AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.3

National and global energy resources

Past-paper questions

Tier	**Higher**
Question groups	**107**
Available paper years	**2004–2025**

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.

4.1.3 National and global energy resources

Question 01

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*.

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(2 marks)

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

You may give your answer as a labelled diagram.

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(1 mark)

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

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(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.

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(1 mark)

5

4.1.3 National and global energy resources

Question 02

June 2004 | 3462H3 | Original Q8 | Legacy

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

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(2 marks)

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(1 mark)

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4.1.3 National and global energy resources

Question 03

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?

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(2 marks)

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

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(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?

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(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?

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(2 marks)

6

4.1.3 National and global energy resources

Question 04

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?

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(2 marks)

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

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(2 marks)

6

4.1.3 National and global energy resources

Question 05

November 2006 | PHY1A | Original Q2 | Legacy

QUESTION TWO

This question is about some of the energy sources that are used to generate electricity.

Match energy sources, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A coal

B hydroelectric

C nuclear

D wind

	Feature
1	has the highest decommissioning cost
2	causes noise pollution, and the supply is not constant
3	no fuel costs, and can be used to meet sudden demands for electricity
4	transformation of chemical energy to heat energy

4.1.3 National and global energy resources

Question 06

November 2006 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

New power stations need to be built soon – says report

This question is about the production and distribution of electricity. In many types of power station, heat is produced.

5A In a power station which uses plutonium, what is the process which produces this heat?

1 chemical reaction

2 combustion

3 nuclear fission

4 nuclear fusion

5B In a heat-producing power station, what is the heat used for?

1 to boil oil

2 to boil water

3 to power a generator

4 to power a turbine

5C In **most** power stations in the UK, most of the waste heat . . .

1 is recycled.

2 is released to the surroundings.

3 is transformed into electricity.

4 is used to heat neighbouring buildings.

4.1.3 National and global energy resources

Question 06 · continued

5D Step-up transformers are used in the National Grid to . . .

1 increase the current.

2 increase the efficiency of the system.

3 increase safety.

4 increase the speed of the transmission.

Turn over for the next question

4.1.3 National and global energy resources

Question 07

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.

4.1.3 National and global energy resources

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

4.1.3 National and global energy resources

Question 08

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.

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

4.1.3 National and global energy resources

Question 09

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)

4.1.3 National and global energy resources

Question 09 · 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

4.1.3 National and global energy resources

Question 10

March 2007 | PHY1A | Original Q1 | Legacy

QUESTION ONE

Read this extract from a magazine article.

New device improves wind turbines

A recent study found that wind turbines fitted with a new device, which makes them more responsive to small changes in wind direction, give a better output.

Scientists investigated the output of some wind turbines. They compared wind turbines of similar design, in similar locations. Half of the turbines were fitted with 'wind finders' which respond to small changes in wind direction. They found that 'wind finders' can improve the useful output of wind turbines by up to 10 %.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A conclusion

B control

C environment

D evidence

The wind turbines without 'wind finders' were the scientists' . . . **1** . . . .

The useful output from the wind turbines was the scientists' . . . **2** . . . .

What the scientists found out helped them to reach their . . . **3** . . . .

Improving wind turbines is important for the . . . **4** . . . .

4.1.3 National and global energy resources

Question 11

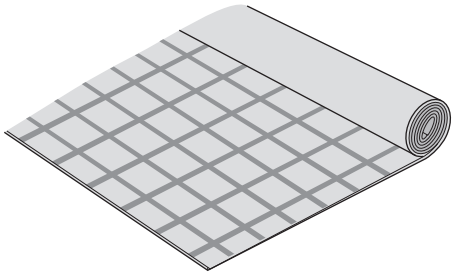
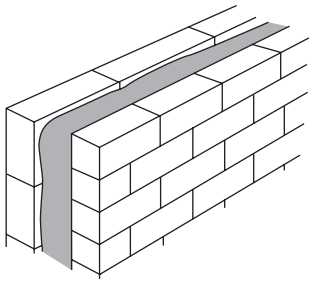
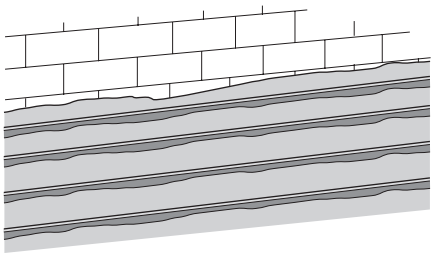
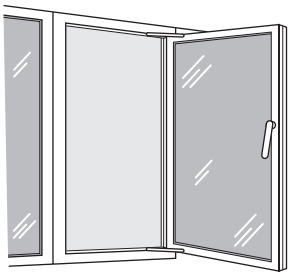
March 2007 | PHY1A | Original Q4 | Legacy

QUESTION FOUR

Energy costs rising

Many householders are concerned at the rising cost of energy.

The drawings are from a magazine article on how to reduce the cost of home heating by using insulation.

Carpeting the floor  Saving per week for each square metre **25p**	**Putting foam in wall cavities**  Saving per week for each square metre **20p**
Insulating the loft  Saving per week for each square metre **10p**	**Fitting double-glazed windows**  Saving per week for each square metre **24p**

4A All the methods shown in the diagrams make use of . . .

1 good emitters of thermal radiation.

2 materials that prevent warm air from rising.

3 trapped air.

4 warm materials.

Question 11 · continued

4B A student is asked to explain why the savings in the magazine article may not be correct for different houses.

The student makes the following points:

- not all double glazing is equally good
- not all insulation in the loft is to the same depth
- the difference between the outside temperature and the inside temperature of the different houses is not constant.

Which one of the following statements is correct?

1 Only the student's first point is correct.

2 Only the student's first two points are correct.

3 All three of the student's points are correct.

4 None of the student's points is correct.

4C An energy saving expert suggests how to reduce the heating bill for a house. She says that having foam inserted in the wall cavity will reduce the heating bill more than having double glazing fitted.

Her statement is correct.

This is because . . .

1 foam insulation is cheaper than double glazing.

2 more heat is lost through each square metre of window compared with each square metre of wall.

3 the area of the walls is much greater than the area of the windows.

4 the windows are not always closed.

4D The Government wants to encourage energy saving. There will be several advantages to the environment if this is achieved.

Which of the following will be the most important advantage to the environment?

1 It will be more important to develop renewable energy technology.

2 Less energy will need to be transformed from fossil fuels.

3 Less energy will need to be transformed from renewable resources.

4 There will be no need to build new nuclear power stations.

4.1.3 National and global energy resources

Question 12

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.

4.1.3 National and global energy resources

Question 12 · 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

4.1.3 National and global energy resources

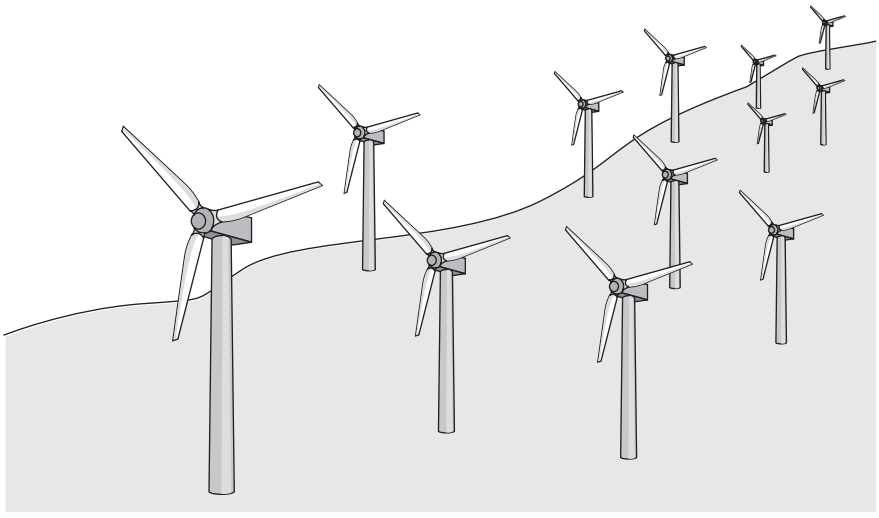
Question 13

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

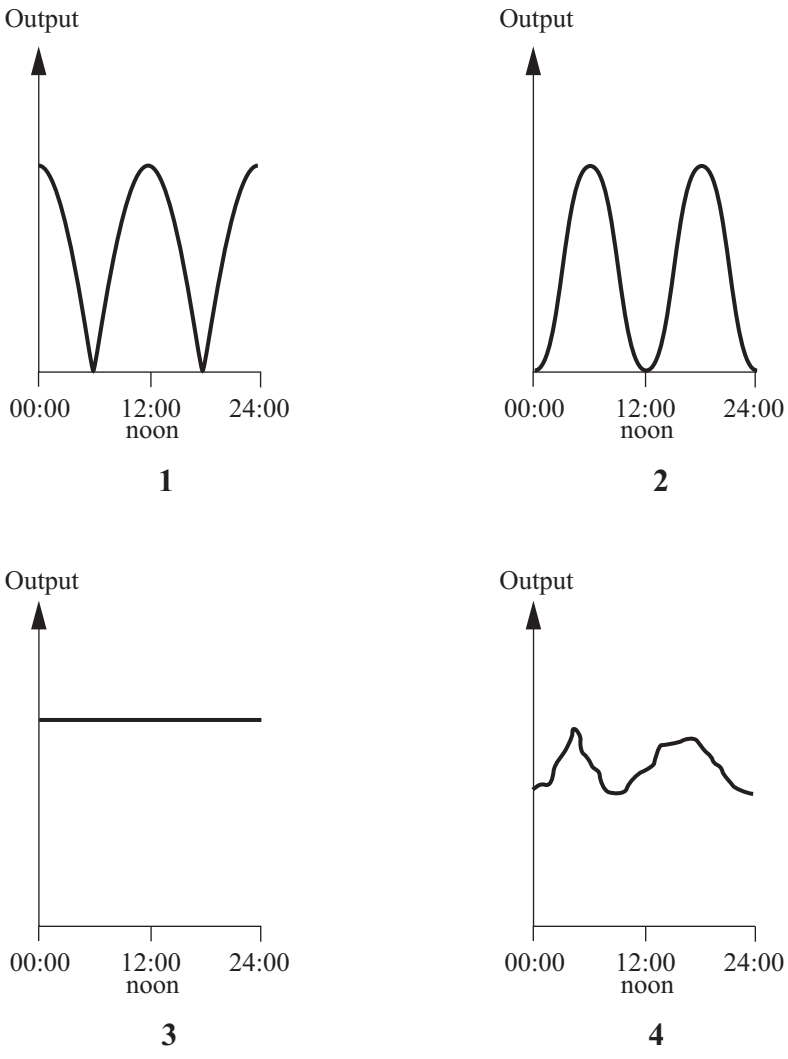
2 offshore – out at sea

3 on a coastal cliff

4 on the top of a hill

Question 13 · continued

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



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.

4.1.3 National and global energy resources

Question 14

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

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

4.1.3 National and global energy resources

Question 15

June 2007 | PHY1A | Original Q4 | Legacy

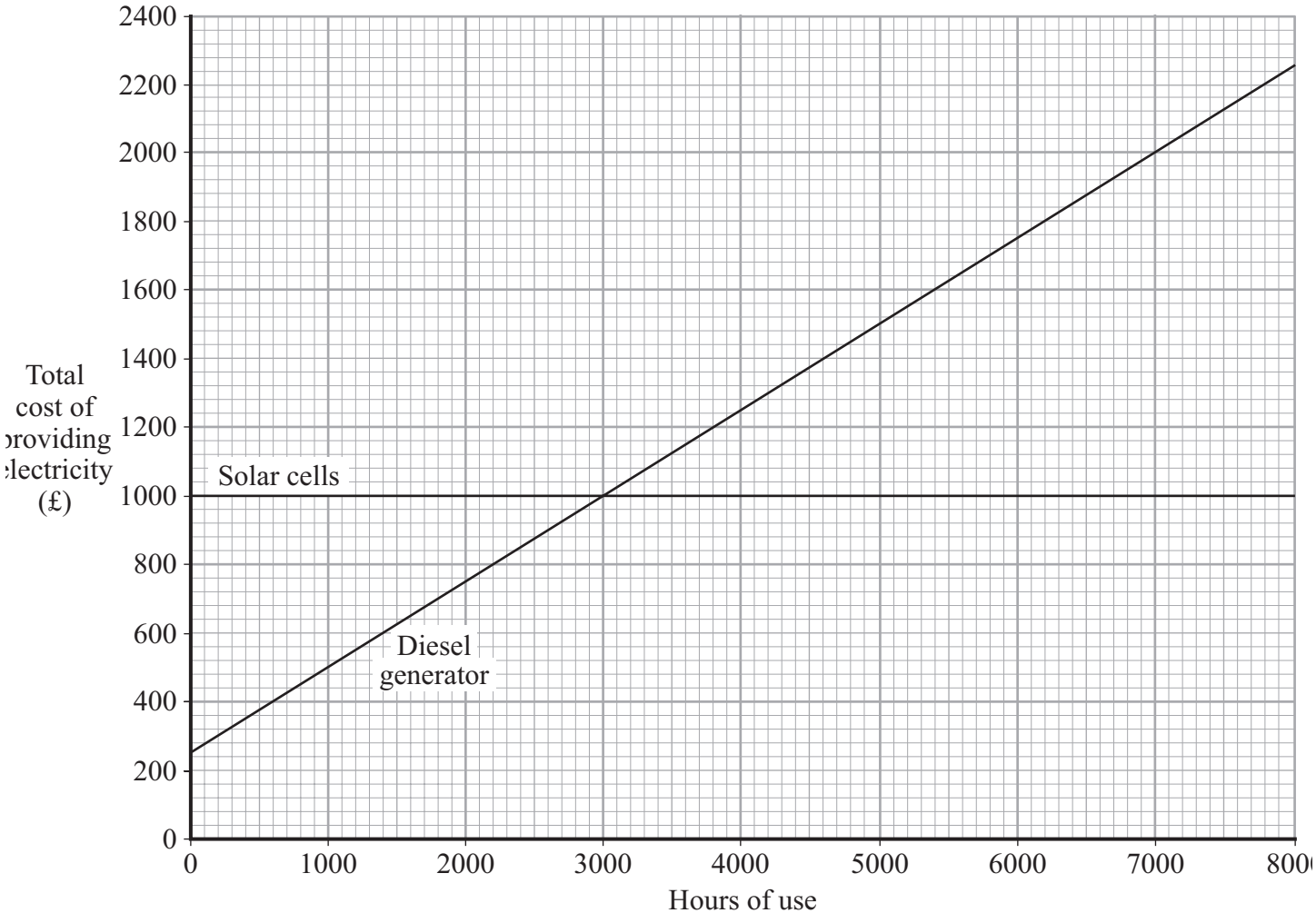
QUESTION FOUR

A remote village in South America is many kilometres from a mains electricity supply.

The villagers plan to pump water from the river and to use some of the water to irrigate fields.

They need an electricity supply to operate the pump.

The graph shows the total cost of two different ways of providing this electricity over time.



4A The graph shows that . . .

1 there are fuel costs but no maintenance costs for the solar cells.

2 there are maintenance costs but no fuel costs for the solar cells.

3 there are no fuel costs and no maintenance costs for the solar cells.

4 there are no fuel costs and no maintenance costs for the diesel generator.

4.1.3 National and global energy resources

Question 15 · continued

4B The price to buy the solar cells, compared with buying the diesel generator, is . . .

1 twice as much.

2 three times as much.

3 four times as much.

4 five times as much.

4C Providing electricity by diesel generator becomes more expensive than by solar cells after . . .

1 1000 hours of use.

2 2000 hours of use.

3 3000 hours of use.

4 4000 hours of use.

4D Maintenance of solar cells costs less than maintenance of the diesel generator mainly because . . .

1 solar cells have no moving parts.

2 solar cells do not produce exhaust gases.

3 solar cells operate at lower temperatures than diesel generators.

4 solar cells work only during the day.

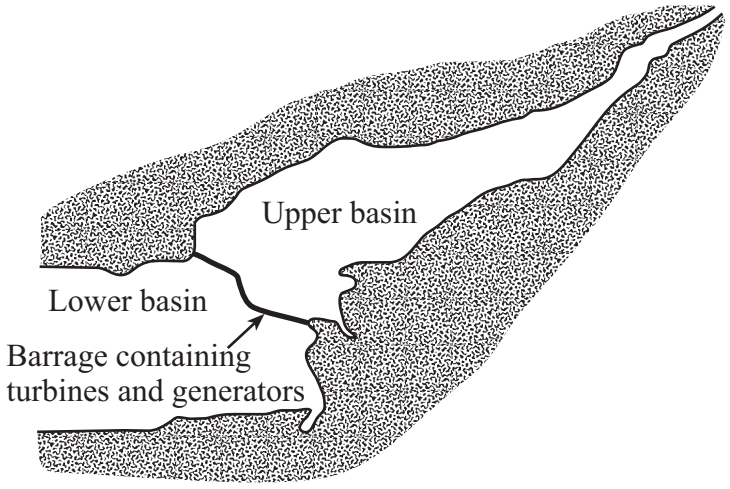
4.1.3 National and global energy resources

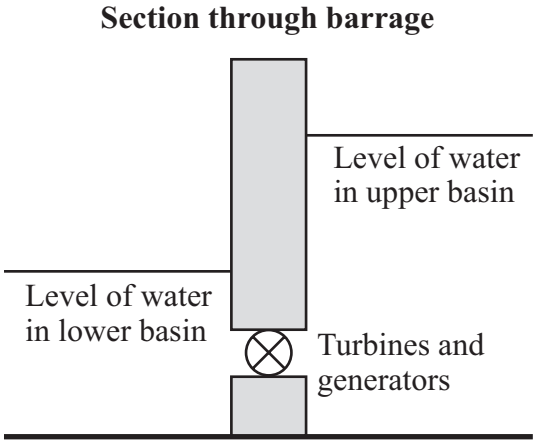
Question 16

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

4.1.3 National and global energy resources

Question 16 · 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.

4.1.3 National and global energy resources

Question 17

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.

Question 17 · 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

4.1.3 National and global energy resources

Question 18

June 2007 | PHY1B | Original Q4 | Legacy

QUESTION FOUR

There was an accident at the Chernobyl nuclear power station in April 1986. This resulted in the release of radioactive materials into the environment. Some of these materials may cause cancer of the thyroid gland in children.

The table shows the number of cases of thyroid cancer in children in two regions near the Chernobyl power station. It also shows the number of cases per 100 000 children in those regions.

		Childhood thyroid cancer cases per year, 1986–1998												
Region \ Year		86	87	88	89	90	91	92	93	94	95	96	97	98
Belarus	Number of cases	3	4	6	5	31	62	62	87	77	82	67	73	48
	Number of cases per 100 000 children	0.2	0.3	0.4	0.3	1.9	3.9	3.9	5.5	5.1	5.6	4.8	5.6	3.9
Ukraine	Number of cases	8	7	8	11	26	22	49	44	44	47	56	36	44
	Number of cases per 100 000 children	0.2	0.1	0.1	0.1	0.2	0.2	0.5	0.4	0.4	0.5	0.6	0.4	0.5

4A By how many did the number of cases of childhood thyroid cancer per year increase in the Belarus region between the year of the Chernobyl accident and 1995?

1 2

2 3

3 79

4 82

4B A city in Ukraine has 200 000 children.

How many cases of childhood thyroid cancer would be expected in the city in 1992?

1 1

2 2

3 5

4 49

4.1.3 National and global energy resources

Question 18 · continued

One of the radioactive materials responsible for producing childhood thyroid cancer is iodine-131. Children may take in iodine-131 in contaminated food. The iodine-131 is accumulated by the thyroid gland.

4C The half-life of iodine-131 is 8 days. 100 atoms of iodine-131 are taken into the thyroid gland.

How many of these radioactive iodine-131 atoms will there be after 16 days?

1 25

2 50

3 75

4 100

4D Which type of radiation is most likely to cause damage by ionisation once inside the body?

1 alpha radiation

2 beta radiation

3 gamma radiation

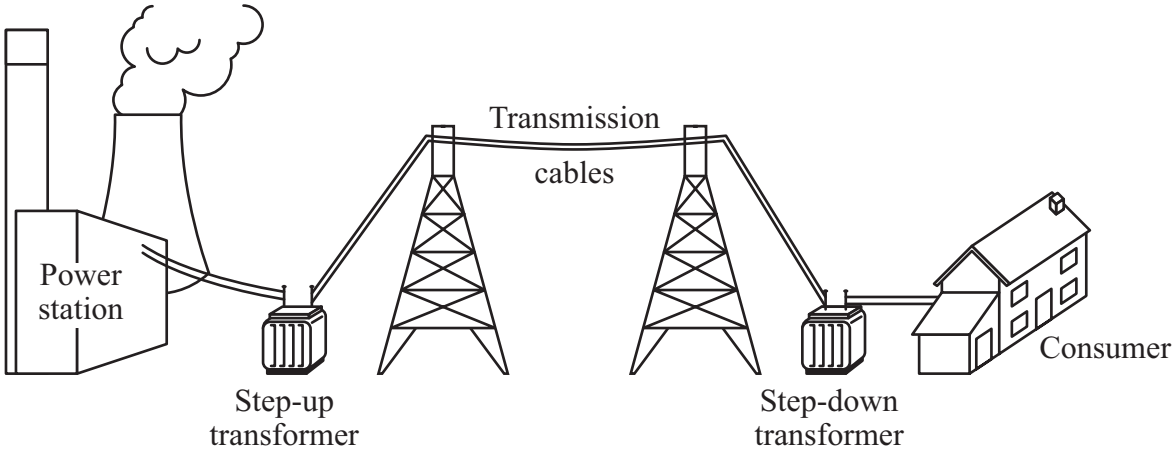
4 ultraviolet radiation

4.1.3 National and global energy resources

Question 19

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.

