OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



EXAM QUESTION PACK

M4 GRAPHS

SCORE	PERCENTAGE
/168	%

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Gateway Physics A (9-1)

Maths 4: Graphs

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **168**.
- The total number of marks may take into account some 'either/or' question choices.

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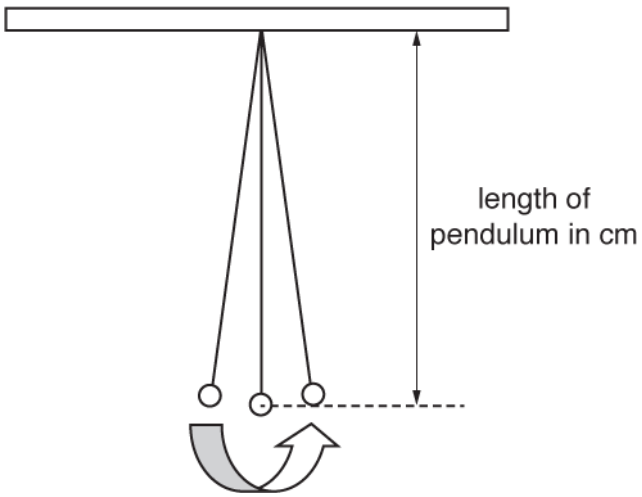
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1(a) Helen investigates children's swings.

She models the swings in the laboratory using weights attached to string.

This type of swing is called a **pendulum**.

She sets up a pendulum and makes it swing.



Helen uses a pendulum that has a length of 50 cm.

She measures the time it takes the pendulum to complete 10 swings.

She repeats this three times, **A, B** and **C**.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s			
	A	B	C	Mean (average)
50	14.62	14.78	14.40	

Calculate the mean (average) time for 10 swings.

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answer

s [1]

(b) Helen changes the length of the pendulum to 60 cm.

She takes three more measurements and calculates the mean.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s			
	A	B	C	Mean (average)
60	16.35		15.65	16.00

The results table is incomplete.

Use the data to calculate the missing value **B**.

answer ---------- s [2]

(c) Helen changes the length of the pendulum to 70 cm.

She takes more measurements and calculates the mean.

Look at her results.

Length of pendulum in cm	Time for 10 swings in s				Mean (average) time for one swing in s
	A	B	C	Mean (average)	
70	17.55	17.65	17.32	17.50666	

Use the data to calculate the mean time for one swing.

Give your answer to 2 decimal places.

answer _____ s **[2]**

(d) Helen wants to find out about real swings, like those used by children.

She uses longer pendulums and investigates the effect of changing the length.

Look at the summary of her results.

Length of pendulum in cm	Mean (average) time for one swing in s
100	2.00
120	2.18
150	2.43
190	2.74

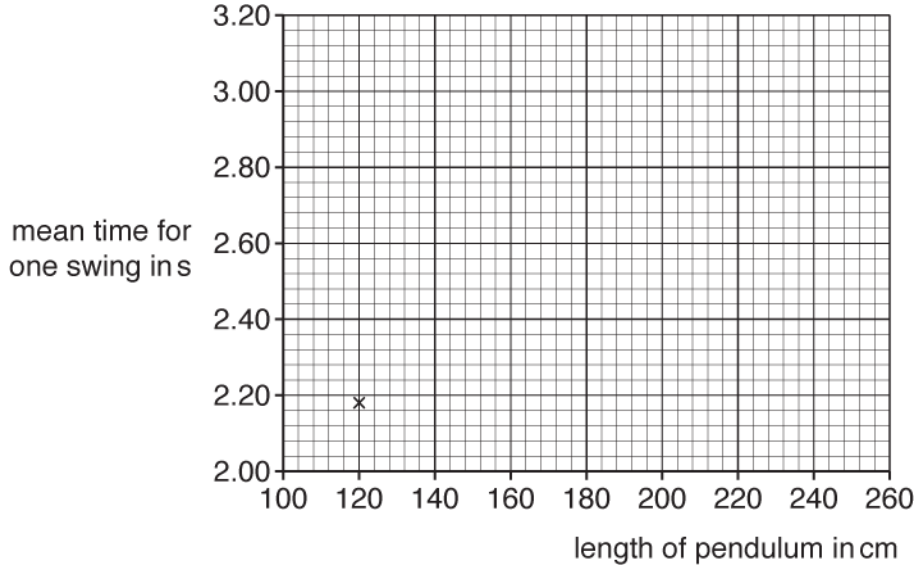
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(i) Plot Helen's results onto the graph. One has been plotted for you.

Draw a line of best fit.



[2]

(ii) Describe the pattern shown by the graph.

---

[1]

(iii) Helen wants to make a pendulum that takes 3 s for one complete swing.

Predict the length of this pendulum.

Show your working on the graph.

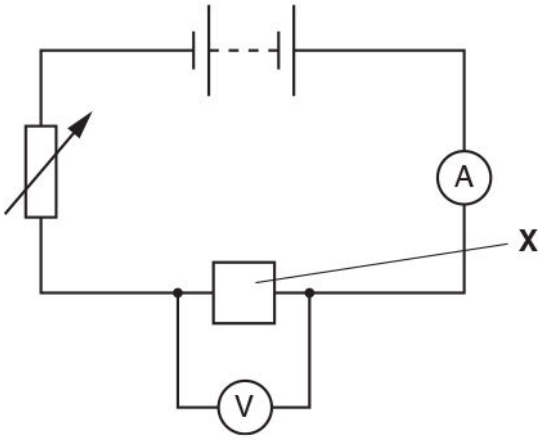
answer ---------- cm [2]

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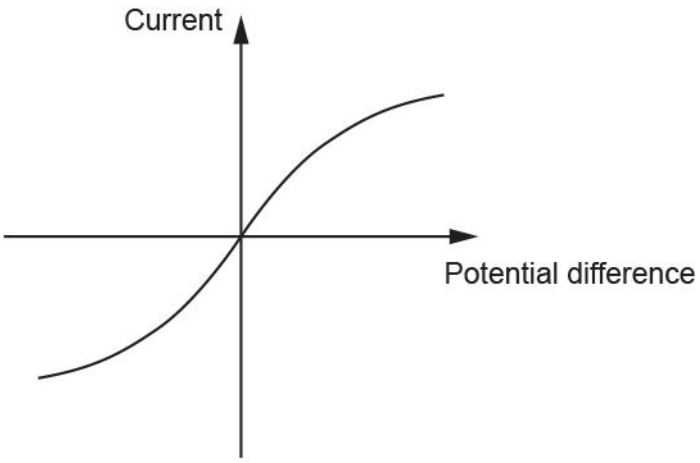
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2 A student builds a circuit to investigate the resistance of component **X**.



The student uses the circuit to take current and potential difference readings.

The student plots a graph of her results.



(i) Look at the graph.

What is component **X** in the circuit?

---

[1]

(ii) The resistance of component **X** varies as the potential difference changes.

Describe **how** the graph shows this and explain **why** this happens.

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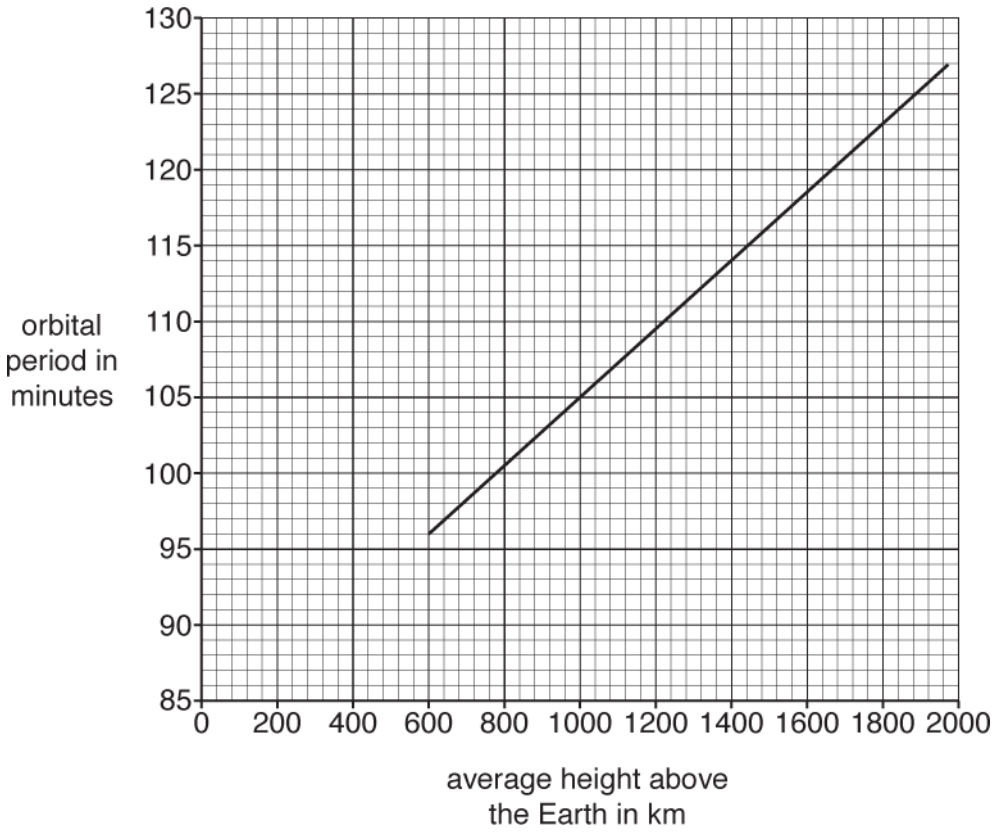
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[3]

3 Weather forecasting satellites are in a low orbit.

The average height of a satellite above the Earth is linked to its orbital period.



(i) A scientist suggests that doubling the height above the Earth from 1000 km to 2000 km will double the time period.

Is he correct?

Use calculations in your answer.

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[2]

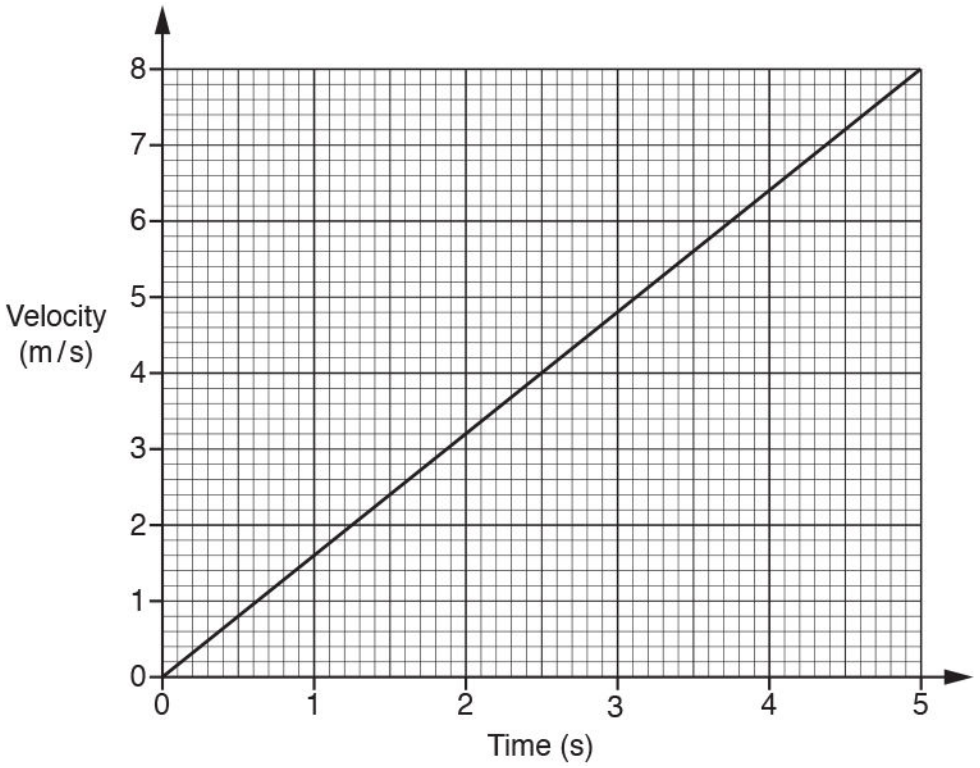
(ii) Write down one **advantage** of a low orbit for weather satellites.

