AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.2

Work done and energy transfer

Past-paper questions

Tier	**Foundation**
Question groups	**31**
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:** _____

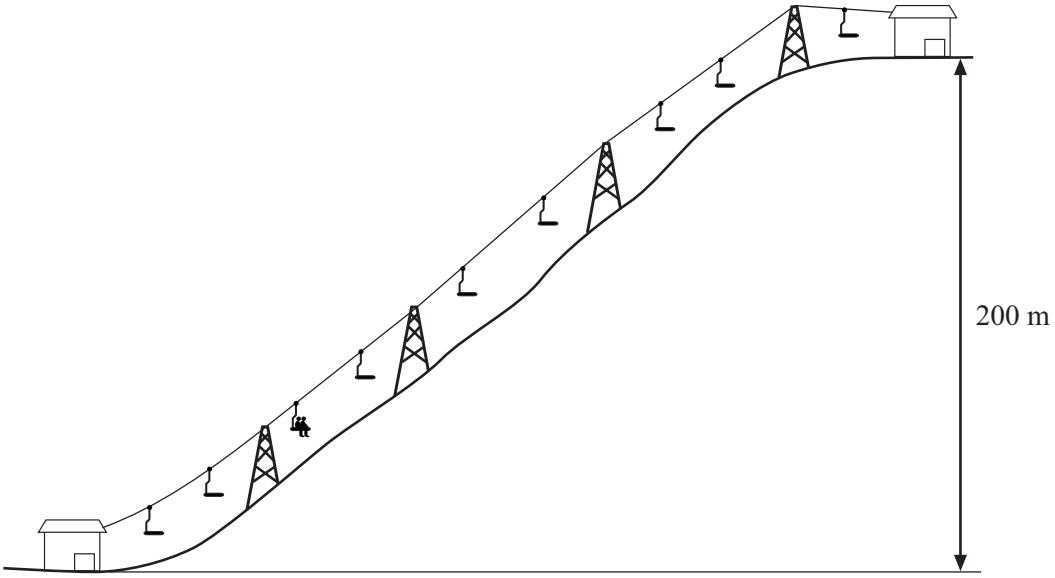
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.2 Work done and energy transfer

Question 01

June 2004 | 3451F | Original Q13 | Legacy

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



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

.....

(1 mark)

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

.....

.....

.....

work done =.....

(3 marks)

4.5.2 Work done and energy transfer

Question 01 · continued

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

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

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

.....

.....

power = ...watts

(2 marks)

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

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

.....

.....

(1 mark)

(ii) Complete the following sentence.

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

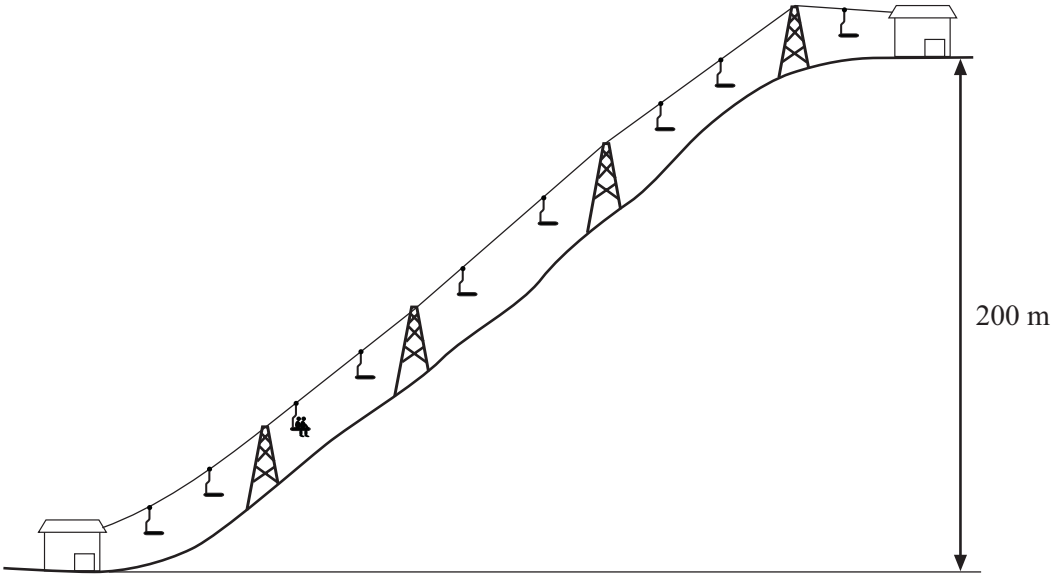
8

4.5.2 Work done and energy transfer

Question 02

June 2004 | 3462F3 | Original Q11 | Legacy

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



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

.....

(1 mark)

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

.....

.....

.....

work done =.....

(3 marks)

4.5.2 Work done and energy transfer

Question 02 · continued

MARGIN BLANK

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

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

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

.....

.....

power = ...watts

(2 marks)

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

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

.....

.....

(1 mark)

(ii) Complete the following sentence.

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

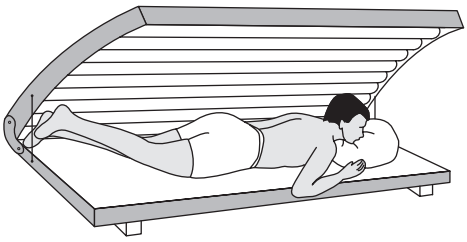
8

4.5.2 Work done and energy transfer

Question 03

June 2006 | 3451 | Original Q2 | Legacy

2 (a) The diagram shows a person using a sunbed.



(i) Which type of radiation is used in a sunbed to give a suntan?

Draw a ring around your answer.

infra red **light** **microwave** **ultraviolet**

(1 mark)

(ii) What can a high dose of radiation from a sunbed do to living cells?

.....

.....

(1 mark)

Question 03 · continued

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(b) The box contains the information shown on the side of a sunbed.

230 V	**1.8 kW**
50 Hz	**7.8 A**

(i) Which **one** of the following statements is true? Put a tick (✓) in the box next to your choice.

The sunbed uses an alternating current (a.c.) electricity supply. ☐

A 5 amp fuse should be used in the plug of the sunbed. ☐

The sunbed transfers 1.8 joules of energy every second. ☐

(1 mark)

(ii) In one week the sunbed is used for a total of 6 hours.

Use the following equation to calculate the number of units of energy transferred by the sunbed in 6 hours.

Show clearly how you work out your answer.

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

.....

.....

Energy transferred = ... kWh

(2 marks)

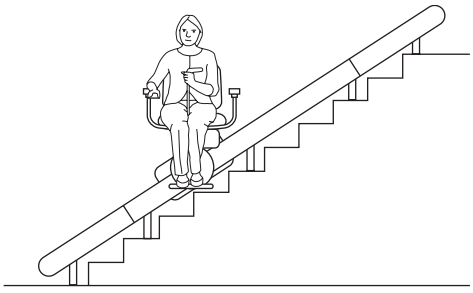
5

4.5.2 Work done and energy transfer

Question 04

June 2006 | 3451 | Original Q7 | Legacy

7 A person uses a stairlift to go upstairs. The stairlift is worked by an electric motor.



(a) Complete the sentences by choosing the correct words from the box.

Each word may be used once or not at all.

chemical	**electrical**	**heat**	**kinetic**	**light**	**sound**

(i) The electric motor is designed to transfer .....

energy to ..... energy.

(2 marks)

(ii) When the electric motor is working, the main energy wastages are

..... and ..... .

(2 marks)

Question 04 · continued

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(b) To lift the person and the chair, the electric motor does 2880 joules of work in 8 seconds.

(i) Use the following equation to calculate the useful power output of the electric motor. Show clearly how you work out your answer.

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

.....

.....

Power = ... J/s

(2 marks)

(ii) The answer to part (b)(i) is in J/s; this is not the usual unit for power. Which **one** of the following units is usually used for power?

Draw a ring around your answer.

coulomb (C) **joule (J)** **newton (N)** **watt (W)**

(1 mark)

(c) The forces on the stairlift are balanced.

Put a tick (✓) in the boxes next to the **two** statements that describe what the stairlift could be doing.

The stairlift is not moving. ☐

The stairlift is moving at a constant speed. ☐

The stairlift is speeding up. ☐

The stairlift is slowing down. ☐

(1 mark)

8

4.5.2 Work done and energy transfer

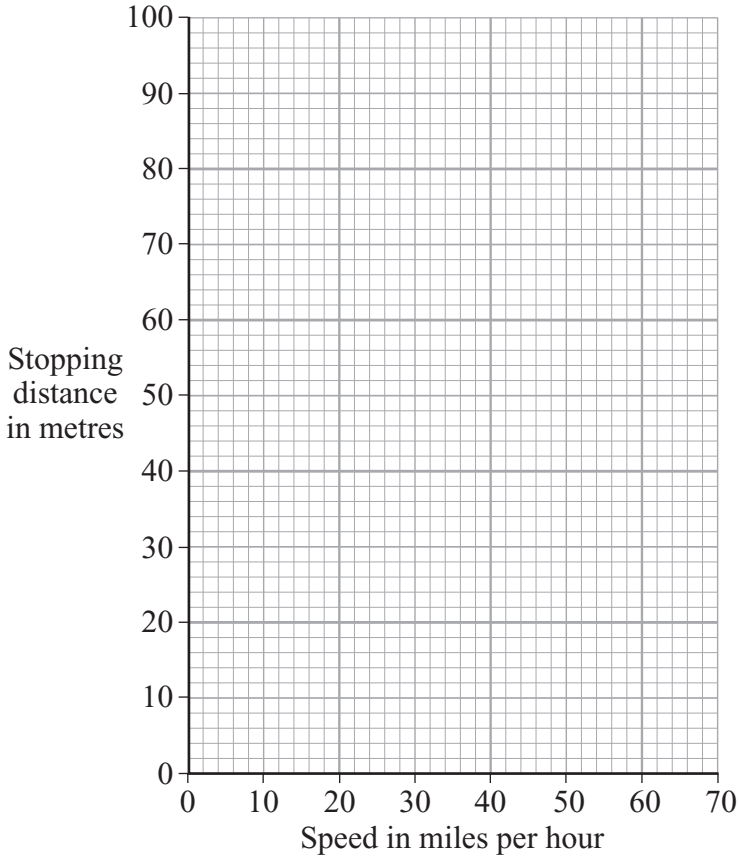
Question 05

June 2006 | 3451 | Original Q15 | Legacy

15 (a) The table shows how the stopping distance of a car, in metres (m), depends on the speed of the car, in miles per hour (mph).

Speed (mph)	20	30	40	50	60	70
Stopping distance (m)	12	23	36	53	73	96

(i) Draw a graph of stopping distance against speed.



(3 marks)

(ii) The speed limit outside a school is 20 mph.

Use the graph to estimate **how much further** a car will travel before it stops when driven at 25 mph instead of 20 mph.

Show clearly how you work out your answer.

.....

.....

(2 marks)

Question 15 continues on the next page

Question 05 · continued

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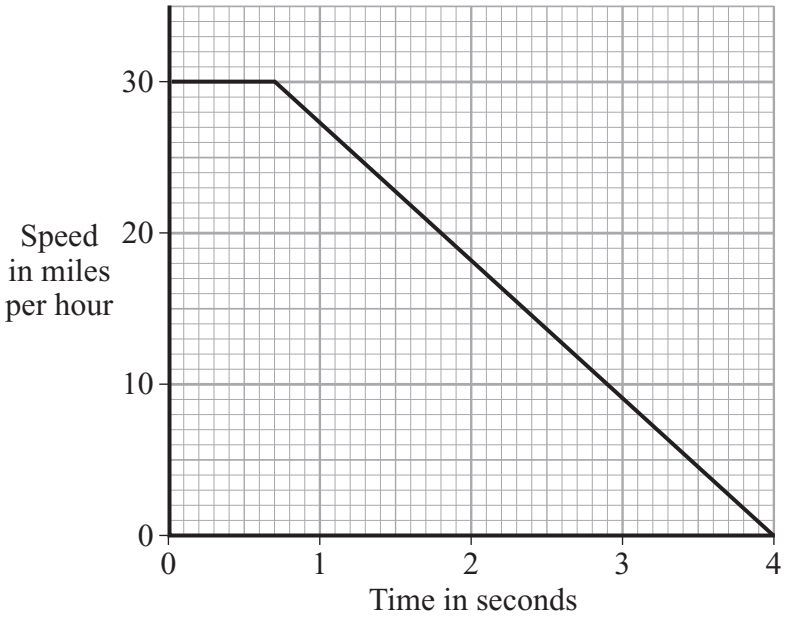
(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.



