isotope.

[3 marks]

4.1.1.4 Power

Question 154 · continued

0 5 . 5 People who work in the nuclear power industry need to be aware of irradiation and contamination.

Describe the difference between irradiation and contamination.

[2 marks]

0 5 . 6 Give **one** health risk to a person working close to a source of nuclear radiation.

[1 mark]

0 5 . 7 Workers in nuclear power stations are monitored to check the radiation they emit.

A worker stands 1 cm away from a radiation detector.

The amount of radiation the worker emits is recorded.

Explain why the worker needs to stand close to the radiation detector.

[2 marks]

4.1.1.4 Power

Question 154 · continued

0 5 . 8 Workers in the nuclear power industry are exposed to nuclear radiation.

Pilots on aircraft are exposed to cosmic radiation from space.

daily dose caused by working in a nuclear power station = 0.00050 mSv

hourly dose from cosmic rays to a pilot while flying = 0.0030 mSv

Calculate the number of days it takes for a nuclear power station worker to receive the same dose as a pilot flying for 24 hours.

[3 marks]

Number of days = _____

17

4.1.1.4 Power

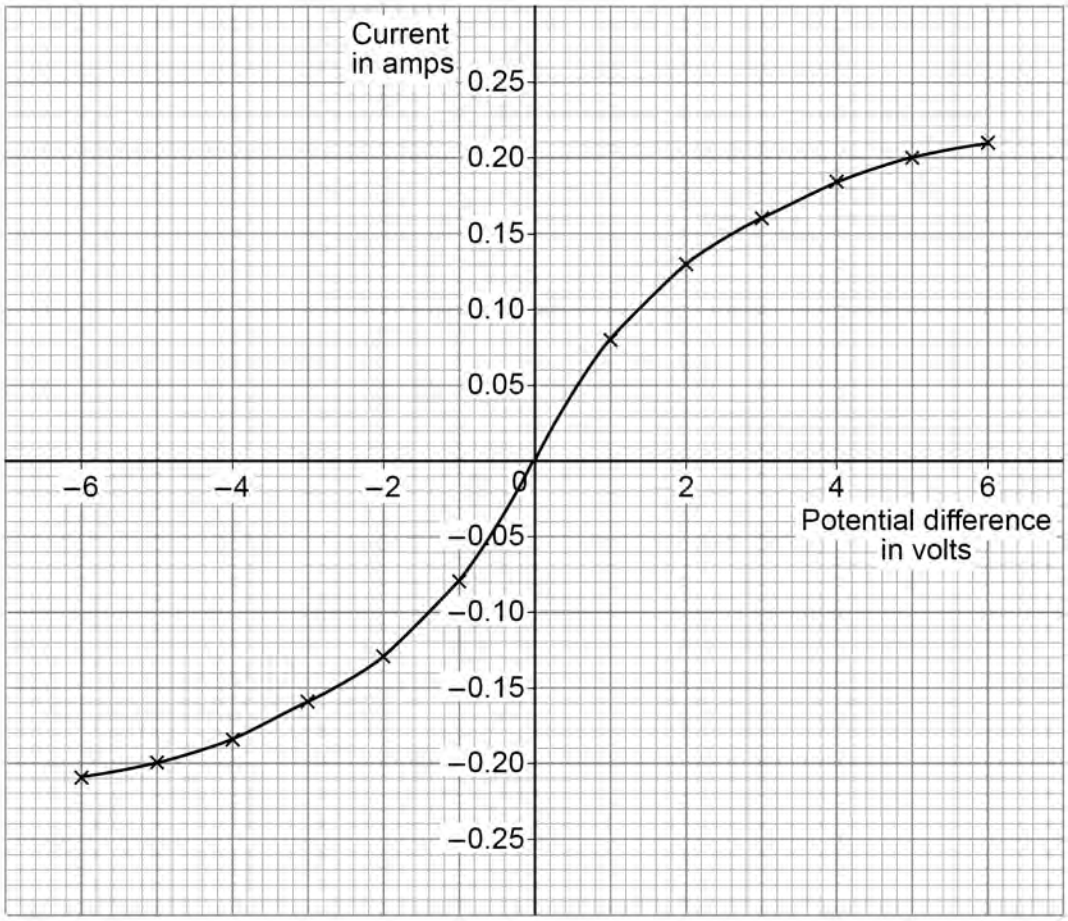
Question 155

June 2023 | 8463/1H | Original Q6

0 6 A student investigated how the current in a filament lamp varies with the potential difference across the filament lamp.