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[1]

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4 Look at the velocity-time graph of an object.



What is the distance travelled by the object in 5s?

A 0.63 m

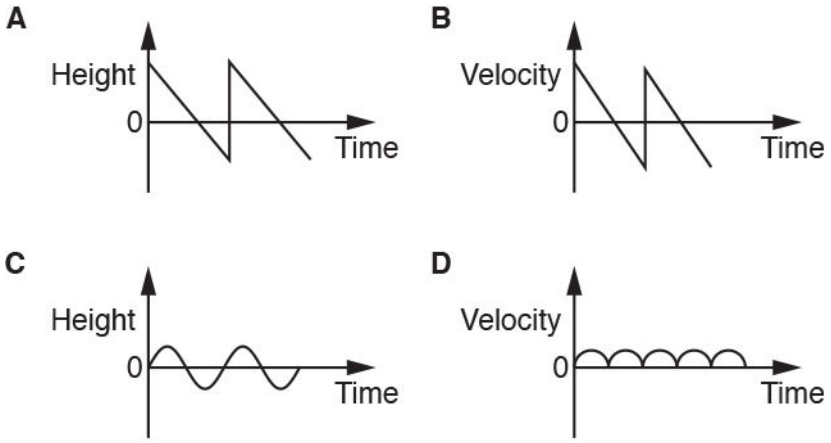
B 1.6 m

C 20 m

D 40 m

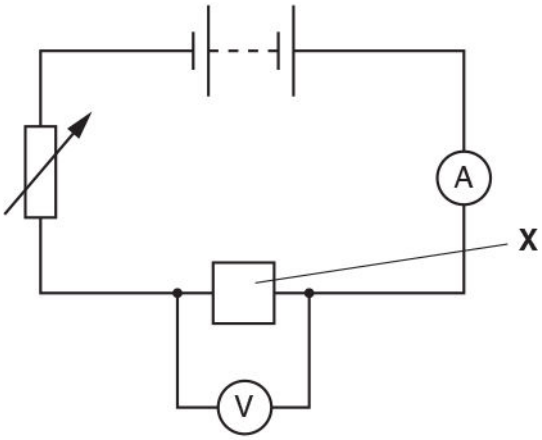
Your answer [1]

5 Which graph shows a bouncing ball?



Your answer ☐ [1]

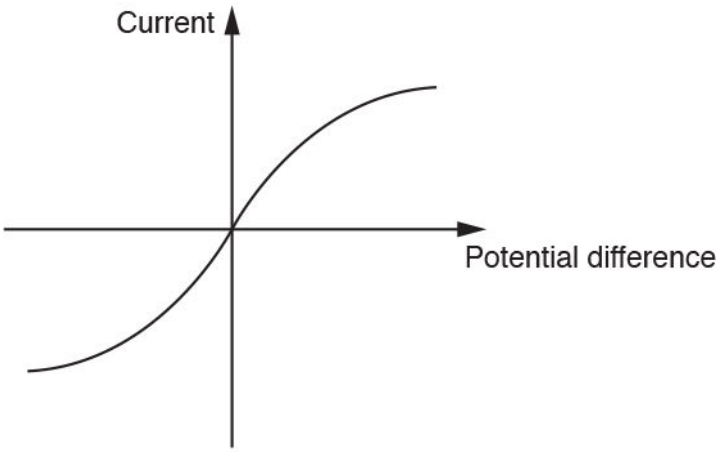
6 A student builds a circuit to investigate the resistance of component **X**.



The student uses the circuit to take current and potential difference readings.

The student plots a graph of her results.

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(i) Look at the graph. What is component **X** in the circuit?

---

[1]

(ii) The resistance of component **X** varies as the potential difference changes.

Describe how the graph shows this and explain why this happens.

---

[3]

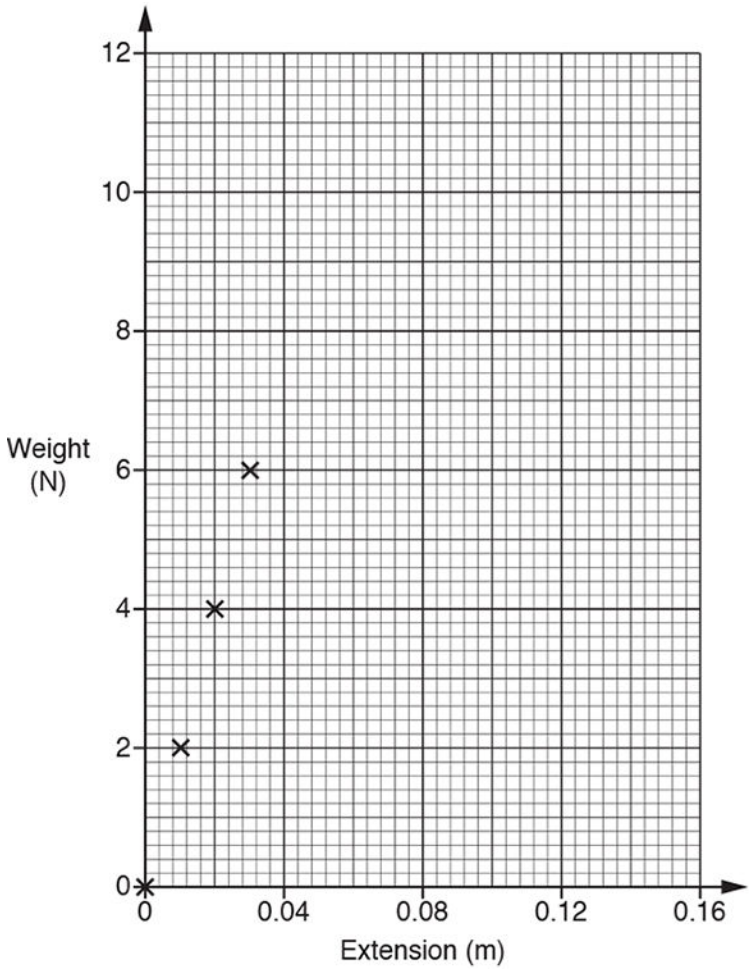
7(a) A student hangs a length of copper wire from the ceiling.

She adds weights to the bottom of the wire and measures the extension of the wire.

Look at a table of some of her results.

Weight (N)	Extension (m)
0	0
2	0.01
4	0.02
6	0.03
8	0.04
10	0.08
12	0.16

(i) Plot the values on the graph. Some have been done for you.



[2]

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(ii) Draw a line of best-fit on the graph.

[1]

(iii) Describe **and** explain the shape of the graph.

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[3]

(b) Calculate the spring constant for the 0 – 6 N part of the graph.

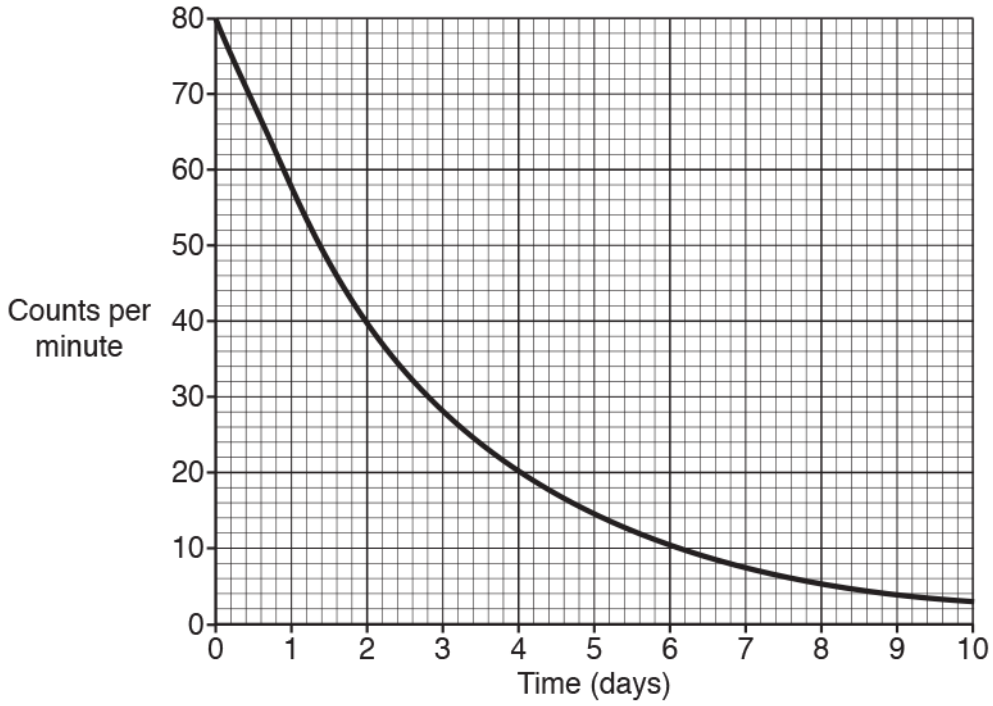
Use the equation: Force = Spring constant × Extension

Answer = ... N/m **[3]**

(c) Calculate the work done in stretching the wire to 0.04 m.

Answer = ... J **[2]**

8 A teacher measures the radiation from a radioactive source for 10 days.



What is the half-life of this radioactive source?

A 1 day

B 2 days

C 4 days

D 5 days

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Your answer  [1]

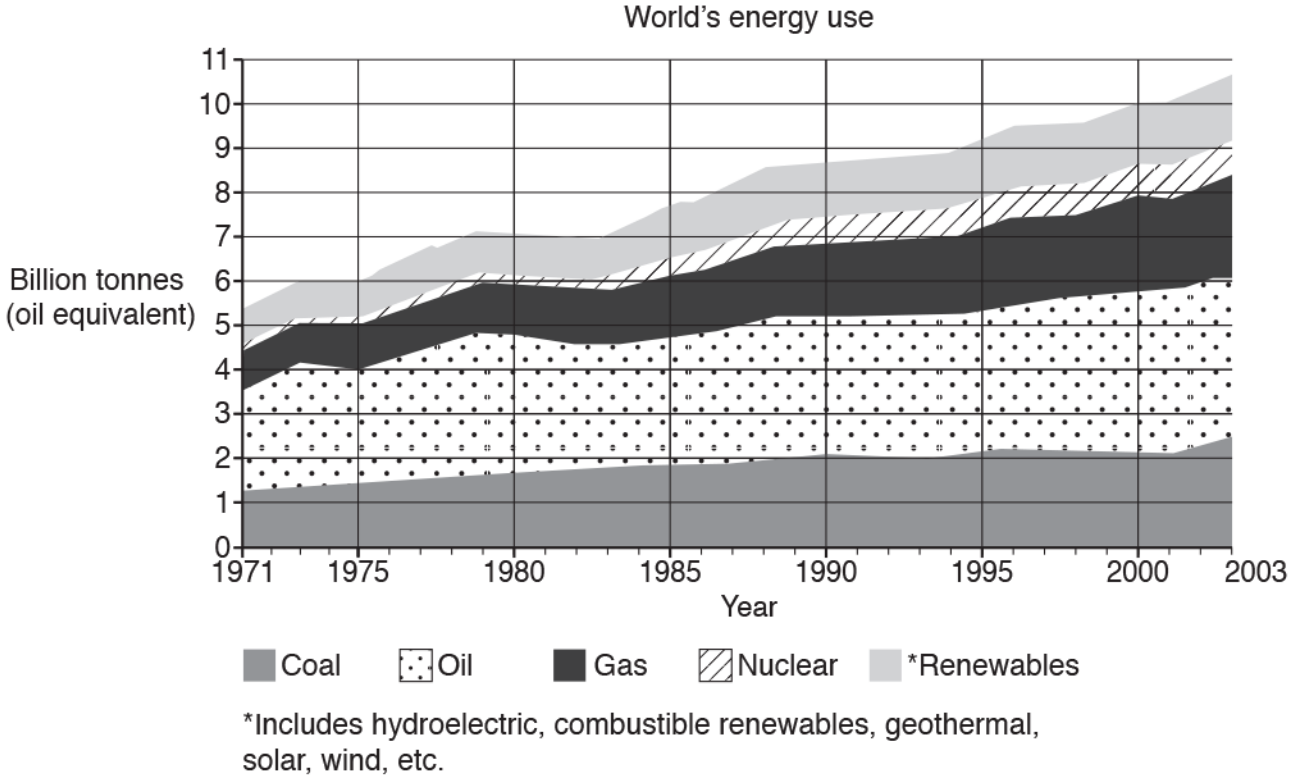
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9(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

It also shows the amount of different energy sources used.