.....

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.....

(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)

Question 19 · 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

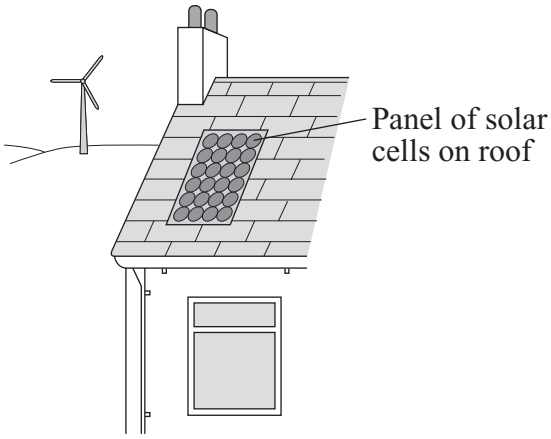
4.1.3 National and global energy resources

Question 20

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

4.1.3 National and global energy resources

Question 20 · 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.

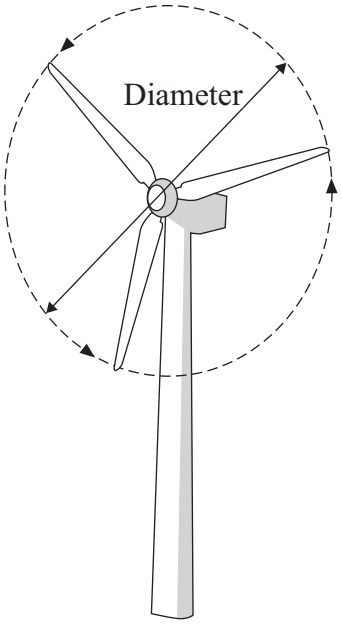
4.1.3 National and global energy resources

Question 21

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.

4.1.3 National and global energy resources

Question 21 · 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.

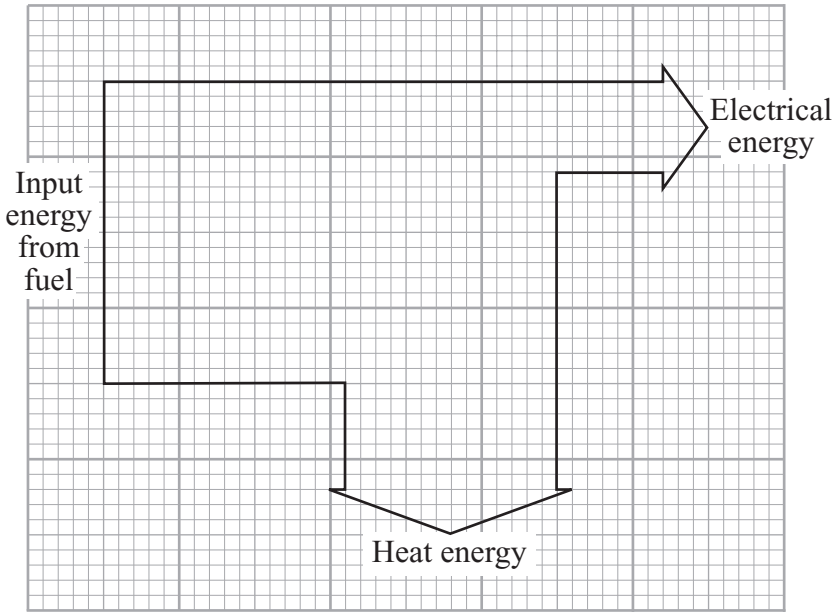
4 they use a non-renewable energy source.

4.1.3 National and global energy resources

Question 22

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

4.1.3 National and global energy resources

Question 22 · 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)

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

4.1.3 National and global energy resources

Question 23

March 2008 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

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

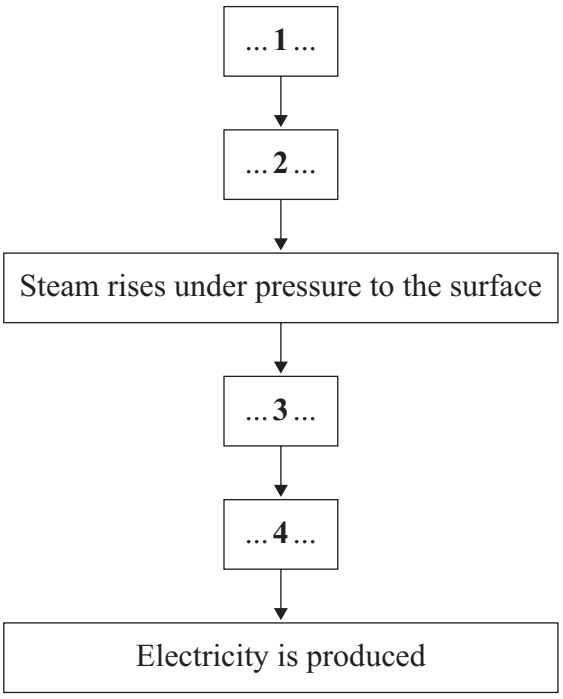
Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the flow chart to explain how the power station works.

A cold water is pumped into the rocks

B steam drives turbines

C turbines drive generators

D water is heated by radioactive decay



4.1.3 National and global energy resources

Question 24

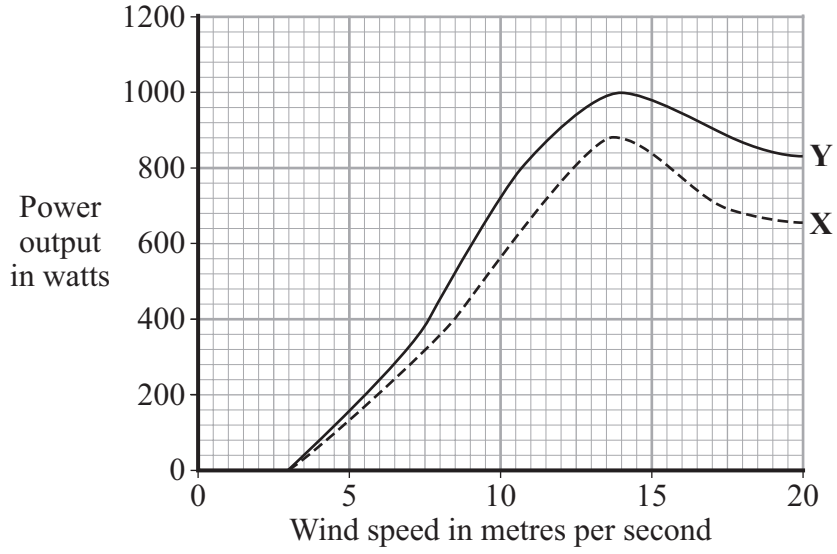
March 2008 | PHY1AP | Original Q4 | Legacy

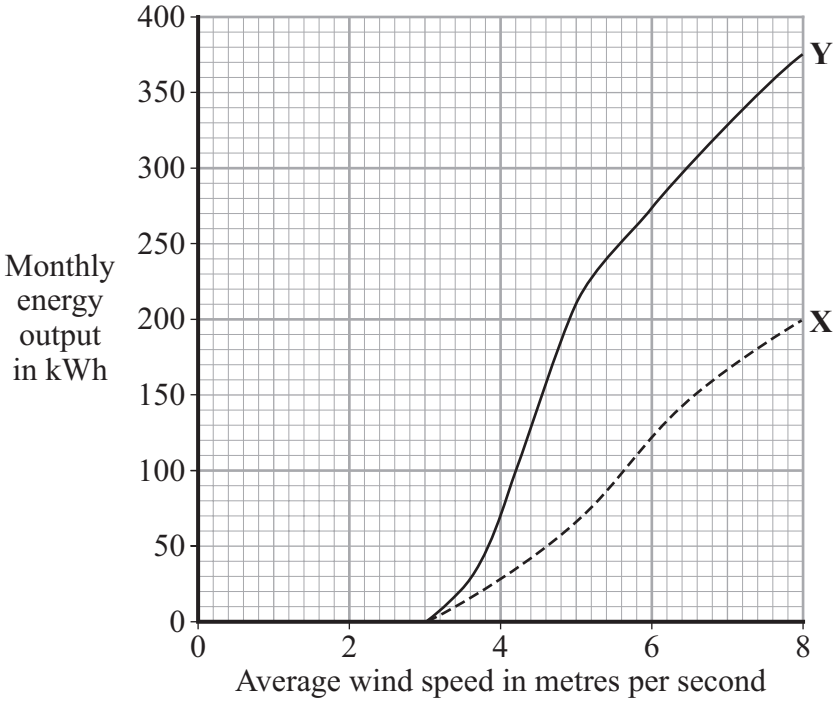
QUESTION FOUR

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

Question 24 · 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.

4.1.3 National and global energy resources

Question 25

March 2008 | PHY1AP | Original Q6 | Legacy

QUESTION SIX

An African village is in a remote location.

The Sun shines for at least a few hours nearly every day.

The villagers want a supply of electricity to pump up water from a well for a few hours each day.

The table shows the costs of two different ways of providing the electricity.

The capital cost is the cost of buying the equipment.

	Capital cost	Capital cost* (per kWh)	Fuel cost* (per kWh)	Maintenance cost* (per kWh)
Solar cells	£1000	20 p	zero	zero
Petrol generator	£250	5 p	20 p	10 p

[*These costs are averaged out over the 20 years that the equipment is expected to last.]

6A Which one of the following statements is true?

1 A petrol generator has a higher initial capital cost.

2 A petrol generator has a higher capital cost per kWh.

3 A petrol generator has a higher overall cost per kWh.

4 A petrol generator needs less maintenance.

6B An advantage of the petrol generator is that . . .

1 it will cause less air pollution.

2 it is cheaper to set up the system in the first place.

3 it has no moving parts.

4 it will cost less over a 20-year period.

4.1.3 National and global energy resources

Question 25 · continued

6C The main reason for choosing the solar cells for pumping water in the African village is that . . .

1 the 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 source of electricity.

4 the village is a long distance from mains electricity sources.

6D The main disadvantage of using the solar cells for pumping water in the African village is that . . .

1 they require no maintenance.

2 they will not work during the night.

3 they can work out cheaper over a 20-year period.

4 they have a high initial capital cost.

4.1.3 National and global energy resources

Question 26

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.

4.1.3 National and global energy resources

Question 26 · continued

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

4.1.3 National and global energy resources

Question 27

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.

4.1.3 National and global energy resources

Question 27 · 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.

4.1.3 National and global energy resources

Question 28

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

4.1.3 National and global energy resources

Question 28 · 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

4.1.3 National and global energy resources

Question 29

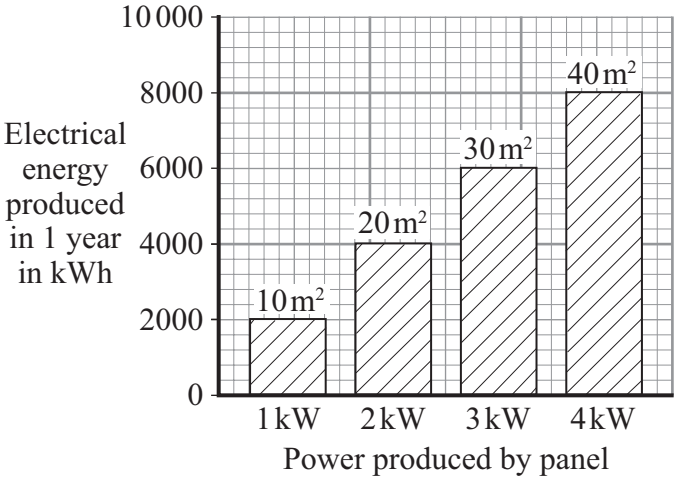
June 2008 | PHY1AP | Original Q8 | Legacy

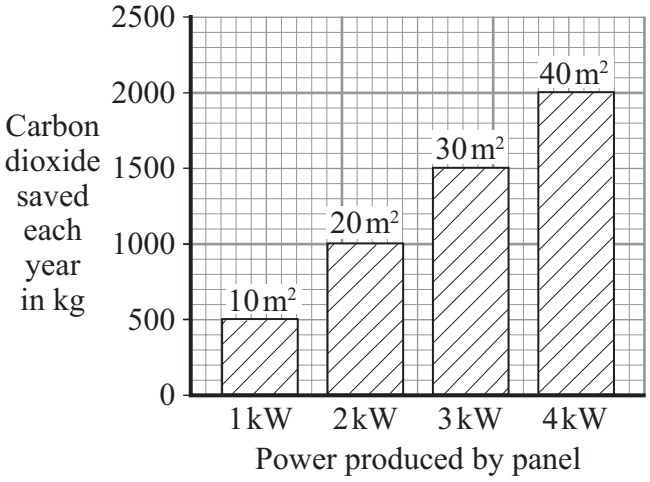
QUESTION EIGHT

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

4.1.3 National and global energy resources

Question 29 · 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.

4.1.3 National and global energy resources

Question 30

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

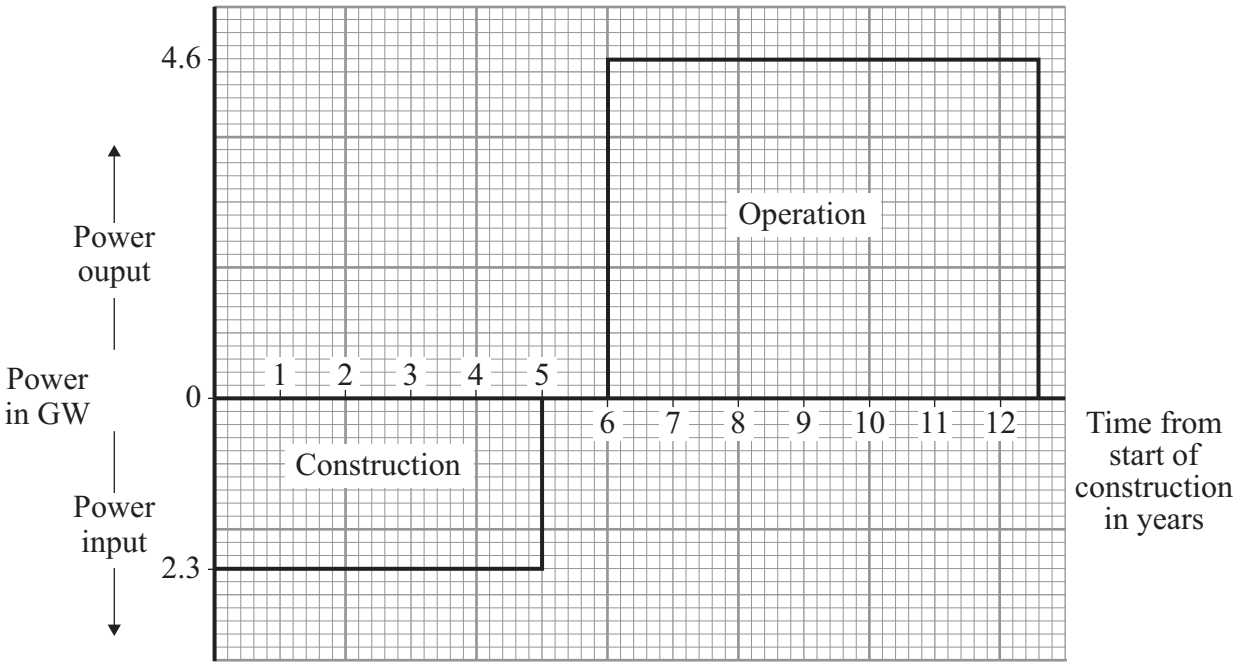
3 80 hours

4 80 000 hours

Question 30 · 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

4.1.3 National and global energy resources

Question 31

June 2008 | PHY1H | Original Q4 | Legacy

4 (a) Solar energy is a *renewable* energy source that can be used to generate electricity.

4 (a) (i) What is meant by an energy source being *renewable*?

.....

(1 mark)

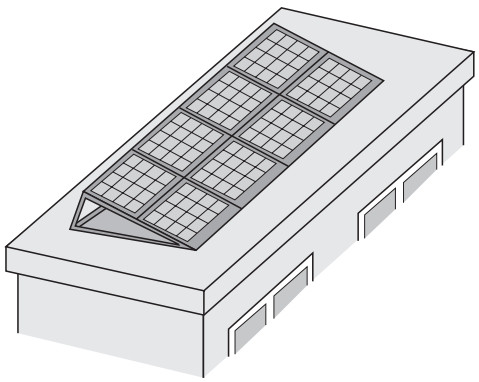
4 (a) (ii) Name **two** further renewable energy sources used to generate electricity.

1 .....

2 .....

(1 mark)

4 (b) A householder uses a bank of solar cells to generate electricity for his home.
The solar cells are tilted to receive the maximum energy input from the Sun.



Question 31 · continued

for mark

The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	Angle of tilt			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

4 (b) (i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

.....

.....

.....

.....

(2 marks)

4 (b) (ii) The bank of solar cells used by the householder has an area of 8 m^2.

The efficiency of the solar cells is 0.15

Use the equation in the box to calculate the average **maximum** electrical energy available from the bank of solar cells each second in June.

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

Show clearly how you work out your answer.

.....

.....

Maximum energy = ... joules/second

(3 marks)

Question 4 continues on the next page

4.1.3 National and global energy resources

Question 31 · continued

for mark

4 (c) The graph shows how the householder's electrical energy needs change over one year.



Why would it be advisable for the householder to remain connected to the National Grid?

.....

.....

(1 mark)

8

4.1.3 National and global energy resources

Question 32

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)

4.1.3 National and global energy resources

Question 32 · 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.

.....

.....

.....

.....

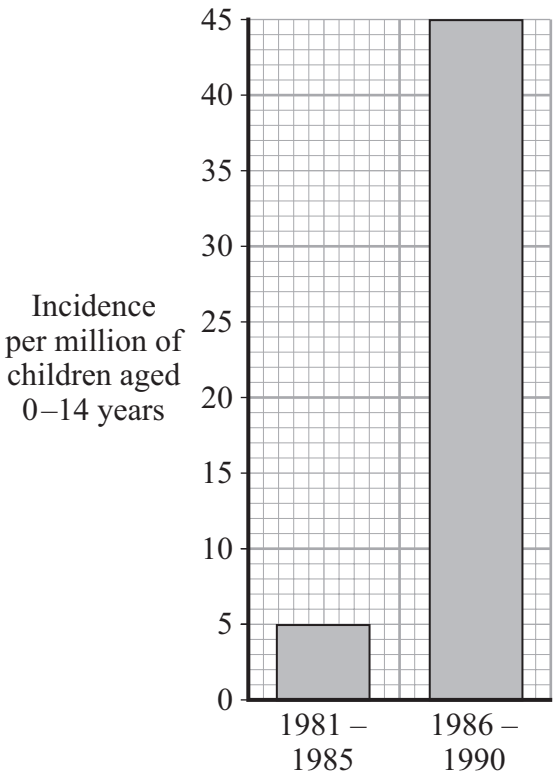
.....

(2 marks)

Question 6 continues on the next page

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)

4.1.3 National and global energy resources

Question 32 · 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

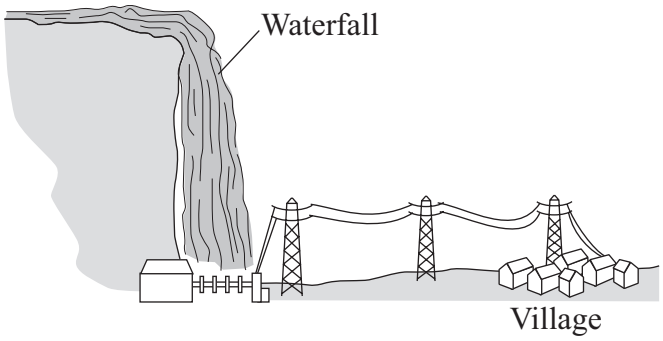
4.1.3 National and global energy resources

Question 33

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.

Question 33 · continued

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

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

4.1.3 National and global energy resources

Question 34

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.

4.1.3 National and global energy resources

Question 34 · continued

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.

4.1.3 National and global energy resources

Question 35

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

4.1.3 National and global energy resources

Question 35 · continued

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.