Figure 6 shows the results.

Figure 6



4.1.1.4 Power

Question 155 · continued

0 6 . 1 Describe a method the student could use to obtain these results.

You should include a circuit diagram.

[6 marks]

4.1.1.4 Power

Question 155 · continued

0 6 . 2 Determine the resistance of the filament lamp when the potential difference across it is +3.0 V.

Use the Physics Equations Sheet.

Use **Figure 6** on page 18.

[3 marks]

Resistance = _____ Ω

0 6 . 3 The current in the lamp is 0.21 A when the potential difference across the lamp is 6.0 V.

Calculate the energy transferred by the filament lamp in 30 minutes.

Use the Physics Equations Sheet.

[5 marks]

Energy transferred = _____ J

4.1.1.4 Power

Question 155 · continued

0 6 . 4 The power output of the lamp is 1.0 W when the potential difference across the lamp is 5.0 V.

A student predicts that the power output would be 4.0 W if the potential difference was doubled.

Explain why the student is **not** correct.

[2 marks]

16

Turn over for the next question

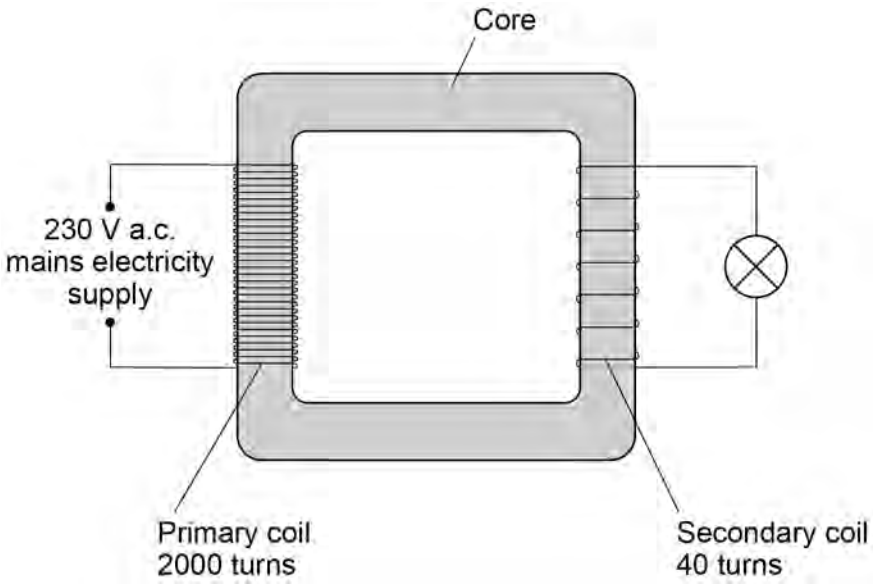
4.1.1.4 Power

Question 156

June 2023 | 8463/2H | Original Q8

0 8 **Figure 21** shows a transformer used to power a lamp using the mains electricity supply.

Figure 21



0 8 . 1 What material is used to make the core of the transformer?

Give the reason for using this material.

[2 marks]

Material _____

Reason _____

_____

4.1.1.4 Power

Question 156 · continued

0 8 . 2 Determine the current in the secondary coil when the power output of the transformer is 6.9 W.

The transformer is 100% efficient.

Use the Physics Equations Sheet.

[5 marks]

Current in the secondary coil = _____ A

7

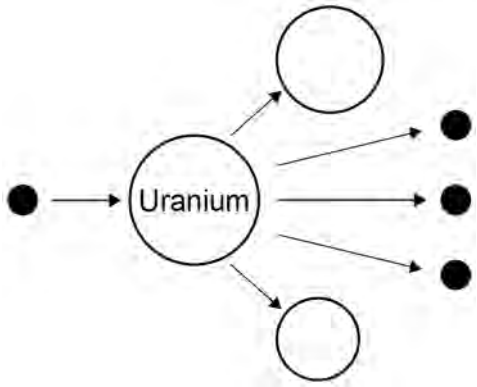
4.1.1.4 Power

Question 157

0 2 The process of nuclear fission is used in nuclear power stations.

Figure 2 shows the process of nuclear fission.

Figure 2



0 2 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

electrons	**gamma rays**	**neutrons**	**nuclei**	**protons**

In nuclear power stations, energy is released from

uranium _____.