(i) Approximately how much did the total World's energy use increase from the year 1971 to the year 2003?

Answer = _____ billion tonnes (oil equivalent) **[1]**

(ii) Which energy source had the **greatest** use in the year 2003?

_____ **[1]**

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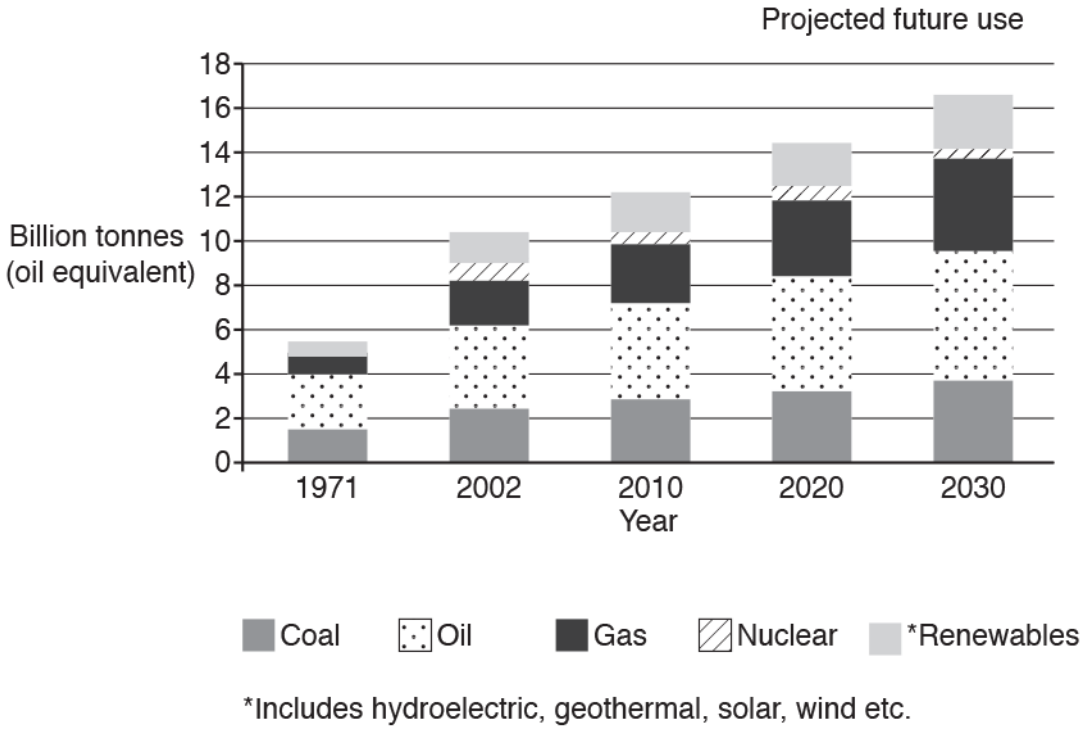
(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

Approximately what percentage of this amount was due to fossil fuel use?

Answer = _____ % **[2]**

(b) Scientists are researching the World's energy use for the future.

The graph shows some of their research.



(i) The future demand for fossil fuels is expected to increase.

Give two reasons why scientists are worried about this increase in demand.

_____

1

---

2 ---

---

[2]

(ii) In the UK the government is closing coal fired power stations and planning for new nuclear power stations to be built.

Suggest why the government wants more nuclear power stations.

---

[2]

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10 Which equation shows a correct alpha decay?

A $^{241}_{95}Am \rightarrow {}^{239}_{91}Np + {}^{2}_{4}He$

B $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{0}_{2}He$

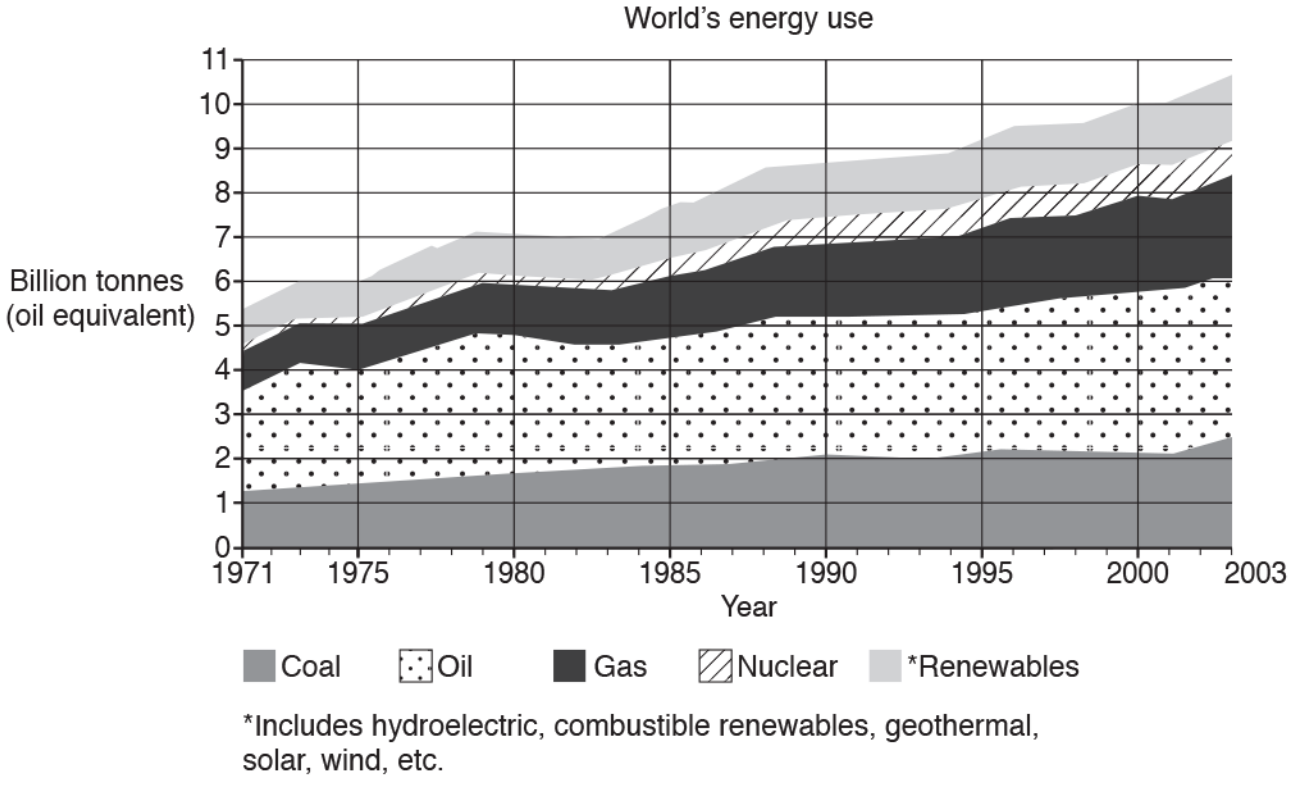
C $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{4}_{2}He$

D $^{241}_{95}Am \rightarrow {}^{237}_{93}Np + {}^{0}_{1}He$

Your answer [ ] [1]

11(a) The graph shows how the World's energy use has changed from the year 1971 to the year 2003.

It also shows the amount of different energy sources used.



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(i) Approximately how much did the total World's energy use increase from the year 1971 to the year 2003?

Answer = _____ billion tonnes (oil equivalent) **[1]**

(ii) Which energy source had the **greatest** use in the year 2003?

_____ **[1]**

(iii) The total energy use in the year 2003 was 10.6 billion tonnes (oil equivalent).

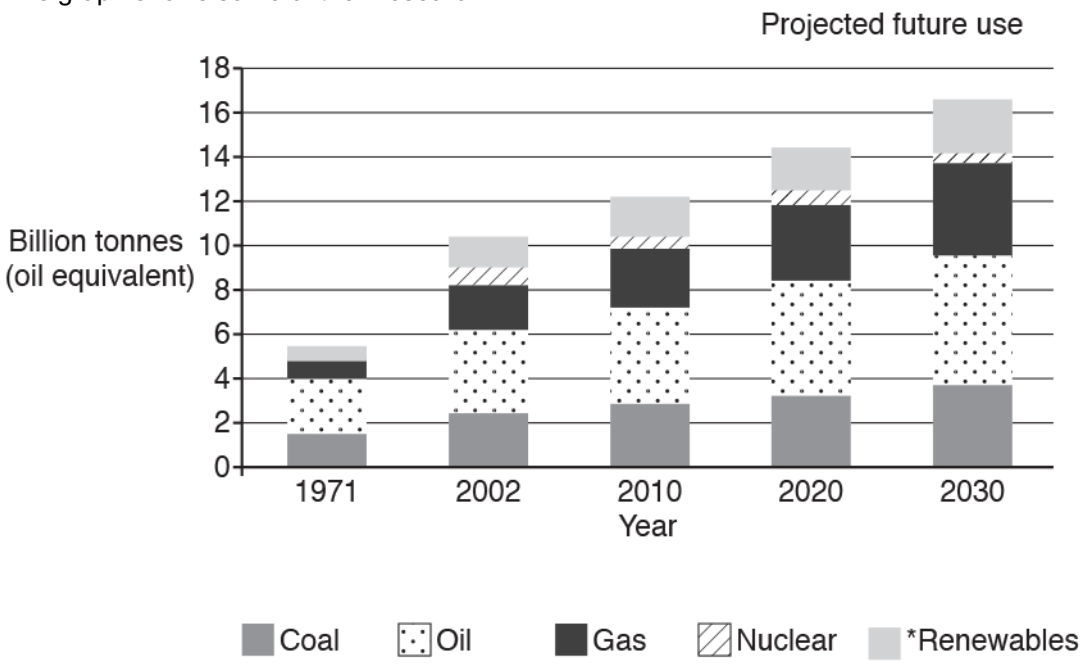
Approximately what percentage of this amount was due to fossil fuel use?

Answer = _____ % **[2]**

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(b) Scientists are researching the World's energy use for the future.

The graph shows some of their research.



(i) The future demand for fossil fuels is expected to increase.

Give two reasons why scientists are worried about this increase in demand.

1. ----------

---

2. ----------

---

[2]

(ii) In the UK the government is closing coal fired power stations and planning for new nuclear power stations to be built.

Suggest why the government wants more nuclear power stations.

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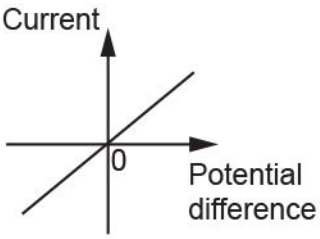
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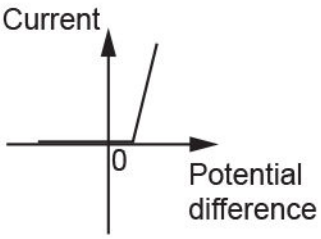
12 A student investigates four different electrical components.