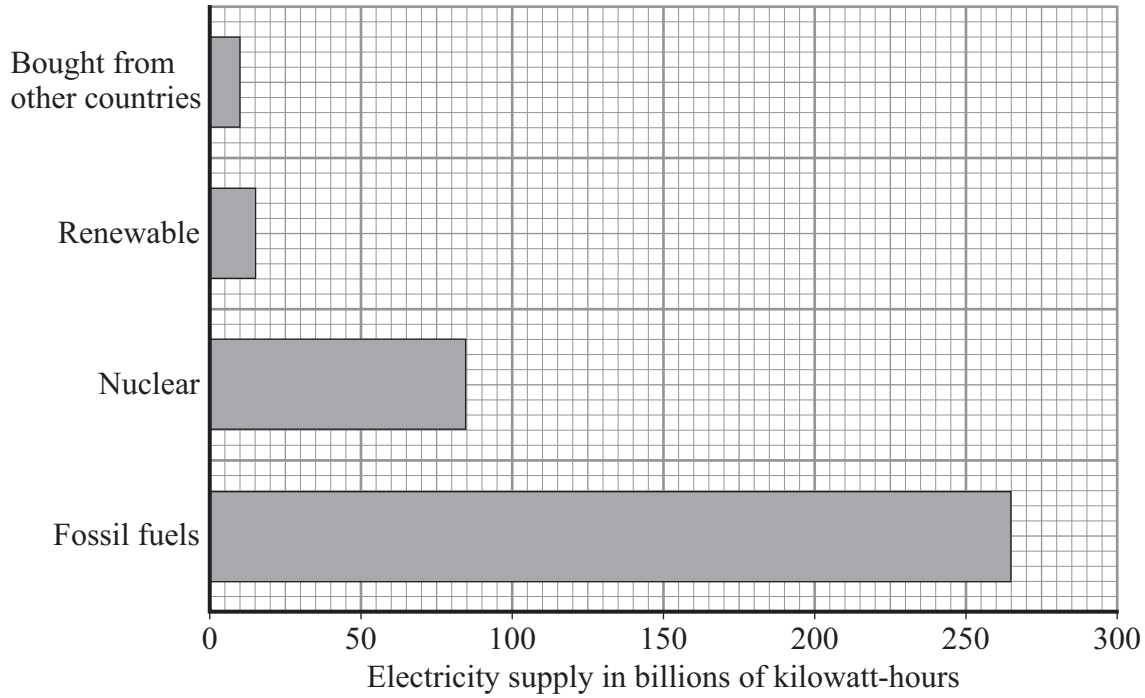
Turn over for the next question

4.1.3 National and global energy resources

Question 36

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)

4.1.3 National and global energy resources

Question 36 · 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.

.....

.....

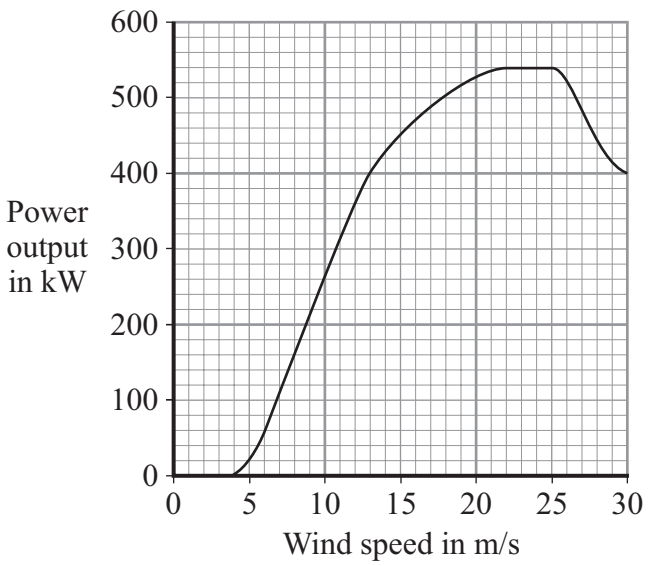
(1 mark)

Question 3 continues on the next page

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

4.1.3 National and global energy resources

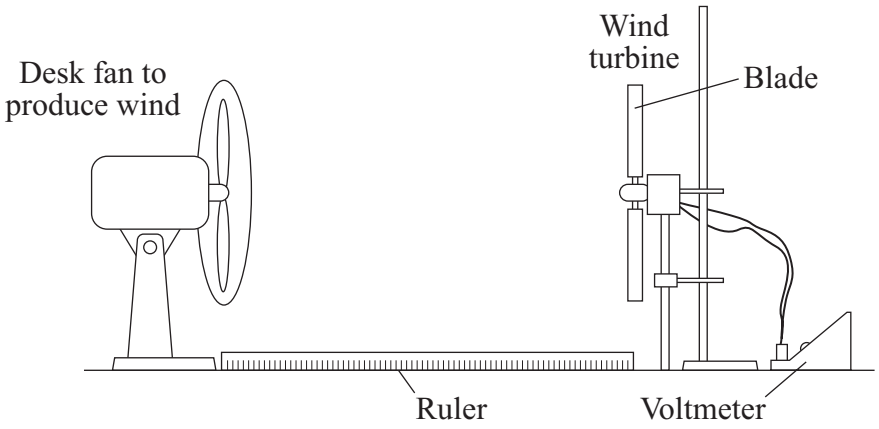
Question 37

March 2009 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

A student investigated a model wind turbine.

The diagram shows the apparatus he used.



3A He noticed that most real wind turbines have three blades. He thought that a model wind turbine with three blades would give the best output.

This thought is known as a . . .

1 conclusion.

2 phenomenon.

3 fair test.

4 prediction.

Question 37 · continued

3B The student wanted to know if the output of the model wind turbine depends on the number of blades.

Which row of the table shows the correct combination of variables?

	Independent variable	Dependent variable	Control variables
1	wind speed	number of blades	distance from fan to turbine, angle of blades to wind, voltage
2	wind speed	voltage	distance from fan to turbine, angle of blades to wind, number of blades
3	number of blades	voltage	distance from fan to turbine, angle of blades to wind, wind speed
4	number of blades	wind speed	distance from fan to turbine, angle of blades to wind, voltage

3C The student took each of his measurements three times and then calculated a mean.

His reason for this was to improve the . . .

1 reliability.

2 sensitivity.

3 validity.

4 calibration.

3D When he had completed his measurements, the student wanted to display his results.

He chose a bar chart because one of the variables was . . .

1 continuous.

2 controlled.

3 discrete.

4 independent.

4.1.3 National and global energy resources

Question 38

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

4.1.3 National and global energy resources

Question 38 · 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

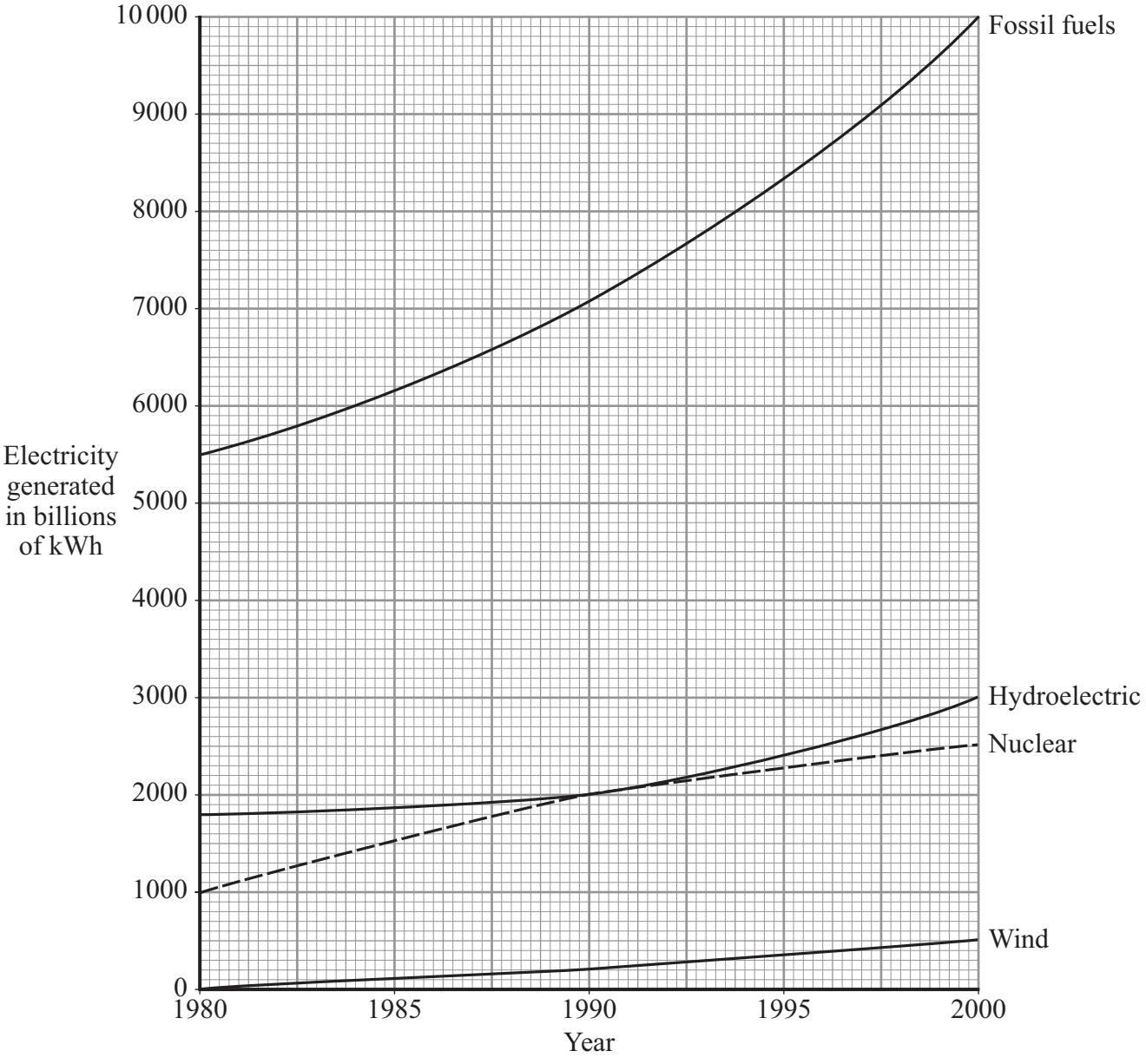
4.1.3 National and global energy resources

Question 39

March 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

The graph shows how much electricity has been generated worldwide from four different energy sources, from 1980 to 2000.



7A Which source has shown the smallest increase in electricity generation between 1990 and 2000?

1 fossil fuels

2 falling water (hydroelectric)

3 nuclear

4 wind

4.1.3 National and global energy resources

Question 39 · continued

7B In 2000, about what percentage of the total electricity was generated by hydroelectricity, nuclear and wind?

1 38 %

2 42 %

3 55 %

4 60 %

7C By 2030, the amount of electricity generated from hydroelectricity, nuclear and wind is likely to be 5 times greater than in 1990.

In 2030, the amount of electricity generated from these three sources, in billions of kWh, will be . . .

1 10 500.

2 11 000.

3 20 500.

4 21 000.

7D Some energy sources can be used to drive turbines directly.

Which two energy sources **cannot** be used to drive turbines directly?

1 nuclear and fossil fuel

2 hydroelectric and fossil fuel

3 nuclear and wind

4 hydroelectric and nuclear

4.1.3 National and global energy resources

Question 40

June 2009 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about energy resources that can be used to produce electricity.

Match words, **A**, **B**, **C** and **D**, with the pairs of statements **1**–**4** in the table.

A coal

B nuclear

C tides

D wind

	Advantage	Disadvantage
1	no polluting gases produced	unpredictable supply of energy
2	no polluting gases produced	radioactive waste produced
3	plentiful supply of fuel in Britain	produces acid rain
4	no fuel needed	may destroy habitats of wading birds

4.1.3 National and global energy resources

Question 41

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

4.1.3 National and global energy resources

Question 41 · 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

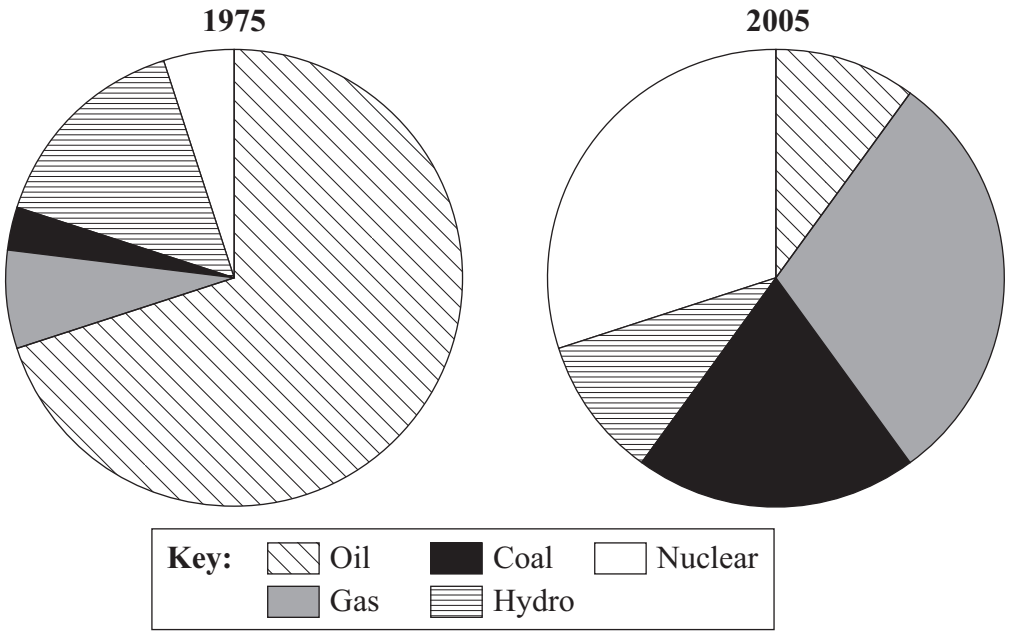
4 480

4.1.3 National and global energy resources

Question 42

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)

4.1.3 National and global energy resources

Question 42 · 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

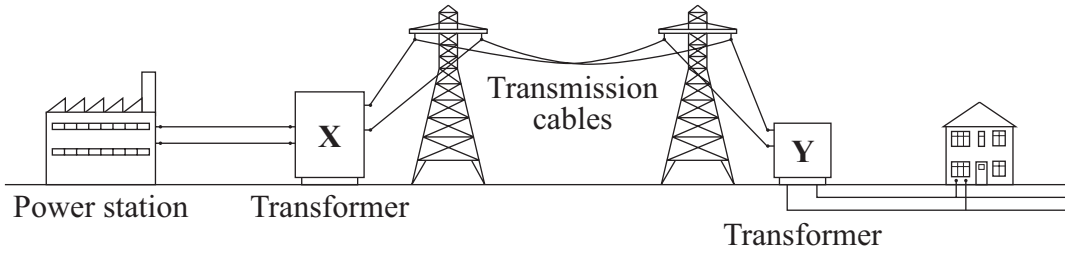
4.1.3 National and global energy resources

Question 43

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

4.1.3 National and global energy resources

Question 43 · 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

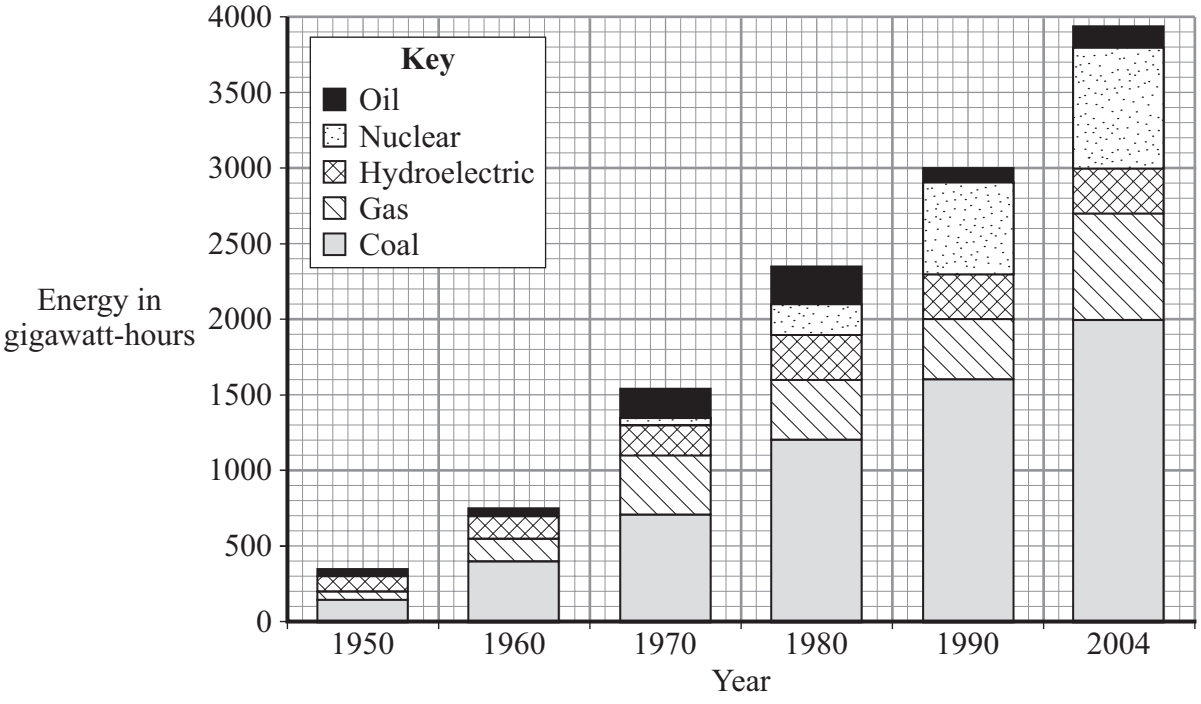
4.1.3 National and global energy resources

Question 44

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

4.1.3 National and global energy resources

Question 44 · 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

4.1.3 National and global energy resources

Question 45

November 2009 | PHY1AP | Original Q7 | Legacy

QUESTION SEVEN

This question is about different ways of generating electricity.

7A Some types of power station heat water to produce steam. The steam then drives a turbine connected to an electrical generator.

Which types of power station produce steam?

1 biomass, coal and nuclear

2 biomass, wind and wave

3 coal, nuclear and wave

4 gas, wind and wave

The table gives data for the cost of generating electricity in different types of power station.

Type of power station	Building and operating costs in pence per kWh	Fuel costs in pence per kWh	Total cost in pence per kWh
Biomass	5.9	0.8	6.7
Coal	1.3	1.2	2.5
Gas	0.7	1.5	2.2
Nuclear	1.8	0.4	2.2
Wave	6.6	0.0	6.6
Wind	3.7	0.0	3.7

7B Which one of the following is correct?

1 Electricity generated from fossil fuels is always the cheapest.

2 The fuel cost for all renewable sources is zero.

3 The most expensive electricity comes from renewable sources.

4 Wind power stations produce the cheapest electricity.

4.1.3 National and global energy resources

Question 45 · continued

7C Fossil fuel power stations release polluting gases into the atmosphere. The government has suggested a carbon tax because of this. This tax would add 0.8 p/kWh to coal prices and 0.4 p/kWh to gas prices.

Which type of power station would produce the cheapest electricity if a carbon tax was added?

1 coal

2 gas

3 nuclear

4 wind

7D The total cost per kilowatt-hour of electricity from a wind-powered station is more than the total cost of electricity per kilowatt-hour from a gas-powered station.

By what percentage would the **fuel** cost of gas have to increase to make the **total** costs the same? (Assume that no carbon tax has been added.)

1 15 %

2 41 %

3 68 %

4 100 %

4.1.3 National and global energy resources

Question 46

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?

.....

