AQA GCSE Physics | 8463

SPECIFICATION POINT 4.1.1.2

Changes in energy

Past-paper questions

Tier	**Higher**
Question groups	**46**
Available paper years	**2003–2025**

Using this booklet

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

Name: _____ **Date:** _____

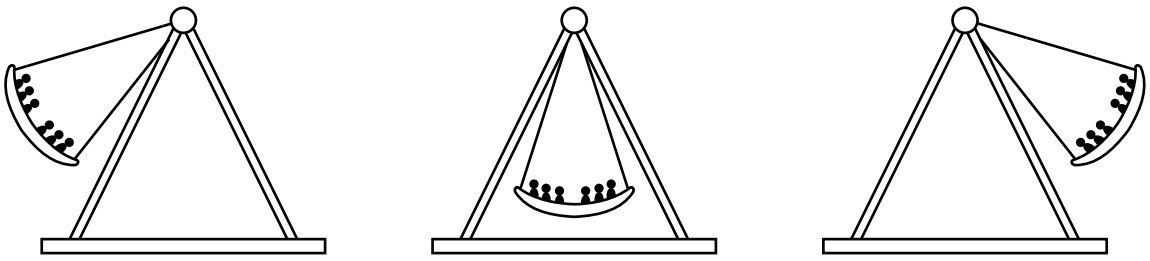
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.1.2 Changes in energy

Question 01

June 2003 | 3451H | Original Q13 | Legacy

13 The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



A **B** **C**

(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

.....

.....

.....

Speed = ...m/s

(2 marks)

4.1.1.2 Changes in energy

Question 01 · continued

MARGIN
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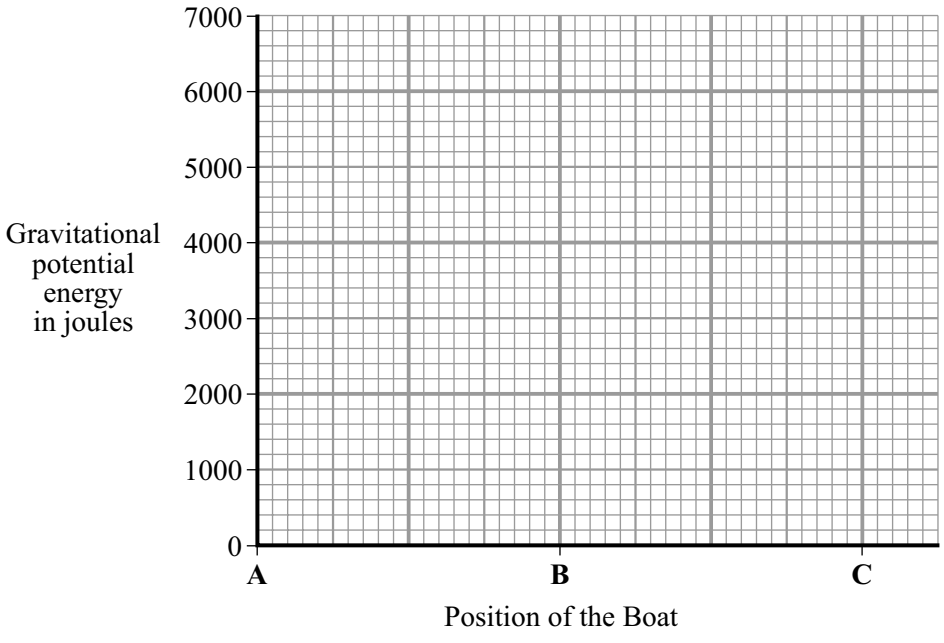
(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.



(2 marks)

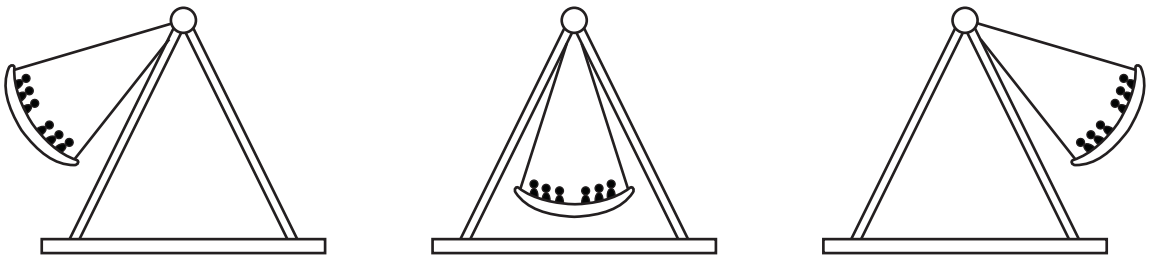
5

4.1.1.2 Changes in energy

Question 02

June 2003 | 3462H3 | Original Q11 | Legacy

11 The Boat is a theme park ride. The Boat swings backwards and forwards. The diagrams show the Boat at the top and bottom of its swing.



A **B** **C**

(a) As the Boat swings from its position in **A** to its position in **B**, a child on the ride gains 5070 joules of kinetic energy. The child has a mass of 60 kg and is sitting at the centre.

(i) Write down the equation which links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the speed of the child as the Boat passes through **B**. Show clearly how you work out your final answer.

.....

.....

.....

Speed = ...m/s

(2 marks)

4.1.1.2 Changes in energy

Question 02 · continued

MARGIN
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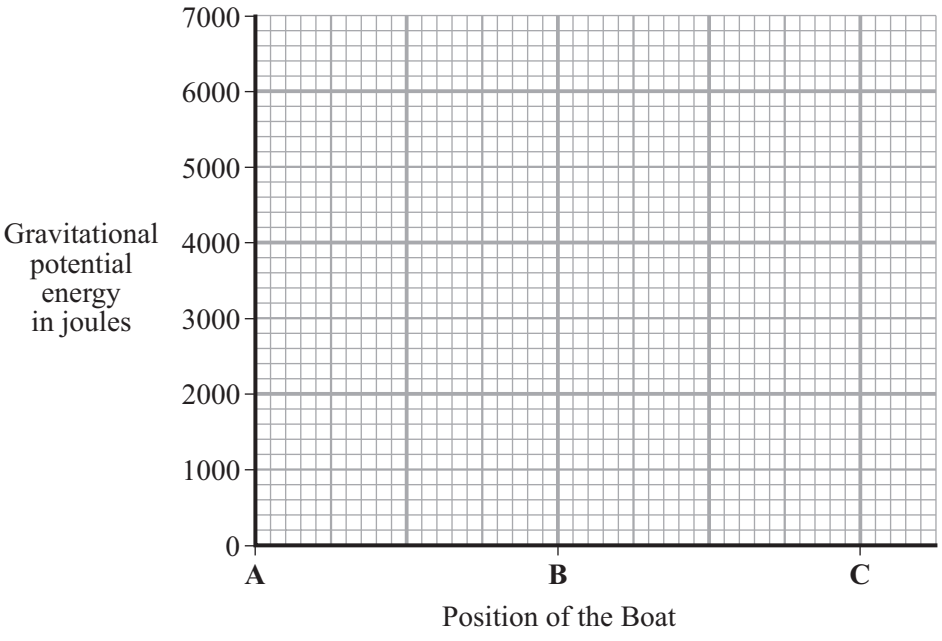
(b) Sketch a graph to show how the gravitational potential energy of the child changes as the Boat swings from **A** to **B** to **C**. The axes have been drawn for you.



(2 marks)

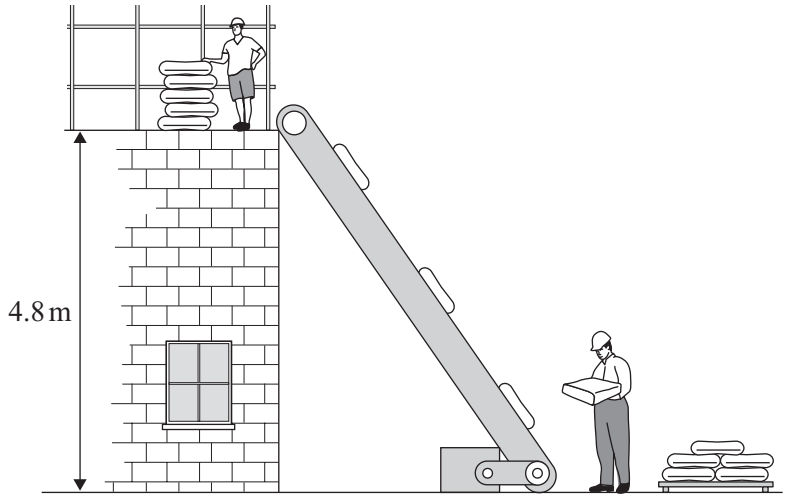
5

4.1.1.2 Changes in energy

Question 03

June 2005 | 3451 | Original Q13 | Legacy

13 A machine is used to lift materials on a building site.



(a) (i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) A 25 kg bag of cement is lifted from the ground to the top of the building.
Calculate the gain in the gravitational potential energy of the bag of cement.

(On Earth a 1 kg mass has a weight of 10 N.)

.....

.....

Change in gravitational potential energy = ... joules
(2 marks)

(b) The conveyor belt delivers six bags of cement each minute to the top of the building.

(i) Calculate the useful energy transferred by the machine each second.

.....

.....

.....

Useful energy transfer each second = ... J
(1 mark)

4.1.1.2 Changes in energy

Question 03 · continued

MARGIN BLANK

(ii) The machine is 40 % efficient.
Use the following equation to calculate the total energy supplied to the machine each second. Show how you work out your answer.

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

.....

.....

Total energy supplied each second = ... J
(2 marks)

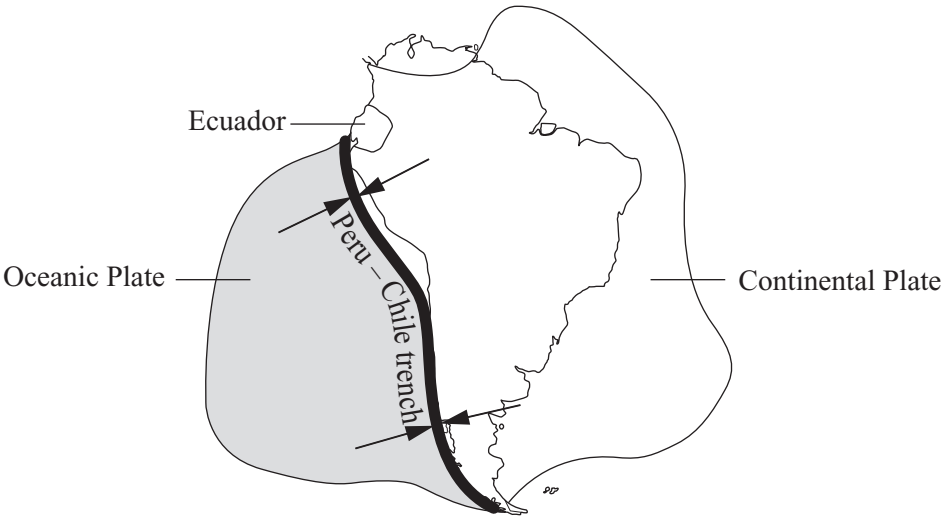
6

TURN OVER FOR THE NEXT QUESTION

4.1.1.2 Changes in energy

Question 04

15 The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

.....

.....

.....

.....

(2 marks)

4.1.1.2 Changes in energy

Question 04 · continued

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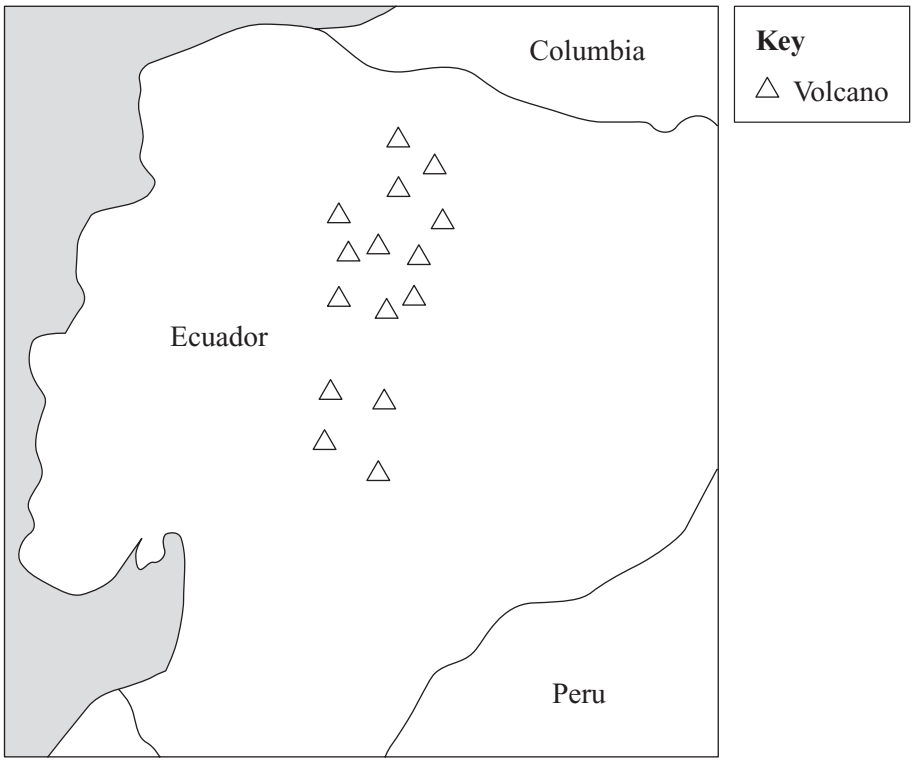
(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.



Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

(1 mark)

QUESTION 15 CONTINUES ON THE NEXT PAGE

4.1.1.2 Changes in energy

Question 04 · continued

MARGIN BLANK

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

(2 marks)

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

.....

.....

Kinetic energy = ... joules
(1 mark)

(e) Read the information in the box and then answer the questions.

> Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.
>
> Potassium-40 decays into argon-40 which is stable.
>
> Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.
>
> A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

(1 mark)

(ii) Calculate the age of the rock.

.....

Age of rock = ... million years
(1 mark)

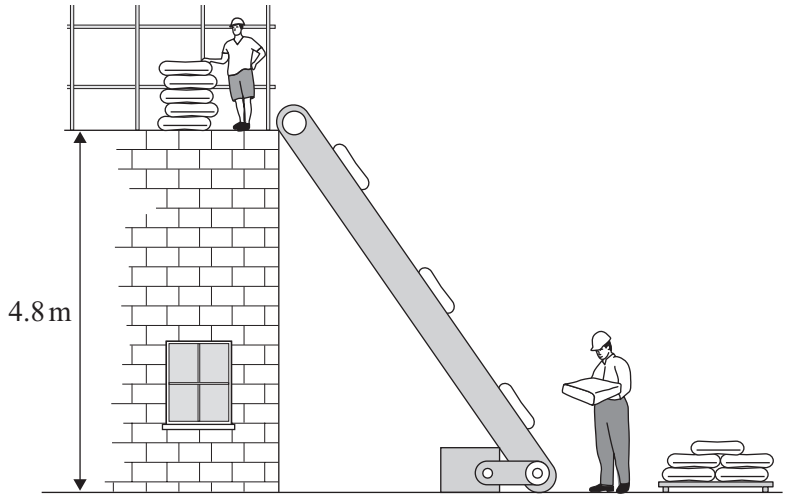
12

4.1.1.2 Changes in energy

Question 05

June 2005 | 3462 | Original Q10 | Legacy

10 A machine is used to lift materials on a building site.



(a) (i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) A 25 kg bag of cement is lifted from the ground to the top of the building.
Calculate the gain in the gravitational potential energy of the bag of cement.

(On Earth a 1 kg mass has a weight of 10 N.)

.....

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Change in gravitational potential energy = ... joules
(2 marks)

(b) The conveyor belt delivers six bags of cement each minute to the top of the building.

(i) Calculate the useful energy transferred by the machine each second.

.....

.....

.....

Useful energy transfer each second = ... J
(1 mark)

4.1.1.2 Changes in energy

Question 05 · continued

MARGIN BLANK

(ii) The machine is 40 % efficient.
Use the following equation to calculate the total energy supplied to the machine each second. Show how you work out your answer.

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

.....

.....