She plots current-potential difference graphs for the components.

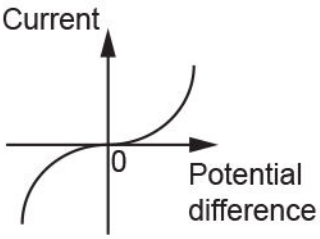
A



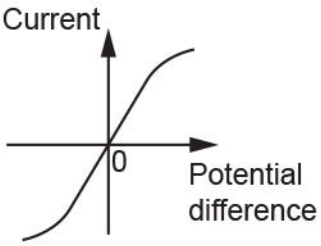
B



C



D



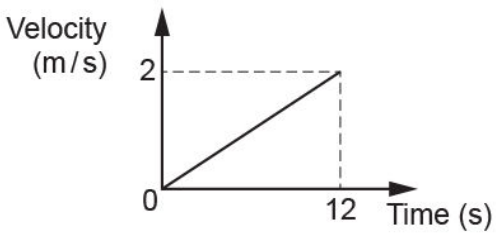
Which of the above shows the characteristic graph for a diode?

Your answer ☐ [1]

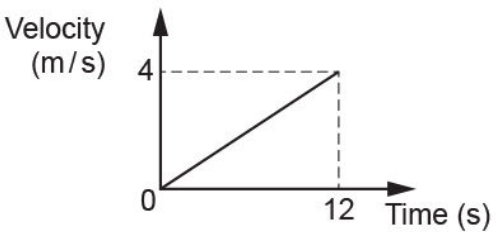
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13 Look at the motion graphs.

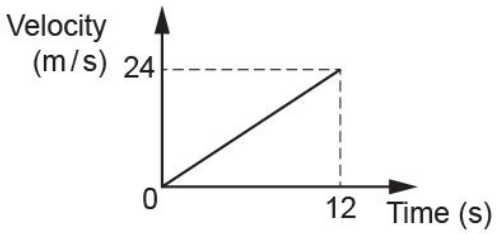
A



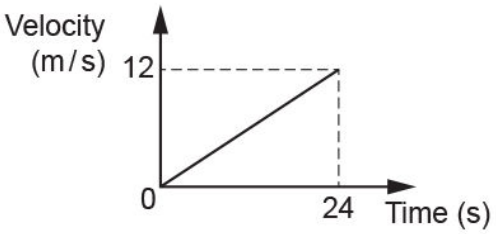
B



C



D



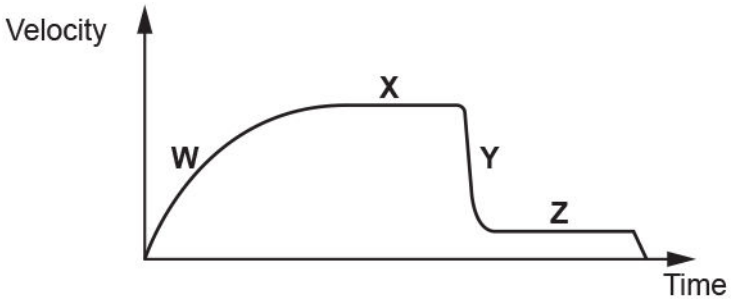
Which graph shows a journey with a distance of 24 m?

Your answer ☐ **[1]**

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14 A skydiver falls from a plane. His parachute opens and he lands safely.

Look at the velocity-time graph of his journey.



Which parts of the graph show balanced forces on the skydiver?

A X only

B Y and Z

C X and Z

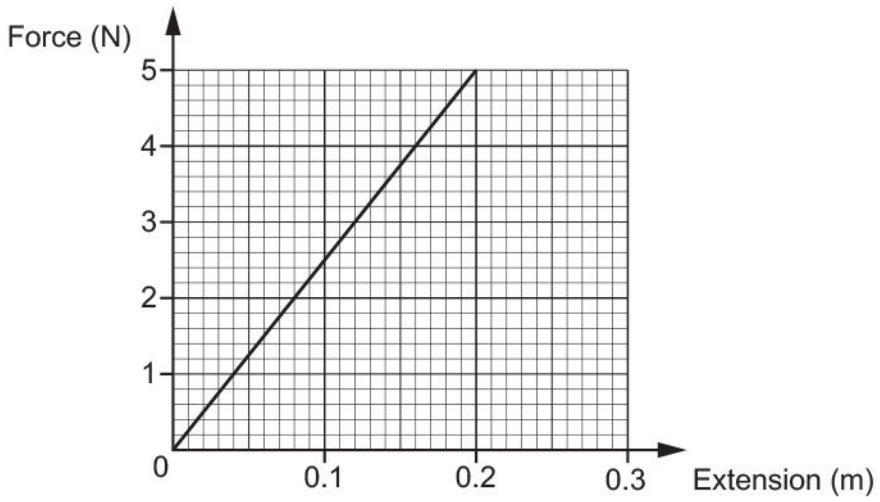
D Y only

Your answer [1]

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15(a) A student investigates how a spring stretches when a force is added.

Look at a graph of his results.



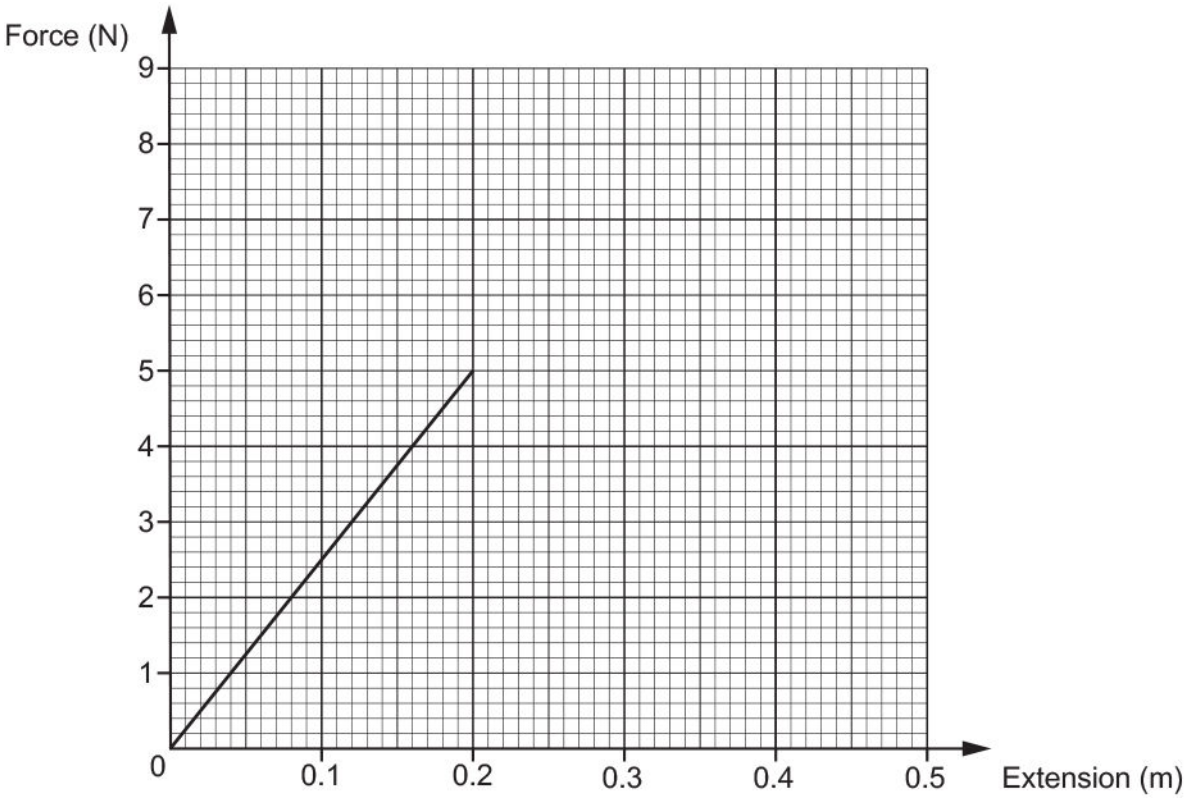
Calculate the spring constant of the spring.

Spring constant = ... N / m **[3]**

(b) A student investigates how a spring stretches when a force is added.

The student continues to load the spring until it passes its elastic limit.

Complete the force-extension graph and label the elastic limit.



[2]

16(a) A student investigates how the angle of a ramp affects the final speed of a trolley.

He uses light gates to record the speed of the trolley at the bottom of the ramp.

The student releases the trolley from rest at the same point on the ramp each time.

Look at his results.

Angle of ramp (°)	Final speed (m / s)			
	Attempt 1	Attempt 2	Attempt 3	Mean
10	1.81	1.80	1.81	1.81
20	2.58	2.56	2.57	2.57
30	3.1	3.11	3.11	3.11

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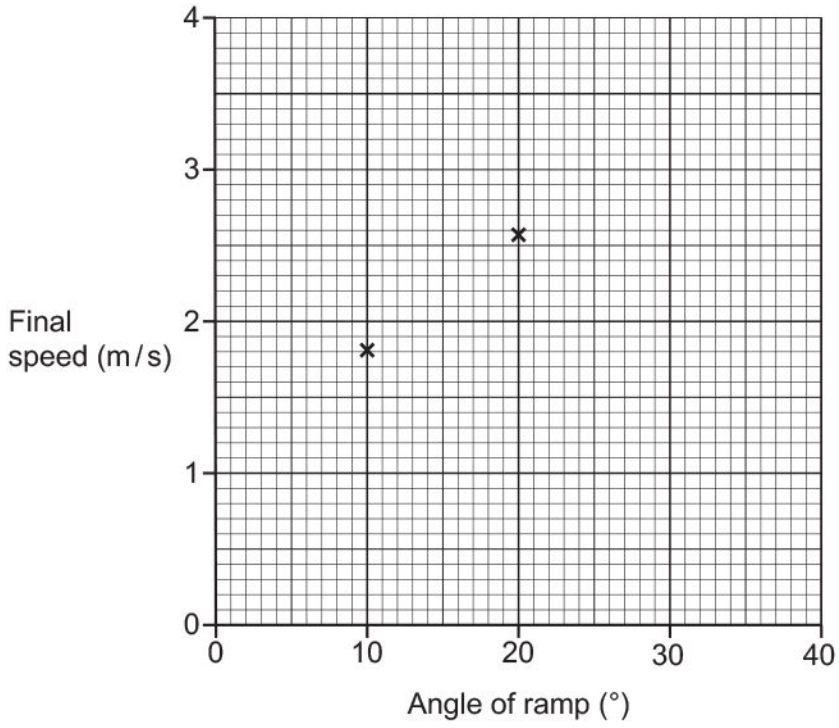
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40	3.52	3.51	3.50	3.51

(i) Plot the results on the graph and draw a line of best fit.

Two results have been plotted for you.



[2]

(ii) Describe the pattern shown by the results.

Use data from the table or graph in your answer.

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[3]

(iii) Explain why the final speed changes when the angle of the ramp increases.

In your answer use ideas about energy.

[2]

(iv) The student made a mistake when recording one of his results.

Identify the mistake **and** explain what he should have done.

[2]

(v) The student thinks this data shows that his results are **reproducible**.

He is **not** correct.

Explain why.

[2]

(b)

(i) The mean final velocity for the ramp at a 40° angle is 3.51 m / s. The distance from the top of the ramp to the light gate at the bottom is 1.0 m.

Calculate the acceleration of the trolley when the ramp is at a 40° angle.

Give your answer to decimal places.

Acceleration = ... m / s^2 **[5]**

(ii) The trolley has a mass of 2.0 kg.

Calculate the kinetic energy of the trolley at a speed of 3.0 m / s.