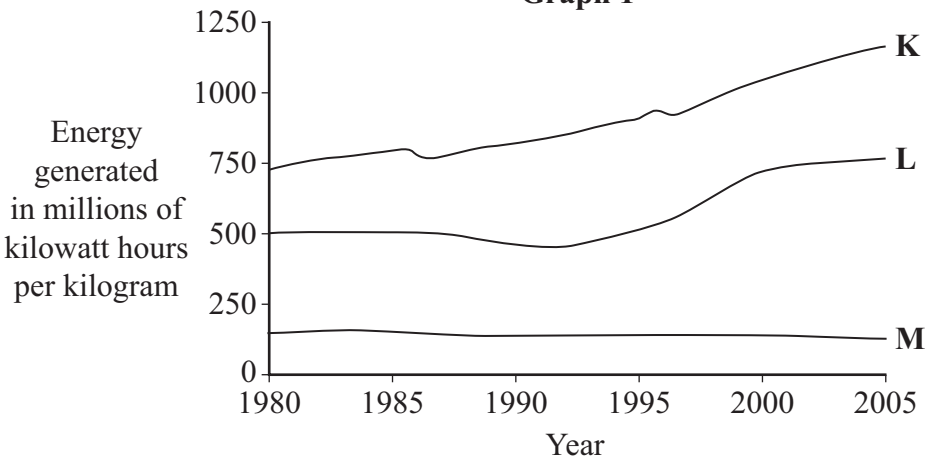
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(1 mark)

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)

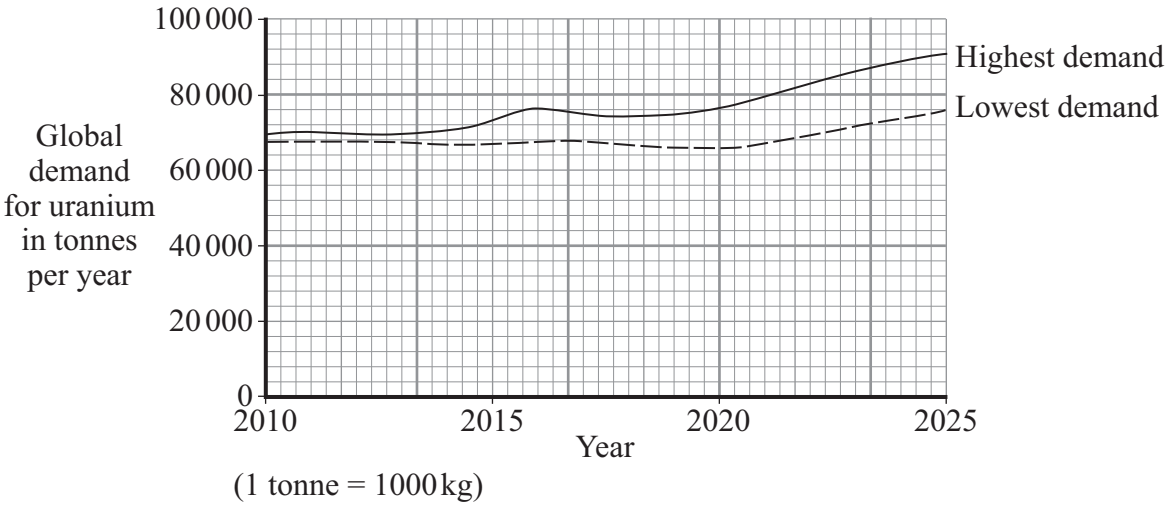
4.1.3 National and global energy resources

Question 46 · 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)

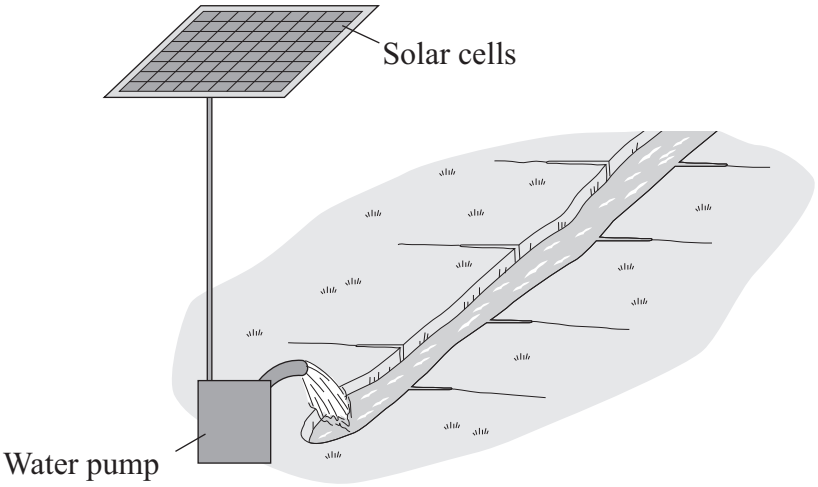
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4.1.3 National and global energy resources

Question 47

January 2019 | 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)

4.1.3 National and global energy resources

Question 47 · 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

4.1.3 National and global energy resources

Question 48

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)

4.1.3 National and global energy resources

Question 48 · 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

4.1.3 National and global energy resources

Question 49

March 2010 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

This question is about useful energy transformations by different electrical devices.

Match devices, **A**, **B**, **C** and **D**, with the useful energy transformations **1–4** in the table.

A computer monitor

B loudspeaker

C microphone

D solar cell

	Useful energy transformations
1	electrical energy into light energy
2	sound energy into electrical energy
3	electrical energy into sound energy
4	light energy into electrical energy

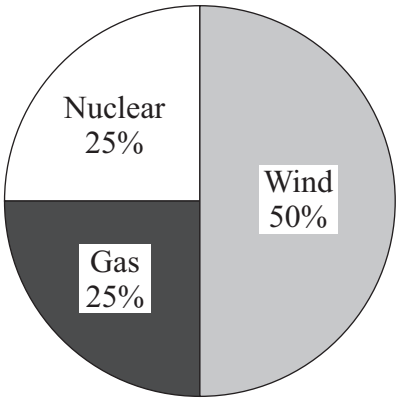
4.1.3 National and global energy resources

Question 50

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%

4.1.3 National and global energy resources

Question 50 · continued

March 2010 | PHY1AP | Original Q8 | Legacy

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.

4.1.3 National and global energy resources

Question 51

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.

4.1.3 National and global energy resources

Question 51 · 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

4.1.3 National and global energy resources

Question 52

March 2010 | PHY1BP | Original Q5 | Legacy

QUESTION FIVE

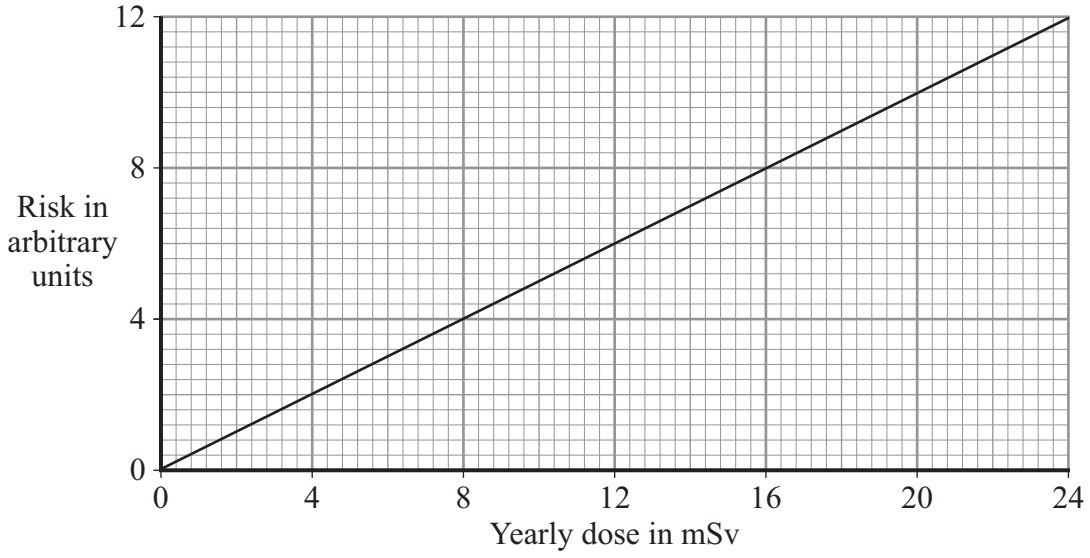
Workers in industries that use radioactive materials have the amount of radiation they receive carefully monitored. The amount of radiation received is called the dose. The industries set dose limits.

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.

Question 52 · 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.

4.1.3 National and global energy resources

Question 53

June 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The table gives data for some energy sources used to generate electricity in the UK.

	Energy source	Generating cost in pence per kWh	Number of grams of carbon dioxide produced per kWh
A	Coal	2.6	1000
B	Gas	2.2	500
C	Hydroelectric (falling water)	3.4	20
D	Nuclear	3.5	5

Use the data in the table above to match energy sources, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table below.

1	produces the cheapest electricity
2	is renewable
3	contributes least to global warming
4	contributes most to global warming

4.1.3 National and global energy resources

Question 54

June 2010 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

Hydroelectric schemes use falling water to produce electricity.

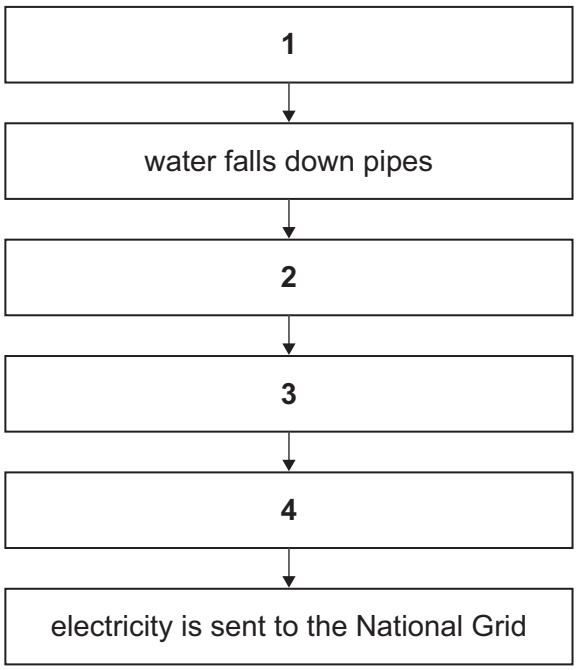
Match statements, **A**, **B**, **C**, and **D**, with the boxes **1–4** in the flow chart to show how a hydroelectric scheme works.

A electricity is produced

B moving water drives turbines

C turbines drive generators

D water collects in a reservoir



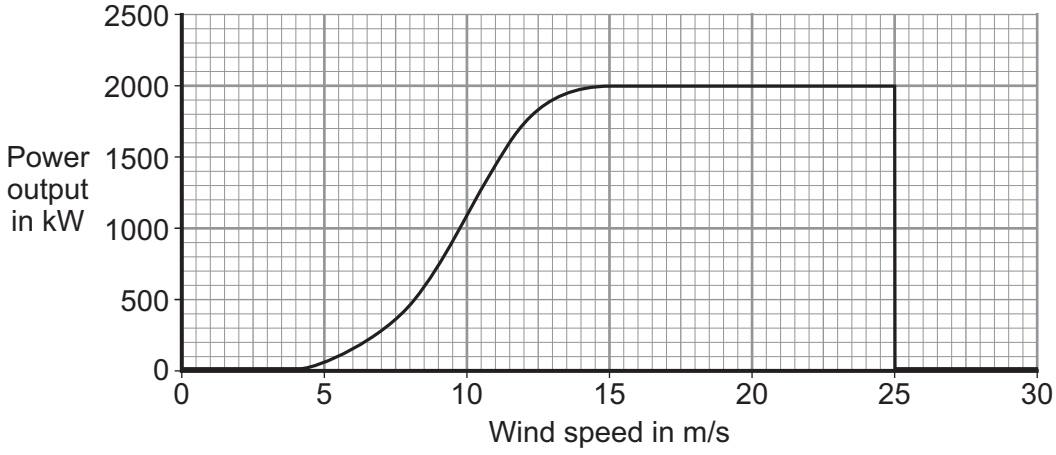
4.1.3 National and global energy resources

Question 55 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

4.1.3 National and global energy resources

Question 55 · 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

4.1.3 National and global energy resources

Question 56

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

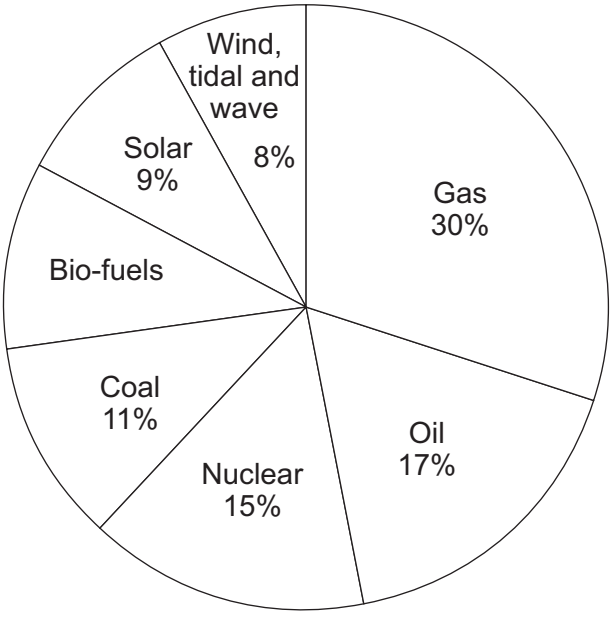
2 build more nuclear power stations

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

4.1.3 National and global energy resources

Question 56 · continued June 2010 | PHY1AP | Original Q8 | Legacy

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

4.1.3 National and global energy resources

Question 57

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.

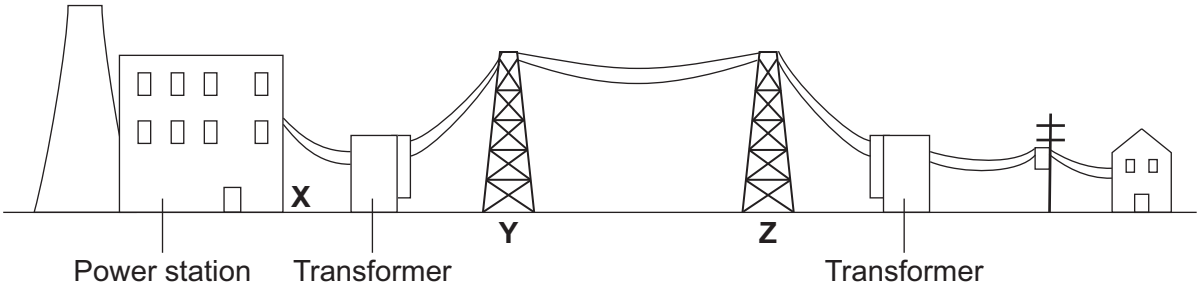
2 decrease the voltage and increase the current.

3 increase the voltage and decrease the current.

4 increase the voltage and increase the current.

Question 57 · 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

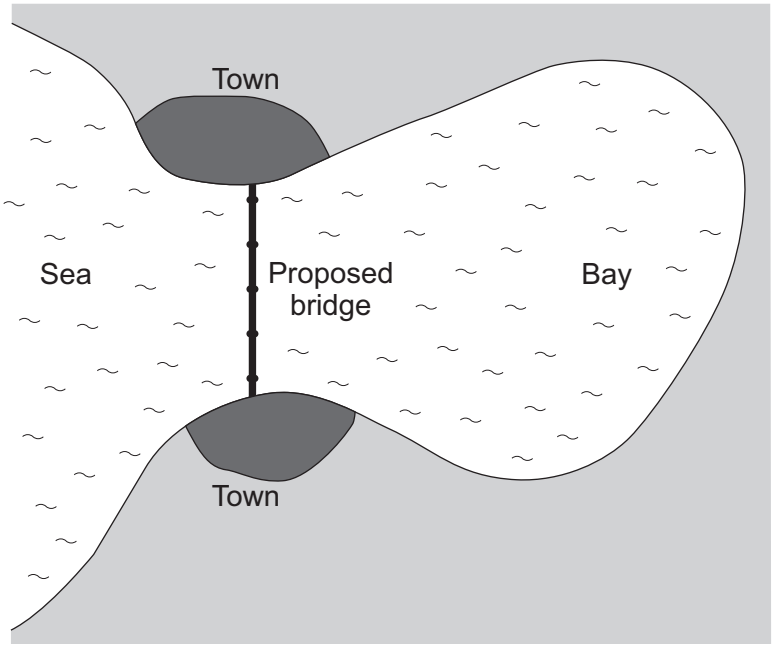
END OF TEST

4.1.3 National and global energy resources

Question 58

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 .....

.....

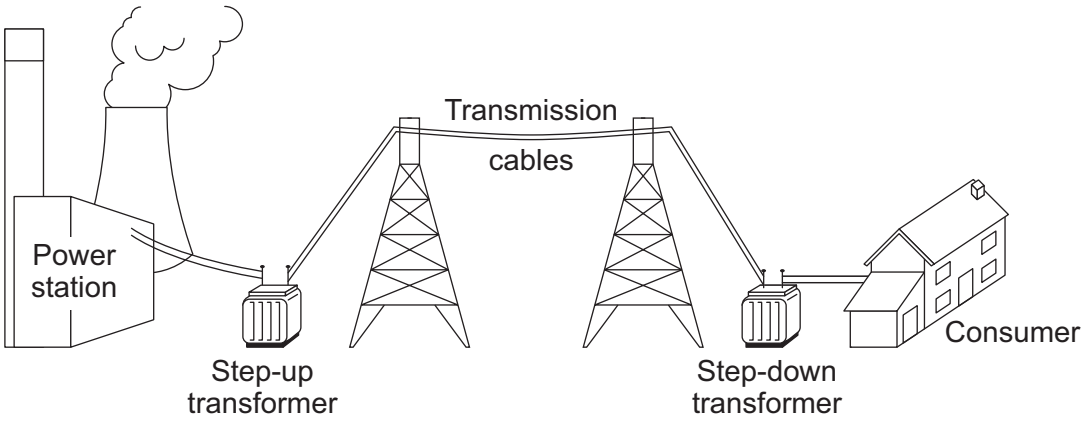
Reason 3 .....

.....

(3 marks)

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

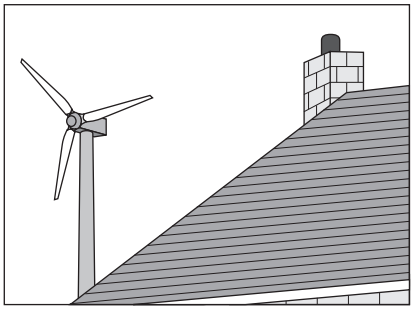
4.1.3 National and global energy resources

Question 59

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?

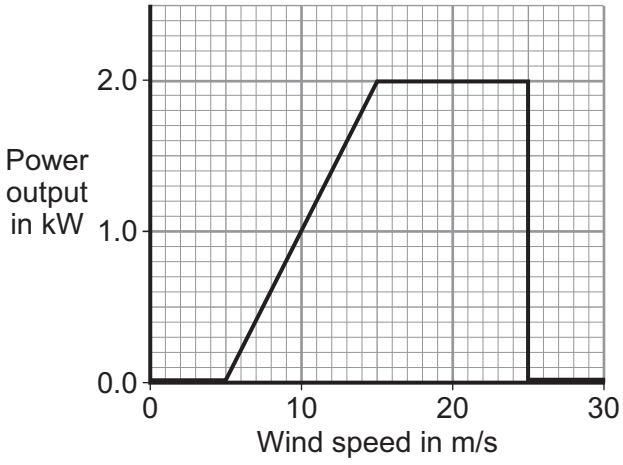
1 1000 days

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

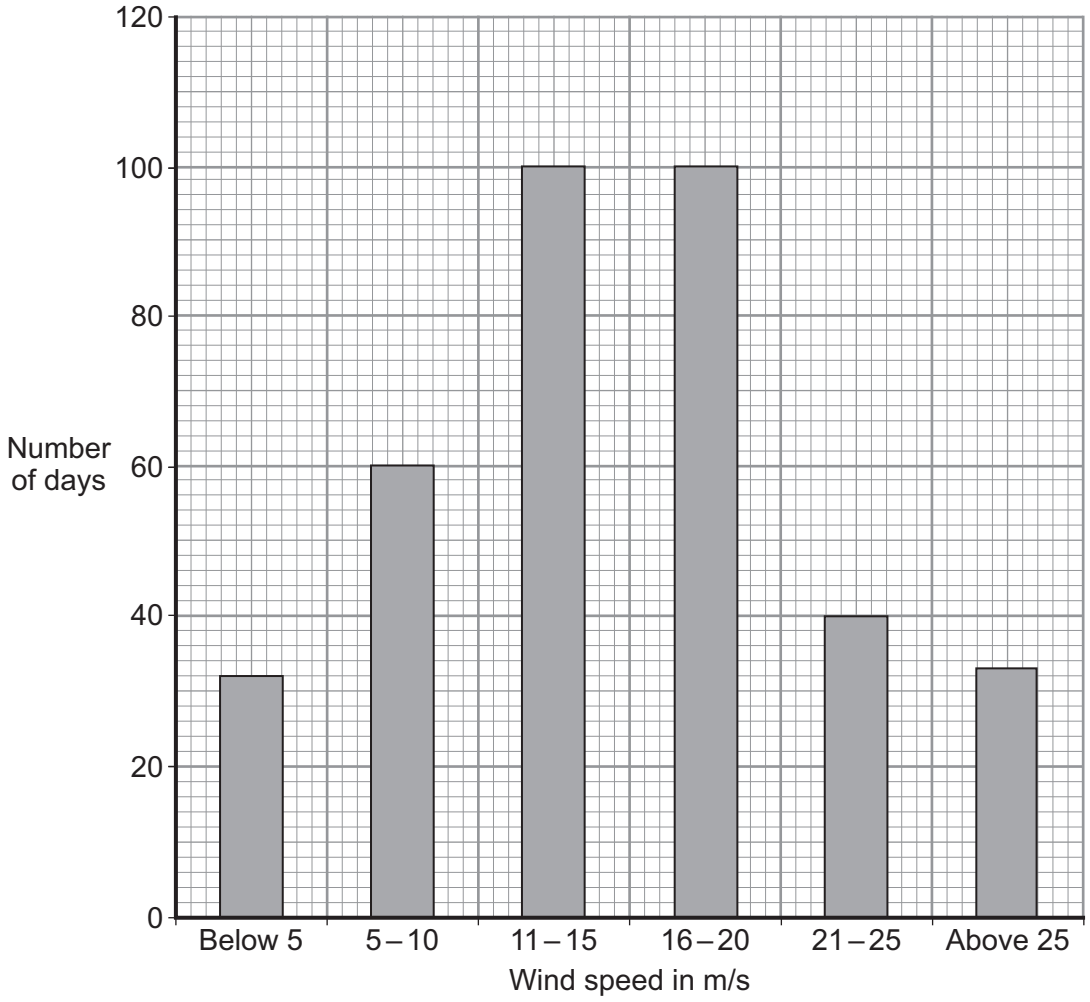
3 15 m/s

4 20 m/s

4.1.3 National and global energy resources

Question 59 · 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.

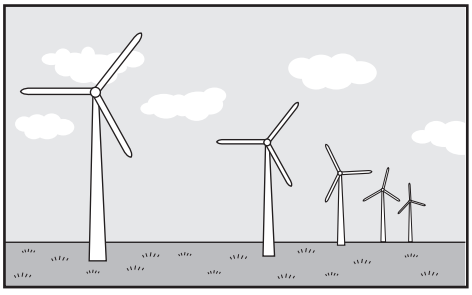
4.1.3 National and global energy resources

Question 60

November 2010 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

A wind turbine manufacturer investigates how the power output from a wind turbine depends on the height of the turbine blades above ground.