(i) What was the driver's reaction time?

.....

(1 mark)

(ii) Describe the motion of the car during the first 0.5 seconds.

.....

(1 mark)

(iii) How long did it take the car to stop once the brakes were applied?

.....

(1 mark)

(iv) The drug cannabis makes the reactions of a person slower.

Explain how the stopping distance of the car would change if the driver had been smoking cannabis.

.....

.....

.....

.....

(2 marks)

4.5.2 Work done and energy transfer

Question 05 · continued

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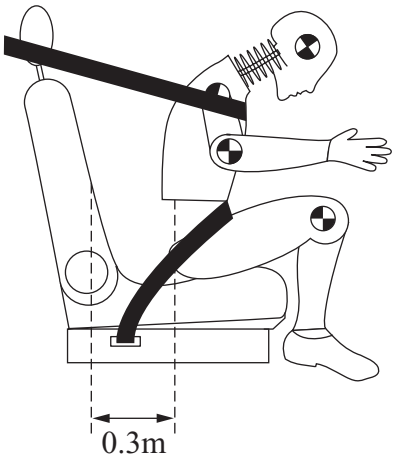
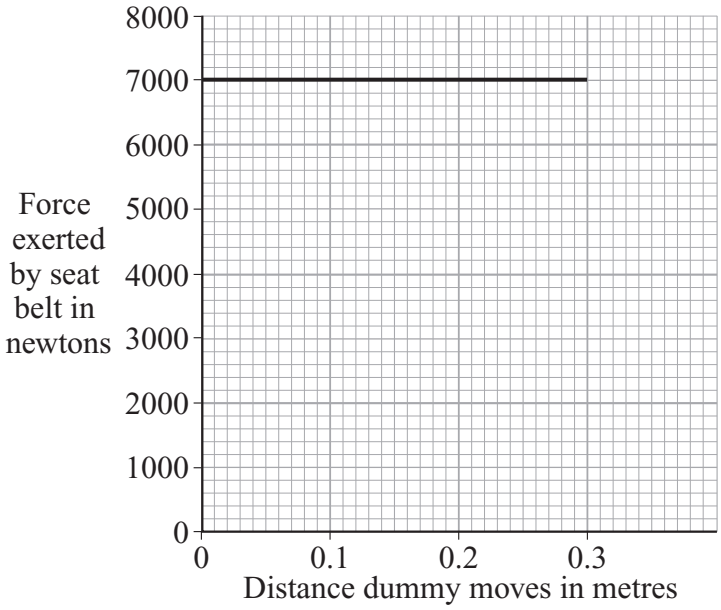
(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.





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

.....

(1 mark)

(ii) Calculate the work done to stop the dummy.

Show clearly how you work out your answer.

.....

.....

.....

Work done = ... joules

(2 marks)

(iii) How much energy is transferred from the dummy during the crash?

.....

(1 mark)

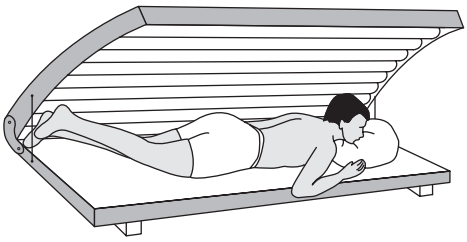
14

4.5.2 Work done and energy transfer

Question 06

June 2006 | 3462 | Original Q2 | Legacy

2 (a) The diagram shows a person using a sunbed.



(i) Which type of radiation is used in a sunbed to give a suntan?

Draw a ring around your answer.

infra red **light** **microwave** **ultraviolet**

(1 mark)

(ii) What can a high dose of radiation from a sunbed do to living cells?

.....

.....

(1 mark)

Question 06 · continued

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(b) The box contains the information shown on the side of a sunbed.

230 V	**1.8 kW**
50 Hz	**7.8 A**

(i) Which **one** of the following statements is true? Put a tick (✓) in the box next to your choice.

The sunbed uses an alternating current (a.c.) electricity supply. ☐

A 5 amp fuse should be used in the plug of the sunbed. ☐

The sunbed transfers 1.8 joules of energy every second. ☐

(1 mark)

(ii) In one week the sunbed is used for a total of 6 hours.

Use the following equation to calculate the number of units of energy transferred by the sunbed in 6 hours.

Show clearly how you work out your answer.

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

.....

.....

Energy transferred = ... kWh

(2 marks)

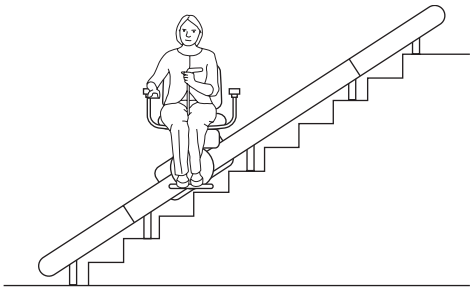
5

4.5.2 Work done and energy transfer

Question 07

June 2006 | 3462 | Original Q7 | Legacy

7 A person uses a stairlift to go upstairs. The stairlift is worked by an electric motor.



(a) Complete the sentences by choosing the correct words from the box.

Each word may be used once or not at all.

chemical	**electrical**	**heat**	**kinetic**	**light**	**sound**

(i) The electric motor is designed to transfer .....

energy to ..... energy.

(2 marks)

(ii) When the electric motor is working, the main energy wastages are

..... and ..... .

(2 marks)

Question 07 · continued

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(b) To lift the person and the chair, the electric motor does 2880 joules of work in 8 seconds.

(i) Use the following equation to calculate the useful power output of the electric motor. Show clearly how you work out your answer.

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

.....

.....

Power = ... J/s

(2 marks)

(ii) The answer to part (b)(i) is in J/s; this is not the usual unit for power. Which **one** of the following units is usually used for power?

Draw a ring around your answer.

coulomb (C) **joule (J)** **newton (N)** **watt (W)**

(1 mark)

(c) The forces on the stairlift are balanced.

Put a tick (✓) in the boxes next to the **two** statements that describe what the stairlift could be doing.

The stairlift is not moving. ☐

The stairlift is moving at a constant speed. ☐

The stairlift is speeding up. ☐

The stairlift is slowing down. ☐

(1 mark)

8

4.5.2 Work done and energy transfer

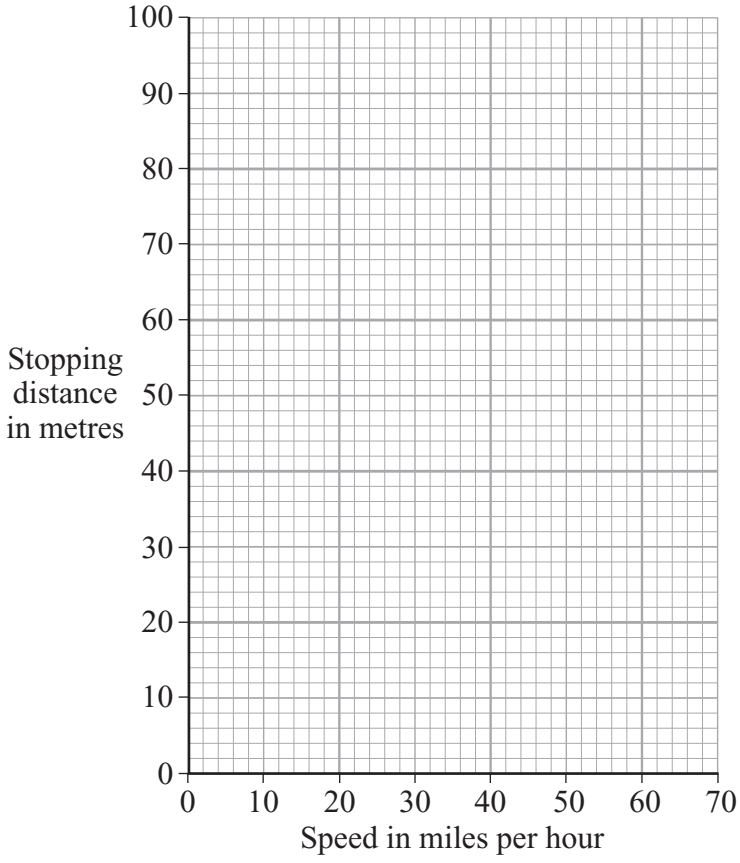
Question 08

June 2006 | 3462 | Original Q13 | Legacy

13 (a) The table shows how the stopping distance of a car, in metres (m), depends on the speed of the car, in miles per hour (mph).

Speed (mph)	20	30	40	50	60	70
Stopping distance (m)	12	23	36	53	73	96

(i) Draw a graph of stopping distance against speed.



(3 marks)

(ii) The speed limit outside a school is 20 mph.

Use the graph to estimate **how much further** a car will travel before it stops when driven at 25 mph instead of 20 mph.

Show clearly how you work out your answer.

.....

.....

(2 marks)

Question 13 continues on the next page

Question 08 · continued

June 2006 | 3462 | Original Q13 | Legacy

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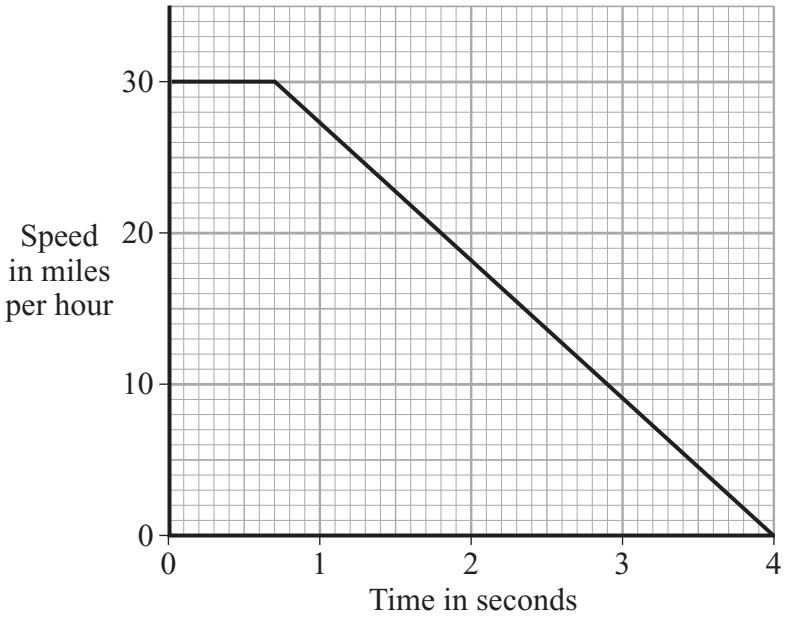
(b) A child ran out in front of a car causing the driver to make an emergency stop. The graph shows how the speed of the car changed from the moment the driver saw the child.



(i) What was the driver's reaction time?

.....

(1 mark)

(ii) Describe the motion of the car during the first 0.5 seconds.

.....

(1 mark)

(iii) How long did it take the car to stop once the brakes were applied?

.....

(1 mark)

(iv) The drug cannabis makes the reactions of a person slower.

Explain how the stopping distance of the car would change if the driver had been smoking cannabis.

.....

.....

.....

.....

(2 marks)

4.5.2 Work done and energy transfer

Question 08 · continued

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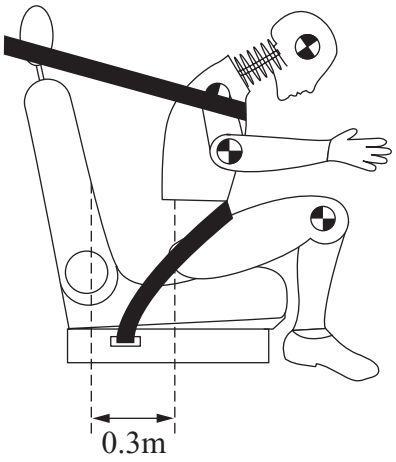
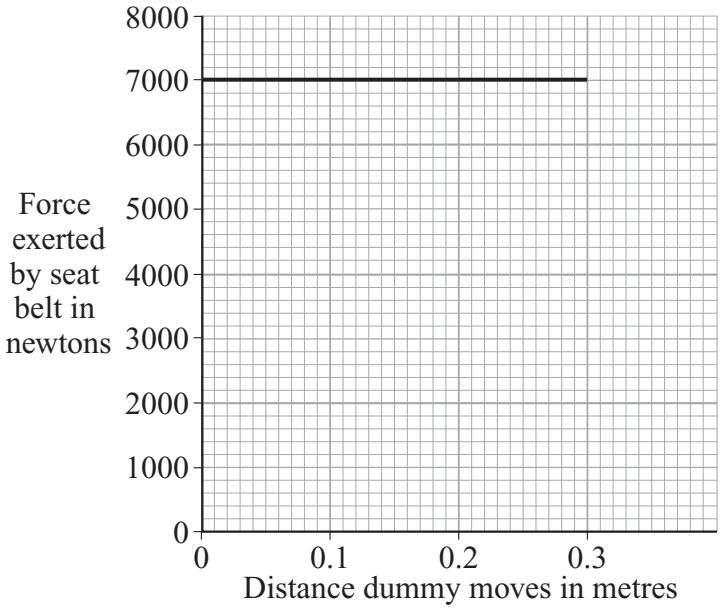
(c) The diagram shows how far a dummy in a car crash test moves before it is stopped by the seat belt. The graph shows the force exerted by the seat belt on the dummy during the crash.