Total energy supplied each second = ... J
(2 marks)

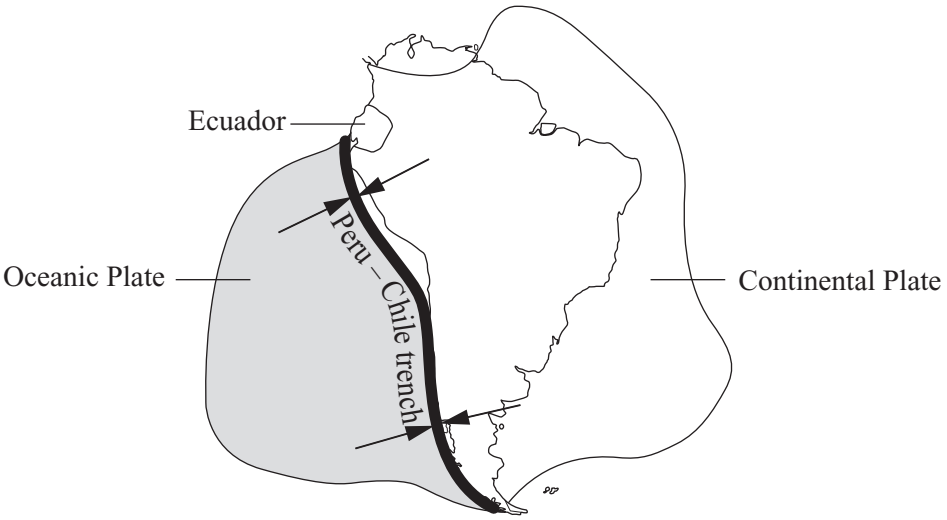
6

TURN OVER FOR THE NEXT QUESTION

4.1.1.2 Changes in energy

Question 06

11 The Peru–Chile trench runs down the west coast of South America. It is the boundary between two tectonic plates that are slowly moving towards each other.



Source: WITNEY, DROZDOWSKA AND MAILE, *AQA GCSE Physics* (Hodder & Stoughton) 2002. Adapted and reproduced by permission of Hodder & Stoughton.

(a) Explain what causes the tectonic plates to move.

.....

.....

.....

.....

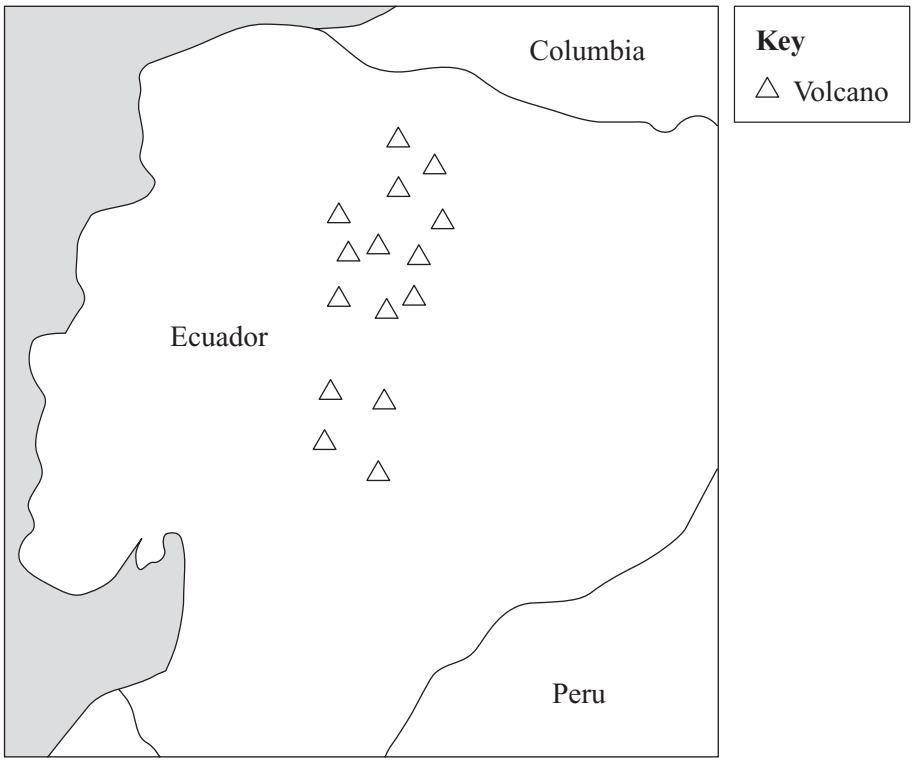
(2 marks)

4.1.1.2 Changes in energy

Question 06 · continued

MARGIN BLANK

(b) The map shows the location of some of the volcanoes in Ecuador. The volcanoes are all close to the Peru–Chile trench.



Explain how the volcanoes were formed.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) The eruption of Mount St Helens in the USA is one of the few volcanic eruptions to have been accurately predicted by scientists. The scientists had been monitoring *seismic activity*, levels of sulphur dioxide and changes to the ground level.

(i) What is meant by *seismic activity*?

.....

(1 mark)

QUESTION 11 CONTINUES ON THE NEXT PAGE

Question 06 · continued

(ii) Suggest why scientists find it difficult to predict accurately when a volcano is going to erupt.

.....

.....

.....

.....

(2 marks)

(d) The molten rock flowing from an erupting volcano can reach a speed of 8 m/s.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the kinetic energy of 1 tonne of molten rock flowing at 8 m/s.
(1 tonne = 1000 kg)

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Kinetic energy = ... joules
(1 mark)

(e) Read the information in the box and then answer the questions.

Igneous rocks contain potassium-40. This is a radioactive isotope. It has a half-life of 1300 million years.

Potassium-40 decays into argon-40 which is stable.

Argon escapes from molten rock. Any argon found in an igneous rock must have been produced since the rock solidified.

A sample of an igneous rock has one atom of potassium-40 for every three atoms of argon-40.

(i) What fraction of the potassium-40 has not yet decayed?

.....

(1 mark)

(ii) Calculate the age of the rock.

.....

Age of rock = ... million years
(1 mark)

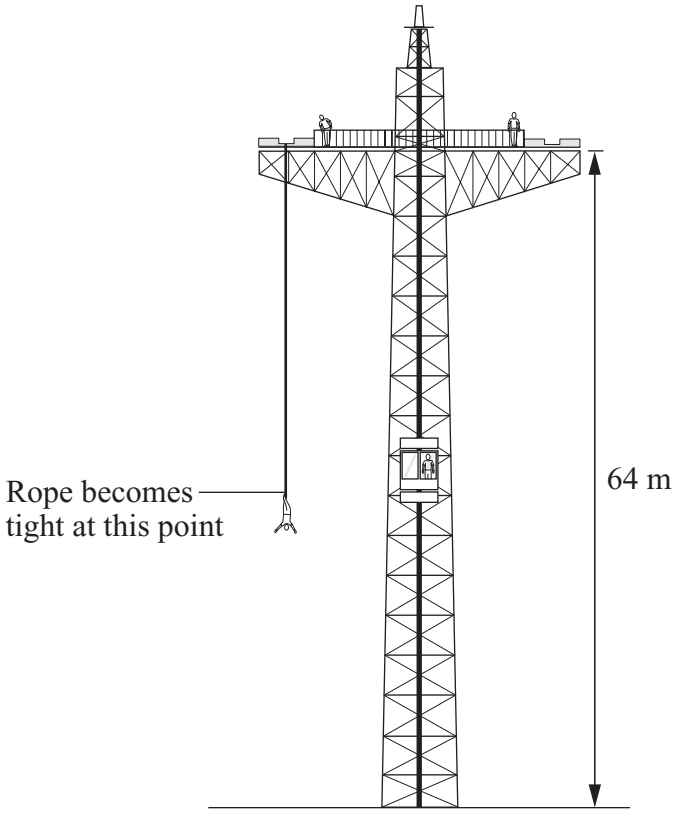
12

4.1.1.2 Changes in energy

Question 07

June 2006 | 3451 | Original Q14 | Legacy

14 The diagram shows a tower used for bungee jumping.



(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

(i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

.....

.....

.....

Increase in gravitational potential energy = ... joules

(2 marks)

4.1.1.2 Changes in energy

Question 07 · continued

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(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

.....

.....

.....

Speed = ... m/s

(3 marks)

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

To gain full marks in this question you should write you ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

(3 marks)

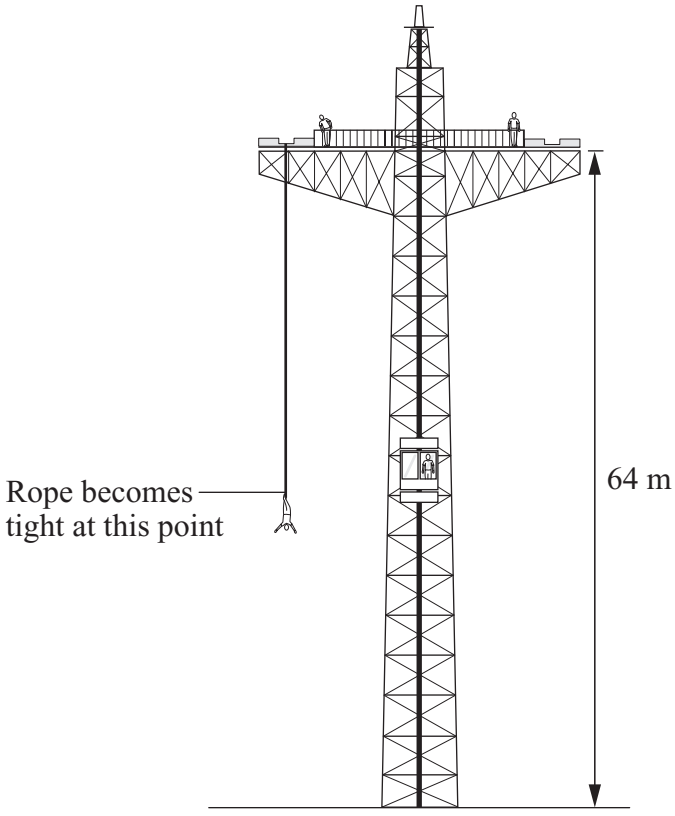
10

4.1.1.2 Changes in energy

Question 08

June 2006 | 3462 | Original Q12 | Legacy

12 The diagram shows a tower used for bungee jumping.



(a) A lift takes a person of mass 55 kg, to a platform 64 metres above the ground.

(i) Write down the equation that links change in gravitational potential energy, change in vertical height and weight.

.....

(1 mark)

(ii) Calculate the increase in the gravitational potential energy of the person when going from the ground to the platform.

Show clearly how you work out your final answer.
(Gravitational field strength = 10 N/kg)

.....

.....

.....

Increase in gravitational potential energy = ... joules

(2 marks)

4.1.1.2 Changes in energy

Question 08 · continued

BLANK

(b) The falling bungee jumper reaches a maximum speed when 15 840 joules of gravitational potential energy have been transferred into kinetic energy.

(i) Write down the equation that links kinetic energy, mass and speed.

.....

(1 mark)

(ii) Calculate the maximum speed of the falling bungee jumper.

Show clearly how you work out your final answer.

.....

.....

.....

Speed = ... m/s

(3 marks)

(c) As the rope stretches the bungee jumper slows down.

Describe fully the energy transfer that happens as the bungee jumper continues to fall towards the ground.

To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.

.....

.....

.....

.....

.....

.....

(3 marks)

10

4.1.1.2 Changes in energy

Question 09

March 2007 | PHY1A | Original Q2 | Legacy

QUESTION TWO

Thermal energy can be transferred in several ways.

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

A free electrons

B ions

C particles

D waves

Convection currents in liquids and gases are the result of expansion caused by . . . **1** . . . moving faster in hotter regions.

Thermal radiation is energy transfer by . . . **2** . . . .

The hotter a metal is, the greater the kinetic energy of the vibrating . . . **3** . . . in the metal structure.

Kinetic energy is transferred to cooler parts of the metal by . . . **4** . . . diffusing through it.

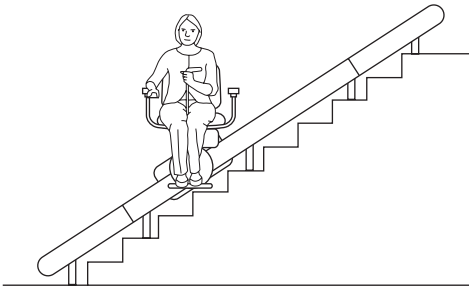
4.1.1.2 Changes in energy

Question 10

June 2007 | PHY1A | Original Q2 | Legacy

QUESTION TWO

The drawing shows a woman being moved upstairs by a stair lift.



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

A electrical energy

B gravitational potential energy

C sound energy

D thermal energy

As the stair lift moves upwards, . . . **1** . . . is usefully transformed to . . . **2** . . . .

Some energy is wasted, mainly as . . . **3** . . . , but also as . . . **4** . . . .

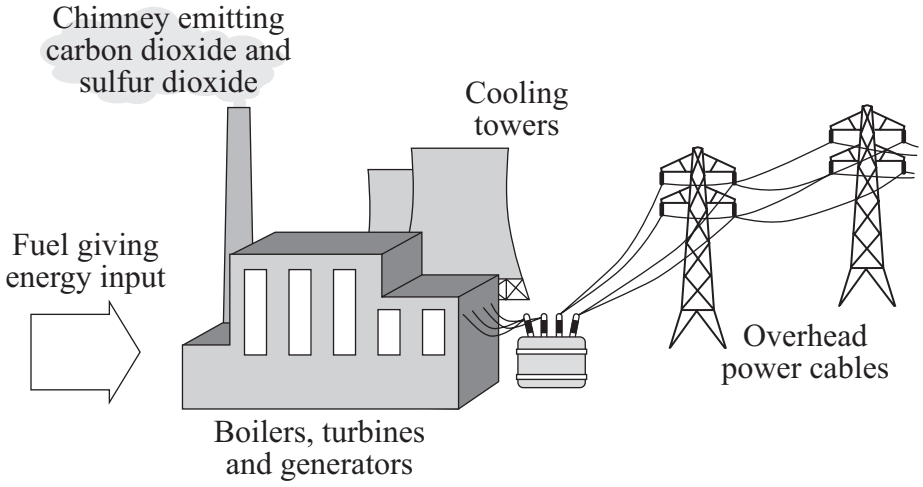
4.1.1.2 Changes in energy

Question 11

June 2007 | PHY1A | Original Q5 | Legacy

QUESTION FIVE

The diagram shows a power station.



5A What type of power station is this?

1 coal-burning

2 gas-burning

3 geothermal

4 nuclear

5B Which part transforms kinetic energy into electrical energy?

1 boiler

2 cooling tower

3 generator

4 turbine

4.1.1.2 Changes in energy

Question 11 · continued

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

What types of pollution are caused by the cooling towers?

1 chemical and noise

2 noise and thermal

3 thermal and visual

4 visual and chemical

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

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

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

2 More jobs will be created.

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

4 Waste heat can be used in nearby buildings.

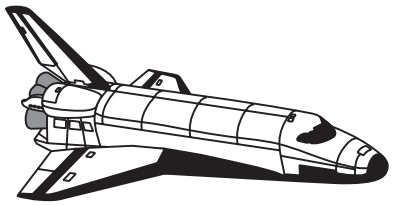
4.1.1.2 Changes in energy

Question 12

November 2007 | PHY1A | Original Q1 | Legacy

QUESTION ONE

The diagram shows the space shuttle returning to Earth. As it moves towards Earth, it moves faster.



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

A gravitational potential energy

B kinetic energy

C light energy

D thermal energy

As the shuttle moves towards Earth, it loses . . . **1** . . . .

When the shuttle moves faster, it gains . . . **2** . . . .

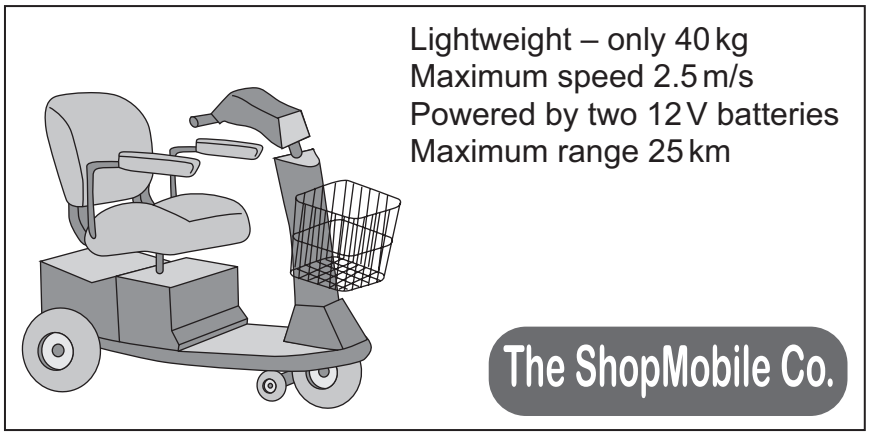
When the shuttle enters the Earth's atmosphere, there is a lot of friction. This makes the tiles covering the shuttle glow red. As a result, the shuttle gives off a lot of . . . **3** . . . and a little . . . **4** . . . .

4.1.1.2 Changes in energy

Question 13

January 2008 | PHY2H | Original Q3 | Legacy

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



(a) The batteries are joined in series.

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

.....

(1 mark)

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

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

.....

.....

(1 mark)

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

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

.....

.....

.....

.....

(2 marks)

4.1.1.2 Changes in energy

Question 13 · continued

BLANK

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

.....