Kinetic energy = ... J **[3]**

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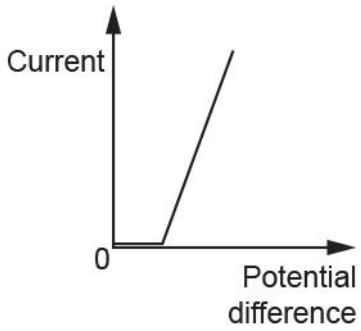
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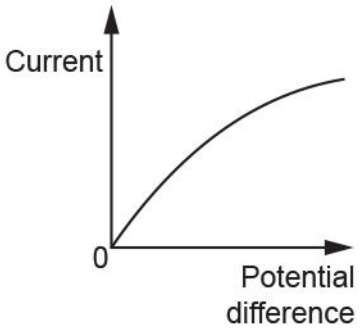
17 A student investigates how current and potential difference vary in different components.

Look at the graphs of her results.

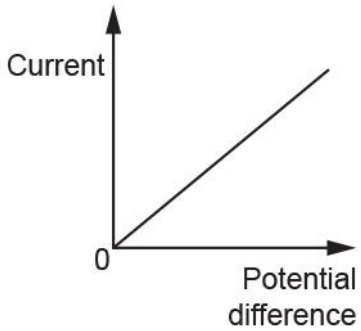
A



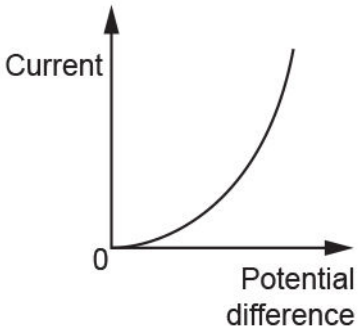
B



C



D



Which graph shows a filament lamp?

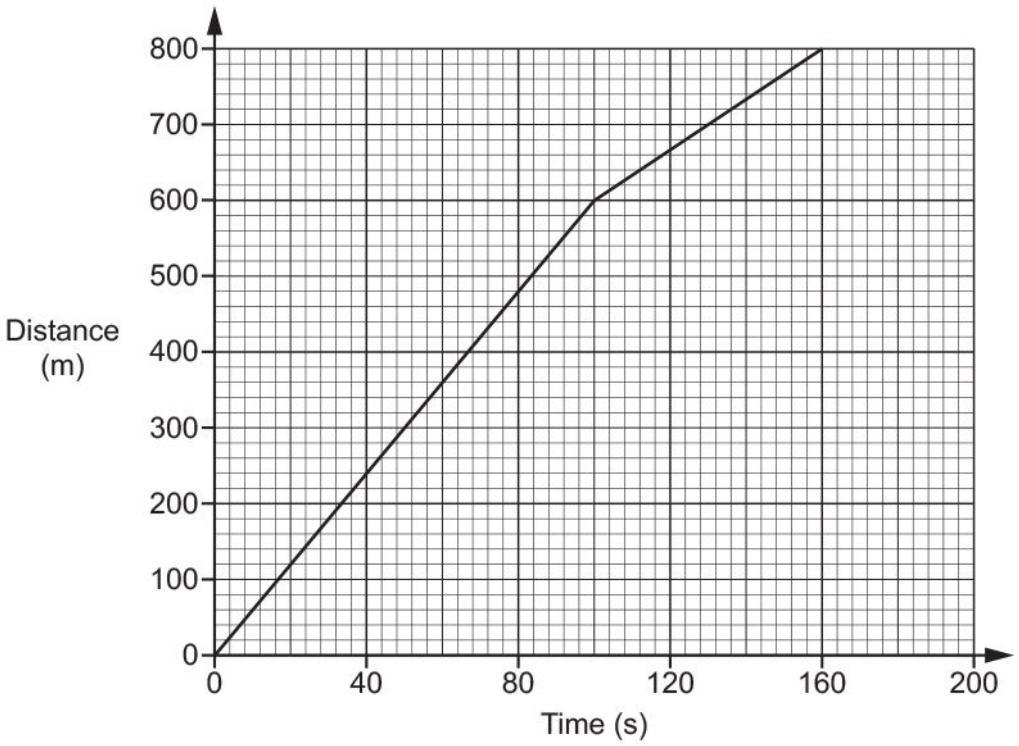
Your answer [ ] [1]

18 Look at the distance-time graph for a journey to school.

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What is the average speed for the journey?

Use the equation: average speed = distance travelled ÷ time

A 0.2 m/s

B 5.0 m/s

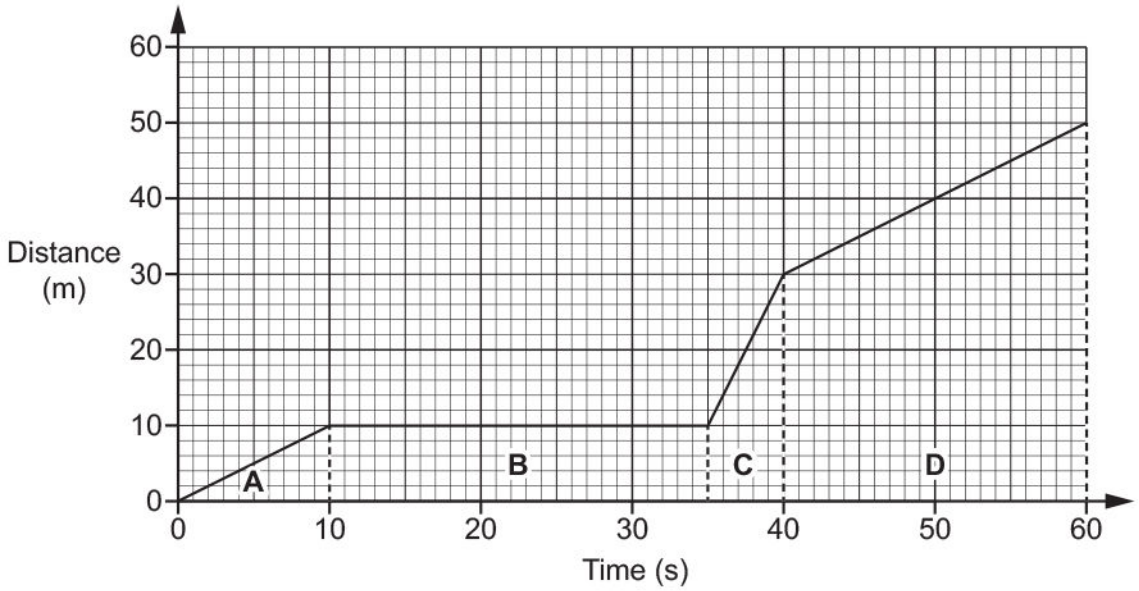
C 6.0 m/s

D 50 m/s

Your answer ☐ **[1]**

19(a) A student investigates motion graphs.

Look at a distance-time graph for the movement of a dog in a park.



(i) How far did the dog move in the park?

Distance = ... m **[1]**

(ii) How long was the dog in the park?

Time = ... s **[1]**

(iii) Name a piece of apparatus the student could use to accurately measure the distance the dog moved.

[1]

(b) The distance-time graph has four sections: **A**, **B**, **C** and **D**.

(i) Which section of the graph shows the **greatest** speed?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

Explain your answer.

---

[2]

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(ii) Which section of the graph shows **zero** speed?

Tick (✓) **one** box.

A ☐

B ☐

C ☐

D ☐

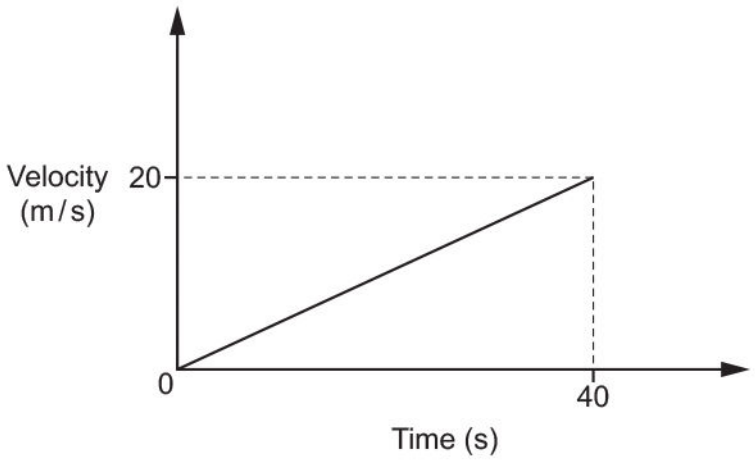
Explain your answer.

---

[2]

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(c) The student draws a velocity-time graph for a boat accelerating.



Acceleration is the gradient of a velocity-time graph.

Calculate the acceleration of the boat.

Use the equation: acceleration = change in velocity ÷ time

Acceleration = ... m/s^2 **[2]**

20 A tall building needs a lift to move people from one floor to another.

The builder has a choice of three different lifts.

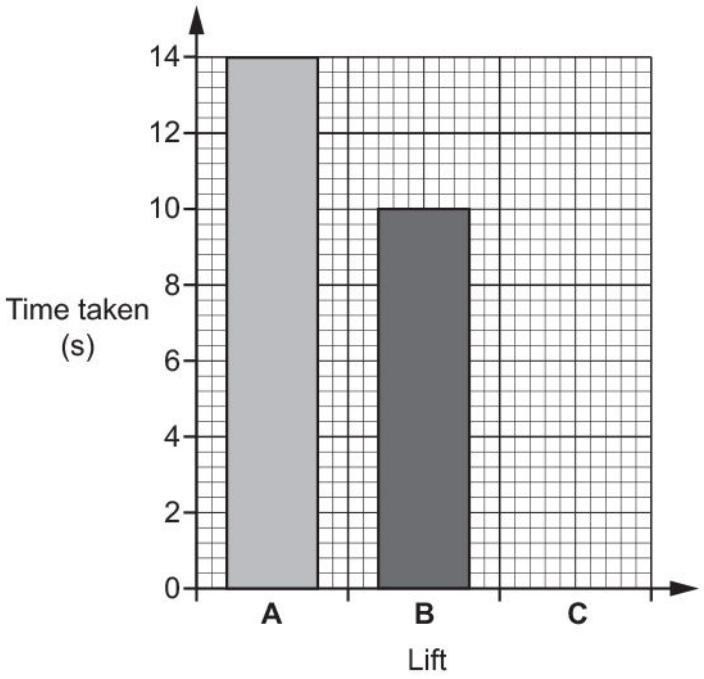
Each lift takes a different amount of time to move between the two floors.

Look at a bar chart of the time taken for each lift.

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(i) Lift **C** takes 12 s to move between the two floors.

Draw a bar for lift **C** on the bar chart. **[1]**

(ii) Calculate the **mean** time of the three lift journeys.

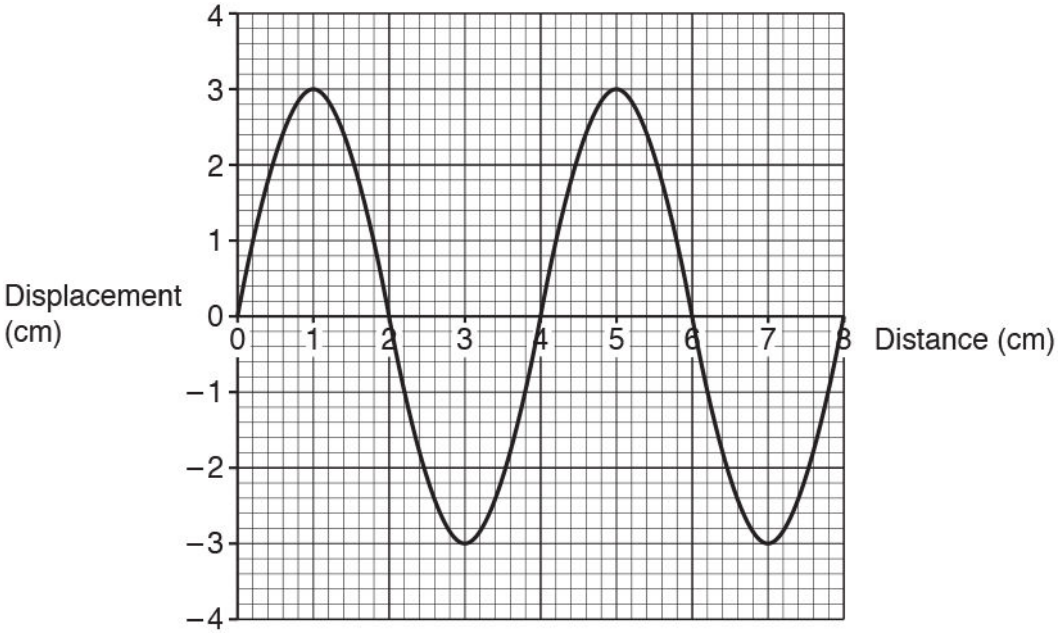
Mean = ... s **[2]**

(iii) Explain which lift uses the most power.