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

.....

(1 mark)

(ii) Calculate the work done to stop the dummy.

Show clearly how you work out your answer.

.....

.....

.....

Work done = ... joules

(2 marks)

(iii) How much energy is transferred from the dummy during the crash?

.....

(1 mark)

14

4.5.2 Work done and energy transfer

Question 09

January 2008 | PHY3F | Original Q8 | Legacy

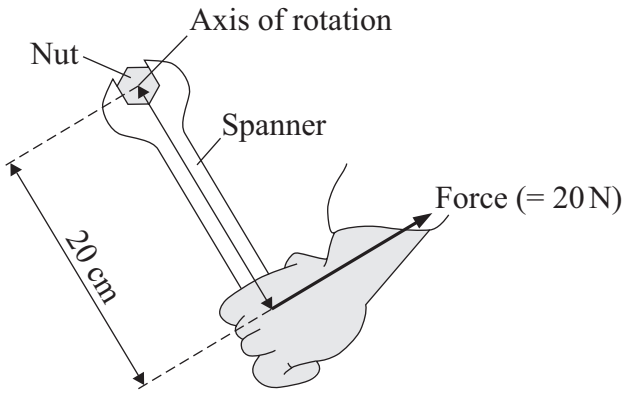
8 A spanner gives a turning effect to undo a nut.

(a) Complete the sentence.

The turning effect of a force is called the ..... of the force.

(1 mark)

(b) The diagram shows a spanner being used.



Use the equation in the box to calculate the spanner's turning effect in newton metres.

turning effect = force × perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

.....

.....

Turning effect = ... Nm

(2 marks)

(c) Give **two** ways in which you can increase the spanner's turning effect.

1 .....

2 .....

(2 marks)

5

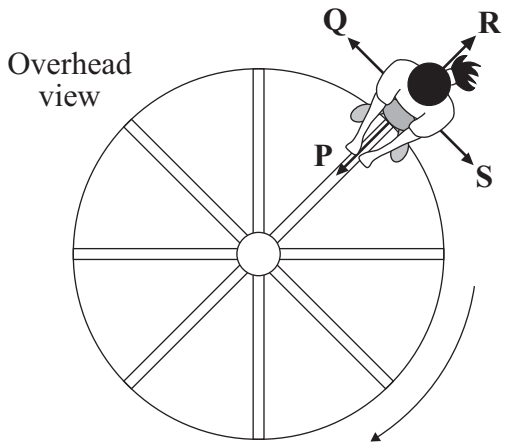
4.5.2 Work done and energy transfer

Question 10

June 2008 | PHY3F | Original Q5 | Legacy

5 A girl and her father visit a children's playground.

5 (a) The diagram shows the girl holding on to a roundabout which is turning.



A centripetal force must act because the girl moves in a circular path.

5 (a) (i) In which direction, **P**, **Q**, **R** or **S**, does the centripetal force act?

Direction ..... *(1 mark)*

5 (a) (ii) What provides this centripetal force?

.....

.....

(1 mark)

5 (a) (iii) Her father pushes the roundabout so that it turns faster. The girl continues to stand on the same part of the roundabout.

Complete the following sentence by drawing a ring around the correct line in the box.

The centripetal force on the girl

decreases
does not change
increases

.

(1 mark)

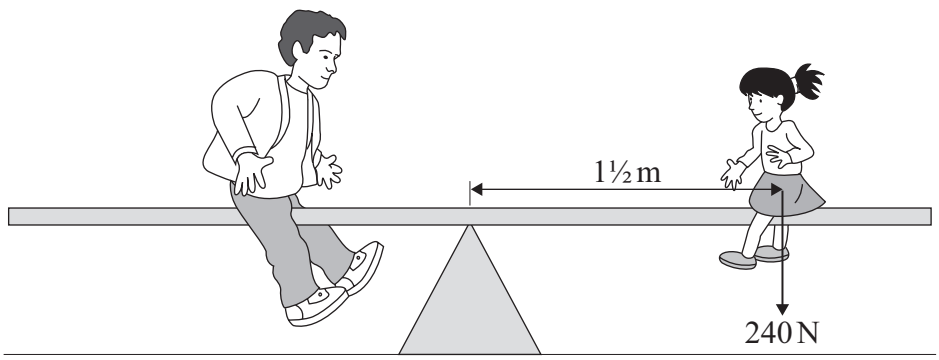
Question 5 continues on the next page

4.5.2 Work done and energy transfer

Question 10 · continued

for mark

5 (b) The diagram shows the girl and her father on a see-saw.



5 (b) (i) Use the equation in the box to calculate the moment of the girl.

moment	= force ×	perpendicular distance from the line of action of the force to the axis of rotation	

Show clearly how you work out your answer.

.....

.....

Moment of the girl = ... Nm

(2 marks)

5 (b) (ii) What must her father do to increase his moment?

.....

.....

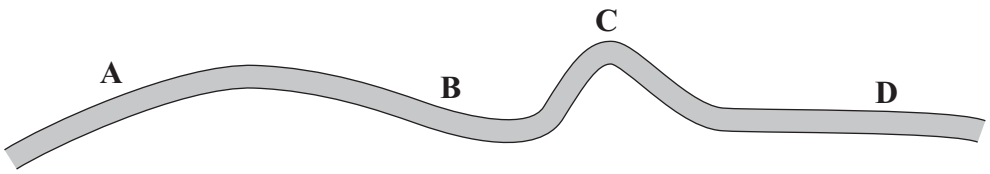
(1 mark)

4.5.2 Work done and energy transfer

Question 10 · continued

for mark

5 (c) The diagram shows part of a level road that they take when they drive home. They drive at a steady speed.



5 (c) (i) At which point, **A**, **B**, **C** or **D**, will the centripetal force on the car be greatest?

Centripetal force is greatest at ..... .

(1 mark)

5 (c) (ii) What provides the centripetal force when the car goes round a bend?

.....

.....

(1 mark)

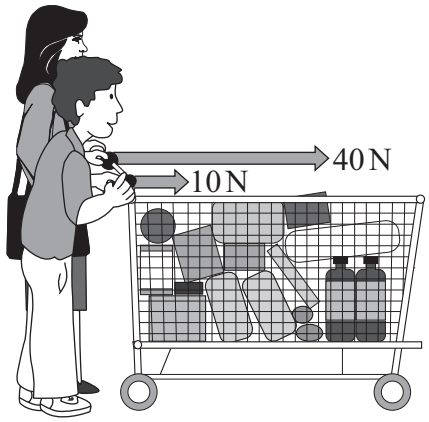
8

4.5.2 Work done and energy transfer

Question 11

June 2009 | PHY2F | Original Q5 | Legacy

5 The diagram shows an adult and a child pushing a loaded shopping trolley.



5 (a) (i) What is the *total force* on the trolley due to the adult and child?

.....

(1 mark)

5 (a) (ii) Which **one** of the terms in the box means the same as *total force*?

Draw a ring around your answer.

answer force	**mean force**	**resultant force**

(1 mark)

5 (a) (iii) The trolley is pushed at a constant speed for 80 metres.

Use the equation in the box to calculate the work done to push the trolley 80 metres.

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

Show clearly how you work out your answer.

.....

.....

Work done = ...

(2 marks)

4.5.2 Work done and energy transfer

Question 11 · continued

for mark

5 (b) Complete the following sentences by drawing a ring around the correct word in each of the boxes.

5 (b) (i) The unit of work done is the | joule / newton / watt | .

(1 mark)

5 (b) (ii) Most of the work done to push the trolley is transformed into | heat / light / sound | .

(1 mark)

6

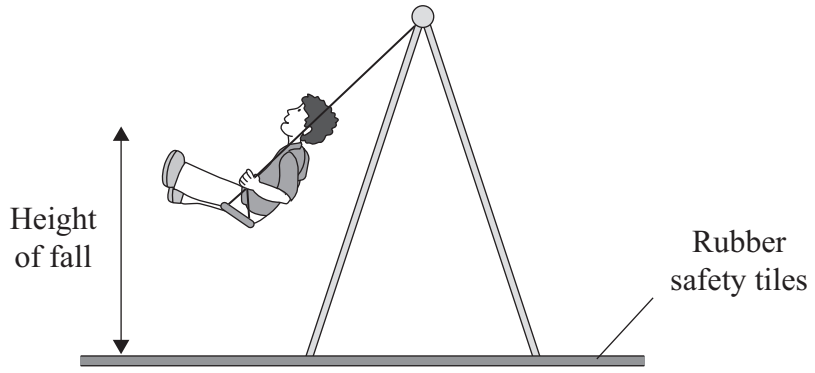
Turn over for the next question

4.5.2 Work done and energy transfer

Question 12

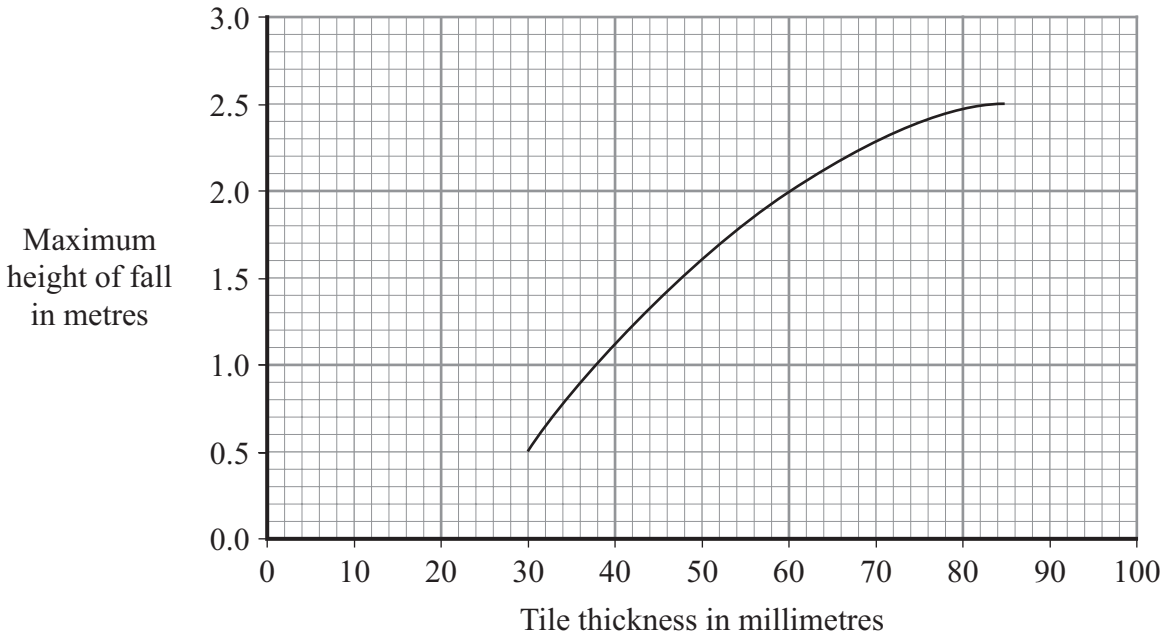
June 2009 | PHY2F | Original Q6 | Legacy

6 The diagram shows a child on a playground swing.



6 (a) The playground surface is covered in rubber safety tiles. The tiles reduce the risk of serious injury to children who fall off the swing.

The graph gives the maximum height that a child can fall onto rubber safety tiles of different thicknesses and be unlikely to get a serious head injury.



6 (a) (i) Describe how the maximum height of fall relates to the thickness of the rubber safety tile.

.....

.....

(1 mark)

4.5.2 Work done and energy transfer

Question 12 · continued

for mark

6 (a) (ii) The maximum height of any of the playground rides is 2 metres.

What tile thickness should be used in the playground?

.....

Give a reason for your answer.