(1 mark)

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

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

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

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2 marks)

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

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

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

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

.....

.....

Charge stored = ...

(3 marks)

10

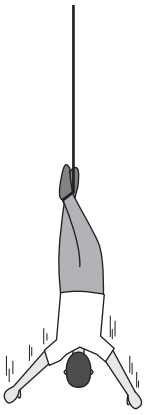
4.1.1.2 Changes in energy

Question 14

June 2008 | PHY1AP | Original Q2 | Legacy

QUESTION TWO

During a bungee jump, energy is transformed.



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

A gravitational potential energy

B heat (thermal energy)

C kinetic energy

D elastic potential energy

At the top of the jump there is . . . **1** . . . .

As the bungee jumper falls, he gains . . . **2** . . . .

During the fall, energy is wasted as . . . **3** . . . .

As the bungee cord is stretched, it gains . . . **4** . . . .

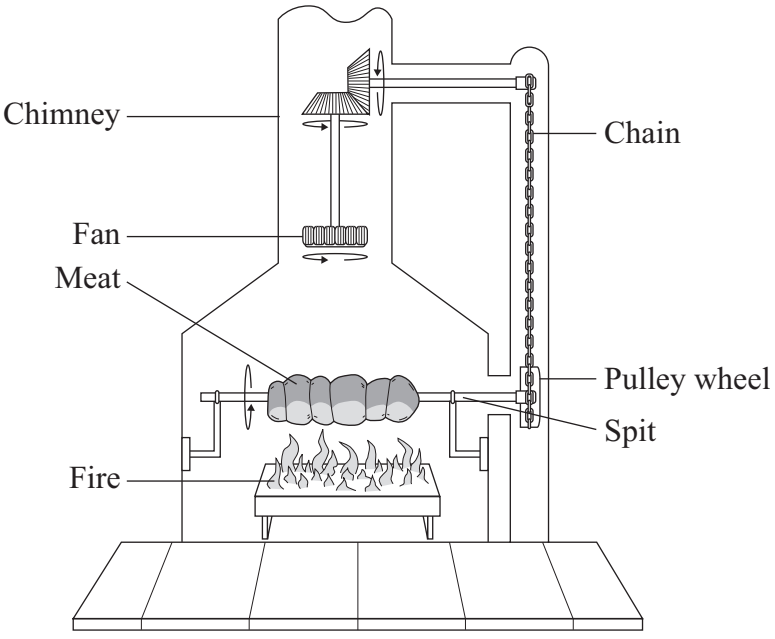
4.1.1.2 Changes in energy

Question 15

June 2008 | PHY1AP | Original Q5 | Legacy

QUESTION FIVE

The diagram shows a device called a spit-roast. The meat is both turned and cooked by the energy from the fire.



5A The fan turns because energy is transferred to it by . . .

1 combustion.

2 conduction.

3 convection.

4 radiation.

5B The surface of the meat darkens as it cooks.

As a result of this, the meat . . .

1 absorbs energy from convection currents less rapidly.

2 absorbs energy from convection currents more rapidly.

3 absorbs energy in the form of radiation more easily.

4 stays hot for longer after it has been removed from the spit.

4.1.1.2 Changes in energy

5C Heat is transferred through the meat mainly by . . .

1 conduction.

2 convection.

3 convection and radiation.

4 radiation.

5D As the spit turns, some kinetic energy will be transformed and wasted as . . .

1 chemical energy.

2 sound energy.

3 light energy.

4 electrical energy.

Turn over for the next question

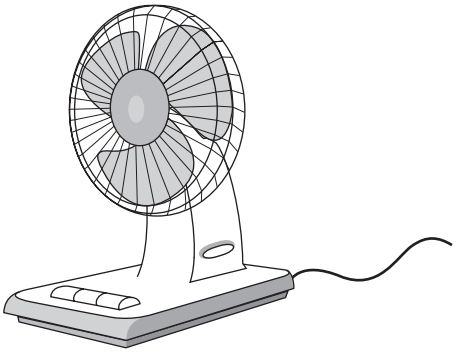
4.1.1.2 Changes in energy

Question 16

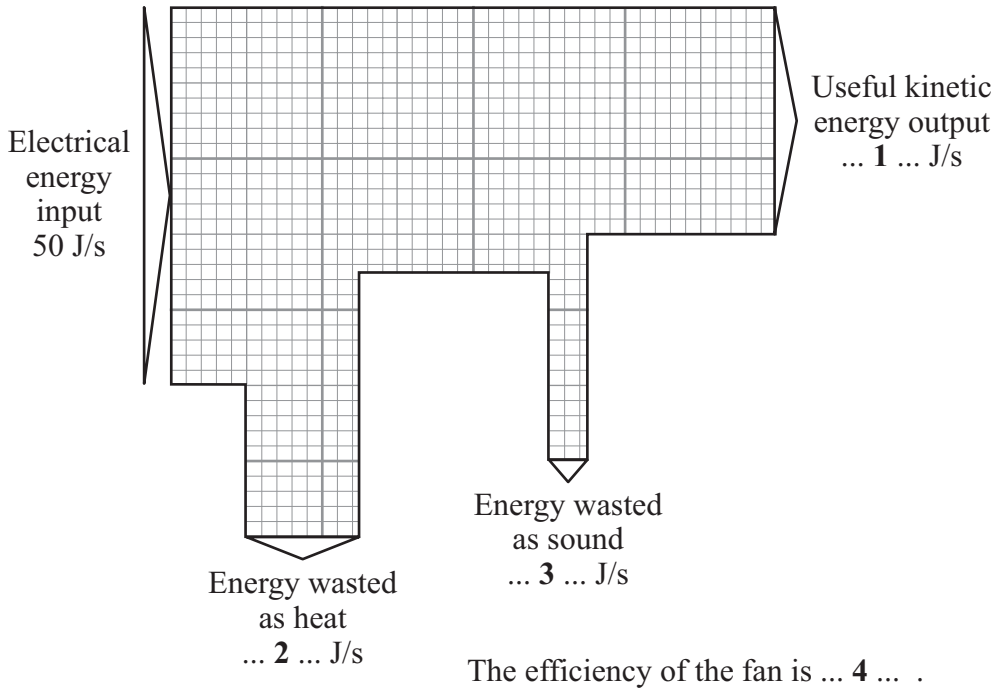
November 2008 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The diagram shows an electric fan.



The Sankey diagram gives the energy transformations for the fan.



The efficiency of the fan is ... **4** ... .

4.1.1.2 Changes in energy

Question 16 · continued

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

Match numbers, **A**, **B**, **C** and **D**, with the labels **1–4** on the Sankey diagram.

A 0.6

B 5

C 15

D 30

Turn over for the next question

4.1.1.2 Changes in energy

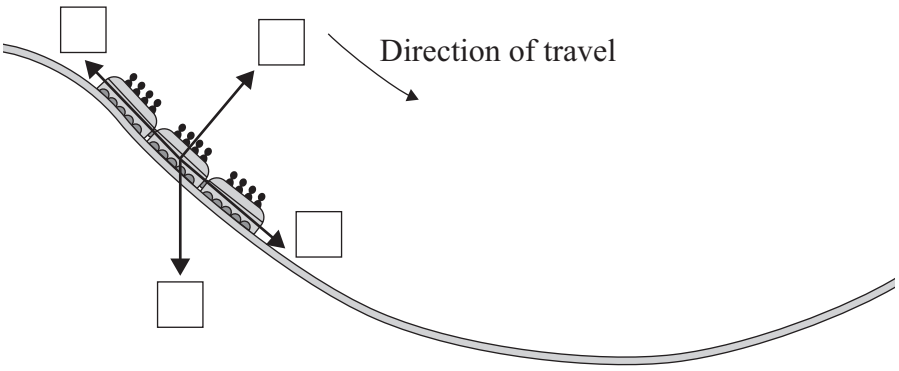
Question 17

January 2009 | PHY2H | Original Q1 | Legacy

1 The diagram shows the passenger train on part of a rollercoaster ride.

1 (a) Which arrow shows the direction of the resultant force acting on the passenger train?

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



(1 mark)

1 (b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

.....

.....

(1 mark)

1 (c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

1 (c) (i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1 mark)

4.1.1.2 Changes in energy

Question 17 · continued

for mark

1 (c) (ii) One of the passengers has a mass of 80 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

weight = mass × gravitational field strength

Show clearly how you work out your answer.

.....

.....

Maximum weight = ... N

(2 marks)

5

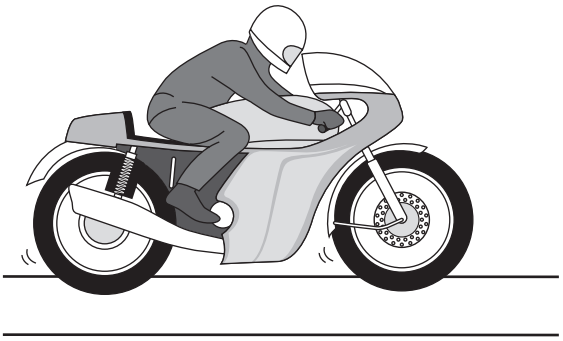
Turn over for the next question

4.1.1.2 Changes in energy

Question 18

June 2009 | PHY2H | Original Q5 | Legacy

5 The diagram shows a motorbike of mass 300 kg being ridden along a straight road.



The rider sees a traffic queue ahead. He applies the brakes and reduces the speed of the motorbike from 18 m/s to 3 m/s.

5 (a) Use the equation in the box to calculate the kinetic energy lost by the motorbike.

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

Show clearly how you work out your answer.

.....

.....

.....

.....

Kinetic energy lost = ... J

(2 marks)

5 (b) (i) How much work is done on the motorbike by the braking force?

.....

(1 mark)

5 (b) (ii) What happens to the kinetic energy lost by the motorbike?

.....

(1 mark)

4

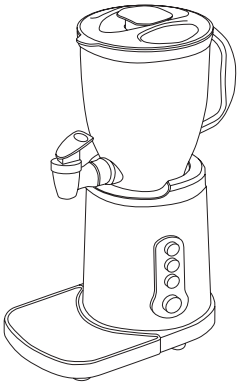
4.1.1.2 Changes in energy

Question 19

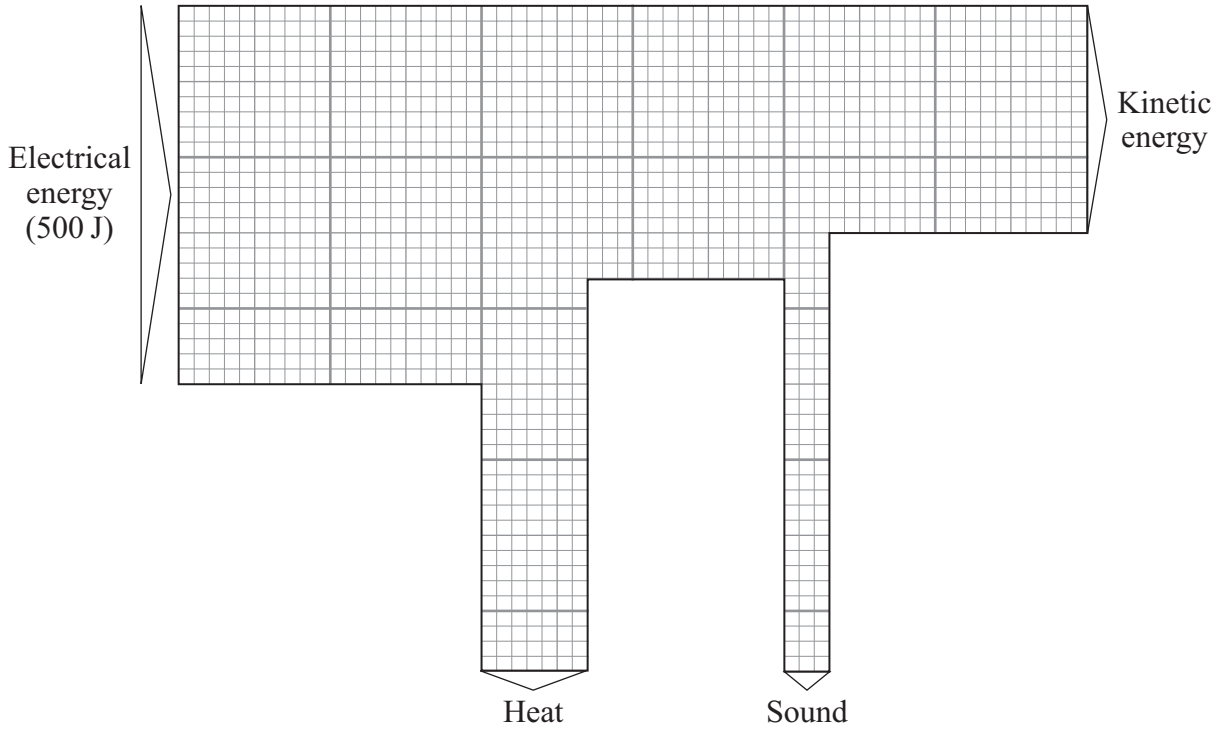
November 2009 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

The diagram shows a smoothie maker.



The Sankey diagram shows the energy transfers that take place each second in this smoothie maker.



4.1.1.2 Changes in energy

Question 19 · continued

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

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

A 0.6

B 140

C 200

D 300

The kinetic energy produced each second is . . . **1** . . . J.

The heat produced each second is . . . **2** . . . J.

The total energy wasted each second is . . . **3** . . . J.

The efficiency of the smoothie maker is . . . **4** . . . .

4.1.1.2 Changes in energy

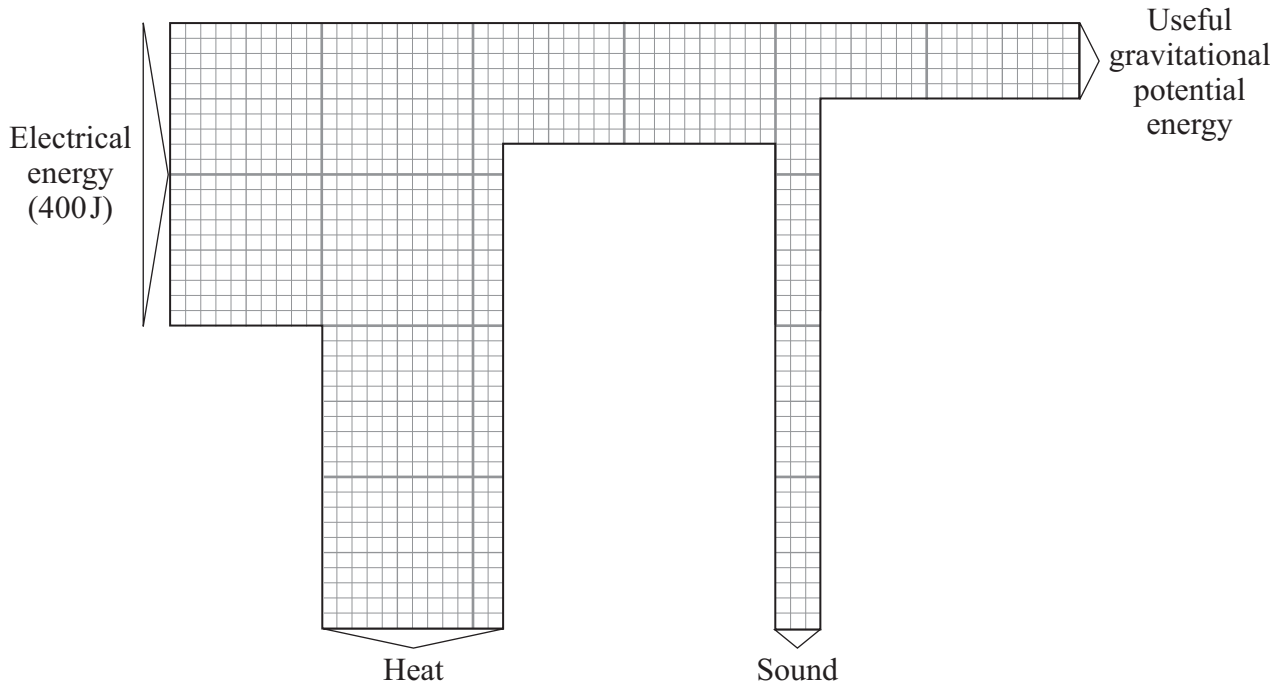
Question 20

March 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

An electric motor is used to lift a weight.

The Sankey diagram shows the energy transformations that take place each second in the electric motor.



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

A 0.25

B 60

C 100

D 240

4.1.1.2 Changes in energy

Question 20 · continued

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

The useful gravitational potential energy gained each second is . . . **1** . . . J.

The heat (thermal energy) produced each second is . . . **2** . . . J.

The sound energy produced each second is . . . **3** . . . J.