The uranium in **Figure 2** splits into two parts and

releases three _____.

The process of nuclear fission releases electromagnetic radiation in the

form of _____.

4.1.1.4 Power

Question 157 · continued

Use the Physics Equations Sheet to answer questions **02.2** and **02.3**.

0 2 . 2 Write down the equation which links energy (*E*), power (*P*) and time (*t*).

[1 mark]

0 2 . 3 A nuclear power station has a power output of 500 MW.

Calculate the energy output in 3600 s.

Give your answer in J.

[3 marks]

Energy output = _____ J

0 2 . 4 Radioactive waste produced by nuclear power stations has a long half-life.

Suggest **one** precaution taken to reduce the hazard caused by radioactive waste from power stations.

[1 mark]

4.1.1.4 Power

Question 157 · continued

0 2 . 5 Nuclear power stations do **not** generate electricity every day of the year.

One nuclear power station generated electricity for 92% of a year.

one year = 365 days

Calculate the number of days during the year that the nuclear power station generated electricity.

[2 marks]

Number of days = _____

10

Turn over for the next question

4.1.1.4 Power

Question 158

June 2025 | 8463/1H | Original Q1

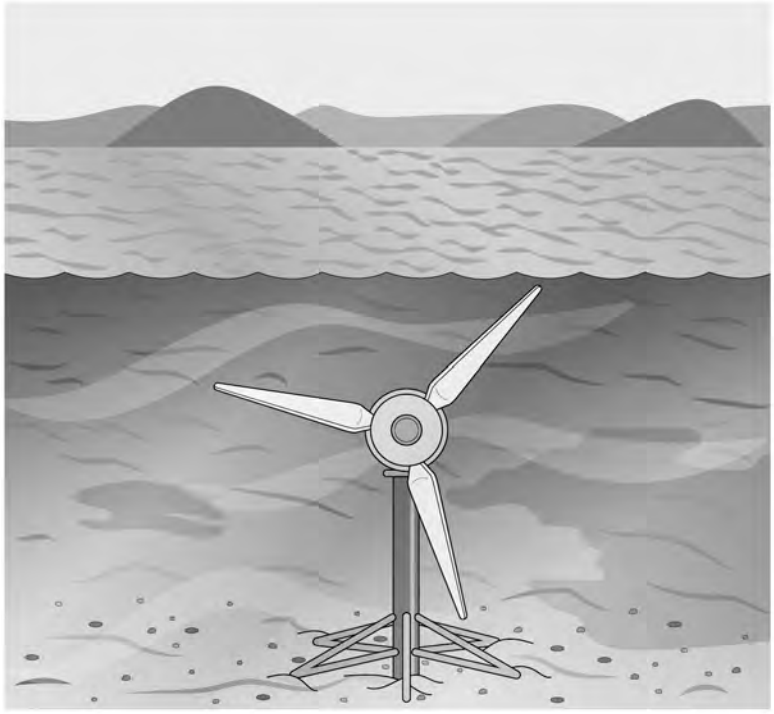
0 1 Tides and wind are two renewable energy resources.

0 1 . 1 Describe the difference between renewable energy resources and non-renewable energy resources.

[2 marks]

Figure 1 shows a new design of tidal turbine to generate electricity using the tides.

Figure 1



4.1.1.4 Power

Question 158 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Write down the equation which links density (ρ), mass (m) and volume (V).

[1 mark]

0 1 . 3 The mass of seawater passing through the tidal turbine each second is 824 000 kg.

The density of seawater is 1030 kg/m^3.

Calculate the volume of seawater passing through the tidal turbine each second.

[3 marks]