.....

.....

(2 marks)

6 (b) Use phrases from the box to complete the following sentences.

the force on	**the work done to stop**	**the time taken to stop**

6 (b) (i) Falling onto a rubber surface compared to a hard surface increases

..... the child.

(1 mark)

6 (b) (ii) Momentum is lost more slowly falling onto a rubber surface than on a hard surface.

This reduces ..... the child.

(1 mark)

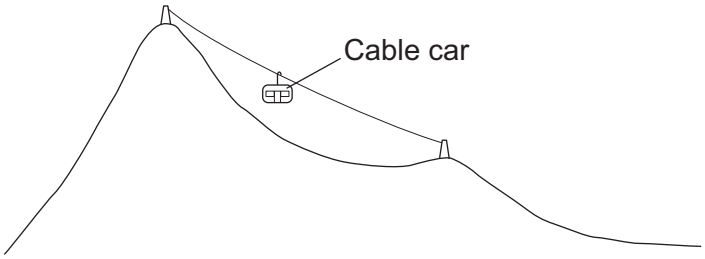
5

4.5.2 Work done and energy transfer

Question 13

June 2010 | PHY2F | Original Q6 | Legacy

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



6 (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)

Question 13 · continued

6 (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)

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



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

(1 mark)

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

.....

.....

.....

.....

(2 marks)

Question 6 continues on the next page

4.5.2 Work done and energy transfer

Question 13 · continued

6 (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)

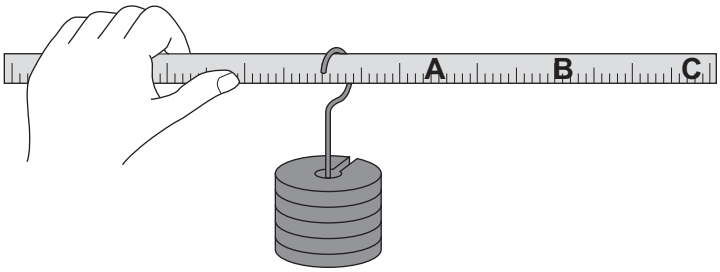
9

4.5.2 Work done and energy transfer

Question 14

January 2011 | PHY3F | Original Q3 | Legacy

3 (a) A student holds a ruler at one end and slides a weight along the ruler.



At which point, **A**, **B** or **C**, will the turning effect of the weight feel greatest?

Write your answer, **A**, **B** or **C**, in the box. Point ☐

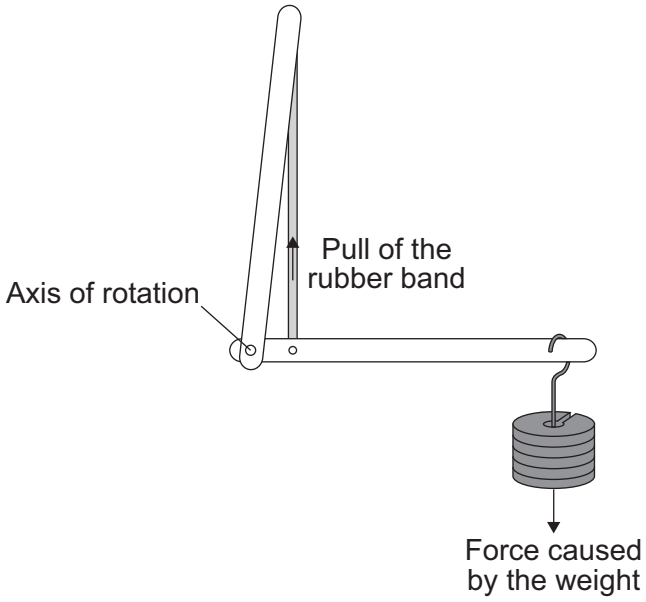
(1 mark)

3 (b) Complete the following sentence by drawing a ring around the correct word in the box.

The turning effect of a force is called the | axis | equilibrium | moment | of the force.

(1 mark)

3 (c) In a human arm, the biceps muscle provides the force needed to hold the arm horizontal. A student uses a model in which a rubber band represents the biceps muscle.



4.5.2 Work done and energy transfer

Question 14 · continued

Complete the following sentence by drawing a ring around the correct line in the box.

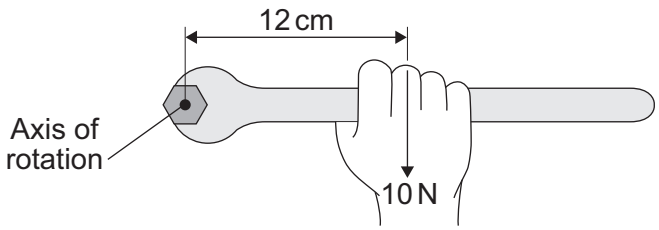
To hold the model arm horizontal, the pull from the rubber band will be

bigger than
smaller than
the same as

the force caused by the weight.

(1 mark)

3 (d) The diagram shows a long spanner.



Use the equation in the box to calculate the moment, in N cm, being produced.

moment	=	force	×	perpendicular distance from the line of action of the force to the axis of rotation

Show clearly how you work out your answer.

.....

.....

Moment = ... N cm

(2 marks)

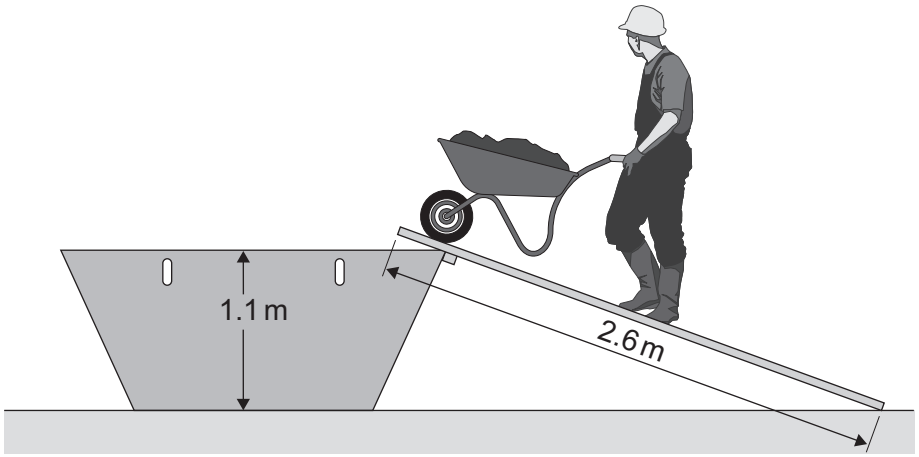
5

4.5.2 Work done and energy transfer

Question 15

June 2011 | PHY2F | Original Q7 | Legacy

7 (a) The diagram shows a builder using a plank to help load rubble into a skip.



The builder uses a force of 220 N to push the wheelbarrow up the plank.

Use information from the diagram and the equation in the box to calculate the work done to push the wheelbarrow up the plank to the skip.

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

Show clearly how you work out your answer.

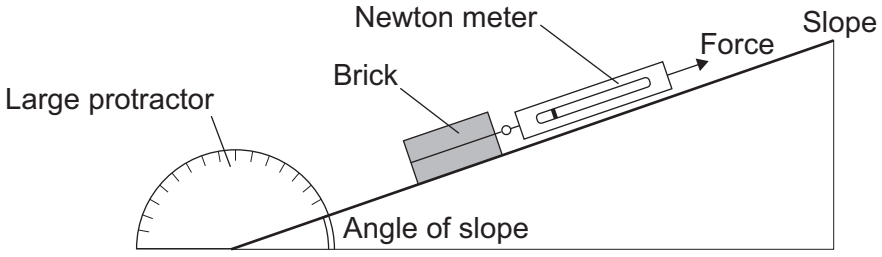
.....

.....

Work done = ... J

(2 marks)

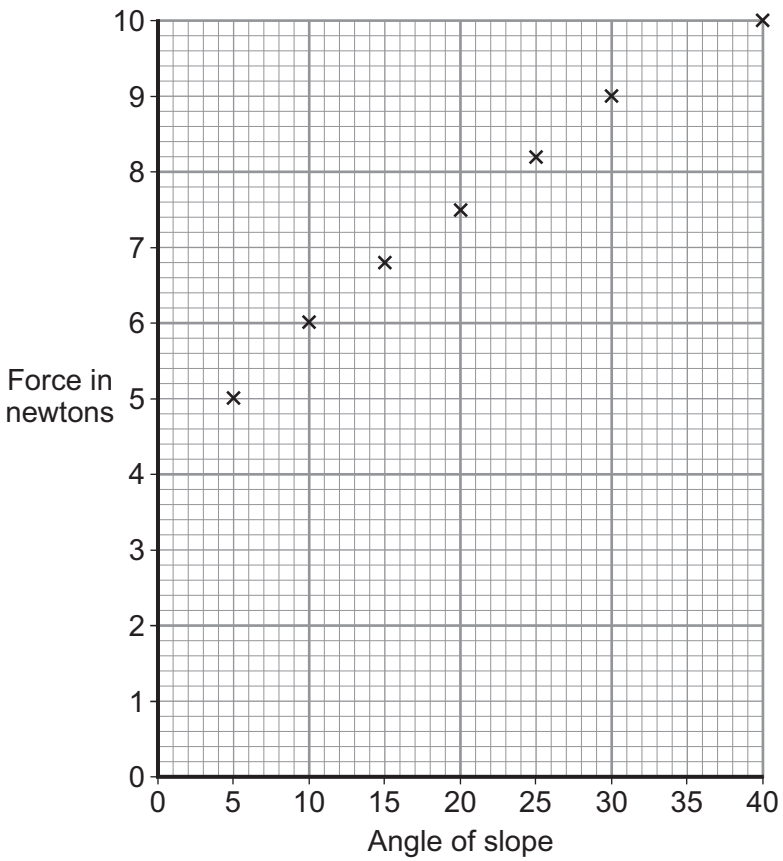
7 (b) A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.



The student used the results from the investigation to plot the points for a graph of force used against the angle of the slope.

4.5.2 Work done and energy transfer

Question 15 · continued



7 (b) (i) Draw a line of best fit for these points. *(1 mark)*

7 (b) (ii) How does the force used to pull the brick up the slope change as the angle of the slope increases?

.....

.....

(1 mark)

7 (b) (iii) Consider the results from this experiment.
Should the student recommend that the builder use a long plank or a short plank to help load the skip?

Draw a ring around your answer.

long plank **short plank**

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

6

4.5.2 Work done and energy transfer

Question 16

June 2011 | PHY3F | Original Q8 | Legacy

8 (a) A student investigates the moment of a force.

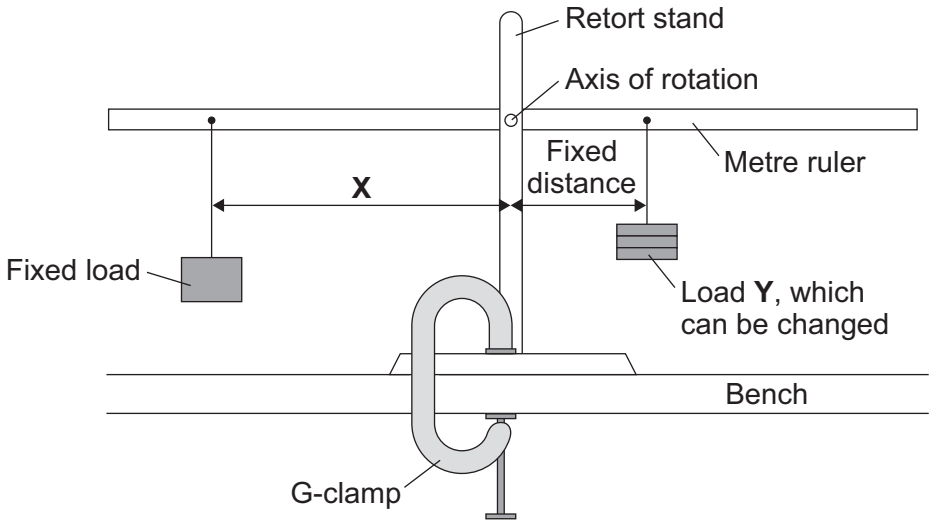
8 (a) (i) What does the word *moment* mean in this sentence?

.....

.....

(1 mark)

8 (a) (ii) The diagram shows how she sets up her apparatus.



Suggest the purpose of the G-clamp.

.....

.....

(1 mark)

4.5.2 Work done and energy transfer

Question 16 · continued

8 (a) (iii) A horizontal rod fits into a hole at the centre of the metre ruler. This is the axis of rotation. The student changes the load **Y** and adjusts the distance **X** until the metre ruler is horizontal. She takes six pairs of measurements which are shown in the table.