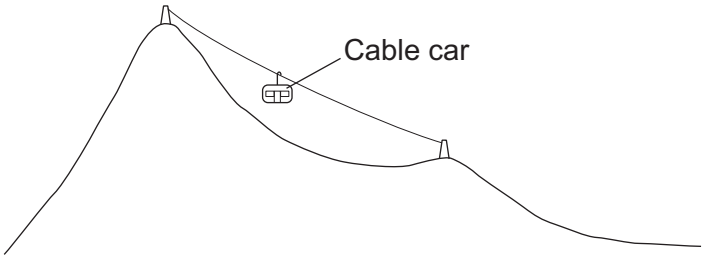
The total energy wasted each second is 300 J. The efficiency of the electric motor is . . . **4** . . . .

4.1.1.2 Changes in energy

Question 21

June 2010 | PHY2H | Original Q1 | Legacy

1 (a) The diagram shows a cable car used to take skiers to the top of a mountain.



1 (a) (i) The total mass of the cable car and skiers is 7500 kg.

Use the equation in the box to calculate the weight of the cable car and skiers.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

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

.....

.....

Weight = ...

(3 marks)

4.1.1.2 Changes in energy

Question 21 · continued

1 (a) (ii) The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Use the following equation to calculate the work done to lift the cable car and skiers.

work done = force applied × distance moved in the direction of force

Show clearly how you work out your answer.

.....

.....

Work done = ... J

(2 marks)

1 (b) The diagram shows a skier who is accelerating down a steep ski slope.



1 (b) (i) Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

(1 mark)

1 (b) (ii) How and why does the kinetic energy of the skier change?

.....

.....

.....

.....

(2 marks)

Question 1 continues on the next page

4.1.1.2 Changes in energy

Question 21 · continued

1 (c) Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet. However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

.....

.....

(1 mark)

9

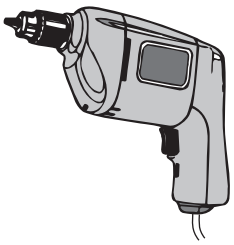
4.1.1.2 Changes in energy

Question 22

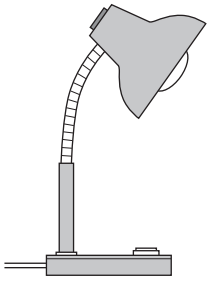
November 2010 | PHY1AP | Original Q1 | Legacy

QUESTION ONE

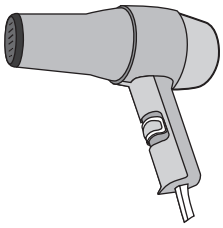
The diagrams show four electrical devices. The Sankey diagrams show the energy transformations involved in the four electrical devices.



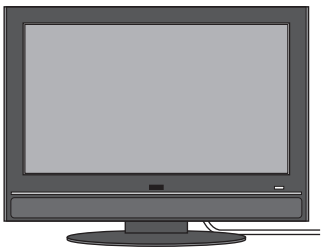
A
Electric drill



B
Desk lamp



C
Hair dryer



D
Television

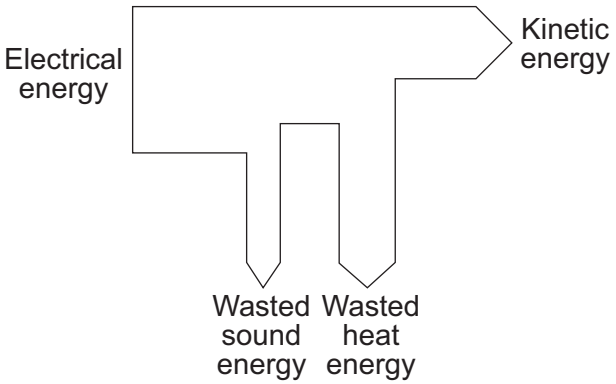
Match devices, **A**, **B**, **C** and **D**, with the Sankey diagrams **1**–**4**.

4.1.1.2 Changes in energy

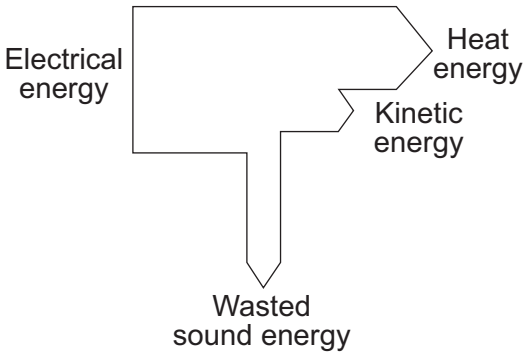
Question 22 · continued

November 2010 | PHY1AP | Original Q1 | Legacy

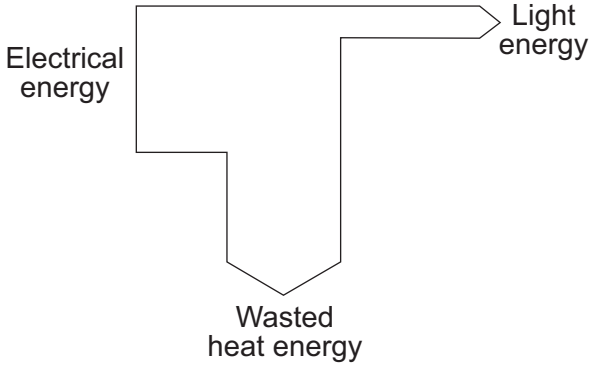
1



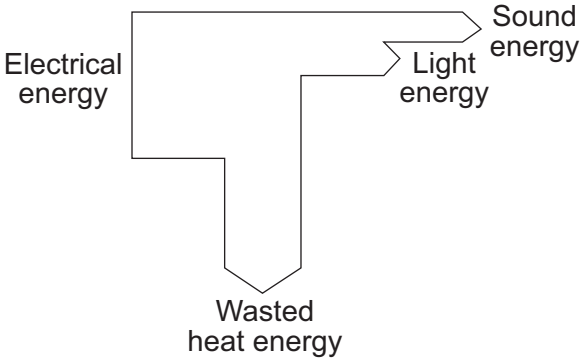
2



3



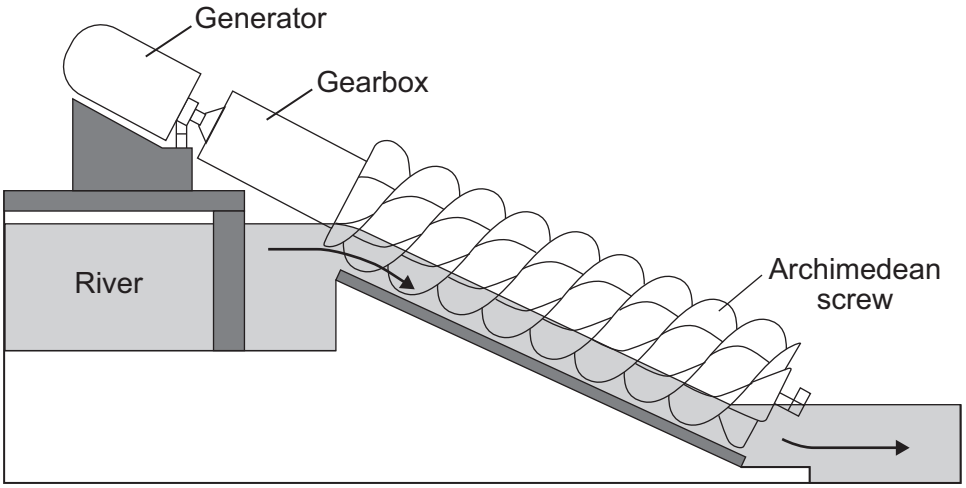
4



4.1.1.2 Changes in energy

Question 23

4 The diagram shows a small-scale, *micro-hydroelectricity* generator which uses the energy of falling river water to generate electricity. The water causes a device, called an Archimedean screw, to rotate.
The Archimedean screw is linked to the generator by a gearbox.



4 (a) Each second, the *micro-hydroelectricity* generator transforms 80 000 joules of gravitational potential energy into 60 000 joules of electrical energy.

4 (a) (i) Fill in the missing word to complete the energy transformation diagram.

Gravitational potential energy of the falling water	→ ..... energy of the Archimedean screw	→ Electrical energy generated

(1 mark)

4 (a) (ii) Use the equation in the box to calculate the efficiency of the *micro-hydroelectricity* generator.

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

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2 marks)

4.1.1.2 Changes in energy

Question 23 · continued

4 (b) The power output from a conventional large-scale hydroelectric power station is 100 000 times more than the power output from a micro-hydroelectric system.

Give **one** disadvantage of a conventional large-scale hydroelectric power station compared to the micro-hydroelectric system.

.....

.....

(1 mark)

4 (c) The electricity generated by a micro-hydroelectric system is transferred via a transformer directly to local homes. The electricity generated by a conventional large-scale hydroelectric power station is transferred to the National Grid, which distributes the electricity to homes anywhere in the country.

4 (c) (i) What is the National Grid?

.....

.....

(1 mark)

4 (c) (ii) Explain why transferring the electricity directly to local homes is more efficient than using the National Grid to distribute the electricity.

.....

.....

.....

.....

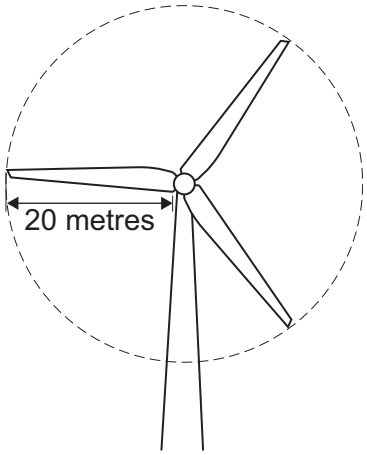
(2 marks)

7

4.1.1.2 Changes in energy

Question 24

4 The diagram shows a wind turbine.



4 (a) The blades of the turbine are 20 metres long. On average, 15 000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

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

Show clearly how you work out your answer.

.....

.....

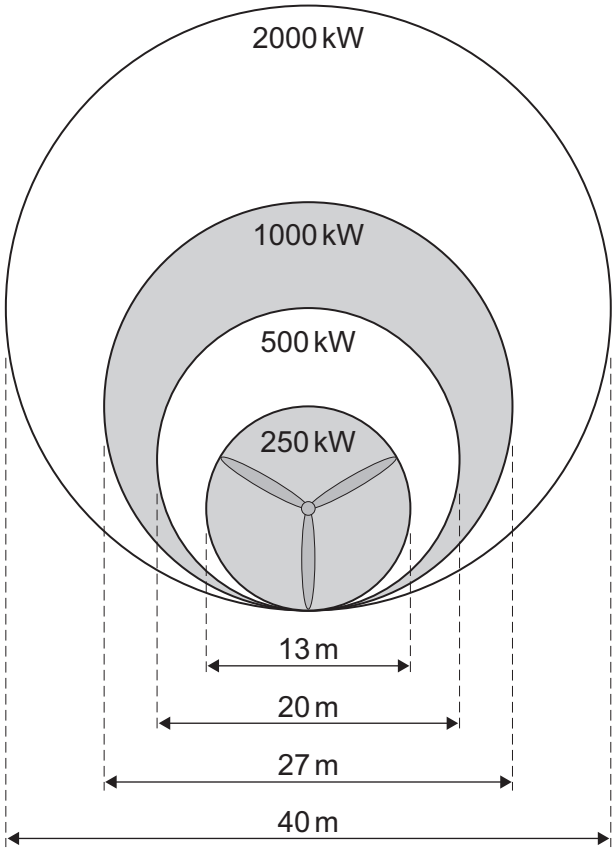
Kinetic energy = ... J

(2 marks)

4.1.1.2 Changes in energy

Question 24 · continued

4 (b) Part of the kinetic energy of the wind is transformed into electrical energy.
The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.



Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

.....

.....

(1 mark)

3

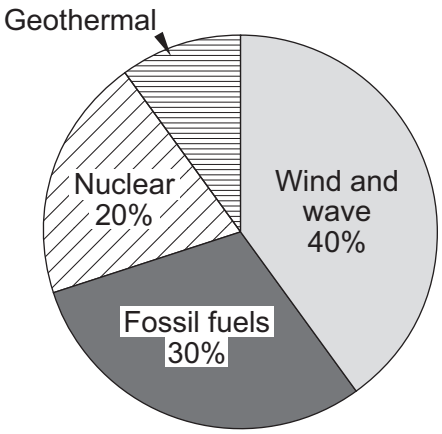
4.1.1.2 Changes in energy

Question 25

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** . . . .

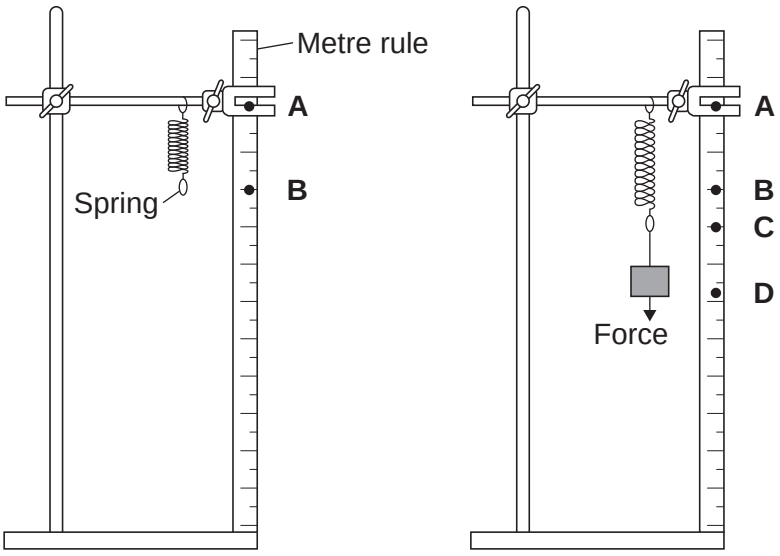
4.1.1.2 Changes in energy

Question 26

June 2012 | PH2HP | Original Q1 | Legacy

1 A student investigated how the extension of a spring depends on the force applied to the spring.

The diagram shows the spring before and after a force had been applied.



1 (a) (i) Complete the following sentence using letters, **A**, **B**, **C** or **D**, from the diagram.

The extension of the spring is the distance between the positions labelled .....

and ..... on the metre rule.

(1 mark)

1 (a) (ii) What form of energy is stored in the stretched spring?

.....

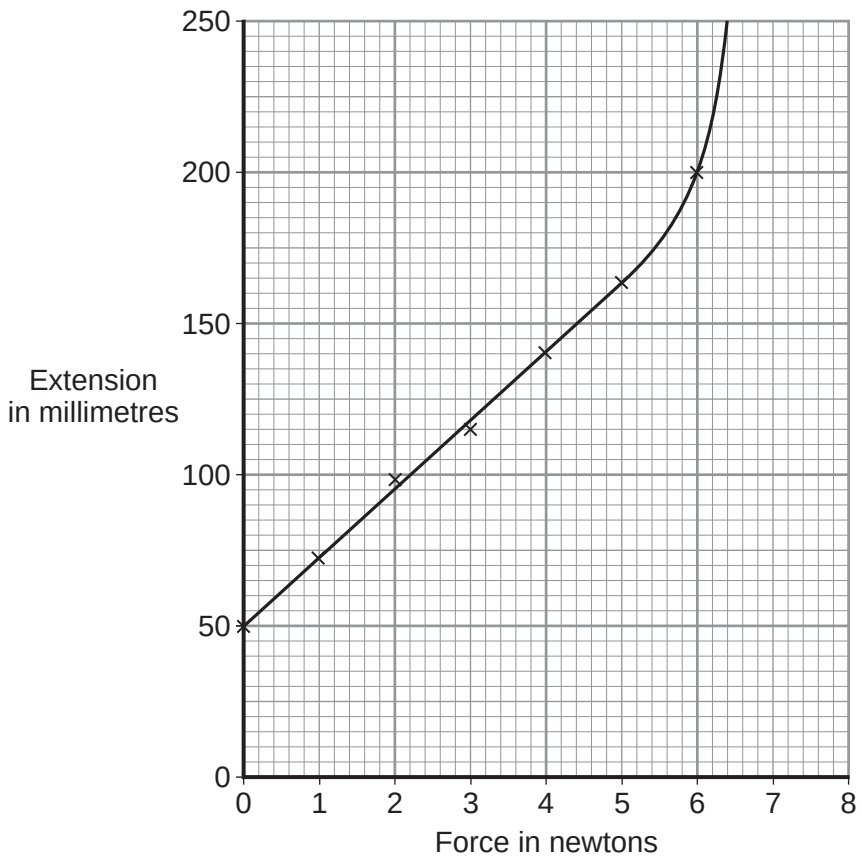
(1 mark)

Question 1 continues on the next page

4.1.1.2 Changes in energy

Question 26 · continued

1 (b) The results from the investigation are plotted on the following graph.



1 (b) (i) The graph shows that the student has made an error throughout the investigation.