---

[2]

21 Look at the diagram of a wave.



What is the wavelength of the wave?

A 2 cm
B 3 cm
C 4 cm
D 6 cm

Your answer [ ] [1]

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22

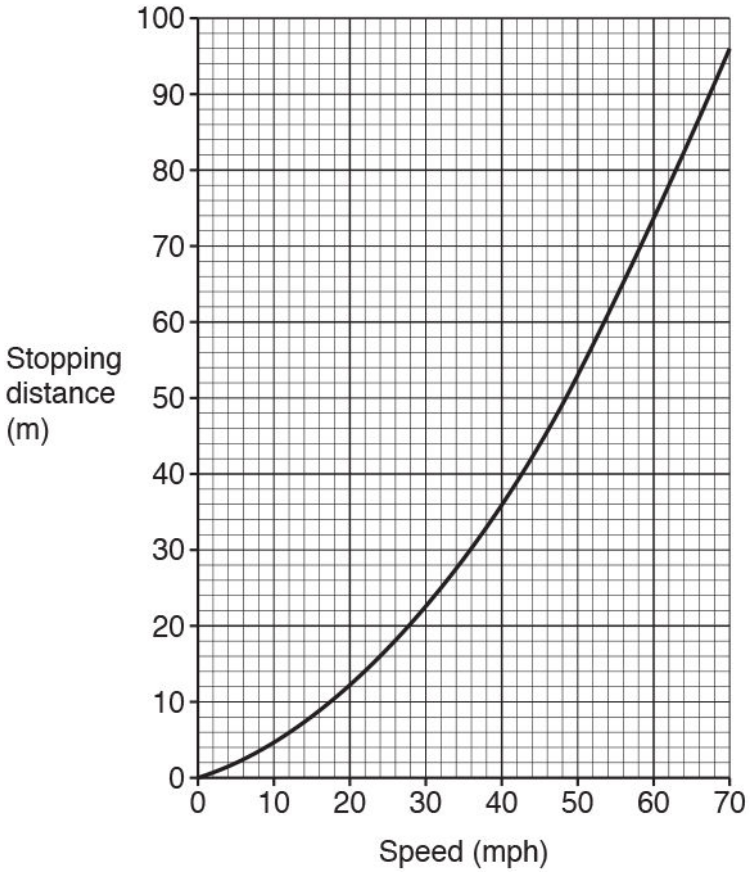
The driver of a car makes an emergency stop.

The thinking distance is 9 m. The braking distance is 14 m.

(i) Calculate the total stopping distance of the car.

Stopping distance = ... m **[1]**

(ii) This graph shows how this driver's stopping distance changes with speed.



- A car is travelling at 50 mph.
- There is a barrier in the road 40 m in front of the car.

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- The driver makes an emergency stop.

Use the graph to work out if the car hits the barrier.
Explain how you obtained your answer.

[2]

(iii) State one factor, other than speed, that affects braking distance.

Explain how this factor changes braking distance.

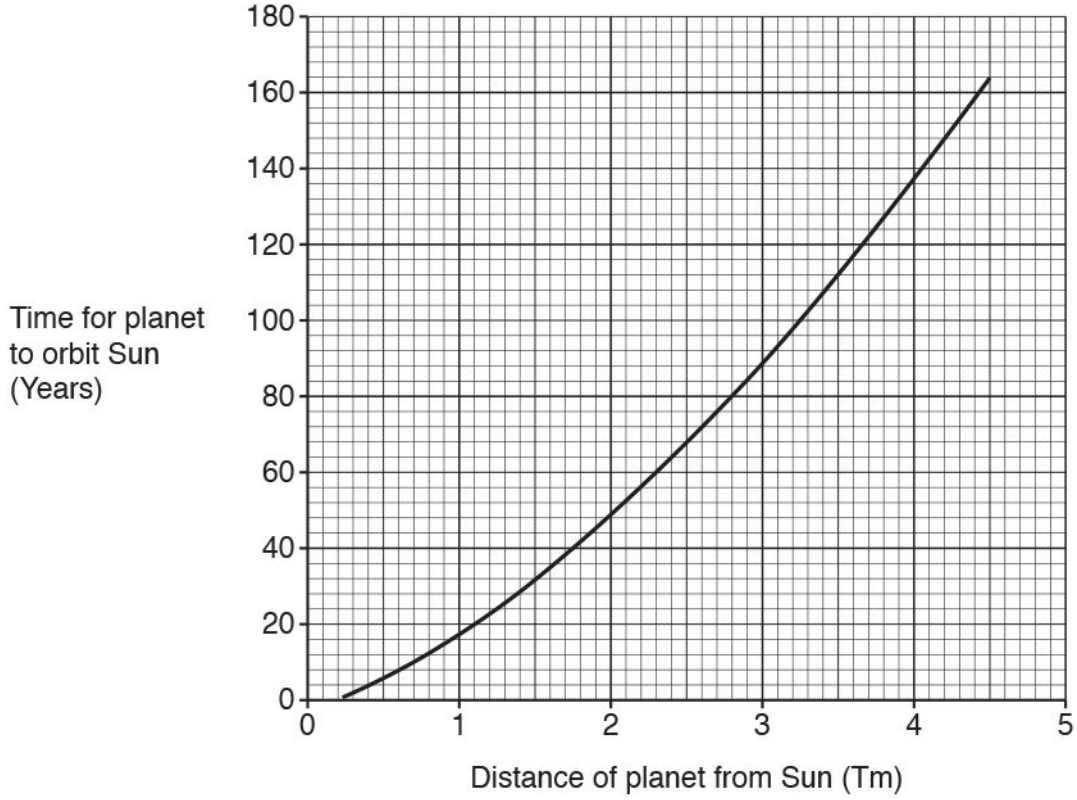
Factor

Explanation

[3]

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23 * This graph shows how a planet's orbit time changes with distance from the Sun in our solar system.



Describe and explain the relationship shown by the graph.

Use data from the graph and ideas about our solar system in your answer.

---

[6]

24 A student investigates the rate of cooling using a cardboard box to model the walls of a building.

She puts a beaker of hot water into the cardboard box. She measures the temperature of the water every two minutes.

She investigates how the rate of cooling changes with the thickness of the walls.

Here are the results of one of her experiments.

Time (minutes)	Temperature of water (°C)
0	90
2	75
4	63
6	54
8	47
10	41
12	37

(i) Plot the results on the grid in **Fig. 22.1**.

Two of the points have been plotted for you.

[2]

(ii) Draw a line of best fit on your graph.

[1]

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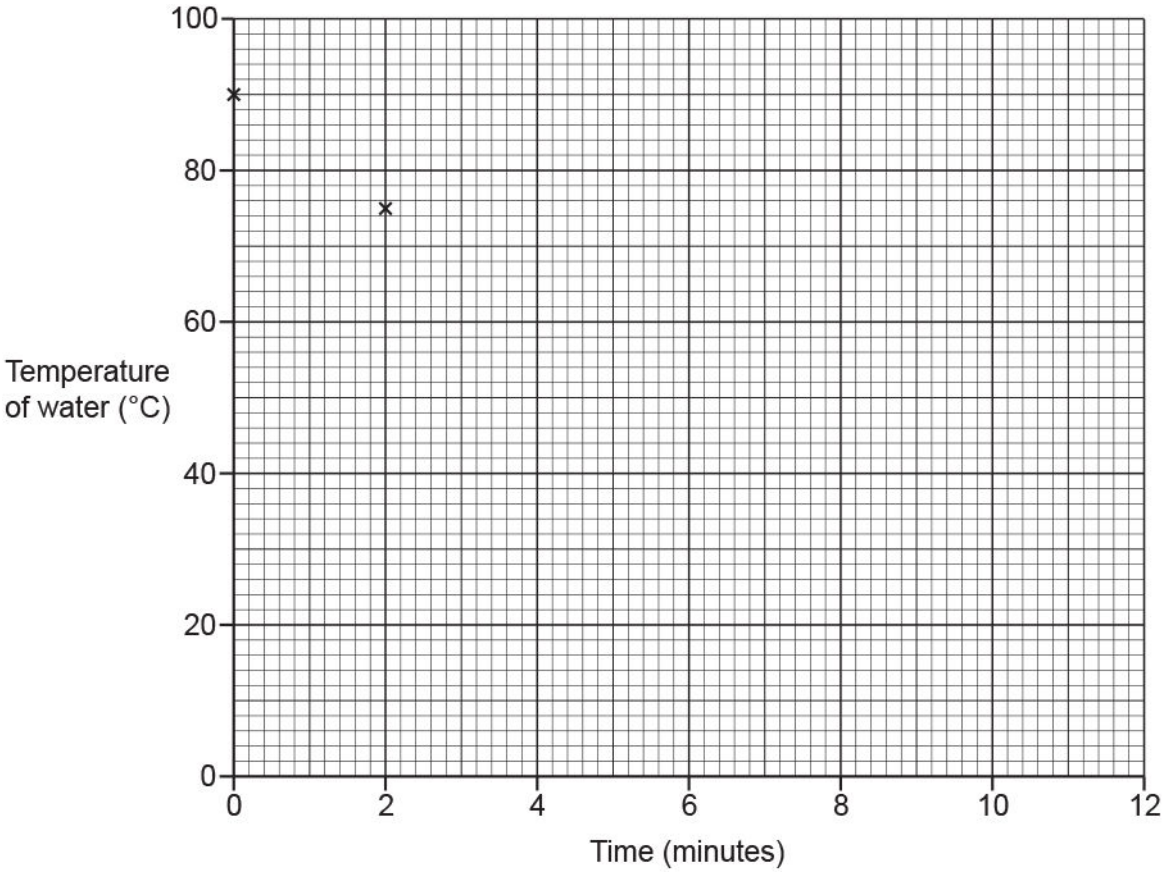


Fig. 22.1

(iii) Describe how the temperature of the water changes with time.
Use data from the graph in **Fig. 22.1** in your answer.

---

[2]

(iv) The thickness of the cardboard box is doubled. Everything else stays the same.

Sketch a line on the graph in **Fig. 22.1** to suggest what these new results may look like.
Label your line **Z**.

[1]

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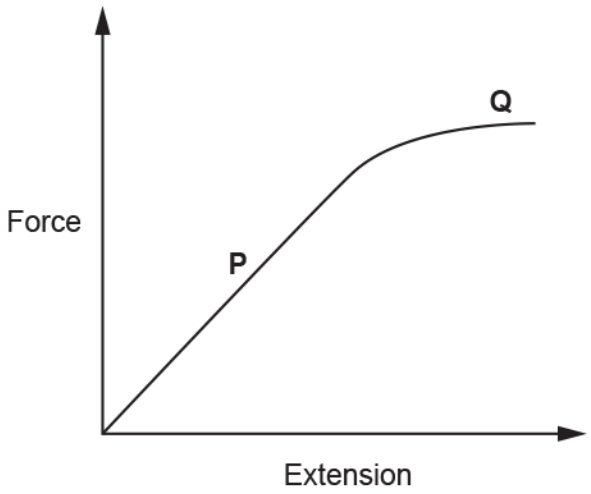
(v) Suggest **one** way to improve the investigation.