Volume = _____ m^3

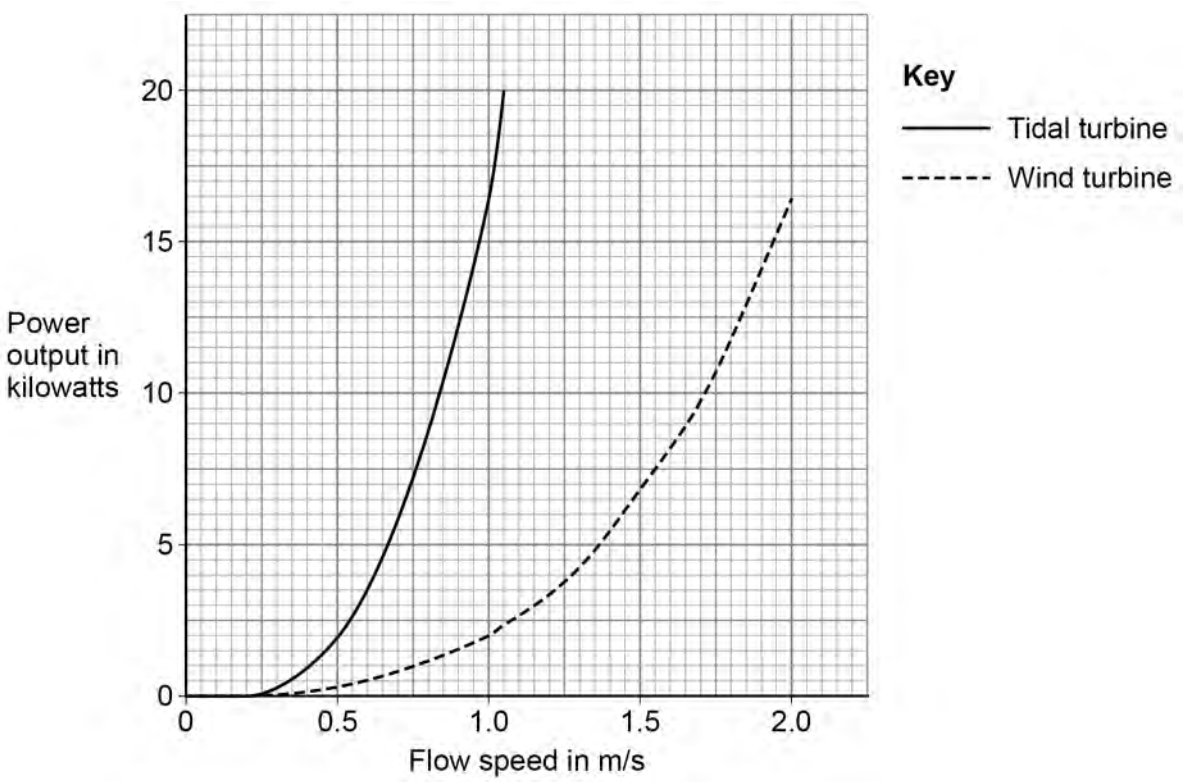
Question 1 continues on the next page

Question 158 · continued

The speed of the tide or the speed of the wind past a turbine is called the 'flow speed'.

Figure 2 shows how the power output of a tidal turbine compares with a wind turbine for different flow speeds.

Figure 2



0 1 . 4 As flow speed increases, power output increases.

Give **two** other conclusions that can be made using information from **Figure 2**.

[2 marks]

1 _____

_____

2 _____

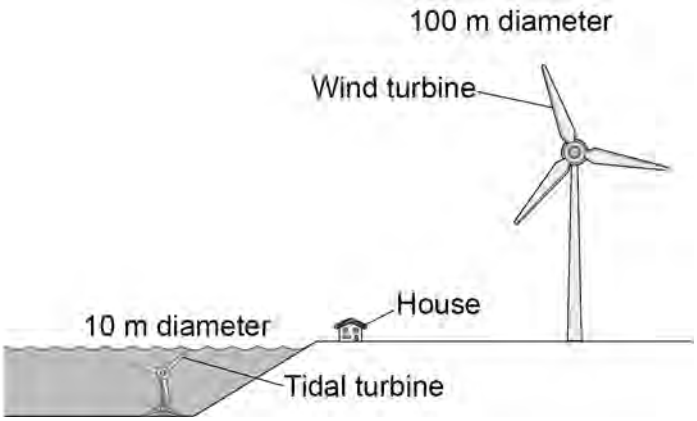
_____

4.1.1.4 Power

Question 158 · continued

0 1 . 5 **Figure 3** shows the turbines used to obtain the data for **Figure 2**.

Figure 3



Compare the environmental impacts of the wind turbine and the tidal turbine in **Figure 3**.

[4 marks]

12

4.1.1.4 Power

Question 159

June 2025 | 8463/1H | Original Q4

0 4 Manufacturing a car produces carbon dioxide.

0 4 . 1 Explain **one** environmental problem caused by the emission of carbon dioxide.