What error has the student made?

.....

.....

Give the reason for your answer.

.....

.....

(2 marks)

4.1.1.2 Changes in energy

Question 26 · continued

1 (b) (ii) The student has loaded the spring beyond its *limit of proportionality*.

Mark on the graph line the *limit of proportionality* of the spring. Label the point **P**.

Give the reason for choosing your point **P**.

.....

.....

.....

(2 marks)

1 (c) The student uses a different spring as a spring balance. When the student hangs a stone from this spring, its extension is 72 mm.

The spring does not go past the limit of proportionality.

Calculate the force exerted by the stone on the spring.

spring constant = 25 N/m

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Force = ... N

(2 marks)

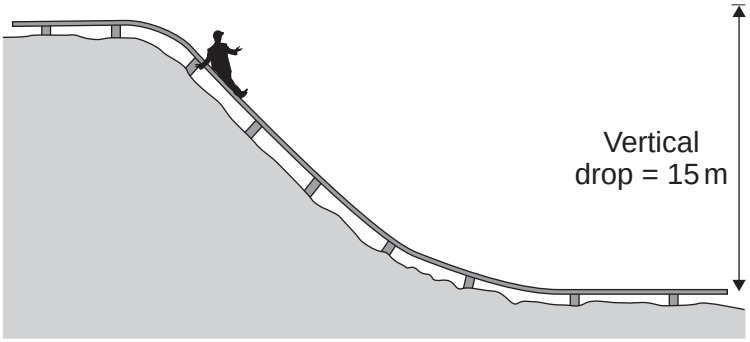
8

4.1.1.2 Changes in energy

Question 27

June 2012 | PH2HP | Original Q4 | Legacy

4 The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.



4 (a) A miner of mass 90 kg travels down the slide.

Calculate the change in gravitational potential energy of the miner when he moves 15m vertically downwards.

gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Change in gravitational potential energy = ... J

(2 marks)

4.1.1.2 Changes in energy

Question 27 · continued

4 (b) Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Give your answer to an appropriate number of significant figures.

.....

.....

.....

.....

Maximum possible speed = ... m/s

(3 marks)

4 (c) The speed of the miner at the bottom of the slide is much less than the calculated maximum possible speed.

Explain why.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

8

4.1.1.2 Changes in energy

Question 28

June 2013 | PH2HP | Original Q4 | Legacy

4 (a) The stopping distance of a vehicle is made up of two parts, the thinking distance and the braking distance.

4 (a) (i) What is meant by *thinking distance*?

.....

.....

(1 mark)

4 (a) (ii) State **two** factors that affect thinking distance.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) A car is travelling at a speed of 20 m/s when the driver applies the brakes. The car decelerates at a constant rate and stops.

4 (b) (i) The mass of the car and driver is 1600 kg.

Calculate the kinetic energy of the car and driver before the brakes are applied.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Kinetic energy = ... J

(2 marks)

4 (b) (ii) How much work is done by the braking force to stop the car and driver?

Work done = ... J

(1 mark)

4.1.1.2 Changes in energy

Question 28 · continued

4 (b) (iii) The braking force used to stop the car and driver was 8000 N.

Calculate the braking distance of the car.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

.....

Braking distance = ... m

(2 marks)

4 (b) (iv) The braking distance of a car depends on the speed of the car and the braking force applied.

State **one** other factor that affects braking distance.

.....

.....

(1 mark)

4 (b) (v) Applying the brakes of the car causes the temperature of the brakes to increase.

Explain why.

.....

.....

.....

.....

(2 marks)

Question 4 continues on the next page

4.1.1.2 Changes in energy

Question 28 · continued

4 (c) Hybrid cars have an electric engine and a petrol engine. This type of car is often fitted with a regenerative braking system. A regenerative braking system not only slows a car down but at the same time causes a generator to charge the car's battery.

State and explain the benefit of a hybrid car being fitted with a regenerative braking system.

.....

.....

.....

.....

.....

.....

(3 marks)

14

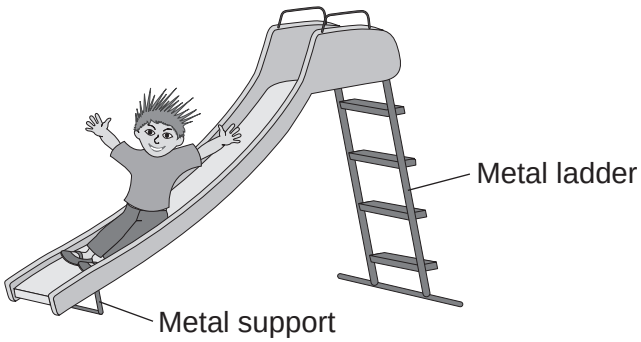
4.1.1.2 Changes in energy

Question 29

June 2014 | PH2HP | Original Q1 | Legacy

1 **Figure 1** shows a slide in a children's playground.

Figure 1



1 (a) A child of mass 18 kilograms goes down the slide.

The vertical distance from the top to the bottom of the slide is 2.5 metres.

Calculate the decrease in gravitational potential energy of the child sliding from the top to the bottom of the slide.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Decrease in gravitational potential energy = ... J

4.1.1.2 Changes in energy

Question 29 · continued

1 (b) The slide is made of plastic.

1 (b) (i) The child becomes electrically charged when he goes down the slide.

Explain why.

[2 marks]

.....

.....

.....

.....

1 (b) (ii) Going down the slide causes the child's hair to stand on end.

What conclusion about the electrical charge on the child's hair can be made from this observation?

[2 marks]

.....

.....

Give a reason for your answer.

.....

.....

1 (b) (iii) Why would the child **not** become electrically charged if the slide was made from metal?

[1 mark]

.....

.....

7

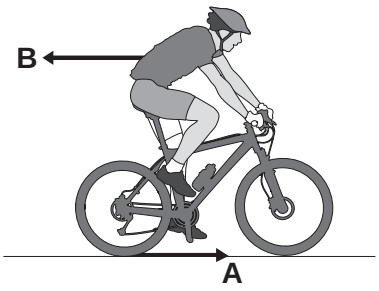
4.1.1.2 Changes in energy

Question 30

June 2014 | PH2HP | Original Q3 | Legacy

3 (a) **Figure 2** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 2



3 (a) (i) What causes force **A**?

Draw a ring around the correct answer.

[1 mark]

friction **gravity** **weight**

3 (a) (ii) What causes force **B**?

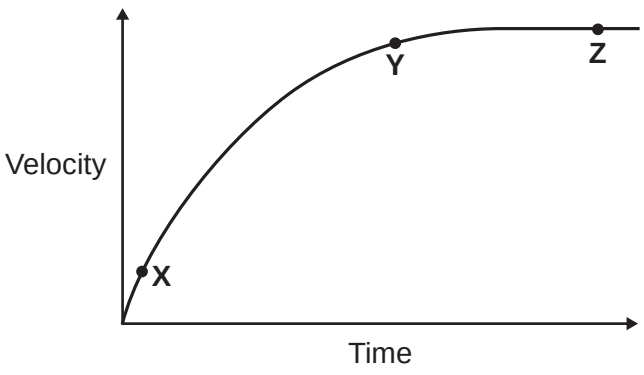
[1 mark]

.....

3 (a) (iii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 3 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

Figure 3



4.1.1.2 Changes in energy

Question 30 · continued

Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 3**.

[6 marks]

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Extra space .....

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4.1.1.2 Changes in energy

Question 30 · continued

3 (b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Work done = ...

3 (b) (ii) Complete the following sentences.

[2 marks]

When the brakes are used, the bicycle slows down. The kinetic energy of the bicycle ..... .

At the same time, the ..... of the brakes increases.

13

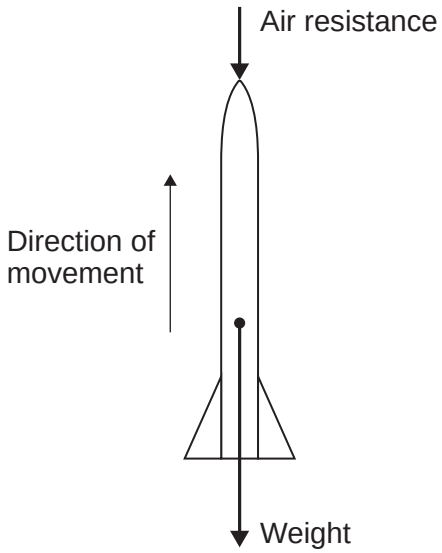
4.1.1.2 Changes in energy

Question 31

June 2015 | PH2HP | Original Q6 | Legacy

6 (a) **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 7



6 (a) (i) How does the velocity of the rocket change as the rocket moves **upwards**?

[2 marks]

.....

Give a reason for your answer.

.....

.....

6 (a) (ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

[1 mark]

.....

.....

.....

4.1.1.2 Changes in energy

Question 31 · continued

6 (b) The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

6 (b) (i) Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Kinetic energy = ... J

6 (b) (ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

6 (b) (iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Maximum height = ... m

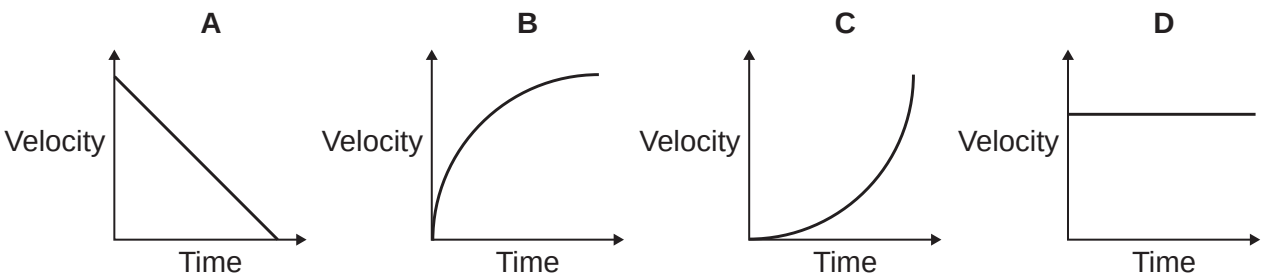
Question 6 continues on the next page

4.1.1.2 Changes in energy

Question 31 · continued

6 (b) (iv) **Figure 8** shows four velocity–time graphs.

Figure 8



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

[1 mark]

Write the correct answer in the box.

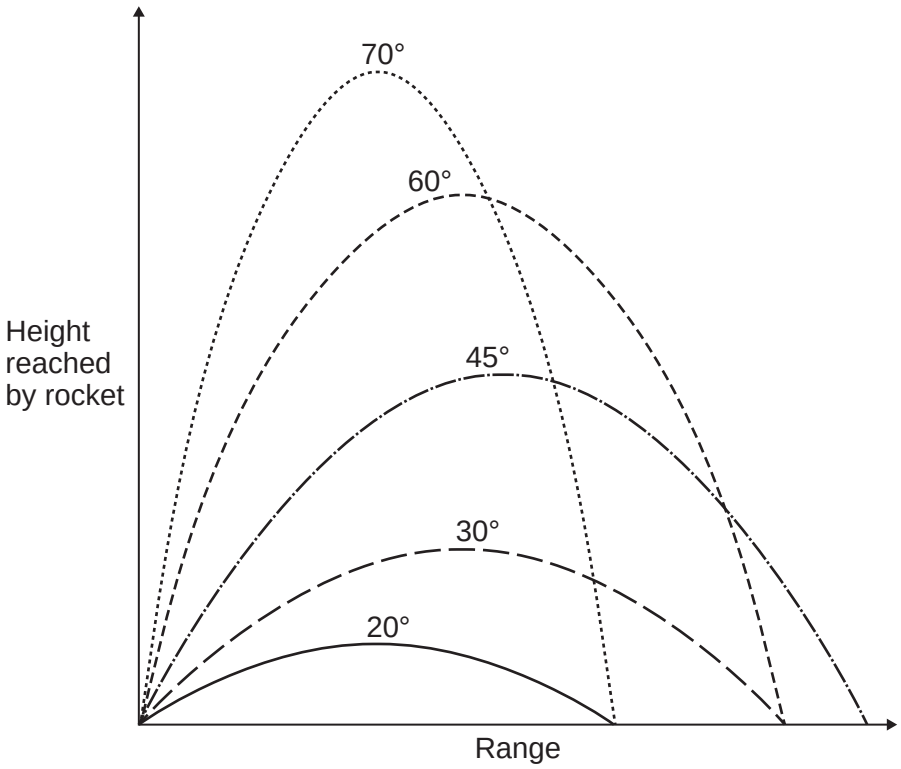
4.1.1.2 Changes in energy

Question 31 · continued

6 (c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 9 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 9



What pattern links the angle at which the rocket is launched and the range of the rocket?

[2 marks]

.....

.....

.....

.....

11

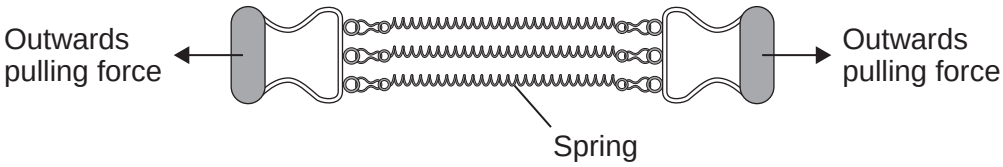
4.1.1.2 Changes in energy

Question 32

June 2016 | PH2HP | Original Q5 | Legacy

5 **Figure 11** shows an exercise device called a chest expander. The three springs are identical.

Figure 11



A person pulls outwards on the handles and does work to stretch the springs.

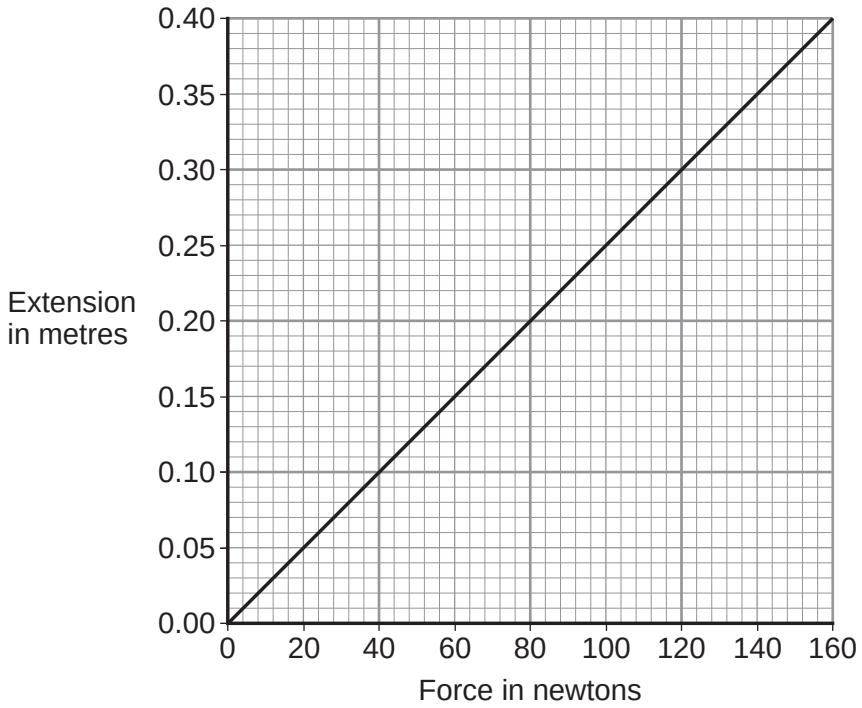
5 (a) Complete the following sentence.

[1 mark]

When the springs are stretched _____ _____ energy is stored in the springs.

5 (b) **Figure 12** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 12



4.1.1.2 Changes in energy

Question 32 · continued

5 (b) (i) How can you tell, from **Figure 12**, that the limit of proportionality of the spring has not been exceeded?

[1 mark]

_____

_____

5 (b) (ii) Use data from **Figure 12** to calculate the spring constant of the spring.
Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Spring constant = _____ Unit _____

5 (b) (iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 12** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

[2 marks]

_____

_____

Total force = _____ N

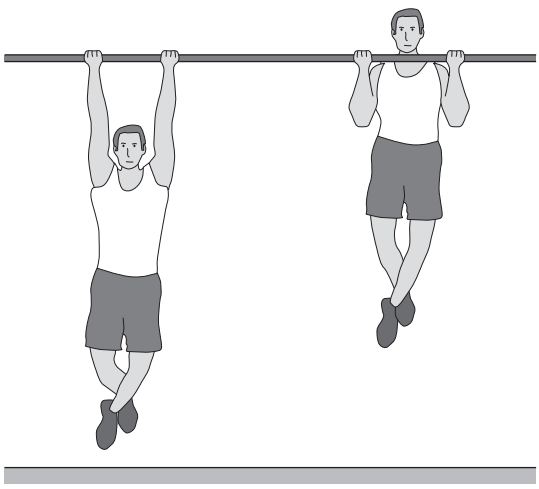
Question 5 continues on the next page

4.1.1.2 Changes in energy

Question 32 · continued

5 (c) The student in **Figure 13** is doing an exercise called a chin-up.