Load Y in newtons	Distance X in centimetres
1	7
2	14
3	21
4	28
5	35
6	42

Explain fully how distance **X** varies with load **Y**.

.....

.....

.....

.....

.....

(2 marks)

8 (a) (iv) The weight of the ruler can be ignored in this experiment.

Which statement gives the reason why?

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

The weight of the ruler is so small it is negligible. ☐

The centre of mass of the ruler is at the axis of rotation. ☐

The ruler is a symmetrical object. ☐

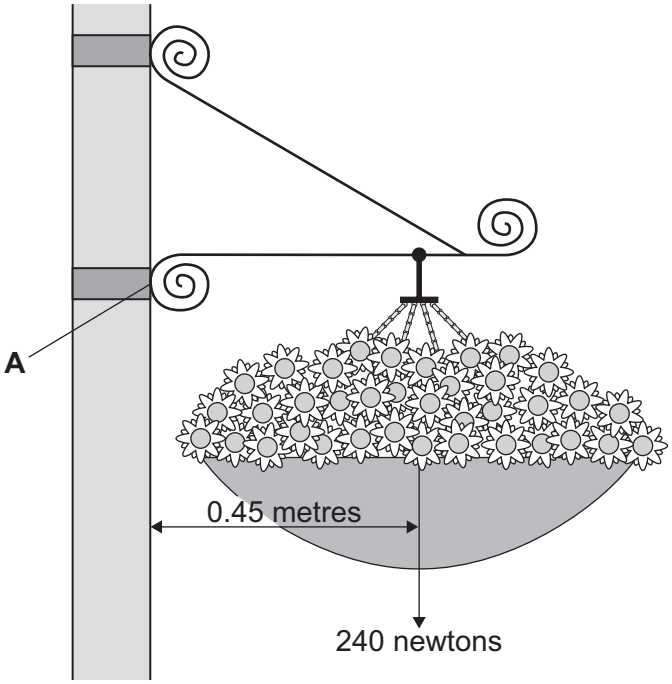
(1 mark)

Question 8 continues on the next page

4.5.2 Work done and energy transfer

Question 16 · continued

8 (b) In the summer, a town council fits hanging baskets to some of its lamp posts.



Use the information in the diagram and the equation in the box to calculate the moment produced by the weight of the hanging basket about an axis through point **A**.

moment = force × perpendicular distance from the line of action of the force to the axis of rotation

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

.....

.....

.....

.....

Moment =.....

(3 marks)

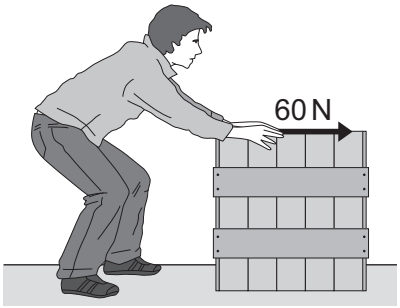
8

4.5.2 Work done and energy transfer

Question 17

June 2012 | PH2FP | Original Q3 | Legacy

3 The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



3 (a) The crate moves at a constant speed in a straight line.

3 (a) (i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1 mark)

3 (a) (ii) State the size of the friction force acting on the moving crate.

..... N

Give the reason for your answer.

.....

.....

(2 marks)

3 (b) Calculate the work done by the worker to push the crate 28 metres.

Use the correct equation from the Physics Equations Sheet.

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

Choose the unit from the list below.

joule **newton** **watt**

.....

.....

Work done = ...

(3 marks)

6

4.5.2 Work done and energy transfer

Question 18

January 2013 | PH2FP | Original Q8 | Legacy

8 A car has an oil leak. Every 5 seconds an oil drop falls from the bottom of the car onto the road.

8 (a) What force causes the oil drop to fall towards the road?

.....

(1 mark)

8 (b) The diagram shows the spacing of the oil drops left on the road during part of a journey from A to B.



Describe the motion of the car as it moves from **A** to **B**.

.....

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

8 (c) When the brakes are applied, a braking force slows down and stops the car.

8 (c) (i) The size of the braking force affects the braking distance of the car.

State **one** other factor that affects the braking distance of the car.

.....

(1 mark)

4.5.2 Work done and energy transfer

Question 18 · continued

8 (c) (ii) A braking force of 3 kN is used to slow down and stop the car in a distance of 25 m.

Calculate the work done by the brakes to stop the car and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Work done =.....

(3 marks)

8

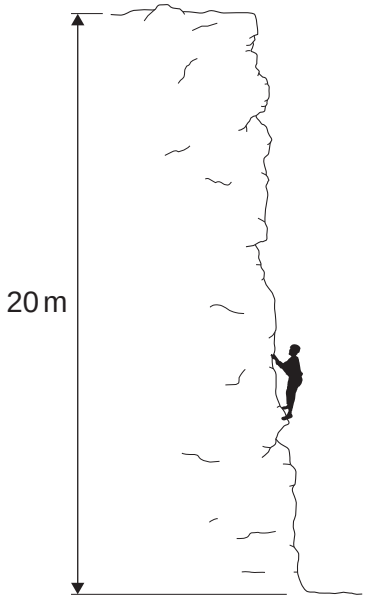
Turn over for the next question

4.5.2 Work done and energy transfer

Question 19

June 2013 | PH2FP | Original Q4 | Legacy

4 The diagram shows a climber part way up a cliff.



4 (a) Complete the sentence.

When the climber moves up the cliff, the climber

gains gravitational ..... energy.

(1 mark)

4 (b) The climber weighs 660 N.

4 (b) (i) Calculate the work the climber must do against gravity, to climb to the top of the cliff.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Work done = ... J

(2 marks)

4 (b) (ii) It takes the climber 800 seconds to climb to the top of the cliff. During this time the energy transferred to the climber equals the work done by the climber.

Calculate the power of the climber during the climb.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Power = ... W

(2 marks)

5

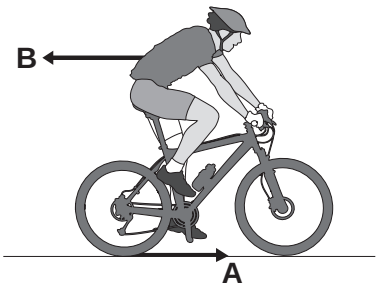
4.5.2 Work done and energy transfer

Question 20

June 2014 | PH2FP | Original Q8 | Legacy

8 (a) **Figure 13** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 13



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

Draw a ring around the correct answer.

[1 mark]

friction **gravity** **weight**

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

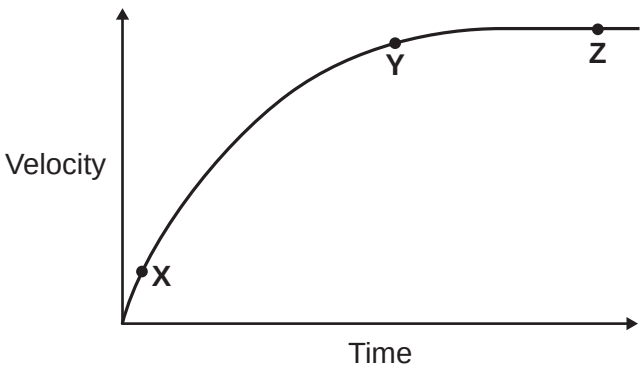
[1 mark]

.....

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

Figure 14 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 14



4.5.2 Work done and energy transfer

Question 20 · 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 14**.

[6 marks]

Extra space .....

Question 8 continues on the next page

4.5.2 Work done and energy transfer

Question 20 · continued

8 (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 = ...

8 (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

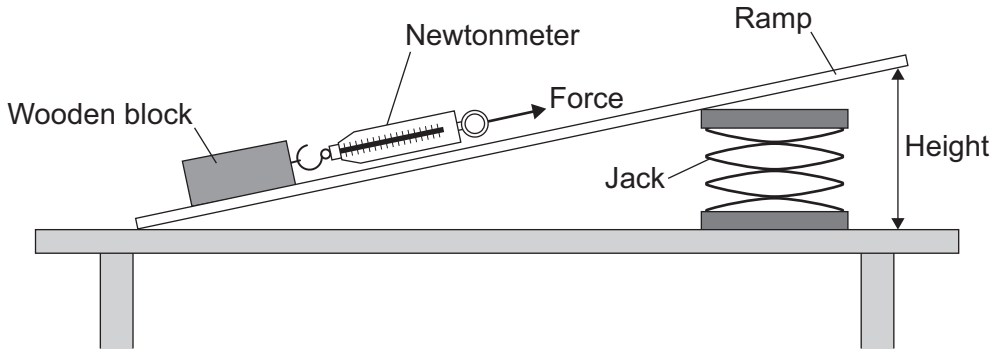
4.5.2 Work done and energy transfer

Question 21

June 2017 | PH2FP | Original Q4 | Legacy

4 A student investigated how the height of a ramp affects the force needed to pull a wooden block up the ramp at a steady speed. **Figure 6** shows the apparatus used by the student.

Figure 6



4 (a) Complete the following sentence.

[1 mark]

To pull the wooden block up the ramp the student must do work against the force of friction and the force of _____ .

4 (b) (i) What was the independent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

- The force used to pull the wooden block. ☐
- The height of the ramp. ☐
- The mass of the wooden block. ☐

4 (b) (ii) What was a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

- The force used to pull the wooden block. ☐
- The height of the ramp. ☐
- The mass of the wooden block. ☐

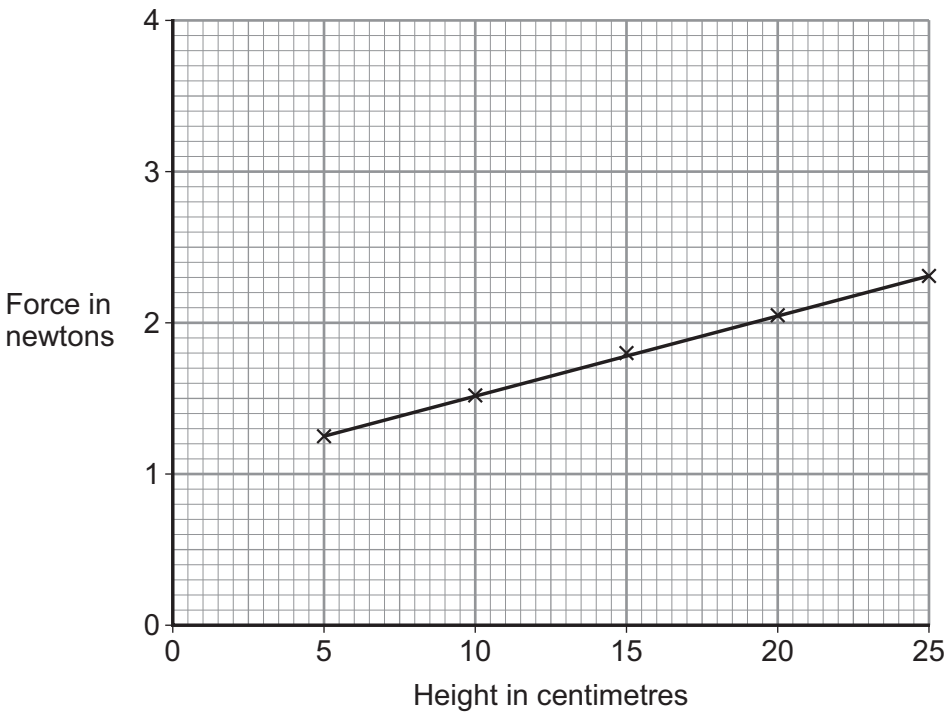
Question 4 continues on the next page

4.5.2 Work done and energy transfer

Question 21 · continued

4 (c) The results from the investigation are plotted in **Figure 7**.

Figure 7



4 (c) (i) How do you know from **Figure 7**, that none of the results were anomalous?

[1 mark]

_____

_____

4 (c) (ii) Use **Figure 7** to estimate the force needed to pull the wooden block along the ramp when the ramp is lying flat on the bench.

[1 mark]

Force = _____ N

4 (c) (iii) What conclusion should be made from the results shown in **Figure 7**?