The results are shown in the table.

Height above ground in m	Power output in kW
10	0
30	160
40	190
50	220
60	250
70	280
80	305
90	310

5A In the table, the height of the turbine above ground is . . .

1 a categoric variable.

2 a control variable.

3 the dependent variable.

4 the independent variable.

Question 60 · continued November 2010 | PHY1AP | Original Q5 | Legacy

5B From the data, which of the following can be deduced?

1 Above a height of 90 m, the power output will not increase.

2 A height of 65 m would produce a power output of about 260 kW.

3 Doubling the height will always double the power output.

4 The minimum height needed to produce a power output is 20 m.

5C Which is the best way to display the pattern of the results for height and power output?

1 construct a pie chart

2 draw a bar chart

3 find the mean of all the power outputs and heights

4 plot a line graph of power output against height

5D The statement below appeared in a newspaper.

Huge expansion of wind power in the UK is to be launched, with turbines that will reach 260 metres into the sky!

What types of pollution are people most likely to complain about when wind farms are built?

1 carbon dioxide and noise

2 carbon dioxide and sulfur dioxide

3 sulfur dioxide and visual

4 visual and noise

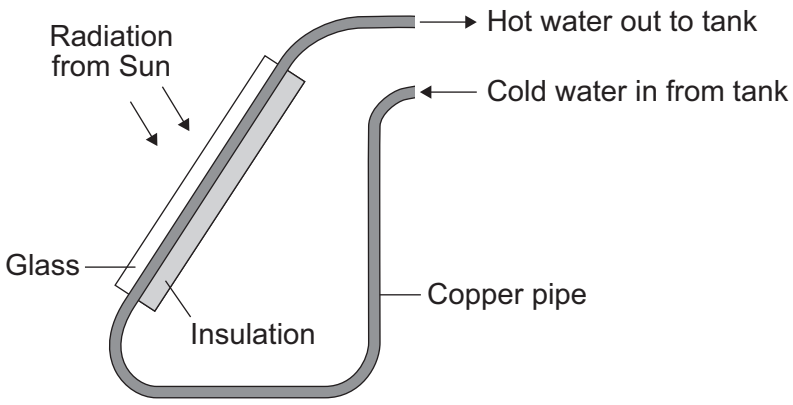
4.1.3 National and global energy resources

Question 61

November 2010 | PHY1AP | Original Q8 | Legacy

QUESTION EIGHT

The diagram shows a solar panel fitted to the roof of a house.
The solar panel is used for heating water.



- The panel is 5 m long and 2 m wide.
- Each square metre of panel receives 0.6 kJ of solar energy each second when the Sun is shining.

8A The solar panel collects . . .

1 infra red radiation from the Sun and transforms it into electricity.

2 infra red radiation from the Sun and uses it to heat water.

3 light energy from the Sun and transforms it into electricity.

4 ultraviolet radiation from the Sun and uses it to heat water.

8B The total amount of solar energy, in kJ, collected by the panel in 5 hours when the Sun is shining is . . .

1 1 800

2 10 800

3 21 600

4 108 000

8C The pipe inside the solar panel has a black surface because . . .

1 black surfaces are good reflectors of radiation.

2 black surfaces are good absorbers of radiation.

3 black surfaces are good emitters of radiation.

4 black surfaces stay hot for longer.

8D The hot water tank is placed higher than the solar panel.

This is because . . .

1 heated water contracts, and sinks.

2 heated water contracts, and rises.

3 heated water expands, and rises.

4 heated water expands, and sinks.

Turn over for the next question

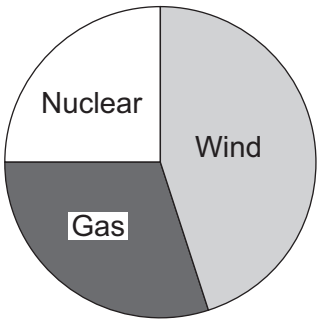
4.1.3 National and global energy resources

Question 62

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)

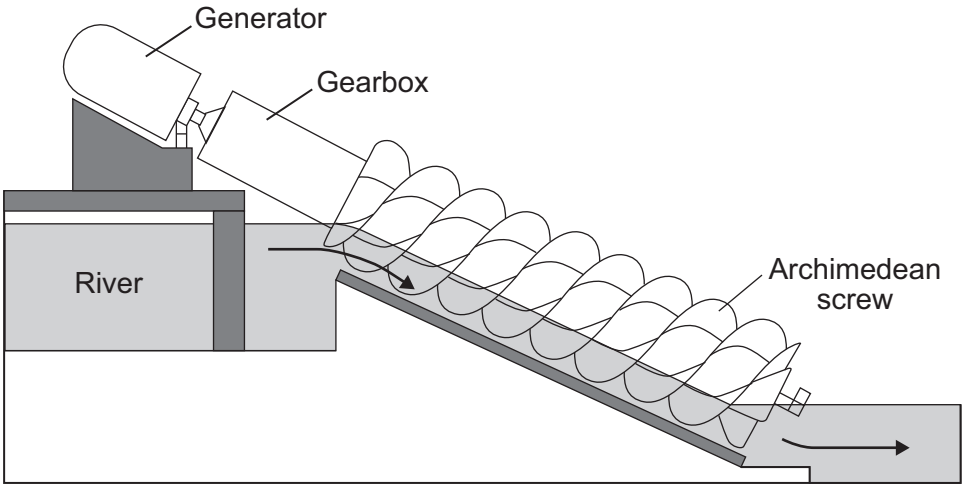
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4.1.3 National and global energy resources

Question 63

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)

4.1.3 National and global energy resources

Question 63 · continued January 2011 | PHY1H | Original Q4 | Legacy

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.

.....

.....

.....

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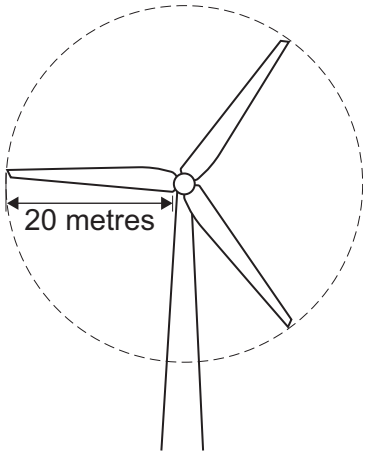
(2 marks)

7

4.1.3 National and global energy resources

Question 64

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.

.....

.....

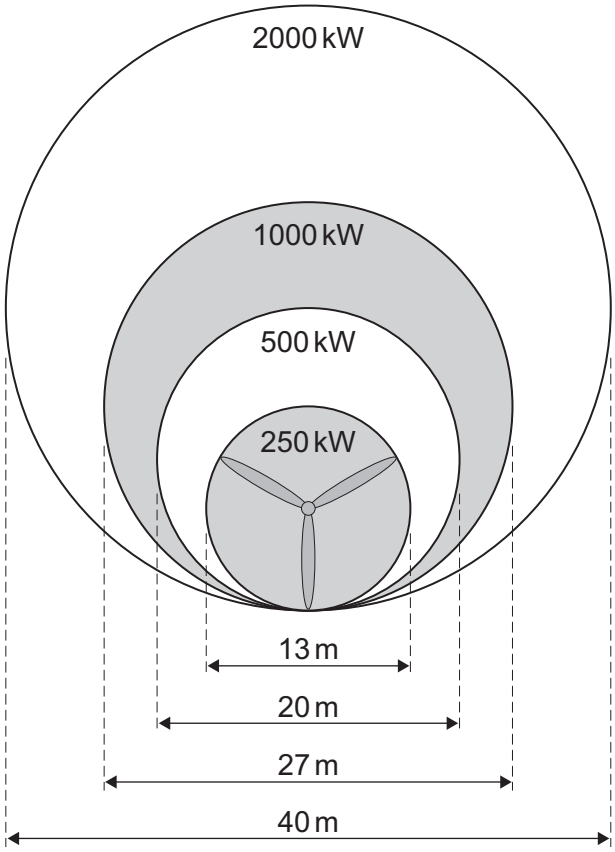
Kinetic energy = ... J

(2 marks)

4.1.3 National and global energy resources

Question 64 · 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

4.1.3 National and global energy resources

Question 65

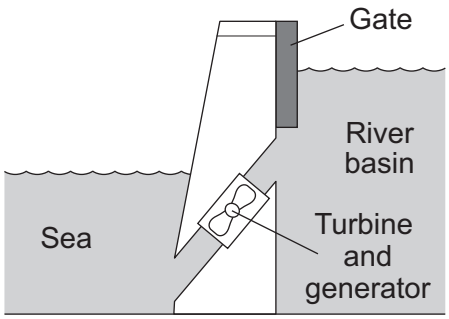
March 2011 | PHY1AP | Original Q3 | Legacy

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

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.

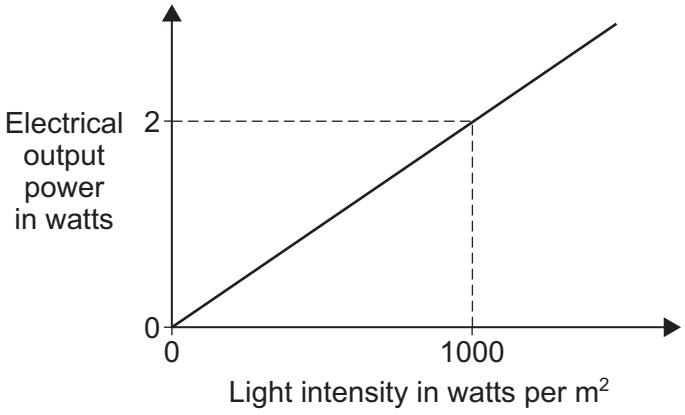
4.1.3 National and global energy resources

Question 66

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

4.1.3 National and global energy resources

Question 66 · 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

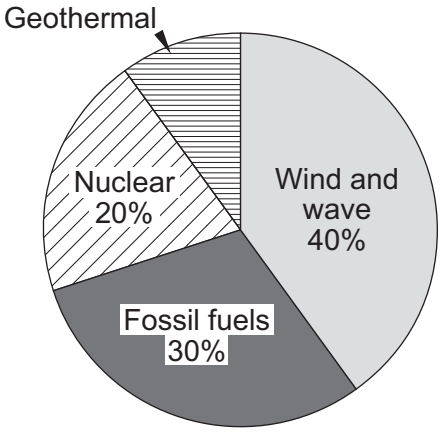
4.1.3 National and global energy resources

Question 67

June 2011 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The pie chart shows how a country's electricity demands are met using different energy sources.



Match percentages, **A**, **B**, **C** and **D**, with the numbers **1**–**4** in the sentences.

A 10 %

B 20 %

C 40 %

D 50 %

The percentage of electricity generated from non-renewable sources is . . . **1** . . . .

The percentage of electricity generated from geothermal sources is . . . **2** . . . .

The percentage of electricity generated using a source that produces radioactive waste is . . . **3** . . . .

The percentage of electricity generated using the kinetic energy of the source directly is . . . **4** . . . .

4.1.3 National and global energy resources

Question 68

June 2011 | PHY1AP | Original Q3 | Legacy

QUESTION THREE

Some dairy farmers have installed electrical generators that run on methane gas.

- Methane gas is produced from rotting vegetation and animal waste.
- On farms, the rotting process takes place in a digester.
- Methane produced in this way is a biofuel called biogas.
- Burning methane produces carbon dioxide and water.
- The electrical generators can be installed in a farm building.

3A Methane is called a biofuel because . . .

1 it is a renewable fuel.

2 it comes from living things.

3 it produces carbon dioxide and water.

4 it is made in a digester.

3B Farmers have been encouraged to install their own biogas generators because . . .

1 this would reduce the amount of fuel used in power stations.

2 this would reduce the amount of animal waste produced.

3 biogas is a non-renewable fuel.

4 this would use less electricity.

3C A farmer's weekly electricity bill using the mains supply is £290. The biogas generator costs £15 000 to install.

The biogas generator provides all of the farmer's electricity.

What is the pay-back time?

1 1.0 years

2 4.3 years

3 5.2 years

4 58 years

4.1.3 National and global energy resources

Question 68 · continued

3D It would have been cheaper for the farmer to install a wind turbine generator.

What is the advantage of the biogas generator over the wind turbine generator?

1 It uses a renewable energy source.

2 It produces water.

3 It can work all the time.

4 It does not require any space.

Turn over for the next question

4.1.3 National and global energy resources

Question 69

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.

4.1.3 National and global energy resources

Question 69 · continued June 2011 | PHY1AP | Original Q8 | Legacy

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.

4.1.3 National and global energy resources

Question 70

June 2011 | PHY1AP | Original Q9 | Legacy

QUESTION NINE

Solar cells are used to produce electricity on a large scale in places such as Australia and California. They are not used on a large scale in the UK.

9A Which of the following statements about solar cells being used to produce electricity on a large scale is correct?

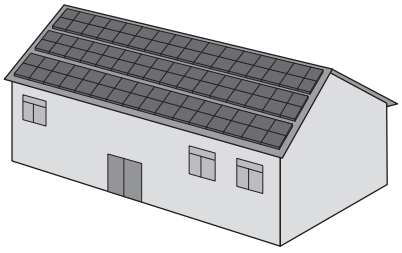
1 Solar cells need a large area of land because solar cells are not very efficient.

2 Solar cells need a large area of land because the Sun does not shine at night.

3 Solar cells need a small area of land because the Sun shines every day.

4 Solar cells need a small area of land because solar cells are very efficient.

9B The drawing shows an array of solar cells on the roof of a new village hall.



The solar cells produce more electricity than is needed by the hall.

The surplus electricity . . .

1 can be stored in the hall until it is needed.

2 can be stored in the solar cells until it is needed.

3 can be sold and transmitted by the National Grid.

4 is wasted energy and spreads out.

The amount of electricity produced each year by an array of solar cells depends on:

- the area of the array
- the angle of tilt of the array
- the direction that the array faces
- which part of the country the array is in.

4.1.3 National and global energy resources

Question 70 · continued

The map shows how much solar radiation, in kWh / m^2, falls on different parts of the UK each year.

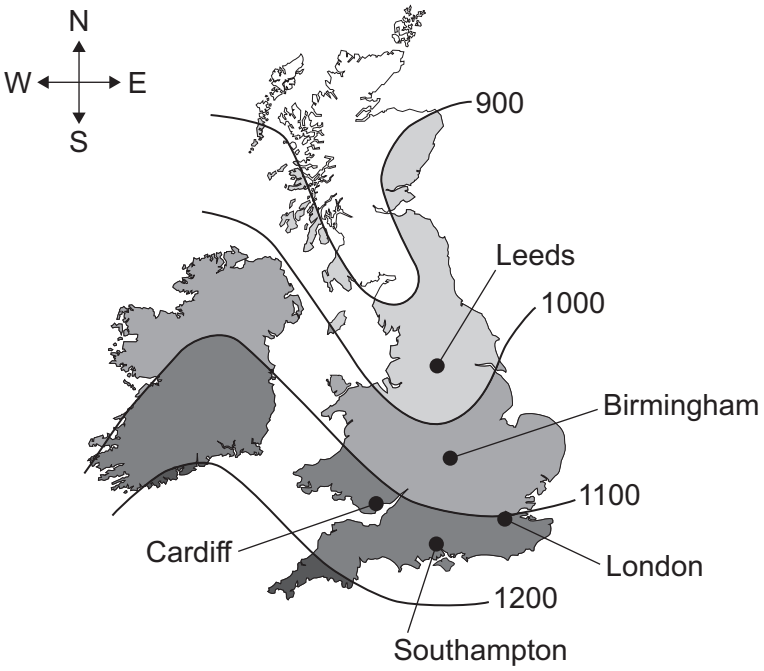


Table 1 gives figures for the annual solar radiation, in kWh / m^2, for London. The table also gives data for various angles of tilt and for various directions that an array faces.

Table 1

Angle of tilt of array to the horizontal	Direction that the array faces				
	South	South-west	West	North-west	North
30°	1042	997	886	762	709
45°	1023	968	829	666	621
60°	960	900	753	580	485
Vertical	724	684	565	427	360

9C Which row in **Table 2** gives the biggest amount of solar radiation?

Table 2

	Location	Angle of tilt in degrees	Direction that the array faces
1	Birmingham	30	South
2	Southampton	30	West
3	Leeds	60	West
4	Cardiff	30	South

Question 9 continues on the next page

4.1.3 National and global energy resources

Question 70 · continued

9D An array with an area of 20 m^2 is installed on a roof in London at an angle of 60°. The array faces south-west. The efficiency of the array is 0.2

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

What is the annual amount of electrical energy produced by the array?

1 3600 kWh

2 4500 kWh

3 18000 kWh

4 90000 kWh

END OF TEST

4.1.3 National and global energy resources

Question 71

June 2011 | PHY1H | Original Q2 | Legacy

2 (a) By 2023, nearly all of the existing nuclear power stations in the UK will be closed down.

2 (a) (i) Before a nuclear power station can be demolished, the remaining nuclear fuel, radioactive waste materials and reactor must be carefully removed.

What is this process called?

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

decommissioning ☐

decontaminating ☐

dismantling ☐

(1 mark)

2 (a) (ii) The workers are exposed to radiation as they remove the reactor. One of the biggest risks is from the isotope cobalt-60, which has a half-life of 5.3 years.

Explain the advantage of waiting 11 years after a nuclear power station has closed down before starting to remove the reactor.

.....

.....

.....

.....

(2 marks)

Question 71 · continued

2 (b) It is almost certain that new nuclear power stations will be built in the UK.

The table shows the results of surveys asking people in the UK whether they were in favour of, or against, the building of new nuclear power stations.

	2001	2005	2007
Percentage (%) in favour	20	41	65
Percentage (%) against	60	28	20
Percentage (%) not sure	20	31	15

2 (b) (i) From these surveys, how did public opinion on the building of new nuclear power stations change between 2001 and 2007?

.....

.....

(1 mark)

2 (b) (ii) Suggest a reason why some people may think that the results from these surveys are unreliable.

.....

.....

(1 mark)

2 (b) (iii) Give **one** reason in favour of building new nuclear power stations.

.....

.....

(1 mark)

Question 2 continues on the next page

4.1.3 National and global energy resources

Question 71 · continued

2 (c) The government of one Middle Eastern country has decided to build its first nuclear power station. The oil that would have been used to generate electricity can then be sold to other countries.

On what is this decision based?

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

economic issues ☐

ethical issues ☐

social issues ☐

(1 mark)

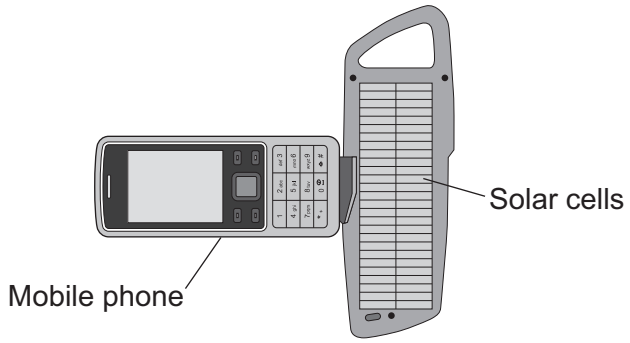
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4.1.3 National and global energy resources

Question 72

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)

4.1.3 National and global energy resources

Question 72 · 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.

.....

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.....

.....

(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.

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(2 marks)

8

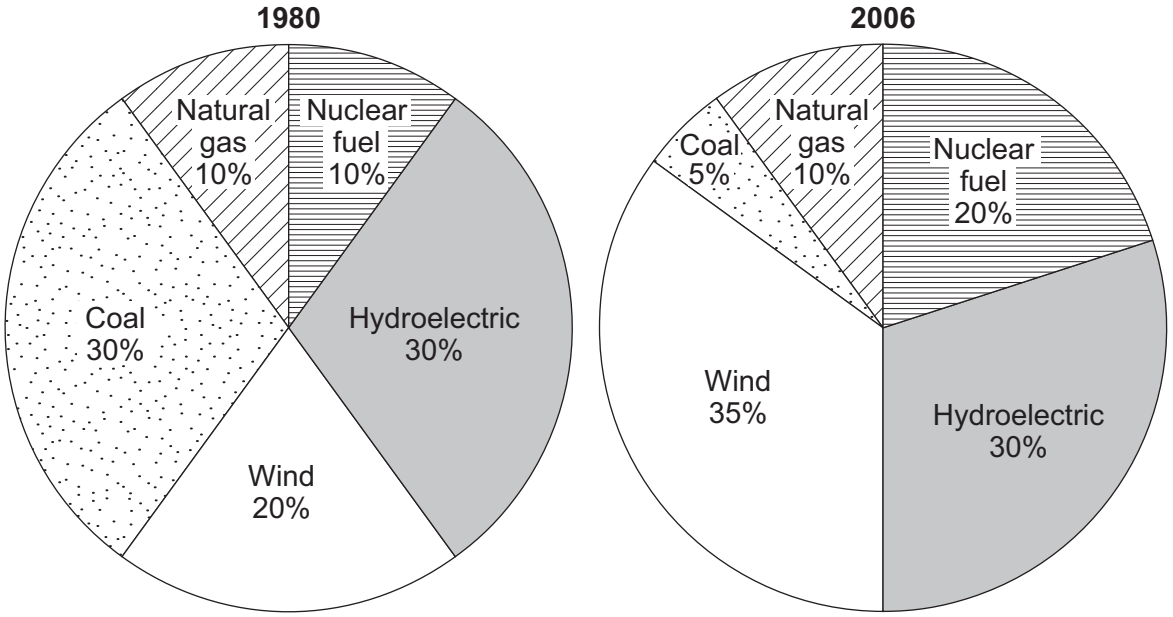
4.1.3 National and global energy resources

Question 73

November 2011 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The two pie charts show the relative proportions of energy sources used to generate electricity in a European country. One is for 1980; the other one is for 2006.