Figure 13



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

Use the correct equations from the Physics Equations Sheet.

[3 marks]

Power = _____ W

10

4.1.1.2 Changes in energy

Question 33

June 2018 | 8463/1H | Original Q10

1 0 **Figure 16** shows a wind turbine.

Figure 16



1 0 . 1 At a particular wind speed, a volume of 2.3×10^4 m^3 of air passes the blades each second.

The density of air is 1.2 kg/m^3.

Calculate the mass of air passing the blades per second.

[3 marks]

Mass of air per second = _____ kg

1 0 . 2 The power output of the turbine is directly proportional to the kinetic energy of the air passing the blades each second.

Describe the effect on the power output when the wind speed is halved.

[3 marks]

4.1.1.2 Changes in energy

Question 33 · 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

4.1.1.2 Changes in energy

Question 34

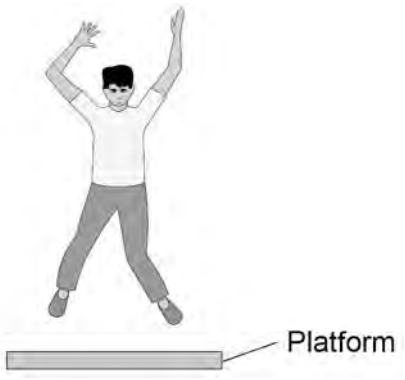
June 2019 | 8463/1H | Original Q3

0 3 A scientist investigated how the maximum muscle power of humans varies with age and gender.

The scientist asked volunteers to stand on a platform and to jump as high as they could.

Figure 4 shows a volunteer taking part in the experiment.

Figure 4



An electronic timer measured the time that the volunteer was in the air.

0 3 . 1 The muscle power in watts per kg is calculated using the following equation:

$$\text{muscle power} = \frac{9.8 \times \text{jump height}}{\text{time}}$$

One volunteer has a muscle power of 41 W/kg

He was in the air for 0.12 s

Calculate his jump height.

[3 marks]

Jump height = _____ m

Question 34 · continued

0 3 . 2 Write down the equation which links kinetic energy, mass and speed.

[1 mark]

0 3 . 3 One volunteer had a kinetic energy of 270 J and a speed of 3.0 m/s at the moment he left the ground.

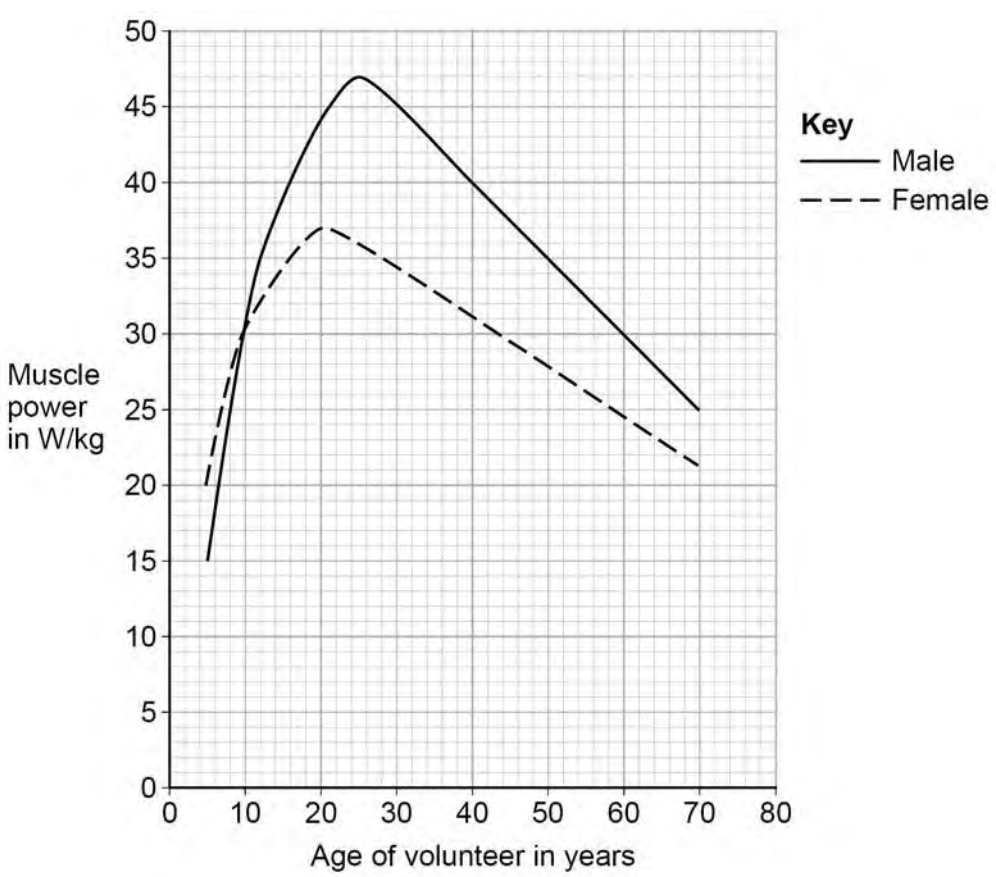
Calculate his mass.

[3 marks]

Mass = _____ kg

Figure 5 shows the scientist's results.

Figure 5



4.1.1.2 Changes in energy

Question 34 · continued

0 3 . 4 Compare the muscle power of males with the muscle power of females.

Use data from **Figure 5** in your answer.

[4 marks]

0 3 . 5 The muscle power of each volunteer was measured five times.

The highest muscle power reading was recorded instead of calculating an average.

Suggest **one** reason why.

[1 mark]

12

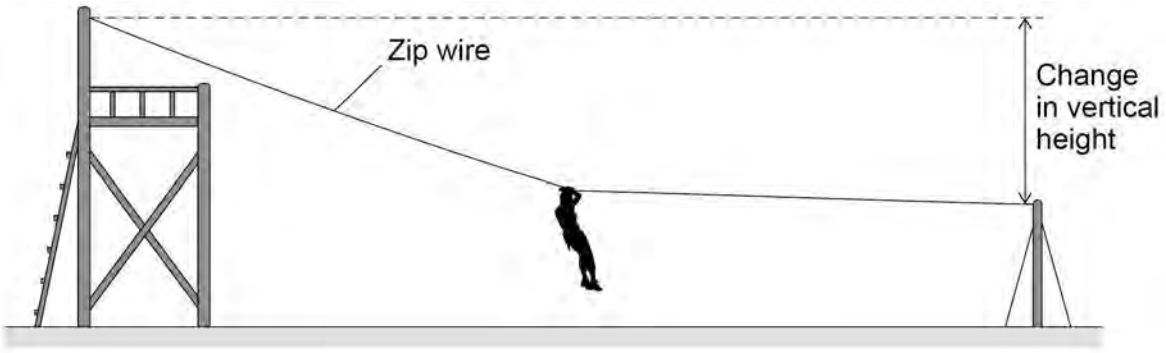
4.1.1.2 Changes in energy

Question 35

June 2019 | 8463/1H | Original Q7

0 7 **Figure 9** shows a person sliding down a zip wire.

Figure 9



0 7 . 1 As the person slides down the zip wire, the change in the gravitational potential energy of the person is 1.47 kJ

The mass of the person is 60 kg

gravitational field strength = 9.8 N/kg

Calculate the change in vertical height of the person.

[3 marks]

Change in vertical height = _____ m

4.1.1.2 Changes in energy

Question 35 · continued

0 7 . 2 As the person moves down the zip wire her increase in kinetic energy is less than her decrease in gravitational potential energy.

Explain why.

[2 marks]

0 7 . 3 Different people have different speeds at the end of the zip wire.

Explain why.

[2 marks]

7

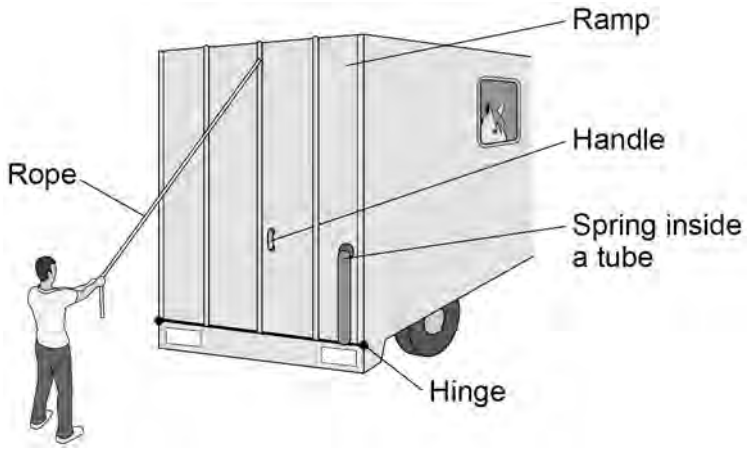
4.1.1.2 Changes in energy

Question 36

June 2019 | 8463/2H | Original Q10

1 0 **Figure 19** shows the back of a lorry. The lorry is used to carry horses.

Figure 19



The ramp is lowered by pulling on the rope or by pulling on the handle.

The hinge acts as a pivot.

1 0 . 1 Explain why it is easier to lower the ramp by pulling on the rope rather than pulling on the handle.

[2 marks]

Question 10 continues on the next page

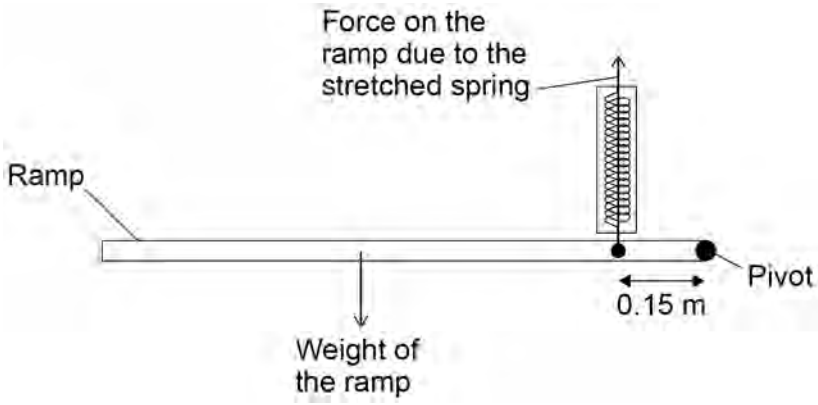
4.1.1.2 Changes in energy

Question 36 · continued

When the ramp is lowered, work is done to stretch a spring on the side of the ramp. Elastic potential energy is stored in the stretched spring.

Figure 20 shows the ramp part way down in a balanced horizontal position.

Figure 20



1 0 . 2 With the ramp horizontal:

the moment caused by the weight of the ramp = 924 Nm

the spring is stretched by 0.250 m

Calculate the elastic potential energy stored in the stretched spring.

Use data from **Figure 20**.

[6 marks]

Elastic potential energy = _____ J

8

4.1.1.2 Changes in energy

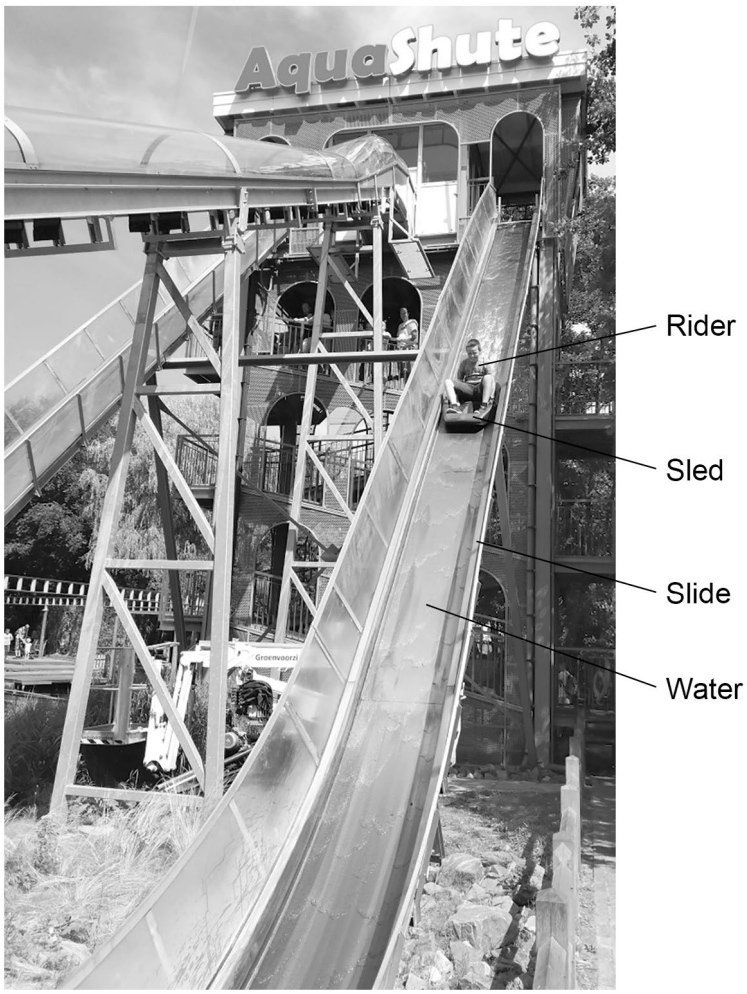
Question 37

November 2020 | 8463/1H | Original Q6

0 6 **Figure 9** shows a theme park ride called AquaShute.

Riders of the AquaShute sit on a sled and move down a slide.

Figure 9



0 6 . 1 A light gate and data logger can be used to determine the speed of each rider and sled.

What two measurements are needed to determine the speed of a rider and sled?

[2 marks]

Tick (✓) **two** boxes.

- Gravitational field strength ☐
- Length of sled ☐
- Mass of rider and sled ☐
- Temperature of surroundings ☐
- Time for sled to pass light gate ☐

4.1.1.2 Changes in energy

Question 37 · continued

0 6 . 2 The decrease in gravitational potential energy of one rider on the slide was 8.33 kJ.

The rider moved through a vertical height of 17.0 m.

gravitational field strength = 9.8 N/kg

Calculate the mass of the rider.

[4 marks]

Mass of rider = _____ kg

0 6 . 3 At the bottom of the slide, all riders and their sleds have approximately the same speed.

Explain why.

[4 marks]

10

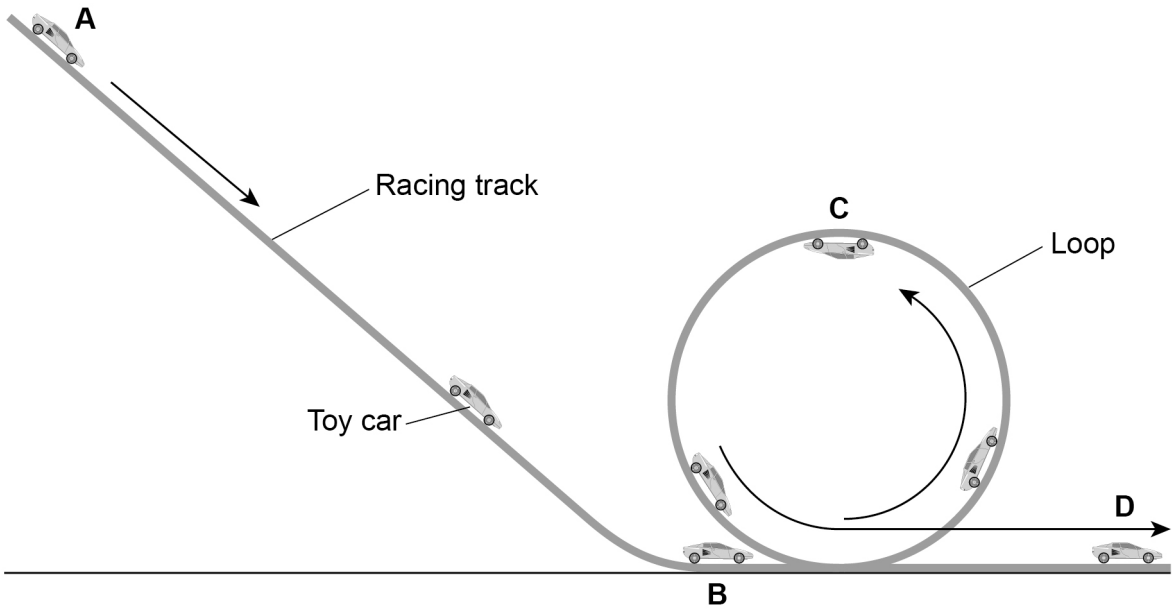
4.1.1.2 Changes in energy

Question 38

November 2021 | 8463/1H | Original Q8

0 8 **Figure 11** shows a toy car in different positions on a racing track.