---

[1]

---

25 A student plots a force-extension graph for a material.



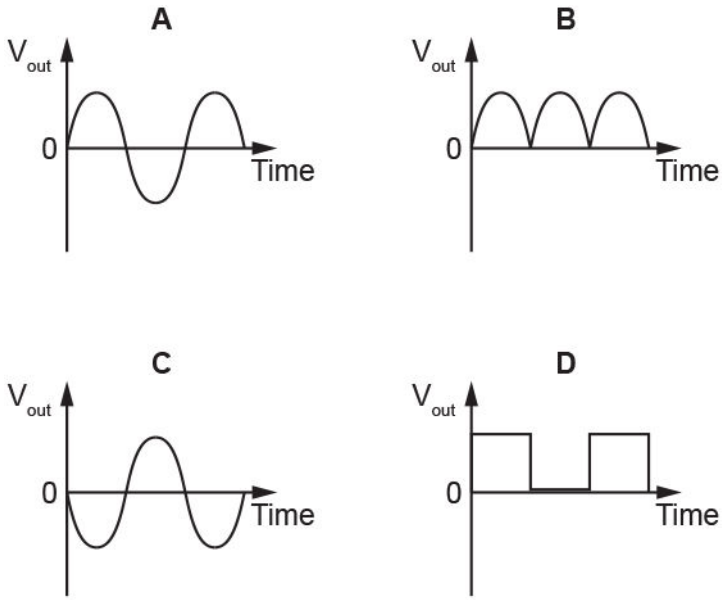
Which row in the table correctly identifies part **P** and part **Q** of the graph?

	Part P	Part Q
A	Elastic	Elastic
B	Elastic	Plastic
C	Plastic	Elastic
D	Plastic	Plastic

Your answer [ ] [1]

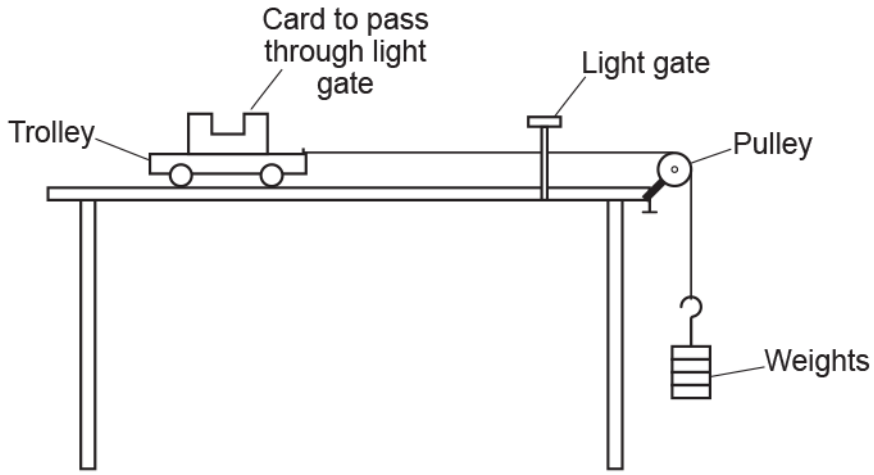
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26 Which of the following graphs shows the typical output potential difference, V_{out}, for a dynamo?



Your answer [1]

27 A student investigates the acceleration of a trolley.



The trolley is released from a fixed position and accelerates.

The accelerating force is provided by the weights attached to the trolley with string.

Acceleration is measured using a light gate and data logging equipment.

Look at the results from the experiment.

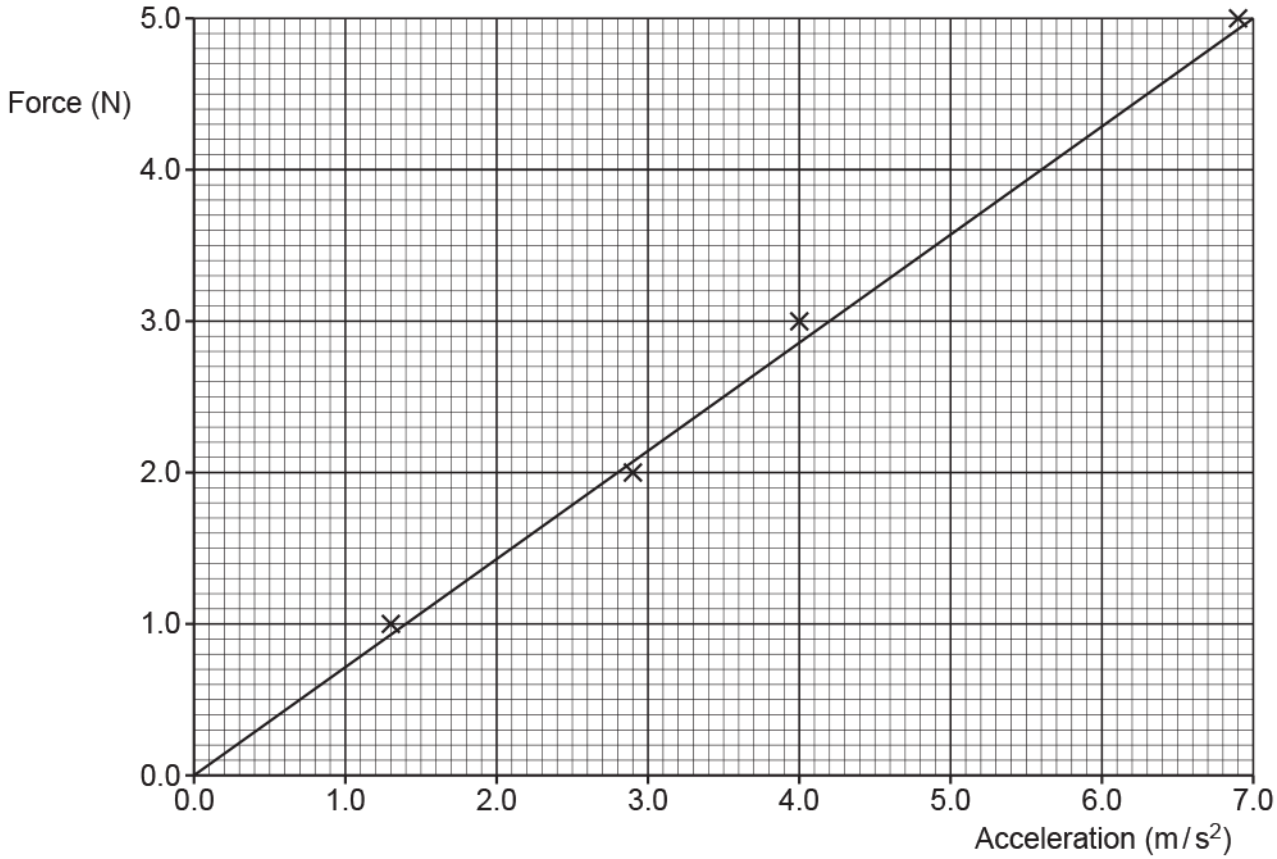
Force (N)	Acceleration
1.0	1.3
2.0	2.9
3.0	4
4.0	5.7
5.0	6.0

The student plots the results on a graph.

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(i) One point has not been plotted on the graph. Plot the missing point on the graph.

[1]

(ii) Describe the relationship between the two variables on the graph.

---

[2]

(iii) Calculate the gradient of the graph and use this to determine the mass of the trolley.

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Mass = ... kg **[2]**

(iv) The actual mass of the trolley is lower than that found in the experiment. Suggest two reasons why.

Use ideas about forces and energy in your answer.

1 ----------

---

2 ----------

---

[2]

(v) Suggest **two** ways the experiment could be improved.

1 ----------

---

2 ----------

---

[2]

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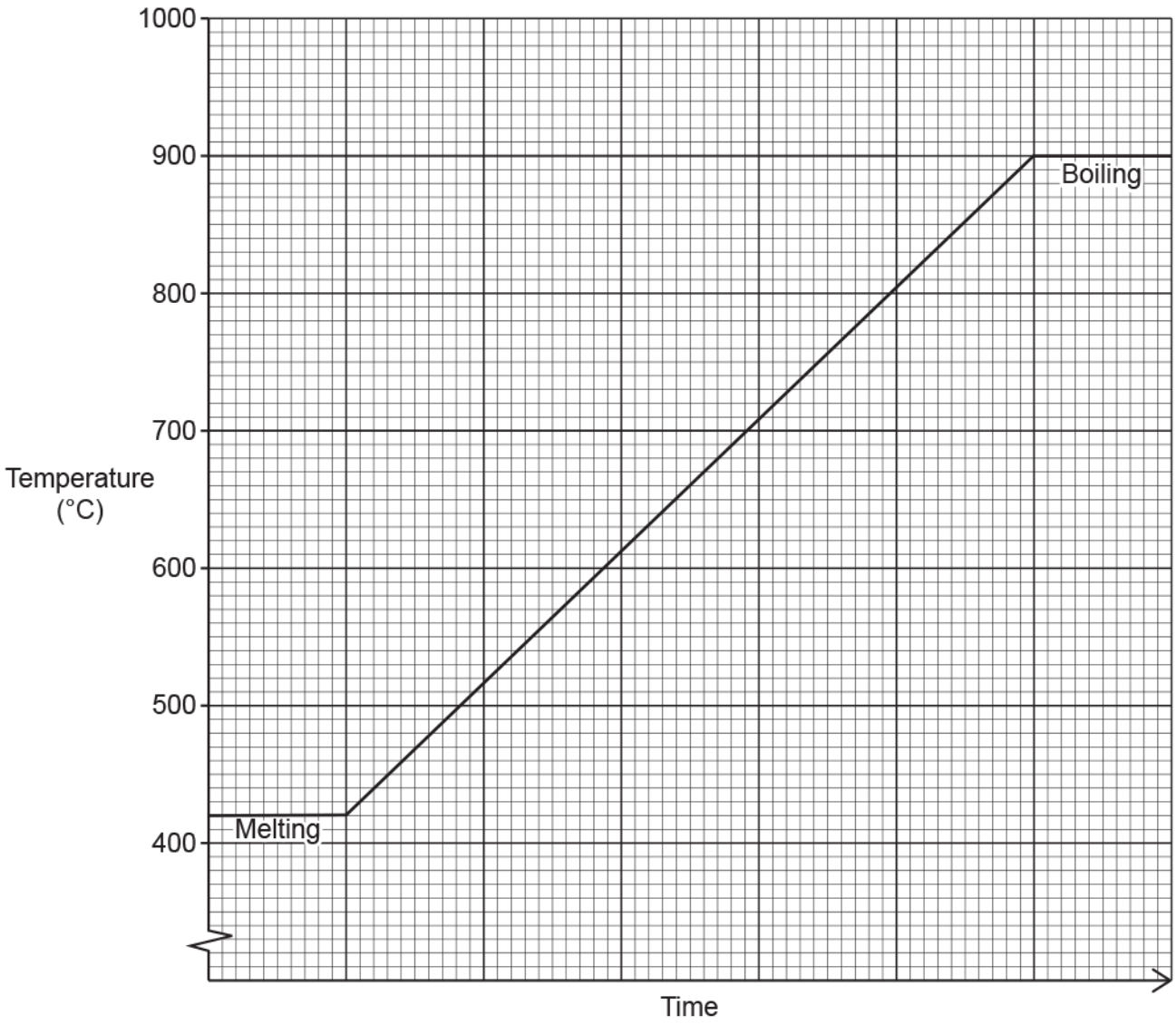
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28(a) The table shows the specific heat capacities of different materials.

Material	Specific heat capacity (J / kg °C)
Copper	330
Brass	380
Zinc	385
Nickel	440
Concrete	880
Concrete	913

A scientist heats an unknown substance from a solid to a liquid.

The graph shows how the temperature of the substance varies with time.



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The scientist has 2.5 kg of the substance and records that it takes 462 kJ of energy to increase it from the lowest to the highest temperature in the liquid state.