Match energy sources, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

A coal

B natural gas

C nuclear fuel

D wind

	Between 1980 and 2006, the relative proportion of . . .
1	this non-renewable energy source decreased in use.
2	this non-renewable energy source doubled in use.
3	this non-renewable energy source was unchanged in use.
4	this renewable energy source had the greatest increase in use.

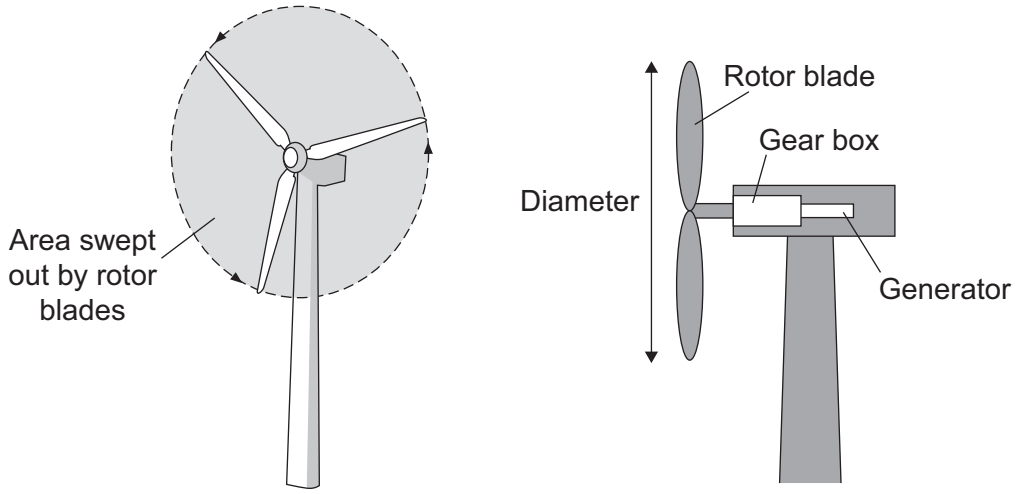
4.1.3 National and global energy resources

Question 74

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?

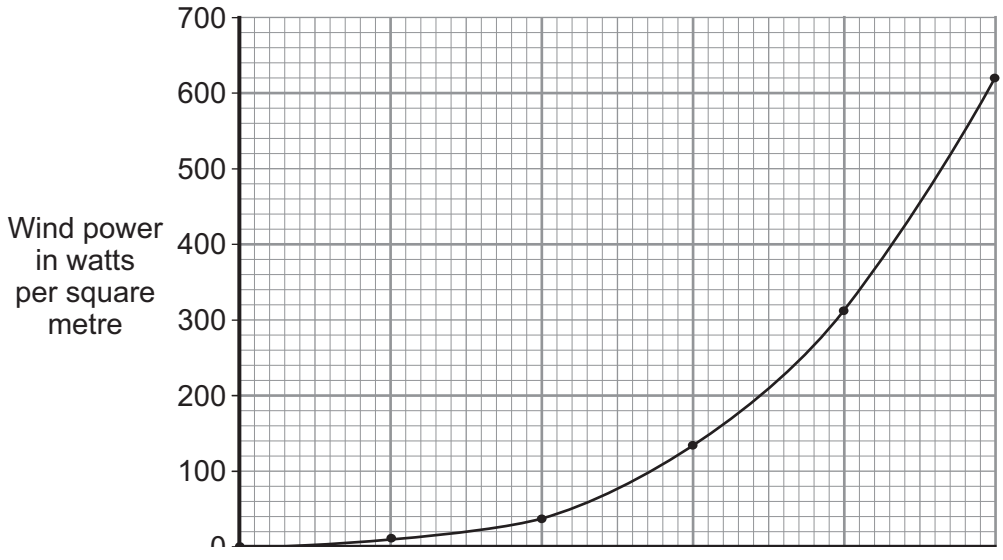
1 potential → electrical, thermal and sound

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.



Question 74 · 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.

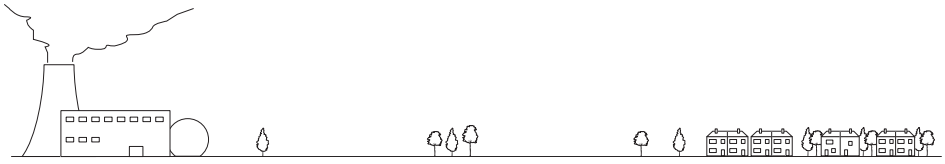
4.1.3 National and global energy resources

Question 75

November 2011 | PHY1BP | Original Q4 | Legacy

QUESTION FOUR

A nuclear power station is built a few miles away from a village.



The nuclear power station uses radioactive uranium as its fuel. After a few years, there are more cases of cancer than usual occurring in the village. The villagers think that this is because of radiation from the power station.

4A Any radiation reaching the village directly from the power station will be . . .

1 alpha radiation only.

2 beta radiation only.

3 gamma radiation only.

4 alpha, beta and gamma radiation.

4B The increased number of cancer cases near the power station . . .

1 proves that the power station is the only cause of these cancers.

2 proves that the power station is one possible cause of these cancers.

3 suggests that the power station is the only cause of these cancers.

4 suggests that the power station is one possible cause of these cancers.

4C Checks are to be made for any link between the power station and the increased number of cancer cases in the village.

This is most likely to be done by . . .

1 shutting down the power station to see if the number of cases decreases.

2 re-housing the villagers away from the power station to see if the number of cancer cases decreases.

3 re-housing the villagers closer to the power station to see if the number of cancer cases increases.

4 comparing the villagers' health records with those of people who do not live near nuclear power stations.

4.1.3 National and global energy resources

Question 75 · continued

4D Exposure to radiation from radioactive sources used in schools must be kept to a minimum.

The best way to do this is to store the source in a box lined with . . .

1 aluminium.

2 glass.

3 lead.

4 wood.

Turn over for the next question

4.1.3 National and global energy resources

Question 76

June 2012 | PH1HP | Original Q1 | Legacy

1 A wood burning stove is used to heat a room.



The fire in the stove uses wood as a fuel. The fire heats the matt black metal case of the stove.

1 (a) The air next to the stove is warmed by infrared radiation.

How does the design of the stove help to improve the rate of energy transfer by infrared radiation?

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.....

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(2 marks)

4.1.3 National and global energy resources

Question 76 · continued

1 (b) Burning 1 kg of wood transfers 15 MJ of energy to the stove. The stove then transfers 13.5 MJ of energy to the room.

Calculate the efficiency of the stove.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

.....

Efficiency = ...

(2 marks)

1 (c) Some of the energy from the burning wood is wasted as the hot gases leave the chimney and warm the air outside the house.

Name **one** other way energy is wasted by the stove.

.....

(1 mark)

1 (d) Some people heat their homes using electric heaters. Other people heat their homes using a wood burning stove.

Give **two** environmental advantages of using a wood burning stove to heat a home rather than heaters that use electricity generated from fossil fuels.

1 .....

.....

2 .....

.....

(2 marks)

Question 1 continues on the next page

4.1.3 National and global energy resources

Question 76 · continued

1 (e) The metal case of the stove gets hot when the fire is lit.

Here is some information about the stove.

Mass of metal case	100 kg
Starting temperature of metal case	20 °C
Final temperature of metal case	70 °C
Specific heat capacity of metal case	510 J/kg °C

Calculate the energy required to raise the temperature of the metal case to 70 °C.

Use the correct equation from the Physics Equations Sheet.

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

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.....

Energy required = ...

(3 marks)

10

4.1.3 National and global energy resources

Question 77

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.

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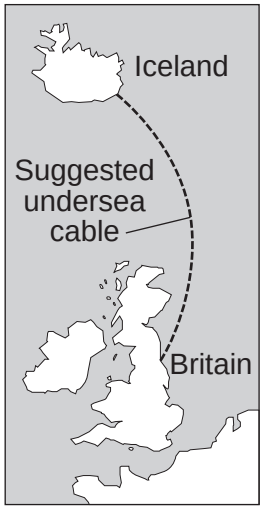
(2 marks)

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.

4.1.3 National and global energy resources

Question 77 · 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)

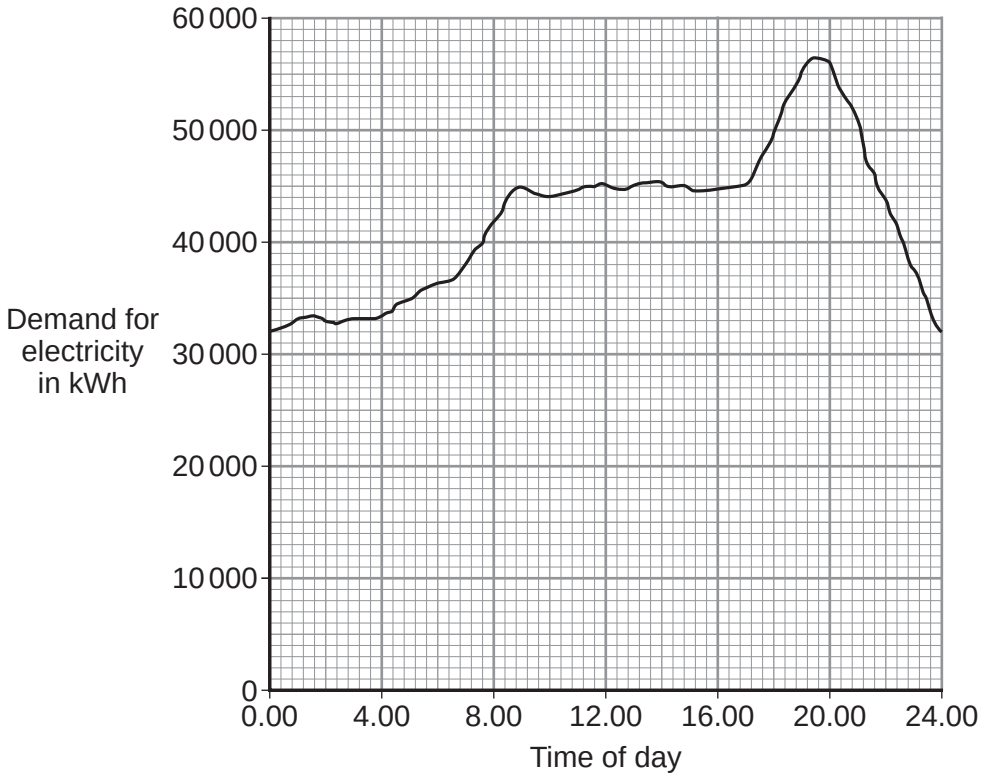
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4.1.3 National and global energy resources

Question 78

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)

4.1.3 National and global energy resources

Question 78 · 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

4.1.3 National and global energy resources

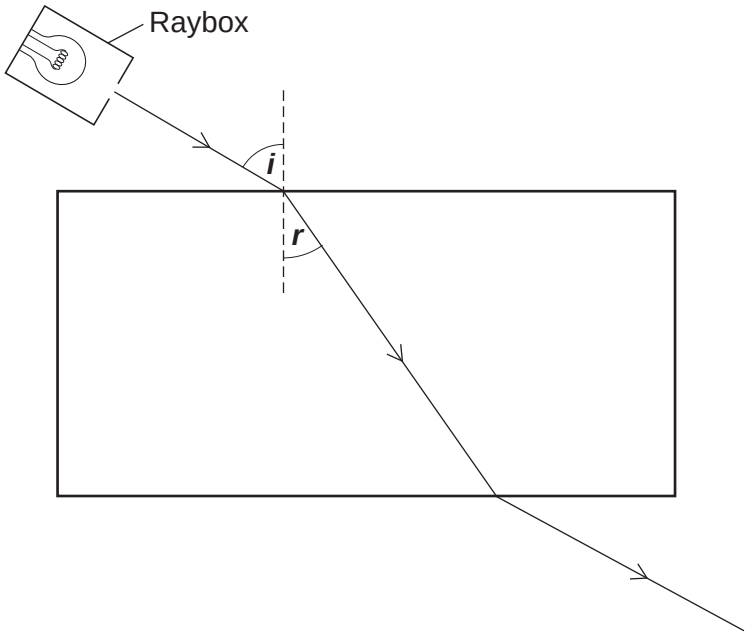
Question 79

January 2013 | PH1HP | Original Q4 | Legacy

4 A student investigated the refraction of light as it passes into and out of a clear plastic block.

Diagram 1 shows the apparatus the student used.

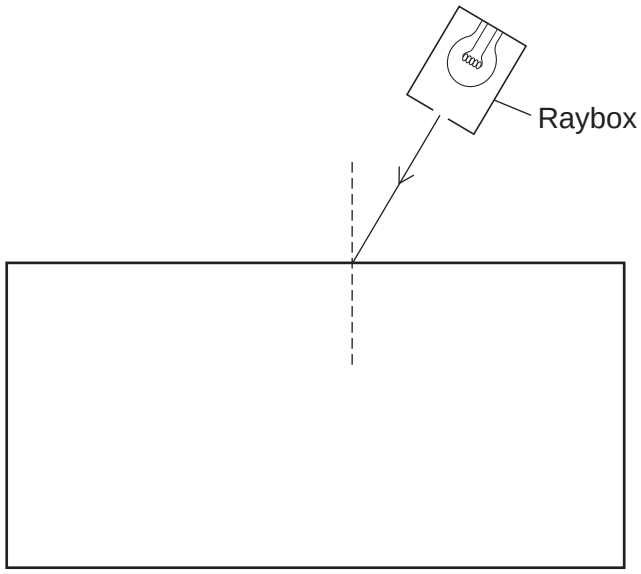
Diagram 1



4 (a) **Diagram 2** shows the same apparatus.

Use a ruler to draw on **Diagram 2** the path of the light ray.

Diagram 2

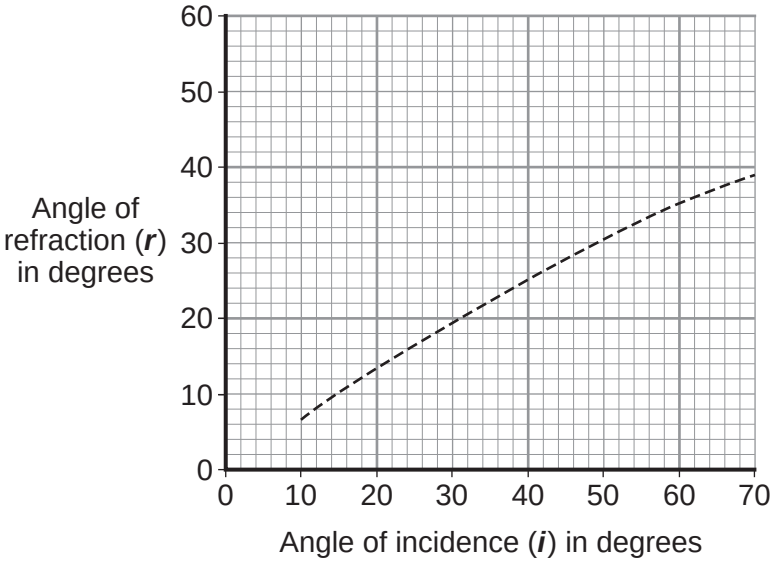


(2 marks)

4 (b) The student measured the angle of refraction (***r***) for different angles of incidence (***i***) for light entering the plastic block.

The results are shown in **Graph 1**.

Graph 1



4 (b) (i) What **two** conclusions can be made about the relationship between the angle of incidence and the angle of refraction from **Graph 1**?

1 .....

.....

2 .....

.....

(2 marks)

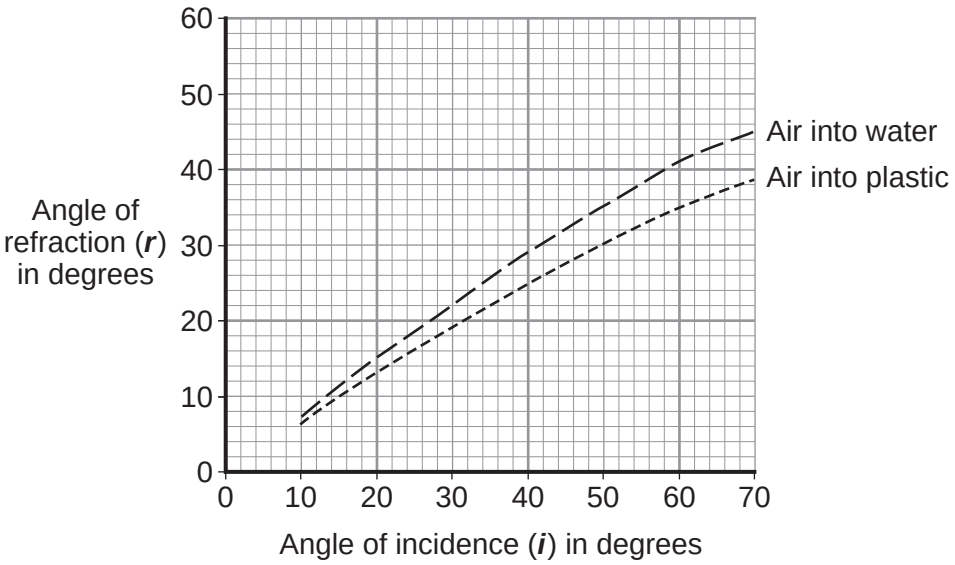
Question 4 continues on the next page

4.1.3 National and global energy resources

Question 79 · continued

4 (b) (ii) **Graph 2** shows the student's results for light passing from air into plastic. The graph also shows the results for light passing from air into water.

Graph 2



How does the refraction of light passing from air into water compare to the refraction of light passing from air into plastic?

.....

.....

(1 mark)

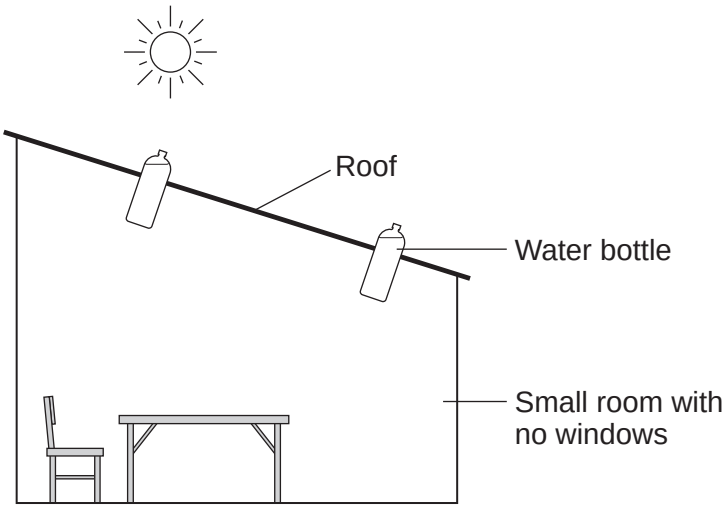
4.1.3 National and global energy resources

Question 79 · continued

4 (c) In some countries people are too poor to pay for electricity. Some people living in small houses with no natural light are using bottles filled with water instead of light bulbs.

The bottles are fitted into small holes in the roof of the house. Sunlight refracts as it passes into and out of the bottle, causing light to spread into the room. This simple device gives about the same amount of light as a 50 W light bulb.

Diagram 3



4 (c) (i) Suggest **one** way this simple device can help improve the lives of the people using it.

.....

.....

(1 mark)

4 (c) (ii) The increasing use of energy resources to generate electricity within developed countries has ethical implications.

Suggest **one** ethical implication.

.....

.....

(1 mark)

7

4.1.3 National and global energy resources

Question 80

January 2013 | PH1HP | Original Q6 | Legacy

6 About half of the UK's electricity is generated in coal-burning power stations and nuclear power stations.

6 (a) Coal-burning power stations and nuclear power stations provide a reliable way of generating electricity.

What is meant by *a reliable way of generating electricity*?

.....

.....

(1 mark)

6 (b) Over the next few years, most of the older nuclear power stations in the UK will be closed down, and the process of decommissioning will start.

What does it mean to *decommission* a nuclear power station?

.....

.....

(1 mark)

6 (c) Climate change has been strongly linked to the emission of carbon dioxide. Many governments around the world are committed to reducing carbon dioxide emissions.

Generating electricity can increase carbon dioxide emissions.

The companies generating electricity could reduce carbon dioxide emissions.

Give **two** ways the companies could do this.

1 .....

.....

2 .....

.....

(2 marks)

4.1.3 National and global energy resources

Question 80 · continued

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

The voltage across the overhead cables of the National Grid needs to be much higher than the output voltage from the power station generators.

Explain why.

.....

.....

.....

.....

.....

.....