Figure 11



0 8 . 1 The toy car and racing track can be modelled as a closed system.

Why can the toy car and racing track be considered 'a closed system'?

[1 mark]

Tick (✓) **one** box.

The racing track and the car both have gravitational potential energy. ☐

The racing track and the car are always in contact with each other. ☐

The total energy of the racing track and the car is constant. ☐

4.1.1.2 Changes in energy

Question 38 · continued

0 8 . 2 The car is released from rest at position **A** and accelerates due to gravity down the track to position **B**.

mass of toy car = 0.040 kg

vertical height between position **A** and position **B** = 90 cm

gravitational field strength = 9.8 N/kg

Calculate the maximum possible speed of the toy car when it reaches position **B**.

[5 marks]

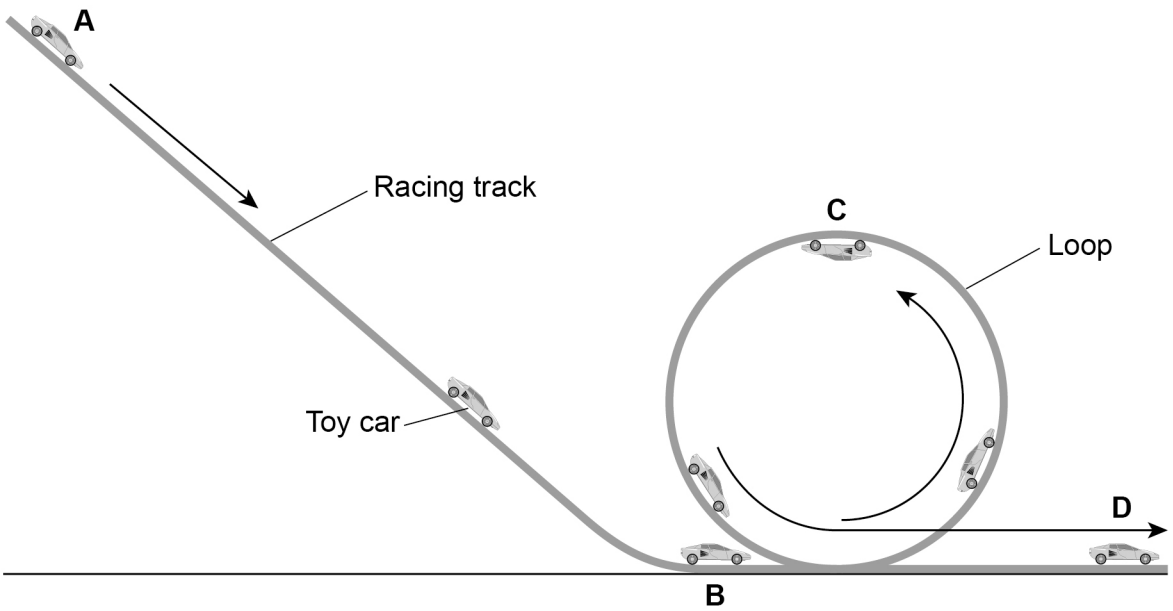
Speed = _____ m/s

Question 8 continues on the next page

Question 38 · continued

Figure 11 is repeated below.

Figure 11



0 8 . 3 At position **C** the car's gravitational potential energy is 0.20 J greater than at position **B**.

How much kinetic energy does the car need at position **B** to complete the loop of the track?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

Less than 0.20 J ☐

Exactly 0.20 J ☐

More than 0.20 J ☐

Reason _____

_____

_____

8

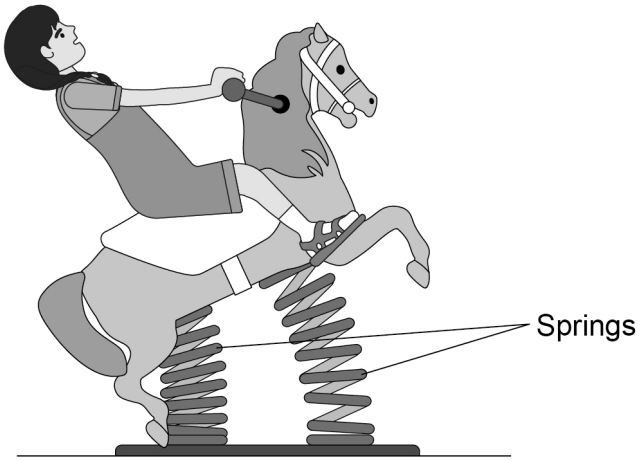
4.1.1.2 Changes in energy

Question 39

November 2021 | 8463/2H | Original Q2

0 2 **Figure 3** shows a child on a playground toy.

Figure 3



0 2 . 1 The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

[2 marks]

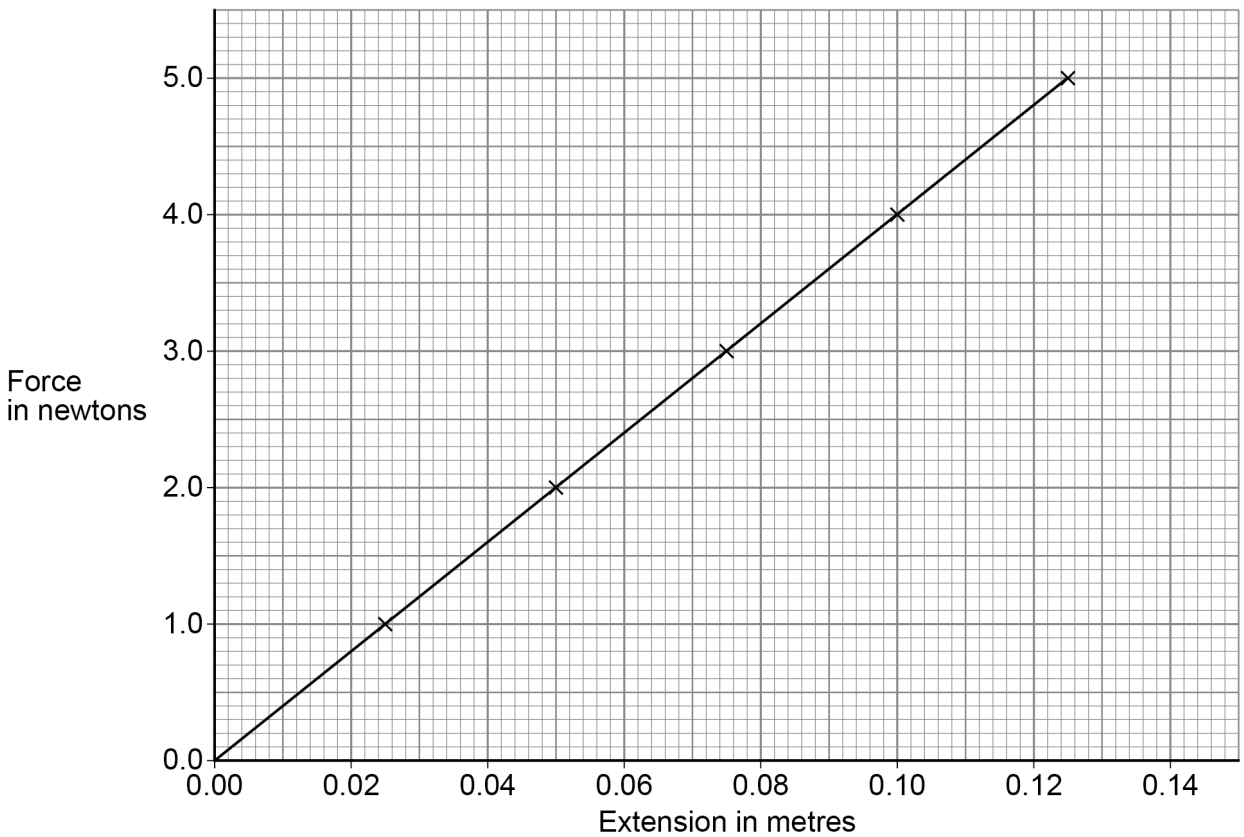
Question 2 continues on the next page

Question 39 · continued

A student investigated the relationship between the force applied to a spring and the extension of the spring.

Figure 4 shows the results.

Figure 4



4.1.1.2 Changes in energy

Question 39 · continued

0 2 . 2 Describe a method the student could use to obtain the results given in **Figure 4**.

You should include a risk assessment for **one** hazard in the investigation.

Your answer may include a diagram.

[6 marks]

Question 2 continues on the next page

Question 39 · continued

0 2 . 3 Which equation links extension (e), force (F) and spring constant (k).

[1 mark]

Tick (✓) **one** box.

force = spring constant × (extension)^2 ☐

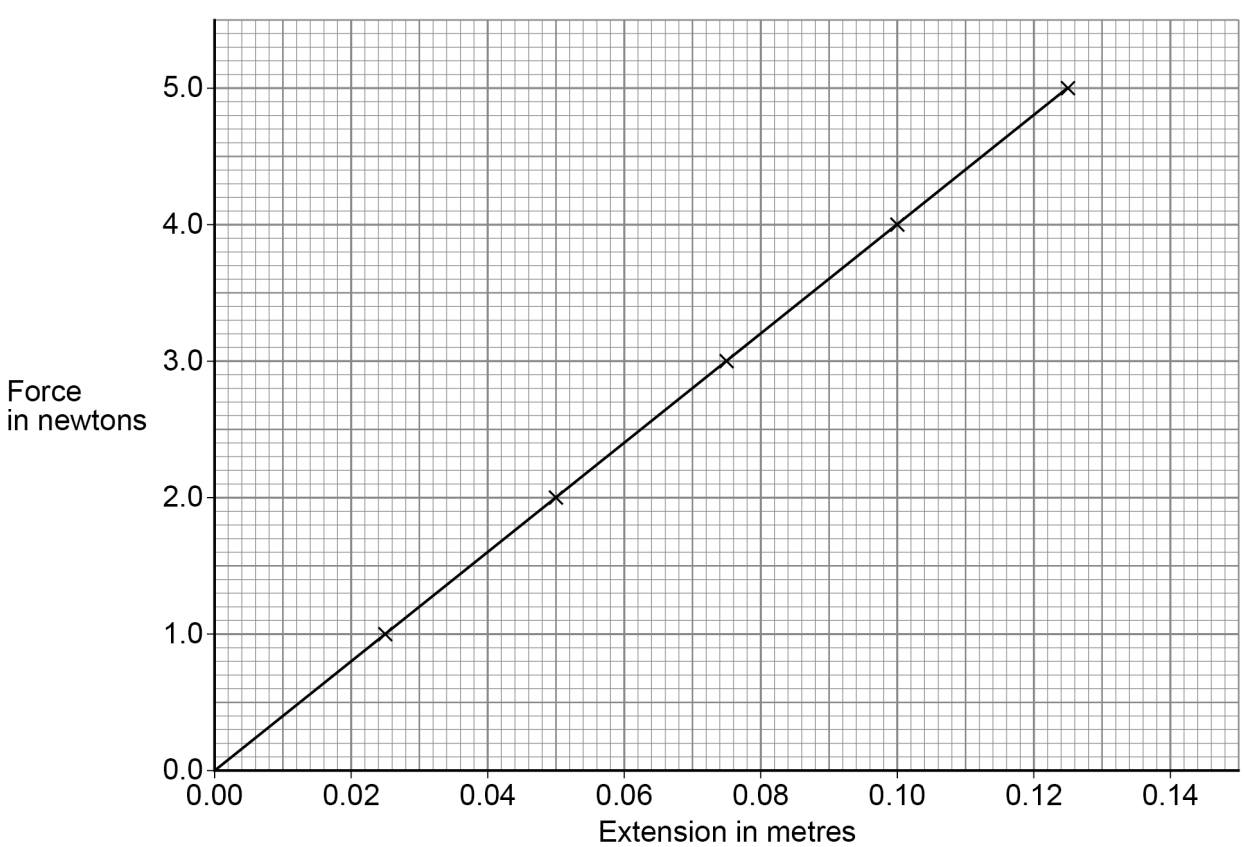
force = spring constant × extension ☐

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

Figure 4 is repeated below.

Figure 4



4.1.1.2 Changes in energy

Question 39 · continued

0 2 . 4 Determine the spring constant of the spring.

Use **Figure 4**.

[3 marks]

Spring constant = _____ N/m

0 2 . 5 The student concluded:

'The extension of the spring is directly proportional to the force applied to the spring.'

Describe how **Figure 4** supports the student's conclusion.

[2 marks]

Question 2 continues on the next page

4.1.1.2 Changes in energy

Question 39 · continued

0 2 . 6 The student repeated the investigation using a different spring with a spring constant of 13 N/m.

Calculate the elastic potential energy of the spring when the extension of the spring was 20 cm.

Use the Physics Equations Sheet.

[3 marks]

Elastic potential energy = _____ J

17

4.1.1.2 Changes in energy

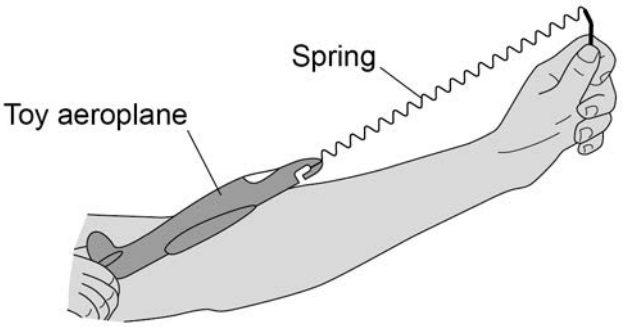
Question 40

June 2022 | 8463/1H | Original Q10

1 0 **Figure 11** shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.

Figure 11



1 0 . 1 Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

[6 marks]

Speed = _____ Unit _____

4.1.1.2 Changes in energy

Question 40 · continued

1 0 . 2 Complete the sentence.

[1 mark]

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

1 0 . 3 Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

[1 mark]

_____

_____

8

Turn over for the next question

4.1.1.2 Changes in energy

Question 41

0 4 Hailstones are small balls of ice. Hailstones form in clouds and fall to the ground.

Figure 7 shows different-sized hailstones.

Figure 7



A hailstone falls from a cloud and accelerates.

0 4 . 1 Why does the hailstone accelerate?

[1 mark]

0 4 . 2 The hailstone stops accelerating and reaches terminal velocity.

Explain why the hailstone reaches terminal velocity.

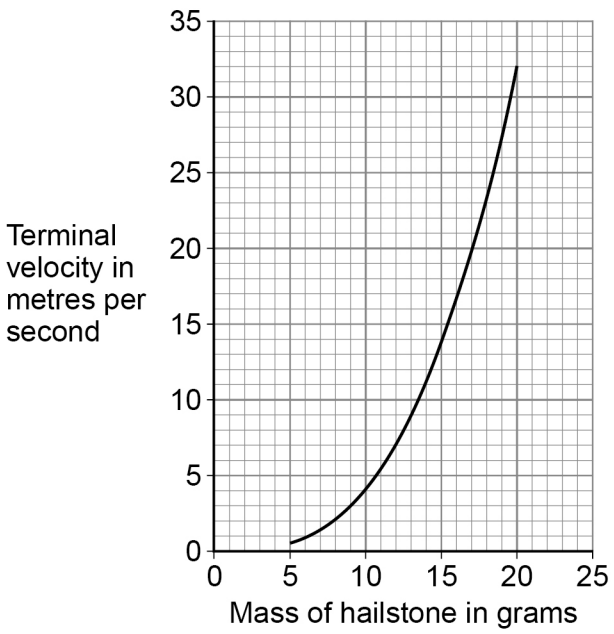
[3 marks]

Question 41 · continued

A scientist investigated how the mass of hailstones affects their terminal velocity.

Figure 8 shows the results.

Figure 8



0 4 . 3 Why does terminal velocity increase with mass?

[1 mark]

Tick (✓) **one** box.

As mass increases the cross-sectional surface area of a hailstone increases. ☐

As mass increases the volume of a hailstone increases. ☐

As mass increases the weight of a hailstone increases. ☐

4.1.1.2 Changes in energy

Question 41 · continued

0 4 . 4 Explain the difference in the maximum kinetic energy of a hailstone with a mass of 10 g and a hailstone with a mass of 20 g.

[3 marks]

0 4 . 5 The kinetic energy of a hailstone is measured in joules.

Which of the following is the same as 1 joule?

[1 mark]

Tick (✓) **one** box.