[2 marks]

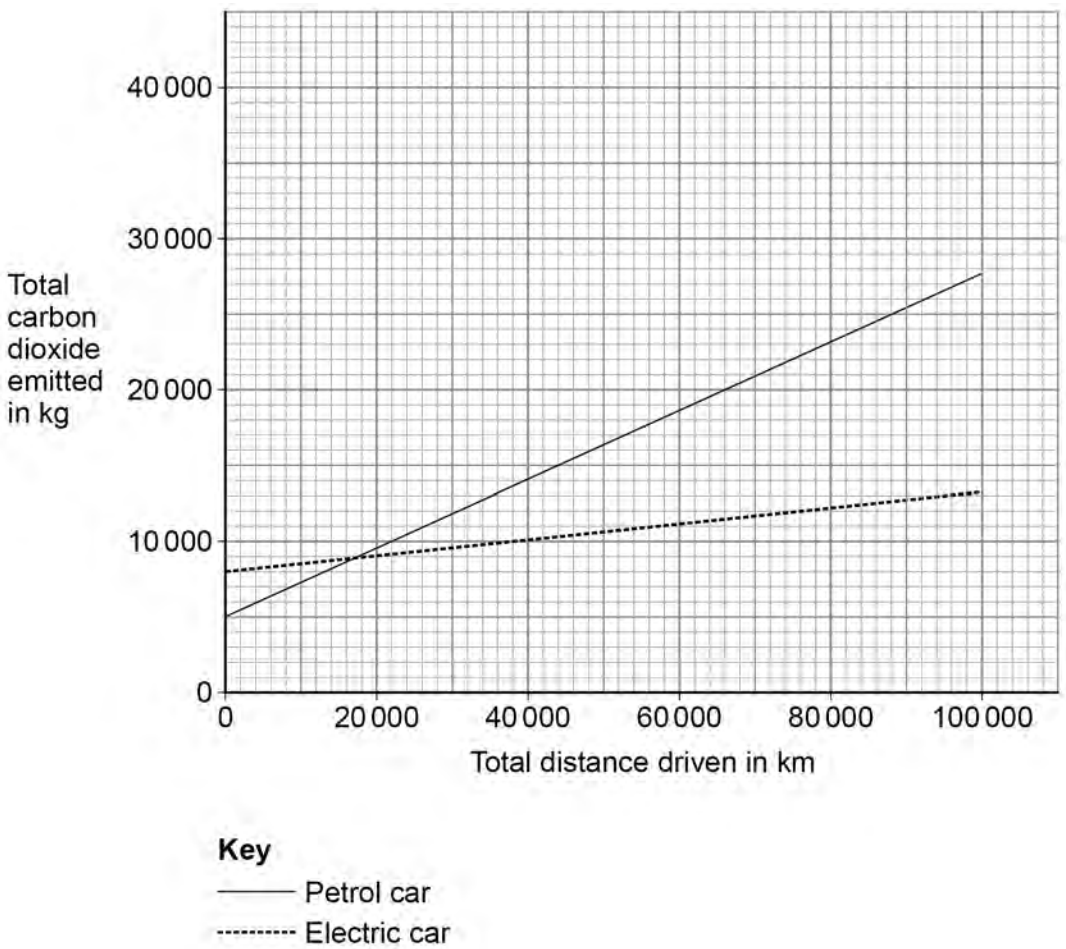
Question 4 continues on the next page

4.1.1.4 Power

Question 159 · continued

Figure 7 shows the carbon dioxide produced during the lifetime of two types of car.

Figure 7



0 4 . 2 What mass of carbon dioxide is produced during the manufacture of the electric car?

[1 mark]

Mass of carbon dioxide = _____ kg

0 4 . 3 At one distance, the amount of carbon dioxide emitted by both cars is the same.

What is this distance?

[1 mark]

Distance = _____ km

4.1.1.4 Power

Question 159 · continued

Some energy resources emit carbon dioxide when used to generate electricity.

0 4 . 4 The battery-powered electric car does not emit carbon dioxide as it is driven.

Explain why more carbon dioxide is produced as the distance travelled by the electric car increases.

[2 marks]

0 4 . 5 Which **two** of the following energy resources do **not** emit carbon dioxide when used to generate electricity?

[2 marks]

Tick (✓) **two** boxes.

- Biofuel ☐
- Nuclear ☐
- Oil ☐
- Solar ☐
- Wood ☐

8

4.1.1.4 Power

Question 160

June 2025 | 8463/1H | Original Q6

0 6 **Figure 8** shows a battery-powered hand warmer that contains a heating pad.

The battery transfers energy to increase the temperature of the heating pad.