(3 marks)

7

Turn over for the next question

4.1.3 National and global energy resources

Question 81

June 2013 | PH1HP | Original Q3 | Legacy

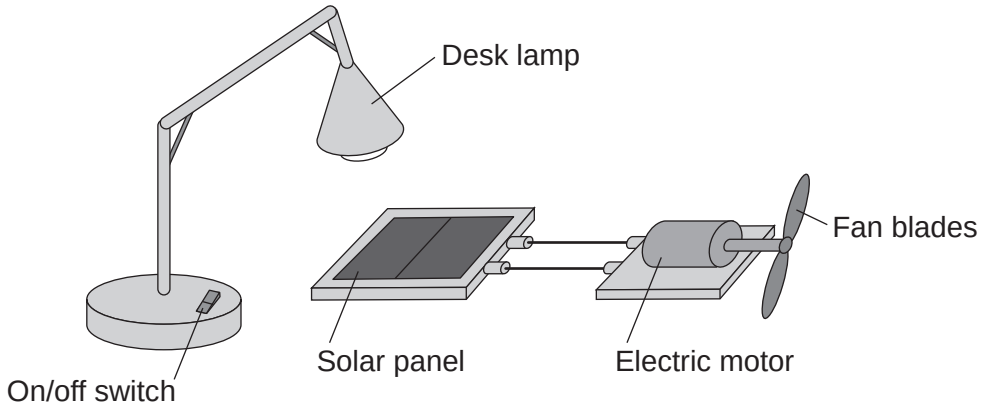
3 (a) Light waves transfer energy.

3 (a) (i) Complete the following sentence.

The oscillations producing a light wave are ..... to the direction of the energy transfer by the light wave.

(1 mark)

3 (a) (ii) The apparatus in the diagram shows that light waves transfer energy.



Describe how switching the desk lamp on and off shows that light waves transfer energy.

You do **not** need to describe the energy transfers.

.....

.....

.....

.....

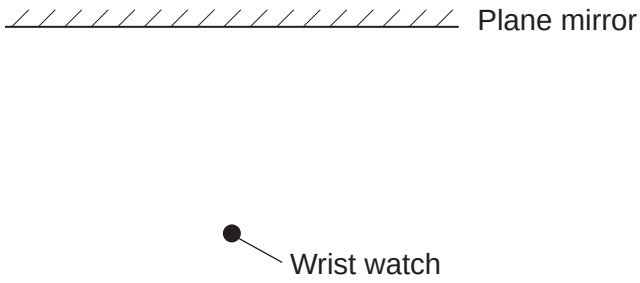
(2 marks)

4.1.3 National and global energy resources

Question 81 · continued

3 (b) A student holds a wrist watch in front of a plane mirror. The student can see an image of the wrist watch in the mirror.

The diagram shows the position of the wrist watch and the mirror.



Draw a ray diagram showing how the image of the wrist watch is formed.

Mark the position of the image.

(4 marks)

3 (c) The image of the wrist watch seen by the student is virtual.

What is a virtual image?

.....

.....

(1 mark)

8

4.1.3 National and global energy resources

Question 82

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)

4.1.3 National and global energy resources

Question 82 · 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

4.1.3 National and global energy resources

Question 83

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.

.....

.....

.....

.....

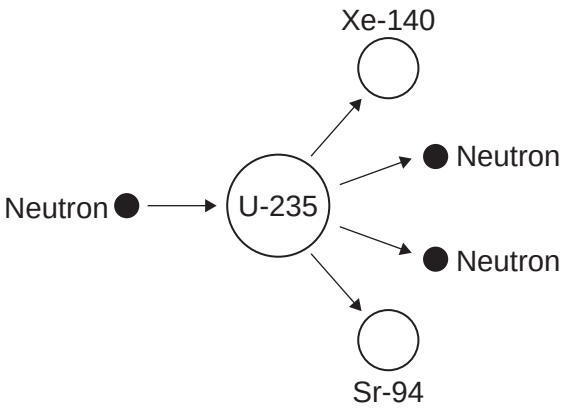
.....

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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.

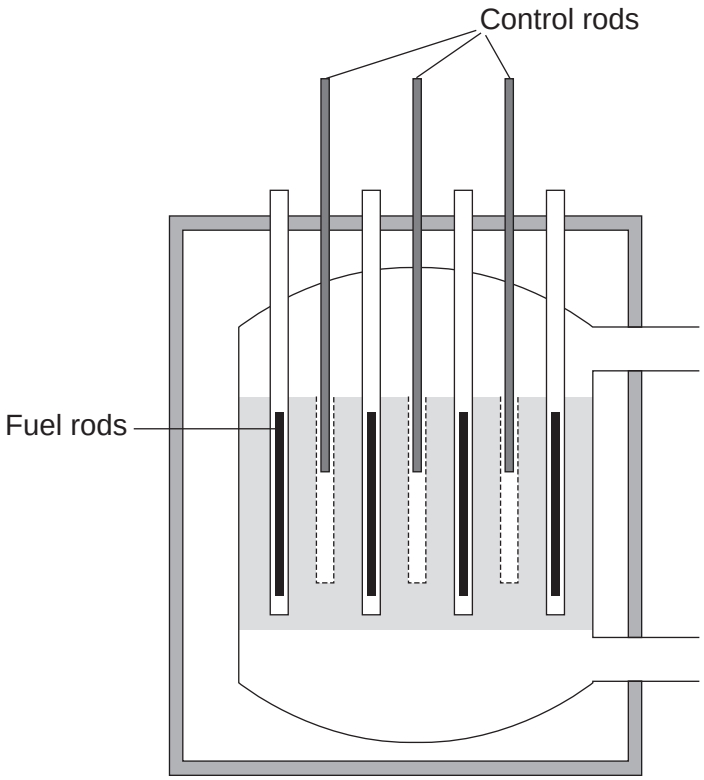


(2 marks)

4.1.3 National and global energy resources

Question 83 · 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

4.1.3 National and global energy resources

Question 84

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

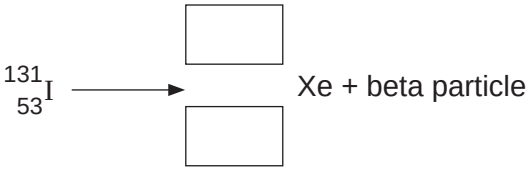
the ..... number.

(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

4.1.3 National and global energy resources

Question 84 · 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

4.1.3 National and global energy resources

Question 85

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]

.....

.....

6

4.1.3 National and global energy resources

Question 86

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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Question 86 · 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]

.....

.....

.....

.....

.....

.....

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

4.1.3 National and global energy resources

Question 87

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]

.....

.....

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

Question 87 · continued

6 (d) Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term 'half-life'?

[1 mark]

.....

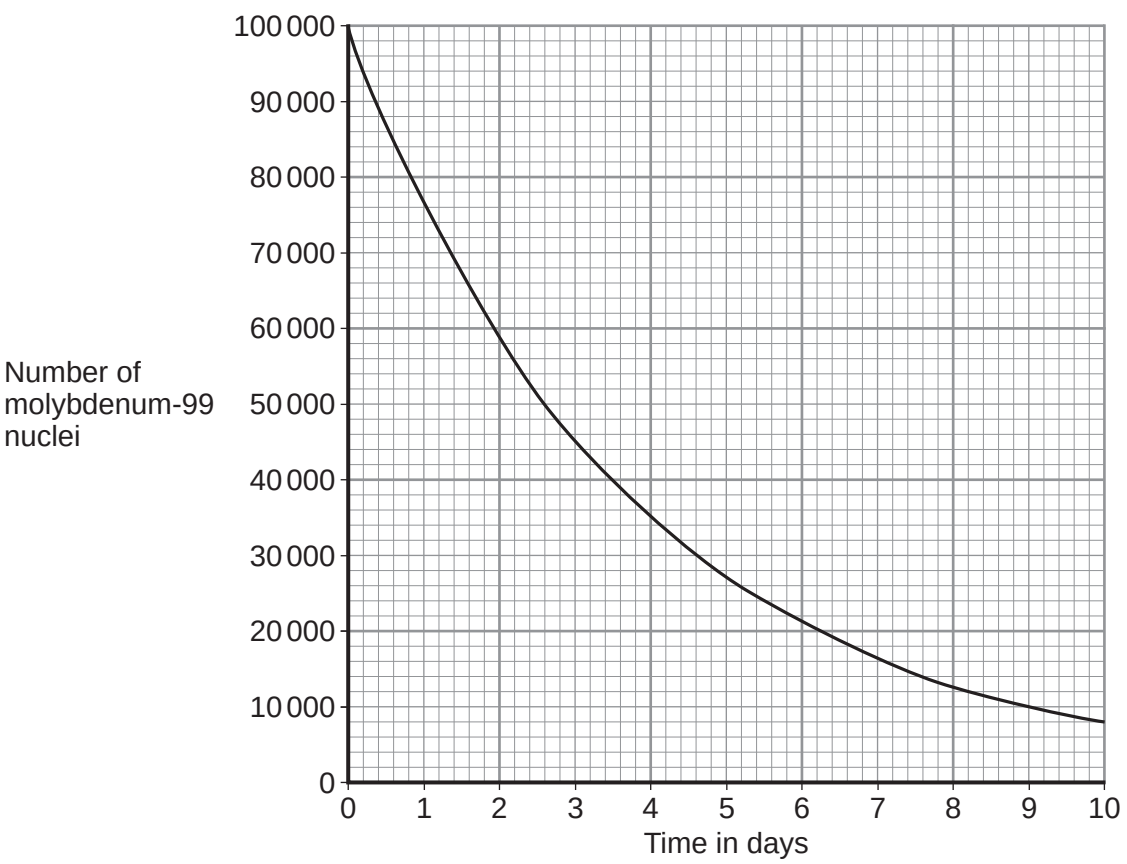
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.....

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



4.1.3 National and global energy resources

Question 87 · 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]

.....

.....

.....

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]

.....

.....

.....

.....

6 (e) (iii) Even though there may be a risk, doctors frequently use radioactive substances for medical diagnosis and treatments.

Suggest why.

[1 mark]

.....

.....

11

4.1.3 National and global energy resources

Question 88

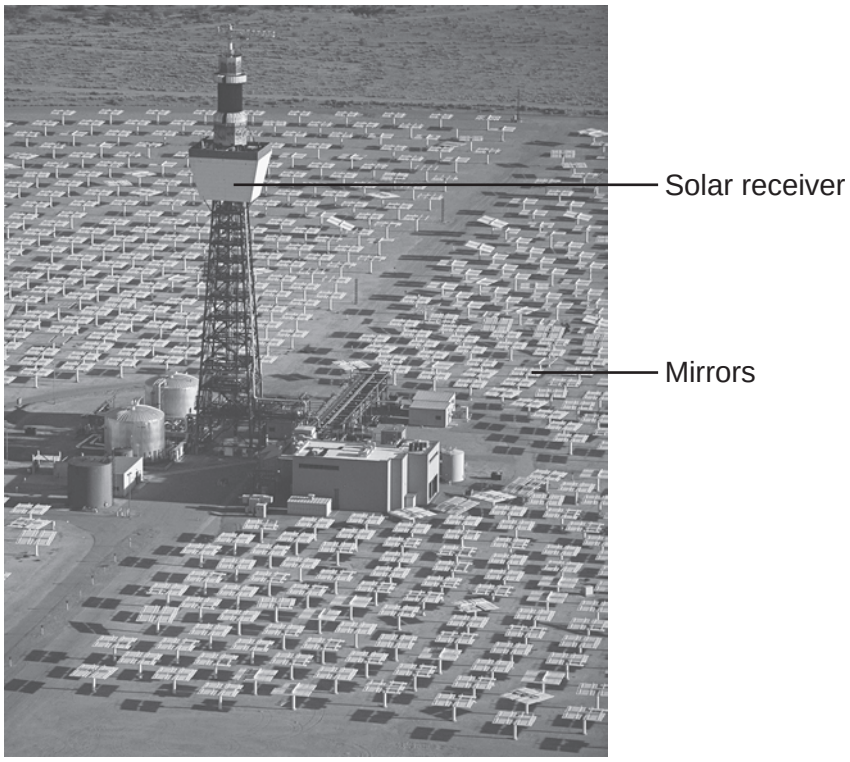
June 2015 | PH1HP | Original Q5 | Legacy

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]

.....

4.1.3 National and global energy resources

Question 88 · continued

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]

.....

.....

.....

Time = ... hours

Question 5 continues on the next page

Question 88 · 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]

.....

.....

.....

.....

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:

$$\text{Capacity factor} = \frac{\text{actual electrical output per year}}{\text{maximum possible electrical output per year}}$$

4.1.3 National and global energy resources

Question 88 · 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]

……

……

……

……

……

……

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]

……

……

14

4.1.3 National and global energy resources

Question 89

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]

.....

.....

3 (b) (ii) Where does nuclear fusion happen naturally?

[1 mark]

.....

Question 89 · 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 .....

.....

.....

2 .....

.....

.....

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]

.....

.....

.....

Question 3 continues on the next page

4.1.3 National and global energy resources

Question 89 · 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

4.1.3 National and global energy resources

Question 90

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.

4.1.3 National and global energy resources

Question 90 · 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

4.1.3 National and global energy resources

Question 91

June 2016 | PH1HP | Original Q6 | Legacy

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 _____

_____

4.1.3 National and global energy resources

Question 91 · 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

4.1.3 National and global energy resources

Question 91 · 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

4.1.3 National and global energy resources

Question 92

June 2017 | PH1HP | Original Q2 | Legacy

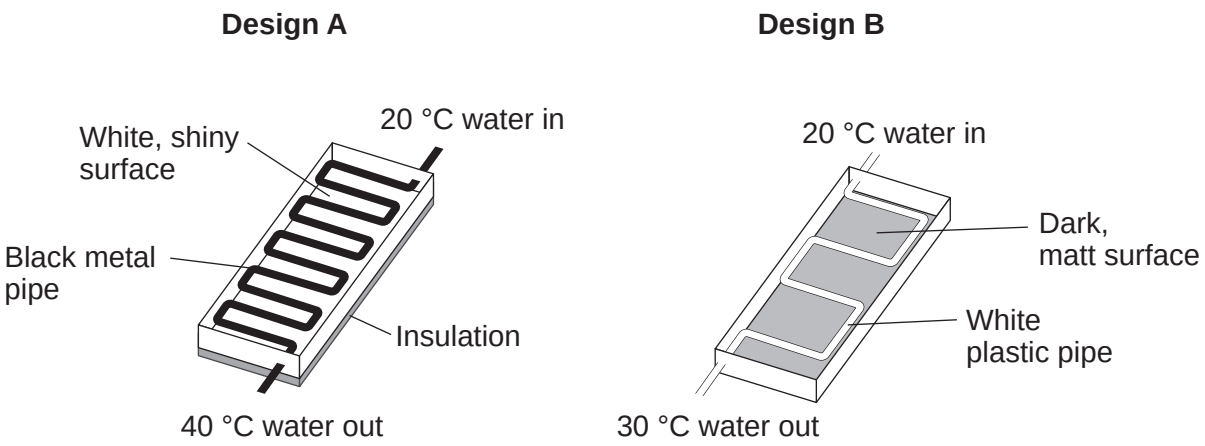
2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Solar panels use energy from the Sun to heat water.

Two different designs of solar panel are shown in **Figure 1**.

Both designs have the same water flow rate.

Figure 1



Explain why **Design A** is better than **Design B** at heating water.

[6 marks]

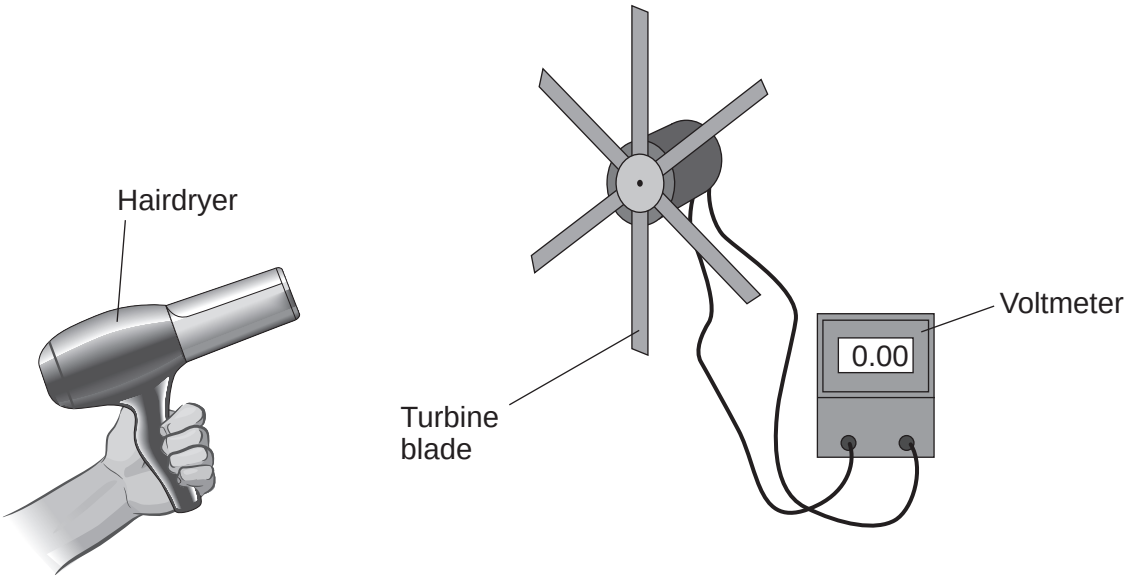
4.1.3 National and global energy resources

Question 93

June 2017 | PH1HP | Original Q3 | Legacy

3 A student investigated how the output voltage of a model wind turbine was affected by the number of turbine blades. The equipment he used is shown in **Figure 2**.

Figure 2



3 (a) Suggest **two** factors, other than the number of turbine blades, that will affect the output voltage of the model wind turbine.

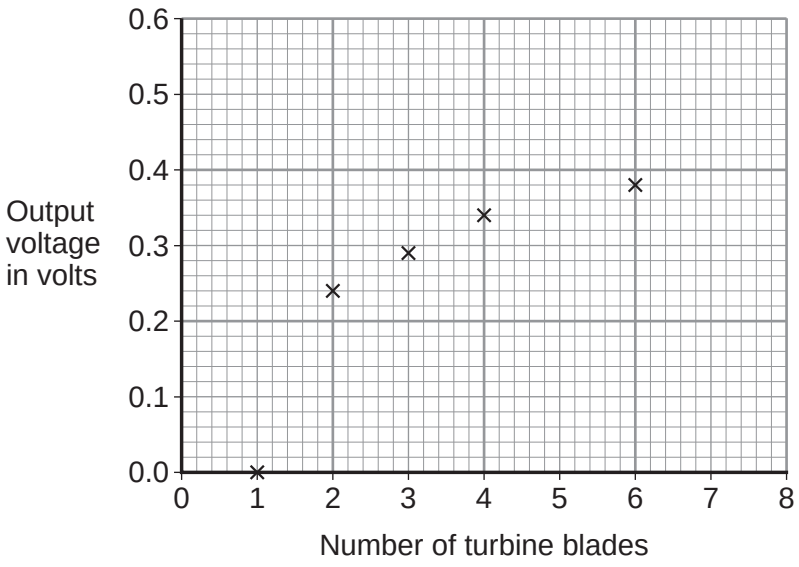
[2 marks]

1 _____

2 _____

3 (b) Some of the student's results are shown in **Figure 3**.

Figure 3



4.1.3 National and global energy resources

Question 93 · continued

3 (b) (i) Plot the remaining results in **Figure 3** using the data in **Table 1**.

[2 marks]

Table 1

Number of turbine blades	Output Voltage in volts
5	0.39
7	0.50
8	0.56

3 (b) (ii) The output voltage for 6 turbine blades is lower than expected. The low value was caused by a measurement error.

State the name of this type of measurement error.

[1 mark]

_____

3 (b) (iii) What **two** conclusions can be made from the student's results as the number of blades is increased from 1 to 4?

[2 marks]

1 _____

_____

2 _____

_____

3 (c) Commercial wind turbines can be manufactured with a number of blades between 2 and 8.

Suggest **two** factors that manufacturers would need to consider when designing and constructing commercial wind turbines.

[2 marks]

1 _____

_____

2 _____

_____

9

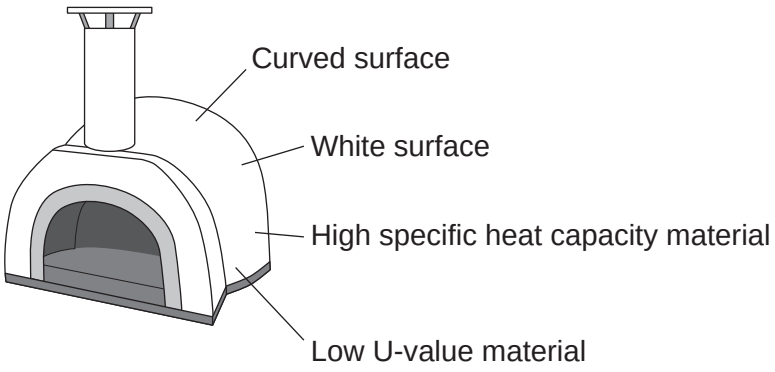
4.1.3 National and global energy resources

Question 94

June 2017 | PH1HP | Original Q5 | Legacy

5 **Figure 5** shows an outdoor pizza oven.