1 N m ☐

1 N/m ☐

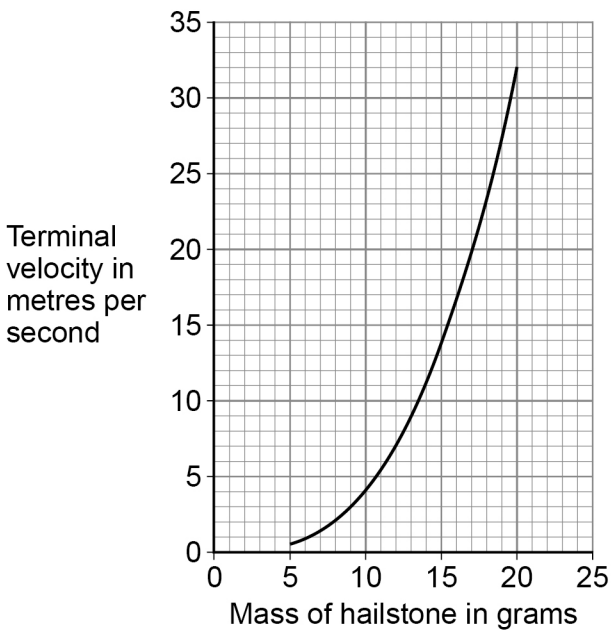
1 N/m^2 ☐

1 N m^2 ☐

Question 4 continues on the next page

Figure 8 is repeated below.

Figure 8



0 4 . 6 A hailstone hit the ground at its terminal velocity of 25 m/s.

The hailstone took 0.060 s to stop moving.

Determine the average force on the hailstone as it hit the ground.

Use information from **Figure 8**.

Use the Physics Equations Sheet.

[3 marks]

Average force = _____ N

12

4.1.1.2 Changes in energy

Question 42

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

Question 42 · 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]

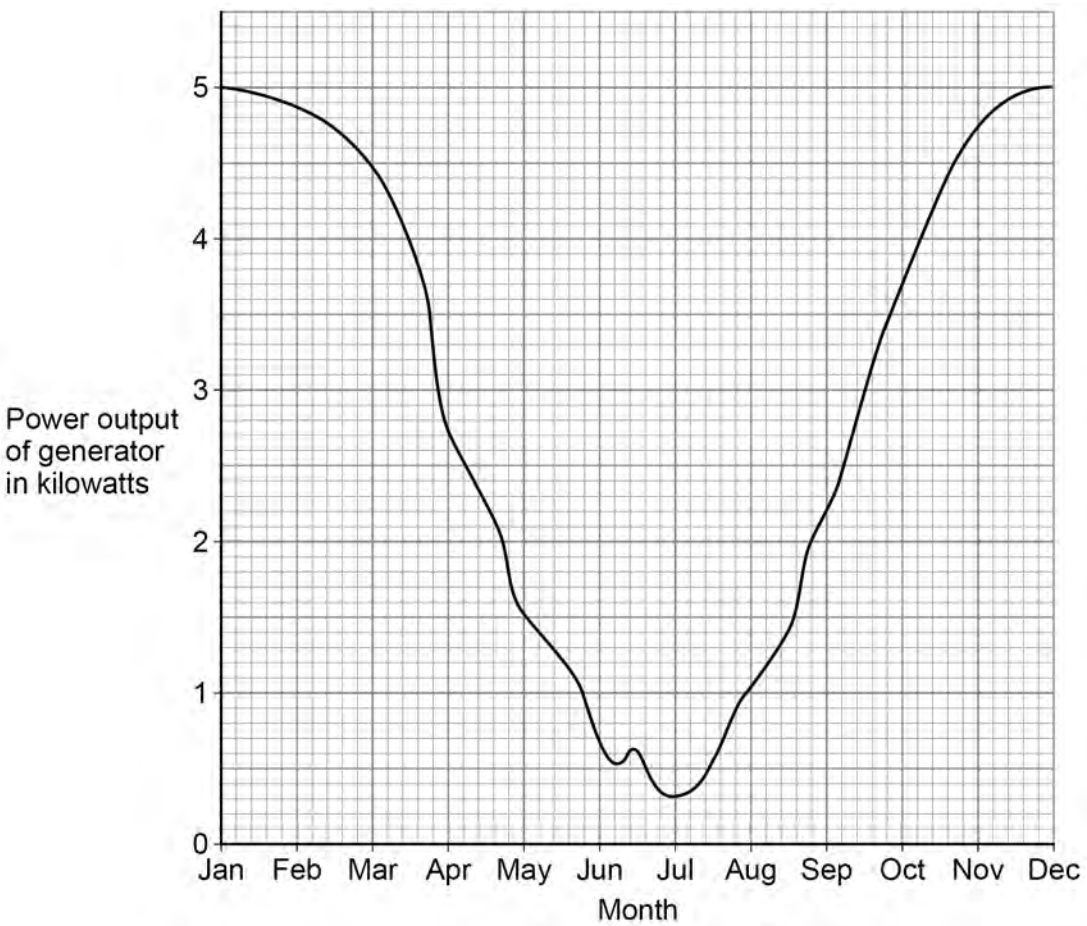
Time taken (in standard form) = _____ s

Question 4 continues on the next page

Question 42 · continued

0 4 . 3 **Figure 5** shows how the power output of the generator varied during one year.

Figure 5



A solar power system is installed in the remote village in addition to the hydroelectric generator.

Explain why this improves the reliability of the electricity supply to the village.

Use information from **Figure 5**.

[2 marks]

11

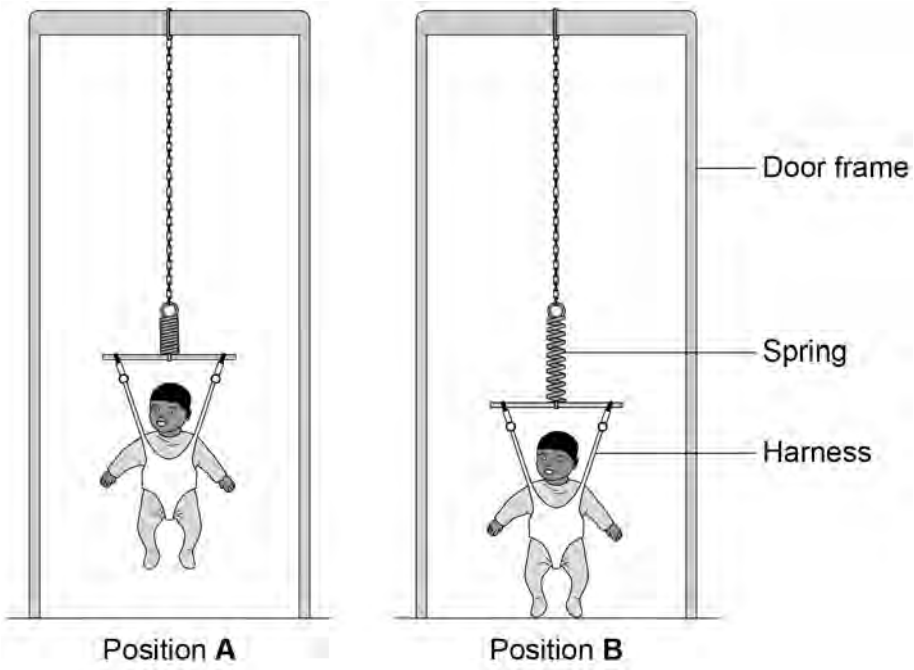
4.1.1.2 Changes in energy

Question 43

0 7 A baby bouncer is a harness attached to a spring that hangs from a door frame.

Figure 7 shows a baby in a baby bouncer in two positions.

Figure 7



0 7 . 1 The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest **one** reason why.

[1 mark]

4.1.1.2 Changes in energy

Question 43 · continued

0 7 . 2 In positions **A** and **B** the baby is stationary.

Describe the energy transfers as the baby moves from position **A** to position **B**.

[3 marks]

0 7 . 3 In one position the extension of the spring is 8.0 cm.

The elastic potential energy stored by the spring is 4.0 J.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.

[4 marks]

Spring constant = _____ N/m

8

4.1.1.2 Changes in energy

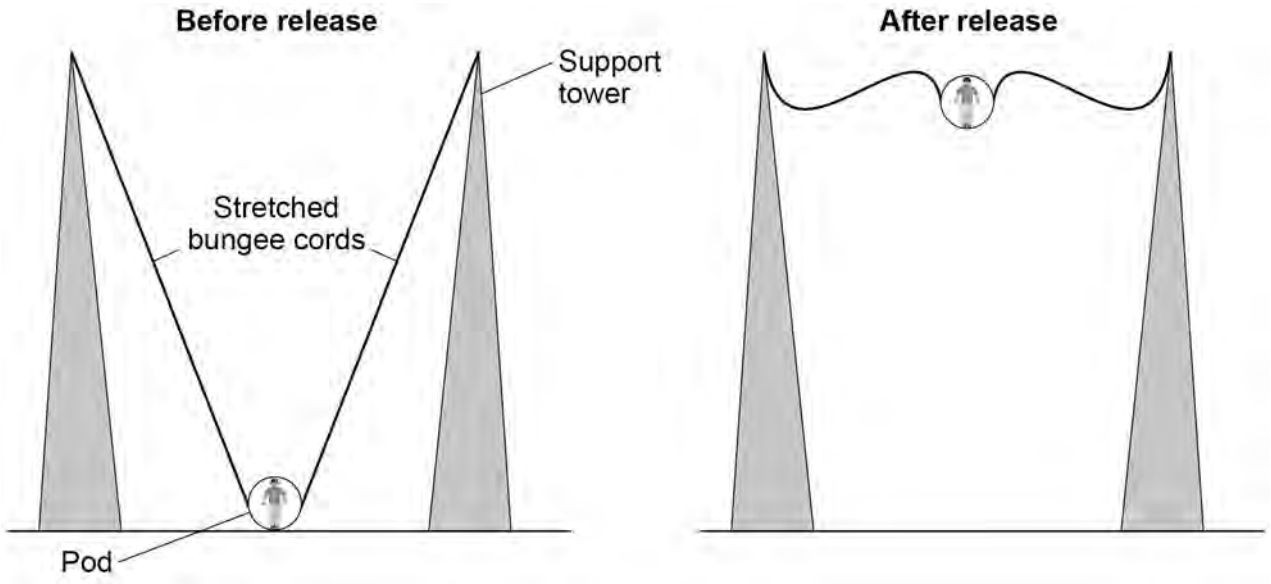
Question 44

0 6 In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

Figure 10 shows a person using the ride.

Figure 10



0 6 . 1 Which energy store increases as the bungee cords are stretched?

[1 mark]

4.1.1.2 Changes in energy

Question 44 · continued

0 6 . 2 When the pod is released, the pod accelerates upwards.

Before the pod is released the extension of **each** of the two bungee cords is 8.0 m.

The spring constant of each bungee cord is 735 N/m.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

Use the Physics Equations Sheet.

[6 marks]

Maximum height = _____ m

0 6 . 3 The actual maximum height reached by the pod will be lower than the correct answer to Question **06.2**

Explain why.

[2 marks]

9

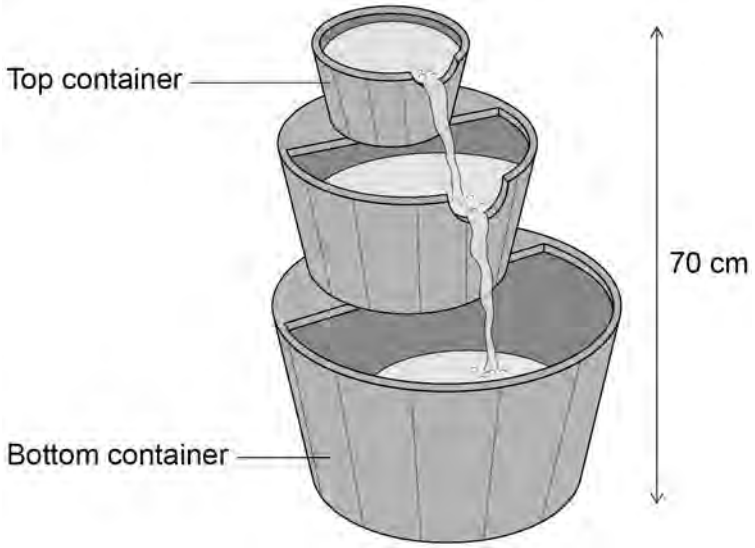
4.1.1.2 Changes in energy

Question 45

June 2025 | 8463/1H | Original Q9

0 9 **Figure 11** shows a garden water feature.

Figure 11



The water feature has an electric motor that pumps water from the bottom container to the top container.

0 9 . 1 The pump transfers 0.343 J of gravitational potential energy to the water each second.

gravitational field strength = 9.8 N/kg

Determine the mass of water passing through the pump each second.

Use the Physics Equations Sheet.

[4 marks]

Mass = _____ kg

Question 45 · continued

0 9 . 2 The power of the pump motor is 4.86 W.

The resistance of the pump motor is 6.0 Ω.

Calculate the charge flow through the motor in 30 minutes.

Use the Physics Equations Sheet.

[6 marks]

Charge flow = _____ C

0 9 . 3 The pump motor breaks and is replaced with a new motor.

The new pump motor has the same power input, but has a greater efficiency.

Explain how the new pump motor would affect the flow of water in the water feature.

[2 marks]

12

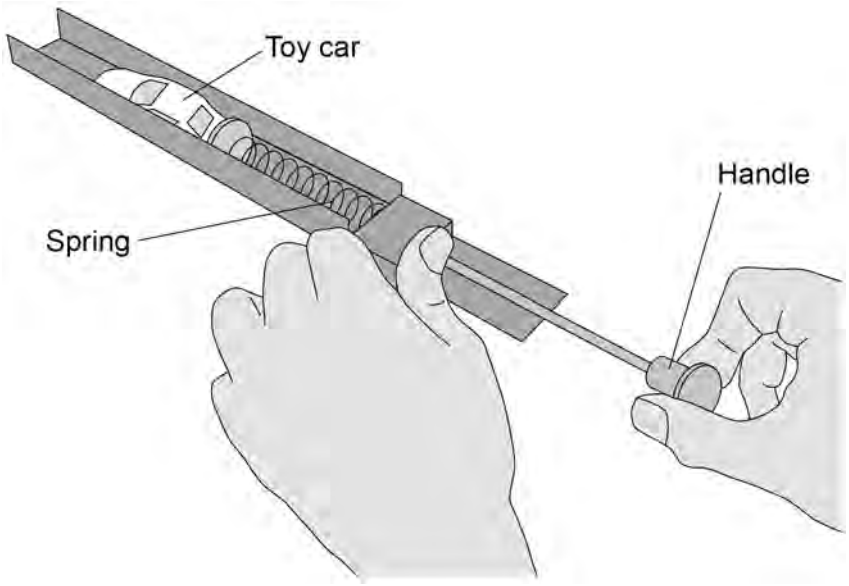
4.1.1.2 Changes in energy

Question 46

June 2025 | 8463/1H | Original Q10

1 0 **Figure 12** shows a device that accelerates a toy car at the start of a race track.

Figure 12



4.1.1.2 Changes in energy

Question 46 · continued

1 0 . 1 Pulling the handle compresses the spring in the device by 0.075 m.

When the handle is released, the energy stored in the compressed spring is transferred to the toy car.

spring constant = 64 N/m

mass of toy car = 0.052 kg

Calculate the maximum possible speed of the toy car just after the car starts to move.

Use the Physics Equations Sheet.

Give your answer to **2** significant figures.

[6 marks]

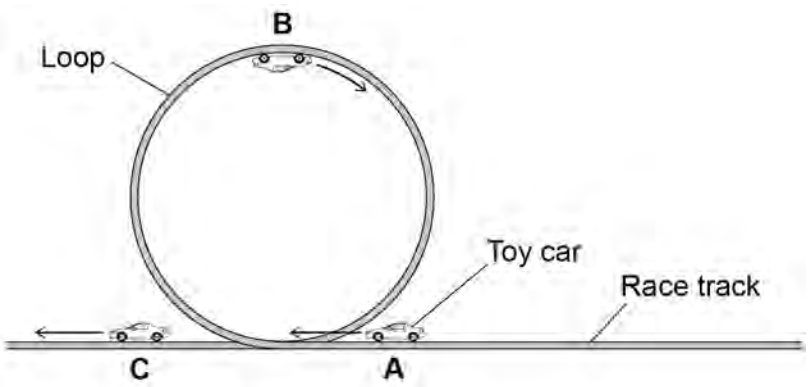
Maximum possible speed (2 significant figures) = _____ m/s

Question 10 continues on the next page

Question 46 · continued

10.2 **Figure 13** shows the path of the toy car along a loop section of the race track.

Figure 13



The car moves along the track from position **A** to position **B** and then to position **C**.

Describe how the energy stores of the car change as the car moves along the track from position **A** to position **C**.

Ignore the effects of friction and air resistance.

[3 marks]

4.1.1.2 Changes in energy

Question 46 · continued

1 0 . 3 At the end of the race track, the toy car passes through a light gate that measures the speed of the car.

Which **two** measurements are needed to determine the speed of the car?

[2 marks]

Tick (✓) **two** boxes.

- Length of the toy car ☐
- Mass of the toy car ☐
- Temperature of the room ☐
- Time for the toy car to pass the light gate ☐
- Total length of the race track ☐

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