[2 marks]

_____

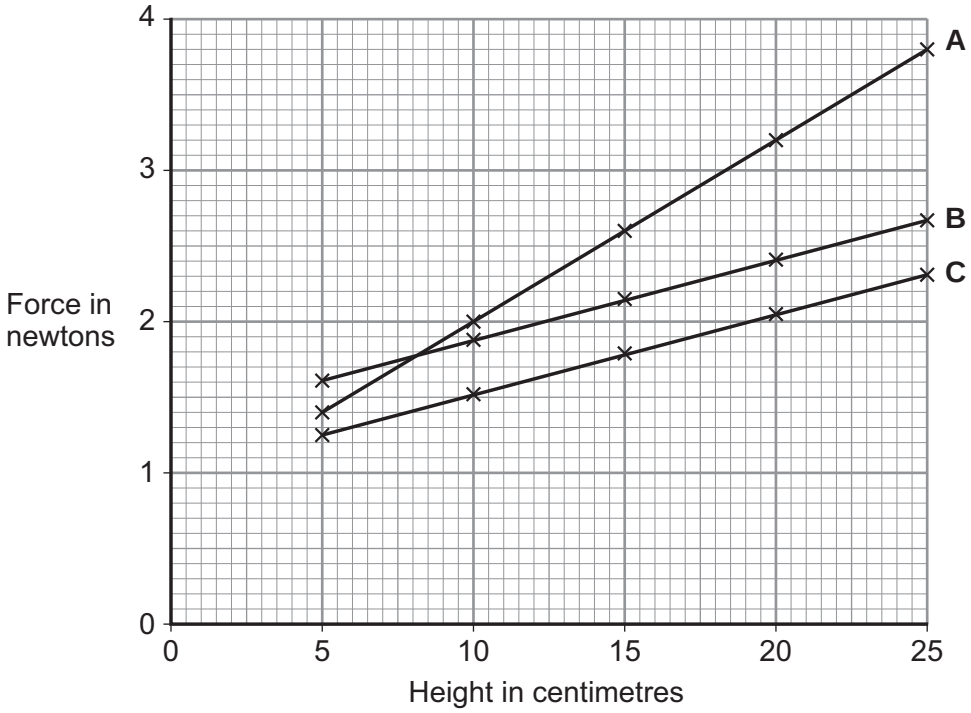
_____

_____

_____

4 (c) (iv) Another student used the same apparatus to repeat the investigation.
The student increased the force of friction by fixing a rough material to the bottom of the wooden block.

Figure 8



Which of the following, **A**, **B** or **C**, in **Figure 8**, shows the results obtained by this student?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

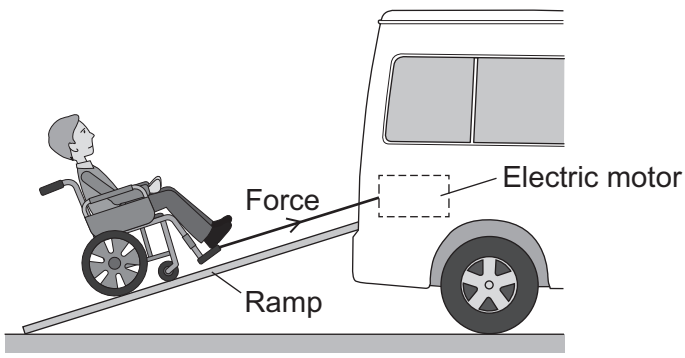
Question 4 continues on the next page

4.5.2 Work done and energy transfer

Question 21 · continued

4 (d) **Figure 9** shows how a ramp is used to help move a child in a wheelchair into a car. The wheelchair is pulled up the ramp by a cable attached to an electric motor.

Figure 9



A force of 260 N is used to pull the child and wheelchair up the ramp.
The ramp is 1.2 m long.

Calculate the work done to pull the child and wheelchair up the ramp.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

Work done = _____ J

10

4.5.2 Work done and energy transfer

Question 22

June 2018 | 8463/1F | Original Q9

0 9 **Figure 13** shows a lift inside a building.

Figure 13



0 9 . 1 The motor in the lift does 120 000 J of work in 8.0 seconds.

Calculate the power output of the motor in the lift.

Use the equation:

$$\text{Power output} = \frac{\text{work done}}{\text{time}}$$

[2 marks]

Power output = _____ W

Question 22 · continued

0 9 . 2 The power input to the motor is greater than the power output.

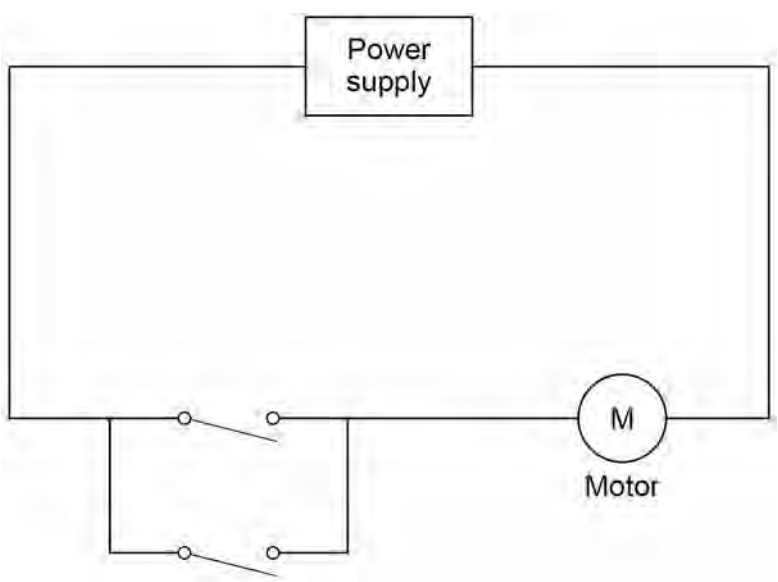
Tick **two** reasons why.

[2 marks]

- Energy is transferred in heating the surroundings. ☐
- Friction causes energy to be transferred in non-useful ways. ☐
- The motor is connected to the mains electricity supply. ☐
- The motor is more than 100% efficient. ☐
- There are only four people in the lift. ☐

0 9 . 3 **Figure 14** shows part of the circuit that operates the lift motor.

Figure 14



The lift can be operated using either of the two switches.

Explain why.

[2 marks]

4.5.2 Work done and energy transfer

Question 22 · continued

0 9 . 4 Write down the equation that links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

0 9 . 5 The lift goes up 14 m. The total mass of the people in the lift is 280 kg.

gravitational field strength = 9.8 N/kg

Calculate the increase in gravitational potential energy of the people in the lift.

Give your answer to 2 significant figures.

[3 marks]

Increase in gravitational potential energy = _____ J

10

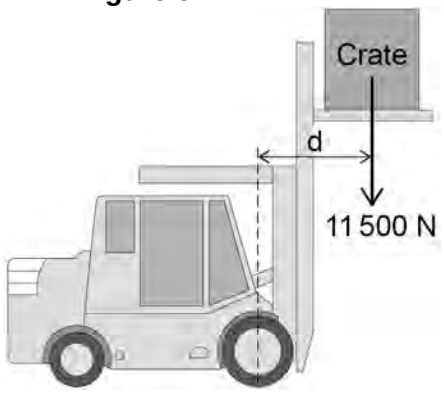
4.5.2 Work done and energy transfer

Question 23

June 2018 | 8463/2F | Original Q7

0 7 **Figure 9** shows a fork-lift truck lifting a heavy crate.

Figure 9



0 7 . 1 The crate weighs 11 500 N and is lifted vertically 2.60 m.

Calculate the work done to lift the crate.

Use the equation:

work done = force × distance

[2 marks]

Work done = _____ J

4.5.2 Work done and energy transfer

Question 23 · continued

June 2018 | 8463/2F | Original Q7

The weight of the crate causes a clockwise moment of 13 800 Nm about the centre of the front wheel of the fork-lift truck.

0 7 . 2 The weight of the fork-lift truck and driver cause an anticlockwise moment.

What is the minimum size of the anticlockwise moment needed so that the fork-lift truck does **not** topple over?

[1 mark]

0 7 . 3 Write down the equation which links distance, force and moment of a force.

[1 mark]

0 7 . 4 Calculate the distance '**d**' marked on **Figure 9**.

[3 marks]

Distance '**d**' = _____ m

7

4.5.2 Work done and energy transfer

Question 24

June 2019 | 8463/2F | Original Q10

1 0 . 1 The driver of a vehicle sees a hazard on the road.

The driver uses the brakes to stop the vehicle.

Explain the factors that affect the distance needed to stop a vehicle in an emergency.

[6 marks]

4.5.2 Work done and energy transfer

Question 24 · continued

June 2019 | 8463/2F | Original Q10

10.2 Write down the equation which links distance, force and work done.

[1 mark]

10.3 The work done by the braking force to stop a vehicle was 900 000 J

The braking force was 60 000 N

Calculate the braking distance of the vehicle.

[3 marks]

Braking distance = _____ m

10.4 The greater the braking force, the greater the deceleration of a vehicle.

Explain the possible dangers caused by a vehicle having a large deceleration when it is braking.

[2 marks]

12

4.5.2 Work done and energy transfer

Question 25

November 2020 | 8463/2F | Original Q7

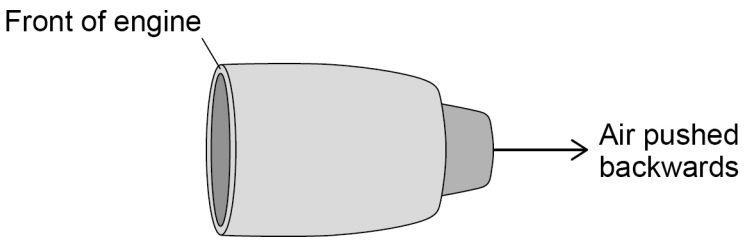
0 7 . 1 An aircraft travels at a constant velocity.

How is the velocity of the aircraft different to the speed of the aircraft?

[1 mark]

0 7 . 2 **Figure 11** shows one of the engines on the aircraft.

Figure 11



Air is taken into the front of the engine and pushed out of the back of the engine.

Explain the effect this has on the engine.

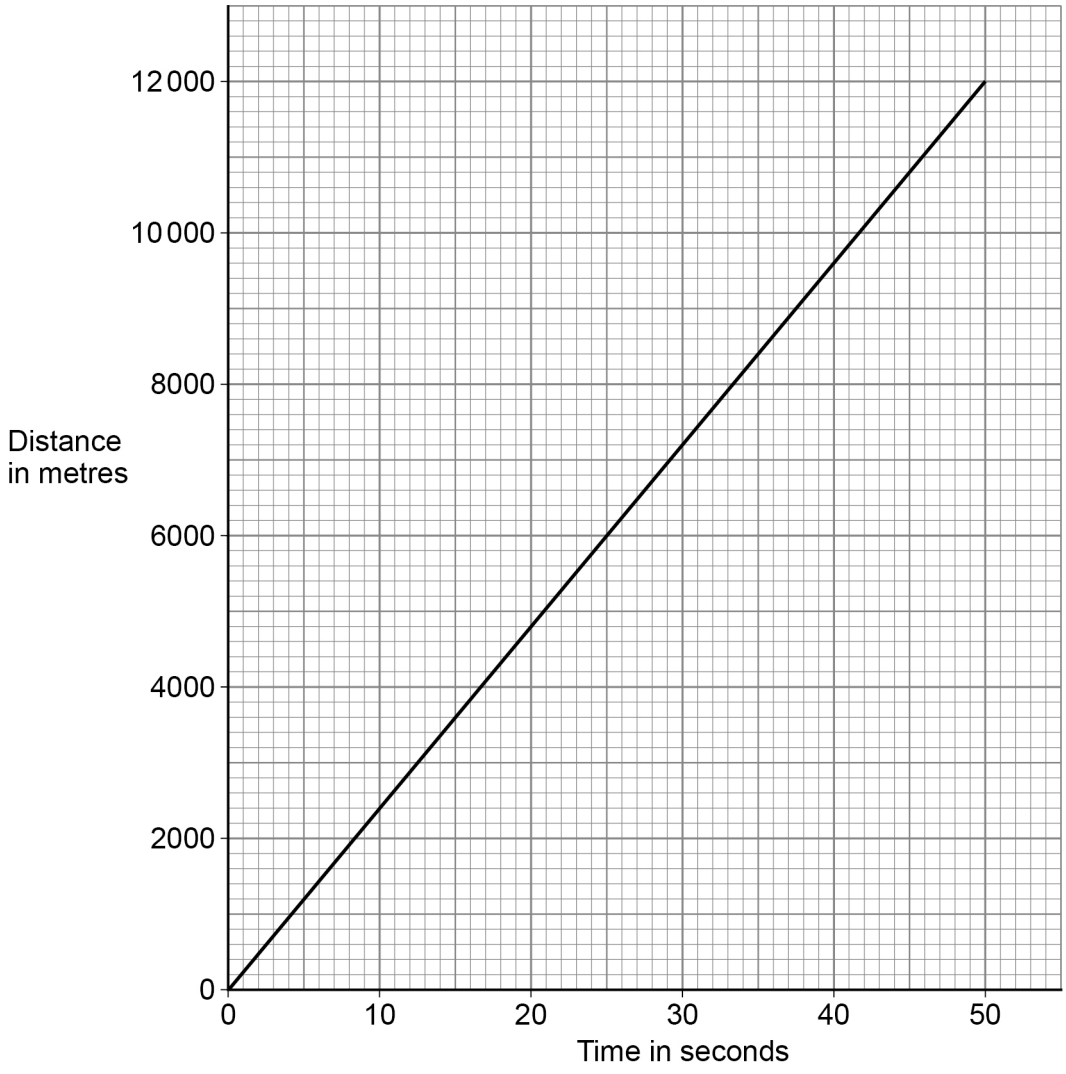
[2 marks]

4.5.2 Work done and energy transfer

Question 25 · continued

0 7 . 3 **Figure 12** shows a distance-time graph for the aircraft.