Figure 8



0 6 . 1 The heating pad has a mass of 0.20 kg.

When the hand warmer was switched on, the energy transferred to the heating pad was 8000 J.

specific heat capacity of heating pad = 1600 J/kg °C

Calculate the temperature increase of the heating pad.

Use the Physics Equations Sheet.

[3 marks]

Temperature increase = _____ °C

4.1.1.4 Power

Question 160 · continued

0 6 . 2 The hand warmer was powered by a 5.0 V battery.

The battery transferred 180 kJ of energy to the heating pad.

Calculate the charge flow through the battery.

Use the Physics Equations Sheet.

[4 marks]

Charge flow = _____ C

Question 6 continues on the next page

4.1.1.4 Power

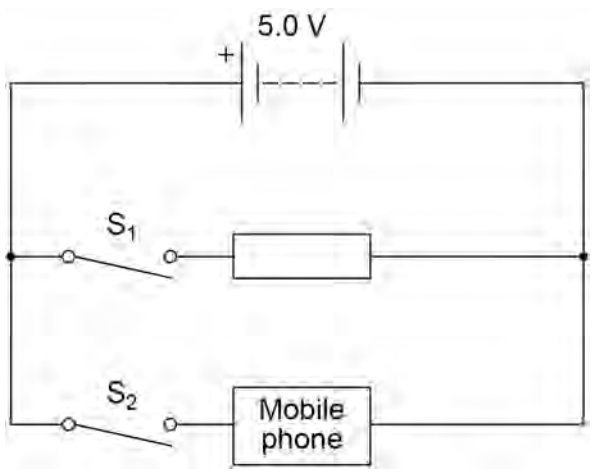
Question 160 · continued

0 6 . 3 The circuit inside the hand warmer can be connected to a mobile phone to recharge the mobile phone.

Figure 9 shows the circuit diagram when the hand warmer is connected to a mobile phone.

The heating pad of the hand warmer is represented by the resistor symbol.

Figure 9



Explain how closing both switches S_1 and S_2 affects the power output of the battery compared with only closing switch S_1.

[3 marks]

10

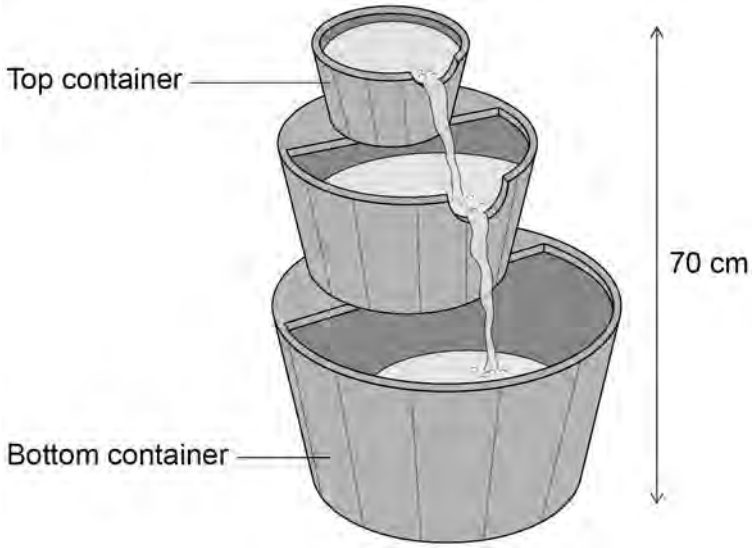
4.1.1.4 Power

Question 161

June 2025 | 8463/1H | Original Q9

0 9 **Figure 11** shows a garden water feature.

Figure 11



The water feature has an electric motor that pumps water from the bottom container to the top container.

0 9 . 1 The pump transfers 0.343 J of gravitational potential energy to the water each second.

gravitational field strength = 9.8 N/kg

Determine the mass of water passing through the pump each second.

Use the Physics Equations Sheet.

[4 marks]

Mass = _____ kg

4.1.1.4 Power

Question 161 · continued

0 9 . 2 The power of the pump motor is 4.86 W.

The resistance of the pump motor is 6.0 Ω.

Calculate the charge flow through the motor in 30 minutes.

Use the Physics Equations Sheet.

[6 marks]

Charge flow = _____ C

0 9 . 3 The pump motor breaks and is replaced with a new motor.

The new pump motor has the same power input, but has a greater efficiency.

Explain how the new pump motor would affect the flow of water in the water feature.

[2 marks]

12