Figure 5



5 (a) A solid biofuel is used to heat the oven.

Name **one** solid biofuel.

[1 mark]

_____

5 (b) The pizza oven is made of concrete. The mass of the concrete is 250 kg

Calculate the temperature increase when 8.36×10^7 J of energy are transferred to the concrete.

Concrete has a specific heat capacity of 880 J/kg °C

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Temperature increase = _____ °C

4.1.3 National and global energy resources

Question 94 · continued

5 (c) The pizza oven is designed to stay hot for at least two hours.

Describe how each of the four labelled design features helps to ensure that the pizza oven stays hot for at least two hours.

[4 marks]

White surface _____

_____

Curved surface _____

_____

High specific heat capacity material _____

_____

Low U-value material _____

_____

7

4.1.3 National and global energy resources

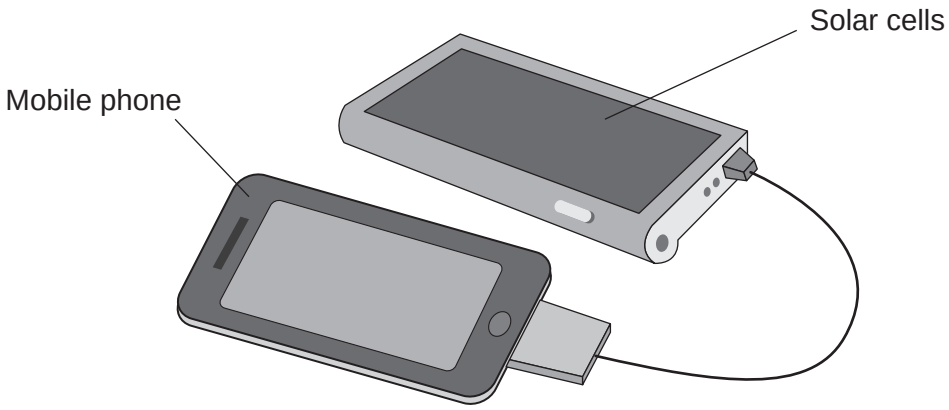
Question 95

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

4.1.3 National and global energy resources

Question 95 · 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

4.1.3 National and global energy resources

Question 96

June 2018 | 8463/1H | Original Q8

0 8 Nuclear power stations generate electricity through nuclear fission. Electricity can also be generated by burning shale gas.

0 8 . 1 Shale gas is natural gas trapped in rocks. Shale gas can be extracted by a process called fracking. There is some evidence that fracking causes minor earthquakes. Burning shale gas adds carbon dioxide to the atmosphere.

Describe the advantages of nuclear power compared with the use of shale gas to generate electricity.

[3 marks]

0 8 . 2 What is the name of **one** fuel used in nuclear power stations?

[1 mark]

4.1.3 National and global energy resources

Question 96 · continued

0 8 . 3 Describe the process of nuclear fission.

[4 marks]

8

Turn over for the next question

4.1.3 National and global energy resources

Question 97

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]

4.1.3 National and global energy resources

Question 97 · continued

1 0 . 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

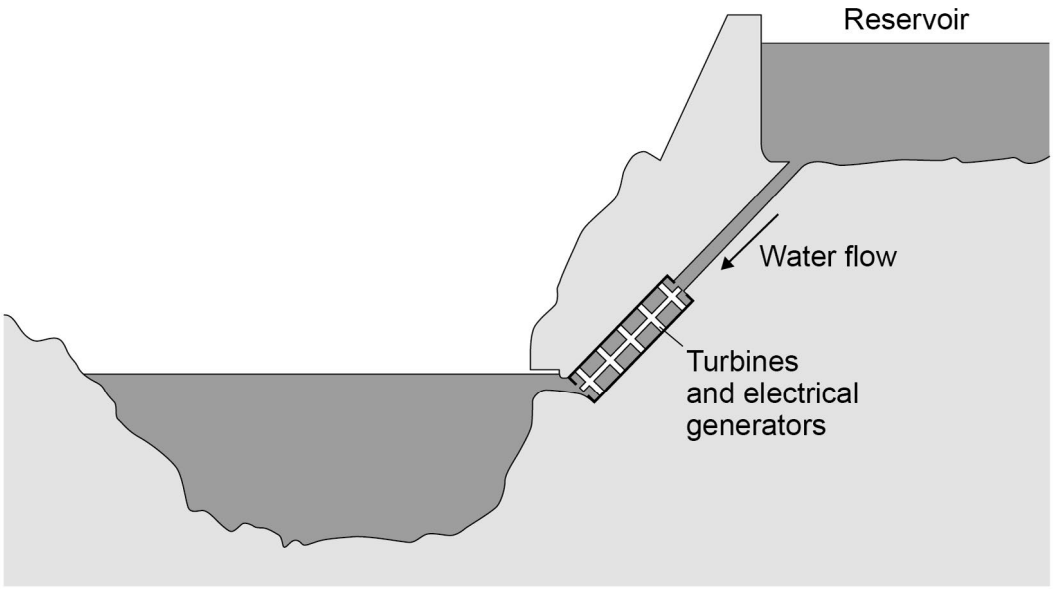
4.1.3 National and global energy resources

Question 98

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

4.1.3 National and global energy resources

Question 98 · 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.

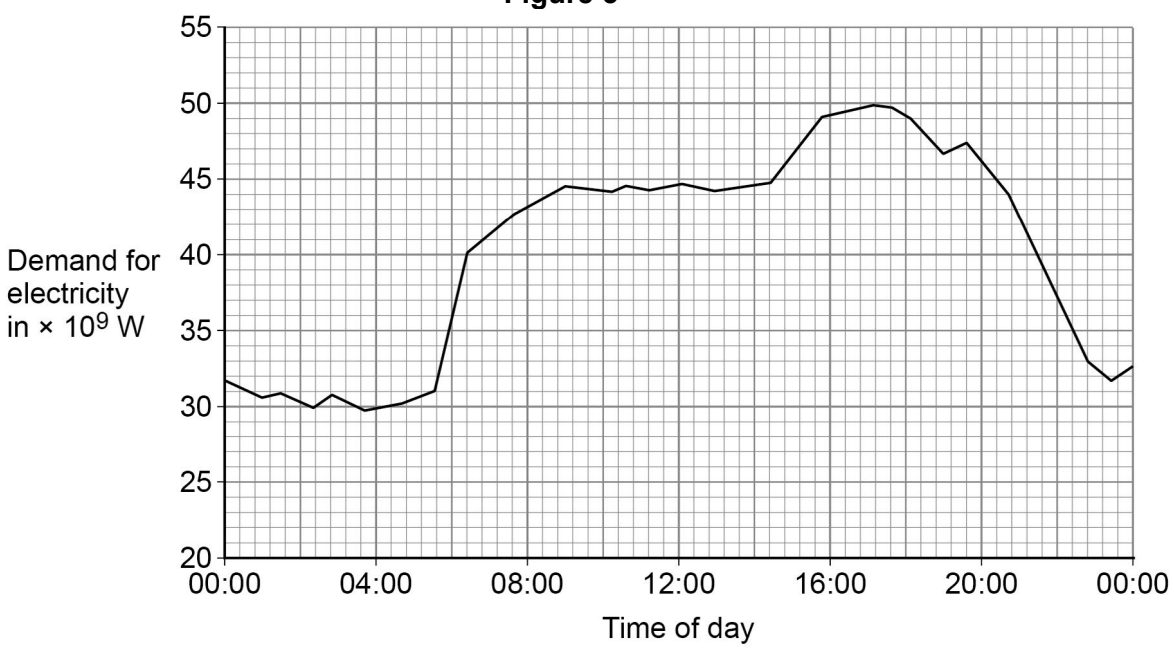
[3 marks]

Energy transferred = _____ J

Question 3 continues on the next page

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

4.1.3 National and global energy resources

Question 99

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]

4.1.3 National and global energy resources

Question 99 · 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

4.1.3 National and global energy resources

Question 100

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

4.1.3 National and global energy resources

Question 100 · 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

4.1.3 National and global energy resources

Question 101

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]

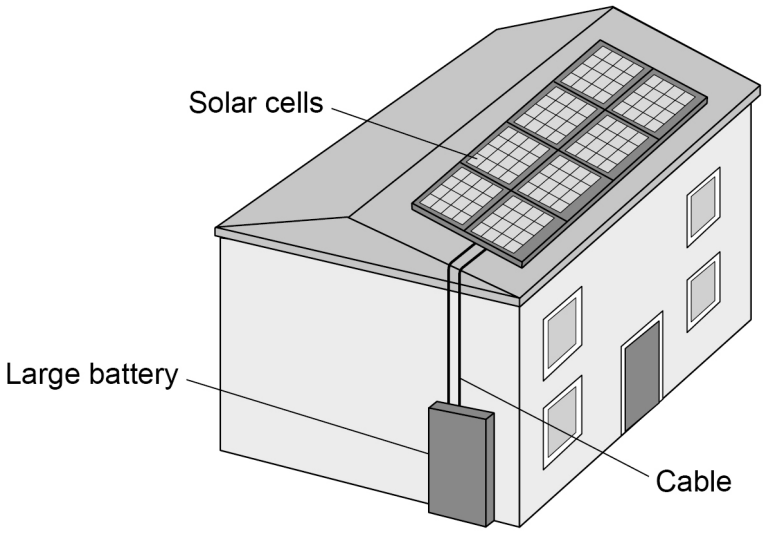
Energy each second (3 significant figures) = _____ J

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



Question 101 · 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

4.1.3 National and global energy resources

Question 101 · 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

4.1.3 National and global energy resources

Question 102

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

4.1.3 National and global energy resources

Question 102 · 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

4.1.3 National and global energy resources

Question 103

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

4.1.3 National and global energy resources

Question 103 · 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.

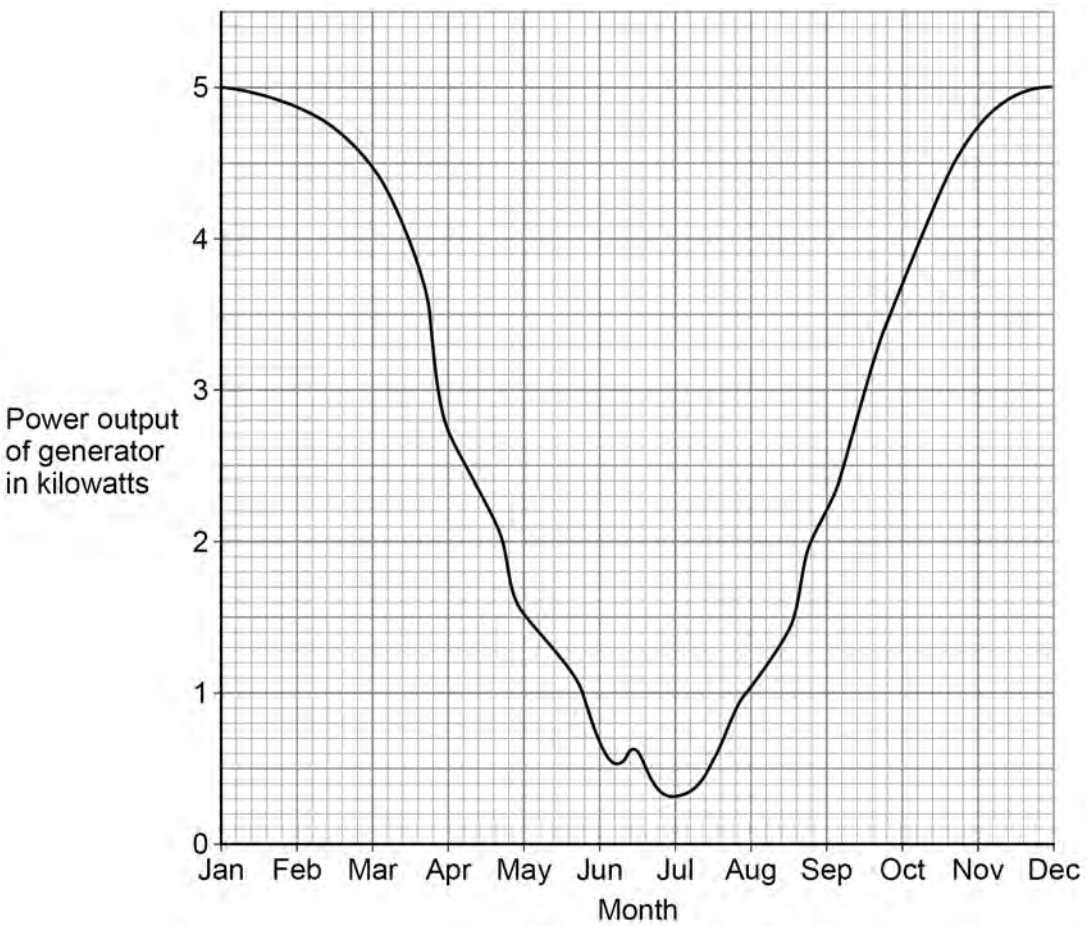
[5 marks]

Time taken (in standard form) = _____ s

Question 4 continues on the next page

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

4.1.3 National and global energy resources

Question 104

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 104 · 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]

4.1.3 National and global energy resources

Question 104 · 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]

4.1.3 National and global energy resources

Question 104 · 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

4.1.3 National and global energy resources

Question 105

June 2024 | 8463/1H | Original Q1

0 1 **Figure 1** shows a wind turbine.

Figure 1



Wind turbines may generate electricity when the electricity is not needed.

Two methods that can be used to store the energy from the turbine are:

Method A: Heating water to a high temperature.

Method B: Pumping water uphill into a reservoir.

0 1 . 1 Which energy store increases when water is heated?

[1 mark]

0 1 . 2 Which energy store increases when water is pumped uphill into a reservoir?

[1 mark]

4.1.3 National and global energy resources

Question 105 · continued

0 1 . 3 **Table 1** shows information about the two methods of storing energy.

Table 1

Method	Energy stored per 100 kg of water in kJ	Percentage of stored energy wasted	Installation
A: Increasing water temperature by 80 °C	33 600	40%	Anywhere
B: Pumping water uphill to a height of 500 m	490	25%	High mountains

Compare the advantages and disadvantages of the two methods of storing energy.

Include calculations in your answer.

[4 marks]

Question 1 continues on the next page

4.1.3 National and global energy resources

Question 105 · continued

0 1 . 4 Decreasing the amount of carbon dioxide released by different activities will help slow down climate change.

Transport and generating electricity are the two activities that released the largest amounts of carbon dioxide in the UK in 2018.

Explain **one** change that would reduce the amount of carbon dioxide released by **each** activity.

[4 marks]

Transport _____

Generating electricity _____

10

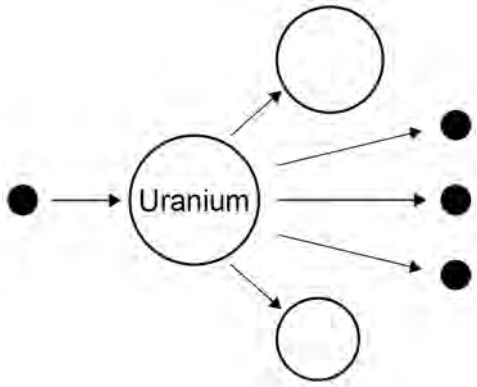
4.1.3 National and global energy resources

Question 106

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 _____.

Question 106 · 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]

4.1.3 National and global energy resources

Question 106 · 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

4.1.3 National and global energy resources

Question 107

June 2025 | 8463/1H | Original Q1

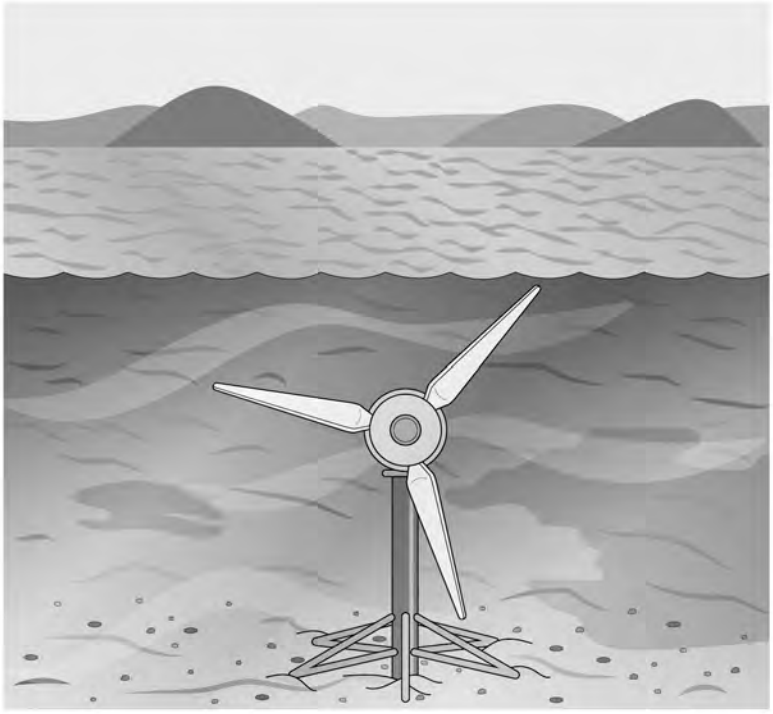
0 1 Tides and wind are two renewable energy resources.

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



4.1.3 National and global energy resources

Question 107 · 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

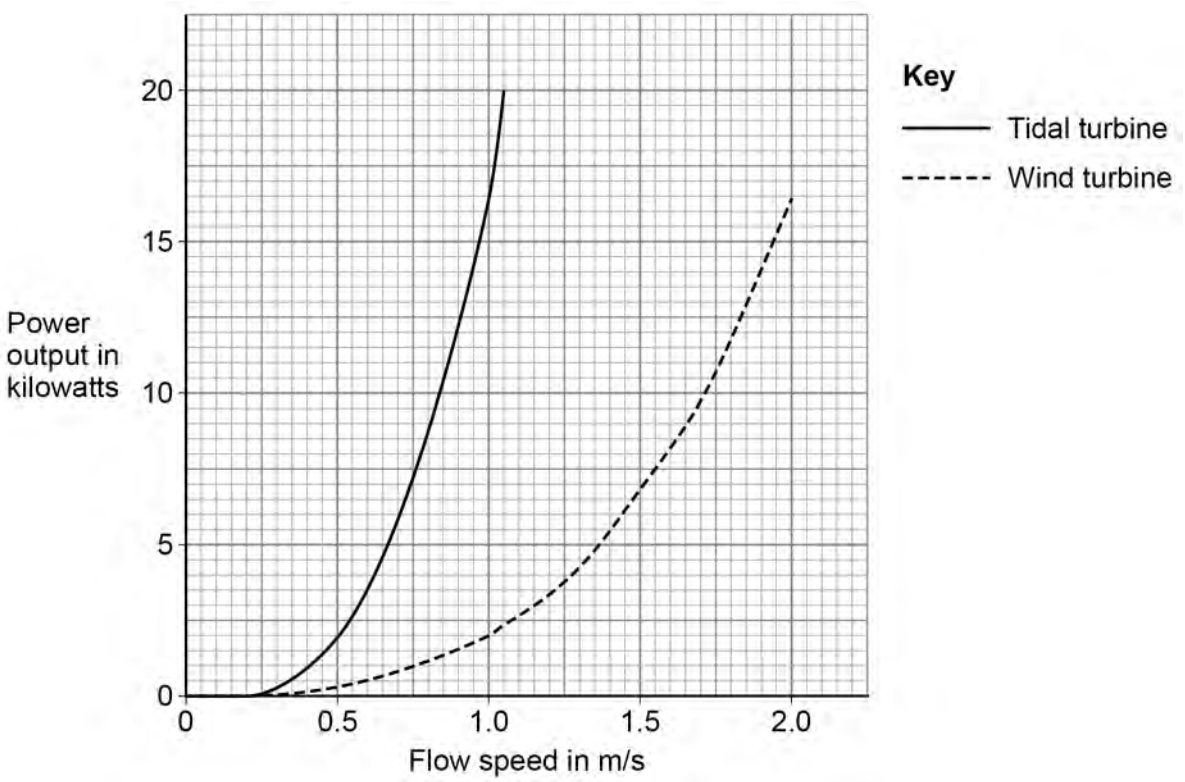
4.1.3 National and global energy resources

Question 107 · 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 _____

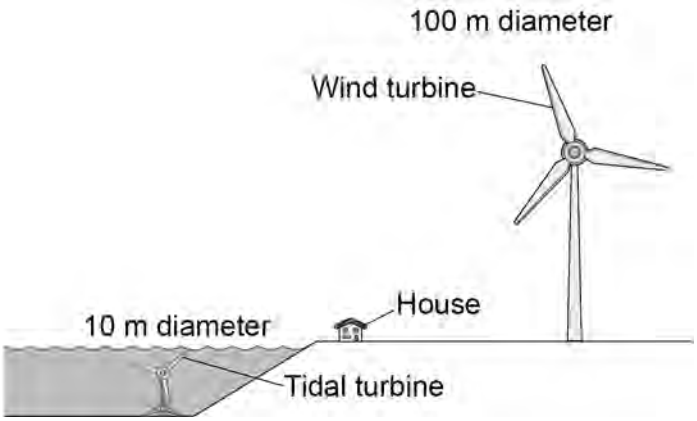
_____

4.1.3 National and global energy resources

Question 107 · 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