Figure 12



Determine the speed of the aircraft.

[3 marks]

Speed = _____ m/s

Question 7 continues on the next page

4.5.2 Work done and energy transfer

Question 25 · continued

0 7 . 4 Write down the equation that links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 7 . 5 At a different stage of the flight, the aircraft was travelling at a velocity of 250 m/s.

The aircraft then decelerated at 0.14 m/s^2.

Calculate the time taken for the aircraft to decelerate from 250 m/s to 68 m/s.

[4 marks]

Time = _____ s

4.5.2 Work done and energy transfer

Question 25 · continued

0 7 . 6 Write down the equation that links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 7 . 7 When the aircraft landed, it travelled 2000 m before stopping.

The work done to stop the aircraft was 140 000 000 J.

Calculate the mean force used to stop the aircraft.

[3 marks]

Mean force = _____ N

15

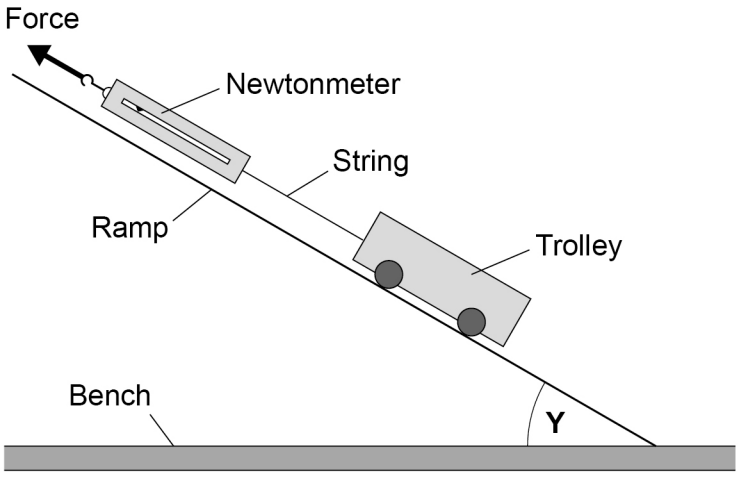
4.5.2 Work done and energy transfer

Question 26

0 4 A student investigated how the angle of a ramp affects the force required to hold a trolley stationary on the ramp.

Figure 10 shows the equipment used.

Figure 10



0 4 . 1 Measure the angle **Y** in **Figure 10**

[1 mark]

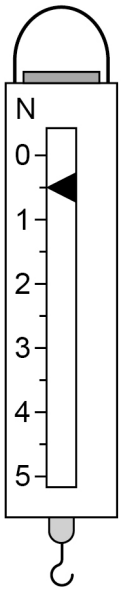
Angle **Y** = _____ degrees

4.5.2 Work done and energy transfer

Question 26 · continued

Figure 11 shows the newtonmeter before the investigation started.

Figure 11



0 4 . 2 What type of error is shown on the newtonmeter in **Figure 11**?

[1 mark]

Tick (✓) **one** box.

Human error ☐

Random error ☐

Zero error ☐

0 4 . 3 How can this error be corrected after the measurements have been taken?

[1 mark]

Tick (✓) **one** box.

Add 0.5 N to each measurement ☐

Multiply each measurement by 0.5 N ☐

Subtract 0.5 N from each measurement ☐

Question 26 · continued

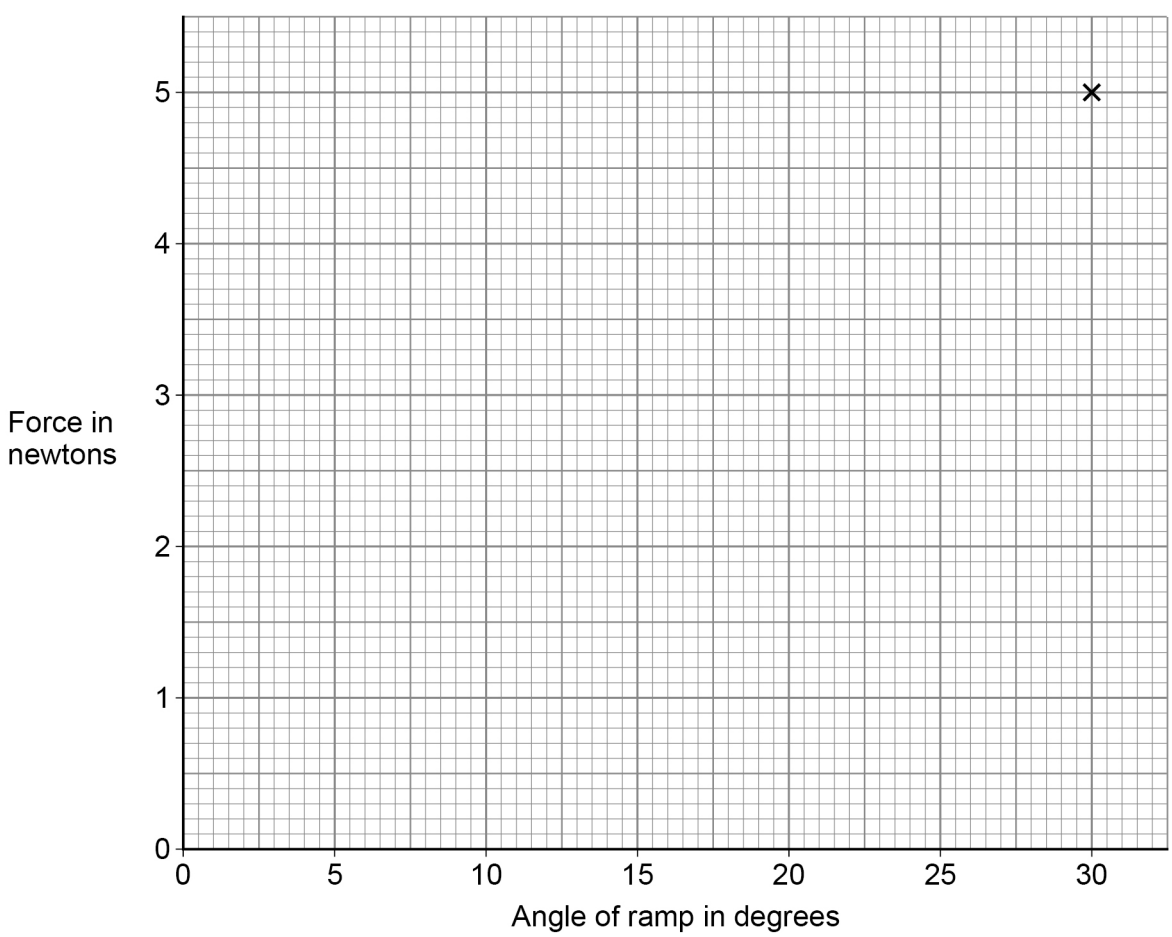
Table 2 shows the corrected results.

Table 2

Angle of ramp in degrees	Force in newtons
5	0.9
10	1.7
15	2.6
20	3.4
25	4.2
30	5.0

Figure 12 is an incomplete graph of the results

Figure 12



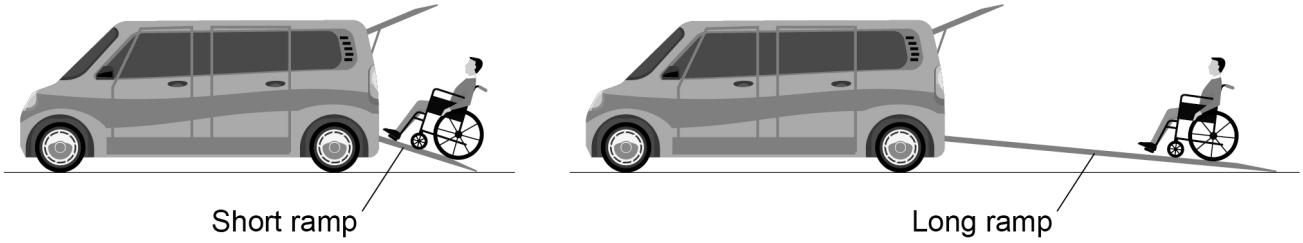
Question 26 · continued

0 4 . 4 Plot the missing results from **Table 2** on **Figure 12**.

[2 marks]

0 4 . 5 **Figure 13** shows a person in a wheelchair using two different ramps to enter a van.

Figure 13



The ramps are at different angles to the ground.

Explain **one** advantage of using the long ramp compared with using the short ramp.

[2 marks]

0 4 . 6 A force of 160 N is used to move the wheelchair up the long ramp.

The ramp is 2.5 m long.

Calculate the work done to move the wheelchair up the ramp.

Use the equation:

work done = force × distance

[2 marks]

Work done = _____ J

9

4.5.2 Work done and energy transfer

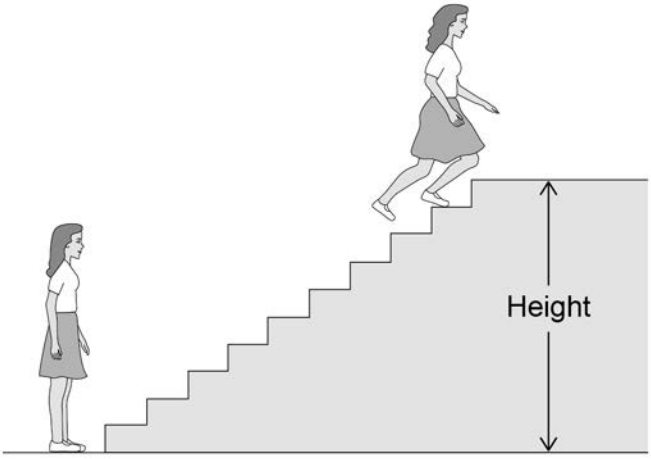
Question 27

June 2022 | 8463/1F | Original Q2

0 2 A girl ran to the top of some stairs.

Figure 2 shows the stairs.

Figure 2



0 2 . 1 The girl measured the height of the stairs.

What measuring instrument should she have used?

[1 mark]

0 2 . 2 The height of the stairs was 1.7 m.

The mass of the girl was 50 kg.

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the girl.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

Question 27 · continued

0 2 . 3 A boy ran up the same stairs and did 1800 J of work.

The time it took the boy to run up the stairs was 1.44 s.

Calculate the power of the boy.

Use the equation:

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

[2 marks]

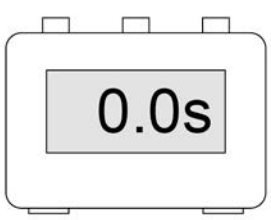
Power = _____ W

0 2 . 4 Which stop-clock was used to measure the time the boy took to run up the stairs?

[1 mark]

Tick (✓) **one** box.

Stop-clock A



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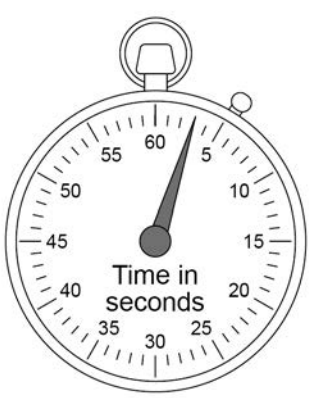
Stop-clock B



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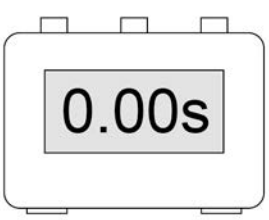
Stop-clock C



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4.5.2 Work done and energy transfer

Question 27 · continued

0 2 . 5 The boy had a speed of 2.0 m/s at the top of the stairs.

The mass of the boy was 70 kg.

Calculate the kinetic energy of the boy at the top of the stairs.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

[2 marks]

Kinetic energy = _____ J

8

4.5.2 Work done and energy transfer

Question 28

June 2022 | 8463/2F | Original Q8

0 8 **Figure 15** shows an electric super-car.

Figure 15



0 8 . 1 The battery in an electric car needs to be recharged.

Suggest **two** factors that affect the distance an electric car can travel before the battery needs to be recharged.

[2 marks]

1 _____

2 _____

4.5.2 Work done and energy transfer

Question 28 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 8 . 3 The maximum acceleration of the car is 20 m/s^2.

Calculate the time taken for the speed of the car to change from 0 m/s to 28 m/s at its maximum acceleration.

[3 marks]

Time taken = _____ s

Question 8 continues on the next page

4.5.2 Work done and energy transfer

Question 28 · continued

0 8 . 4 In a trial run, the car accelerates at 10 m/s^2 until it reaches its final velocity.

distance travelled by the car = 605 m

initial velocity of the car = 0 m/s

Calculate the final velocity of the car.

Use the Physics Equations Sheet.

[3 marks]

Final velocity = _____ m/s

4.5.2 Work done and energy transfer

Question 28 · continued

Use the Physics Equations Sheet to answer questions **08.5** and **08.6**.

0 8 . 5 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 8 . 6 When travelling at its maximum speed the air resistance acting on the car is 4000 N.

Calculate the work done against air resistance when the car travels a distance of 7.5 km at its maximum speed.

[3 marks]

Work done = _____ J

13

4.5.2 Work done and energy transfer

Question 29

June 2023 | 8463/2F | Original Q2

0 2 The stopping distance of a car is the braking distance added to the thinking distance.

0 2 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**electrostatic**	**kinetic**
nuclear		**thermal**

A driver applies the brakes to a moving car.

As the car slows down, there is a decrease in the _____ energy of the car.

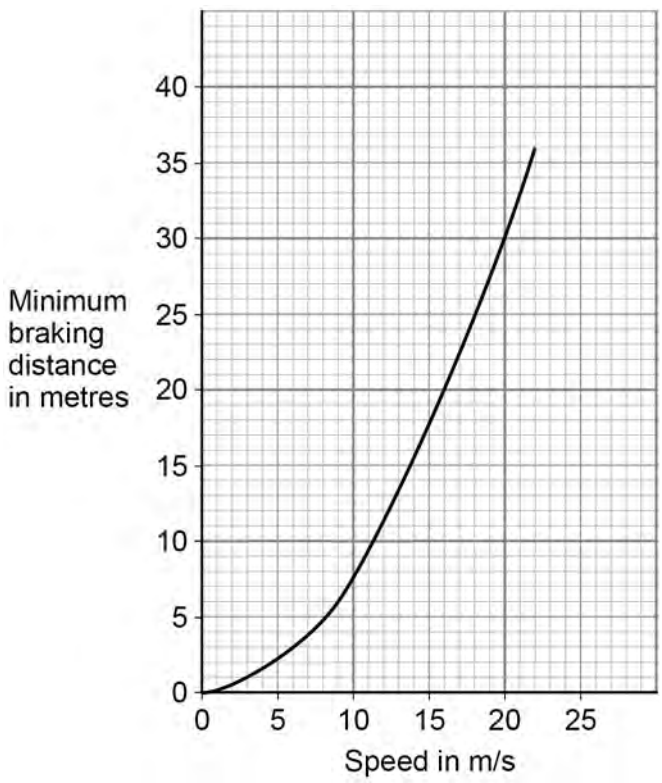
The work done by friction causes an increase in the _____ energy store of the brakes.

Question 2 continues on the next page

Question 29 · continued

0 2 . 2 **Figure 3** shows how the speed of the car affects the minimum braking distance of the car.

Figure 3



Describe the relationship between the speed of the car and the minimum braking distance of the car.

[1 mark]

0 2 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

decreases	**stays the same**	**increases**

When the road becomes icy, the braking distance _____.

4.5.2 Work done and energy transfer

Question 29 · continued

A car driver applies the brakes to decelerate the car as it approaches a road junction.

The car decelerates at 0.25 m/s^2.

mass of the car = 1600 kg

0 2 . 4 Calculate the time taken for the velocity of the car to decrease from 12.5 m/s to 5.0 m/s.

Use the equation:

$$\text{time taken} = \frac{\text{change in velocity}}{\text{deceleration}}$$

[3 marks]

Time taken = _____ s

0 2 . 5 Calculate the resultant force causing the car to decelerate.

Use the equation:

$$\text{resultant force} = \text{mass} \times \text{deceleration}$$

[2 marks]

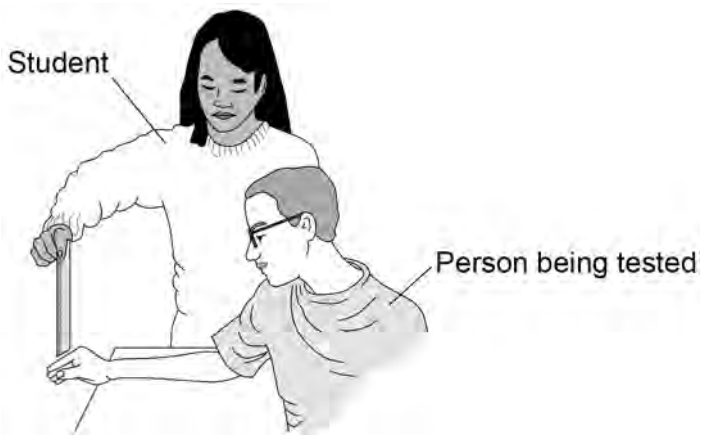
Resultant force = _____ N

Question 29 · continued

Thinking distance is affected by the reaction time of the driver.

Figure 4 shows how a student tested a person's reaction time.

Figure 4



The student held a ruler and then released it.

The person being tested closed his hand to catch the ruler as quickly as possible.

The further the ruler fell the greater the person's reaction time.

0 2 . 6 The student wanted to test the reaction time of the people in her class.

Which of the following could have been a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Distance fallen by the ruler before being caught ☐

Initial height of the ruler above the person's hand ☐

Reaction time of the person being tested ☐

4.5.2 Work done and energy transfer

Question 29 · continued

0 2 . 7 The student tested three people in her class.

The mean distance that the ruler fell before being caught was 18.2 cm.

If all of the people in her class were tested, the mean distance may not be 18.2 cm.

Suggest why.

[1 mark]

0 2 . 8 Describe how this investigation could be changed to find out how listening to music affects reaction time.

[2 marks]

13

4.5.2 Work done and energy transfer

Question 30

June 2024 | 8463/2F | Original Q9

0 9 **Figure 17** shows a young child using a baby walker.

Figure 17



0 9 . 1 The child is standing still.

What is the resultant **vertical** force on the child?

Give a reason for your answer.

[2 marks]

Resultant vertical force = _____ N

Reason _____

_____

4.5.2 Work done and energy transfer

Question 30 · continued

Use the Physics Equations Sheet to answer questions **09.2** and **09.3**.

0 9 . 2 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 9 . 3 The child pushed the baby walker 2.8 m across a horizontal floor.

The work done by the child was 35 J.

Calculate the horizontal force the child applied to the baby walker.

[3 marks]

Horizontal force = _____ N

0 9 . 4 The child pushed the baby walker from a carpet onto a hard floor.

The child applied the same horizontal force to the baby walker.

Explain why the speed of the baby walker increased.

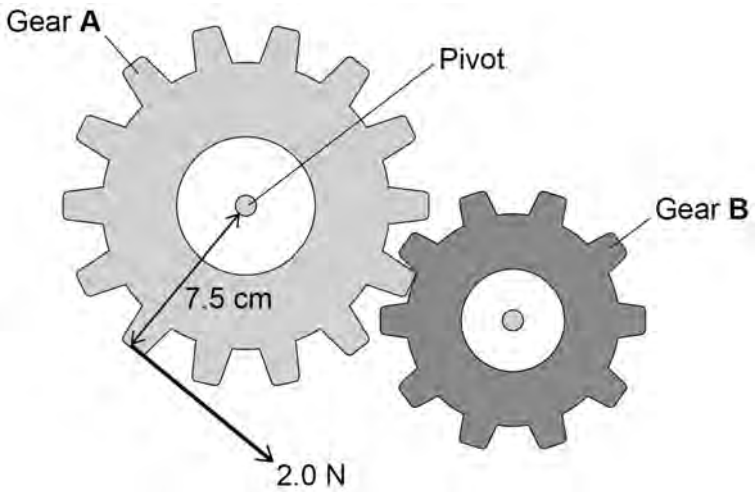
[2 marks]

Question 30 · continued

There are some toy gears on the front of the baby walker.

Figure 18 shows the gears.

Figure 18



The child applies a force to gear **A**.

This causes a moment about the pivot, so gear **A** rotates.

4.5.2 Work done and energy transfer

Question 30 · continued

Use the Physics Equations Sheet to answer questions **09.5** and **09.6**.

0 9 . 5 Write down the equation which links distance (*d*), force (*F*) and moment of a force (*M*).

[1 mark]

0 9 . 6 The child applies a force of 2.0 N on gear **A**.

The perpendicular distance between the force and the pivot is 7.5 cm.

Calculate the moment of the force about the pivot.

[3 marks]

Moment of force = _____ N m

0 9 . 7 Explain what happens to gear **B** when the child applies the force to gear **A**.

[2 marks]

14

4.5.2 Work done and energy transfer

Question 31

June 2025 | 8463/2F | Original Q2

0 2 Very long trains can be pulled by more than one engine.

A train is made up of four engines pulling trucks filled with coal.

0 2 . 1 The coal in one truck has a mass of 75 000 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the coal in **one** truck.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 2 . 2 **One** engine exerts a forward force of 850 000 N.

Calculate the work done by **one** engine when the train moves a distance of 80 m.

Use the equation:

work done = force × distance moved

[2 marks]

Work done = _____ J

Question 31 · continued

0 2 . 3 Each of the four engines exerts a forward force of 850 000 N on the trucks.

Calculate the total forward force on the trucks.

[2 marks]

Total forward force = _____ N

0 2 . 4 The force exerted by the engines on the trucks is a contact force.

Which of the following is also a contact force?

[1 mark]

Tick (✓) **one** box.

- Electrostatic force ☐
- Frictional force ☐
- Gravitational force ☐

Question 2 continues on the next page

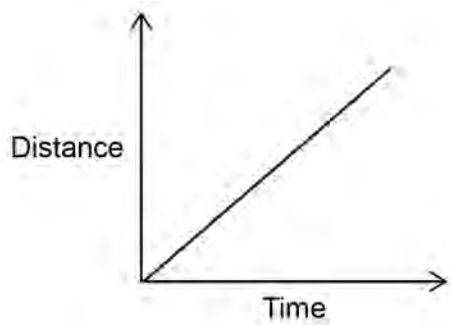
4.5.2 Work done and energy transfer

Question 31 · continued

0 2 . 5 Which sketch graph represents the train moving at a constant speed?

[1 mark]

Tick (✓) **one** box.



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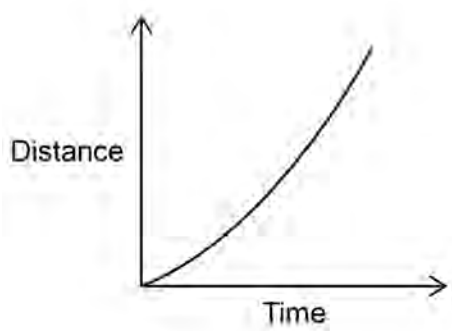

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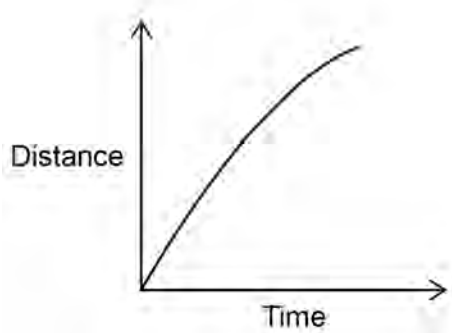

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4.5.2 Work done and energy transfer

Question 31 · continued

0 2 . 6 The train accelerates for 150 s.

The velocity of the train changes from 16 m/s to 25 m/s.

Calculate the acceleration of the train.

Use the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time}}$$

[3 marks]

Acceleration = _____ m/s^2

11

Turn over for the next question