Use the graph to calculate the specific heat capacity of the substance.

Suggest what material it could be from the table.

Specific heat capacity = ... J / kg °C

Material = ...

[5]

(b) Suggest **two** reasons why the scientist cannot be certain that the substance has been identified correctly.

1 ----------

---

2 ----------

---

[2]

29 A student investigates the rate of cooling using a cardboard box to model the walls of a building.

She puts a beaker of hot water into the cardboard box. She measures the temperature of the water every two minutes.

She investigates how the rate of cooling changes with the thickness of the walls.

Here are the results of one of her experiments.

Time (minutes)	Temperature of water (°C)
0	90
2	75
4	63
6	54
8	47
10	41
12	37

(i) Plot the results on the grid in **Fig. 17.1**.

Two of the points have been plotted for you.

[2]

(ii) Draw a line of best fit on your graph.

[1]

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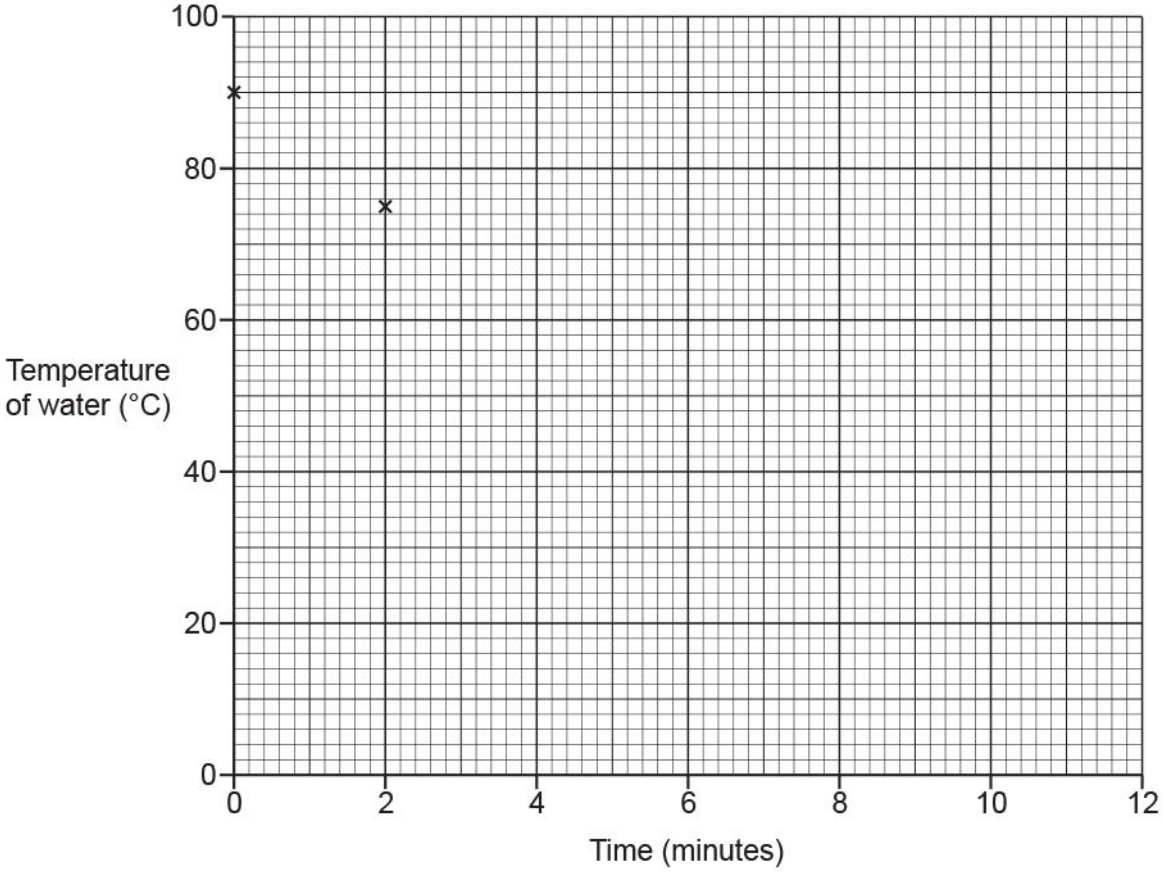


Fig. 17.1

(iii) Describe how the temperature of the water changes with time.
Use data from the graph **Fig. 17.1** in your answer.

---

[2]

(iv) The thickness of the cardboard box is doubled. Everything else stays the same.

Sketch a line on the graph in **Fig. 17.1** to suggest what these new results may look like.
Label your line **Z**.

[1]

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(v) Suggest **one** way to improve the investigation.

---

[1]

30 * The UK generates some of its electrical power from wind turbines.

Fig. 18.1 shows the total electrical power generated by wind turbines in the UK.

The graph is for a single day in December which had very strong winds.

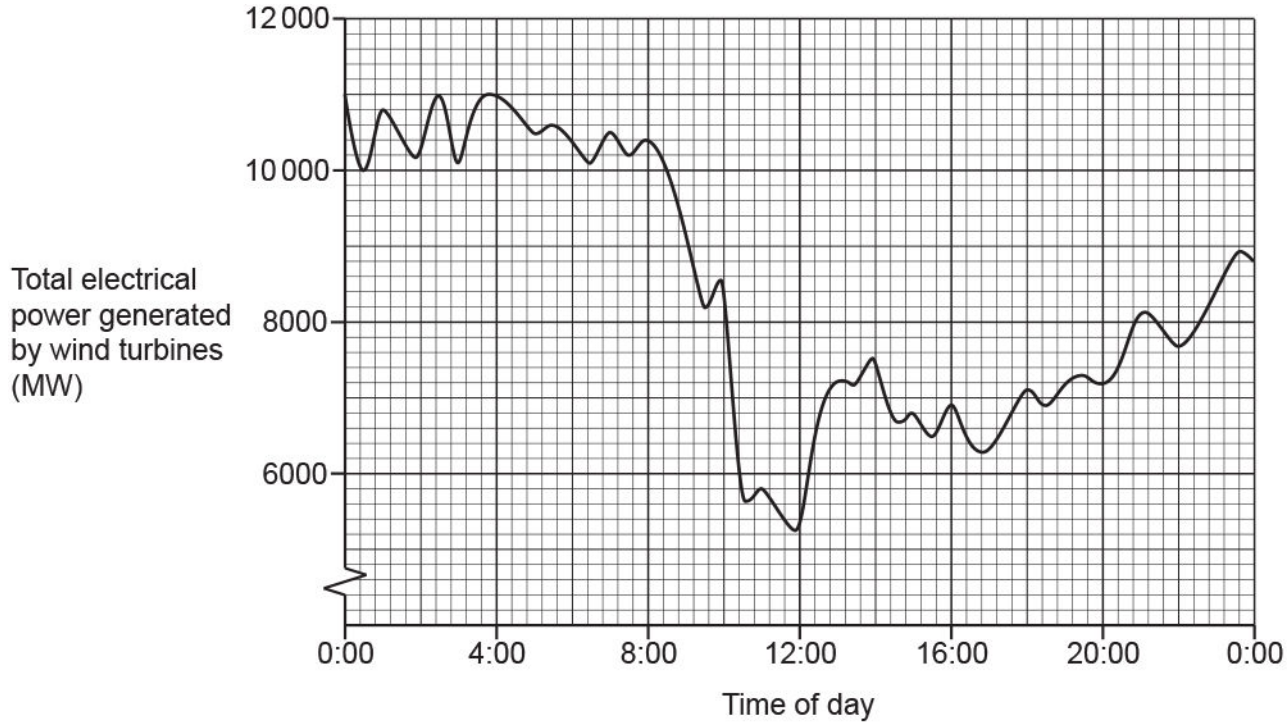


Fig. 18.1

Fig. 18.2 shows the total demand for electrical power in the UK on the same day.

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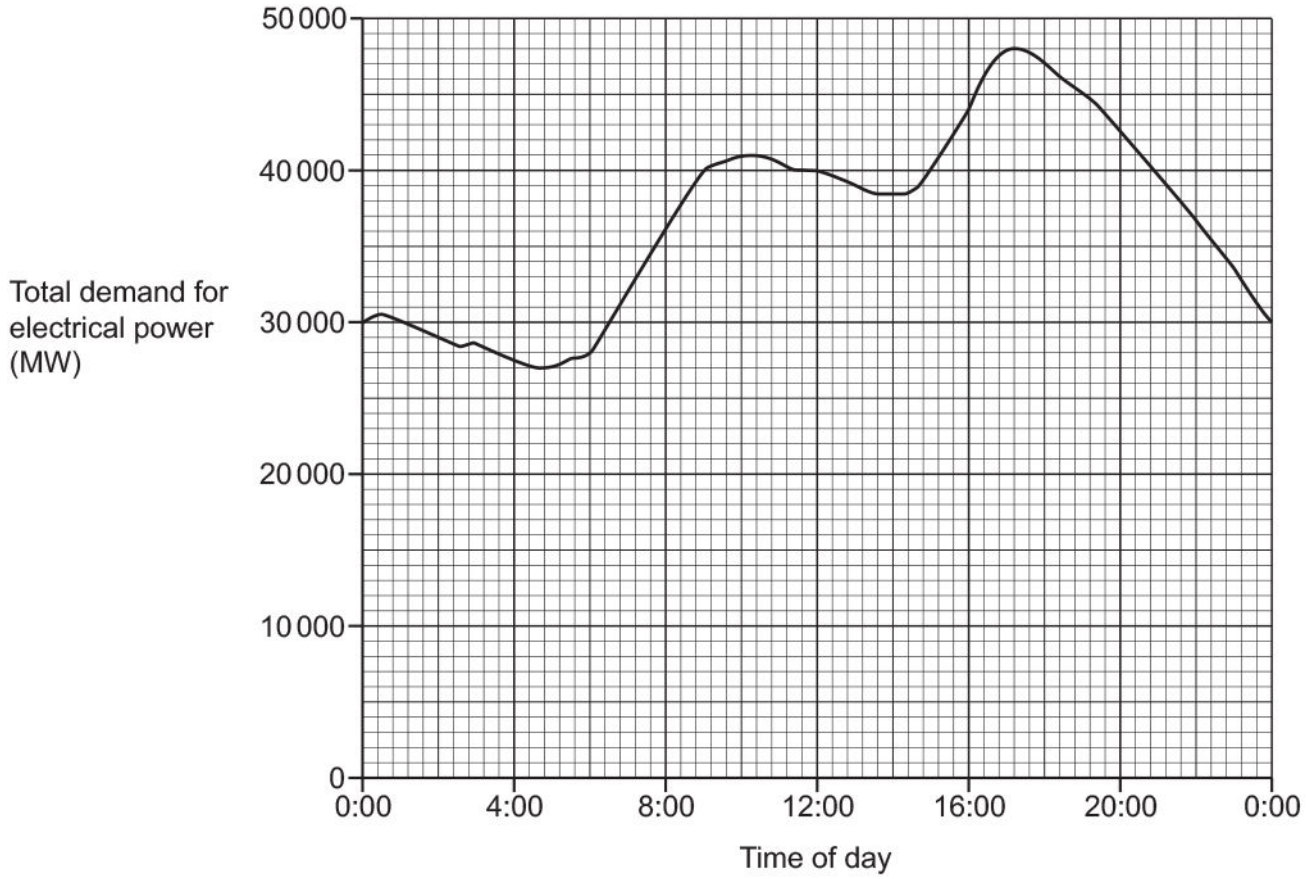


Fig. 18.2

Some experts believe the UK should generate most of its electrical power from wind.

Evaluate the advantages and disadvantages of this idea.

Use the graphs in Fig. 18.1 and Fig. 18.2 and your own ideas about wind turbines to support your answer.

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[6]

31 The graph in **Fig. 19.1** shows how displacement of an ultrasound wave varies with distance.

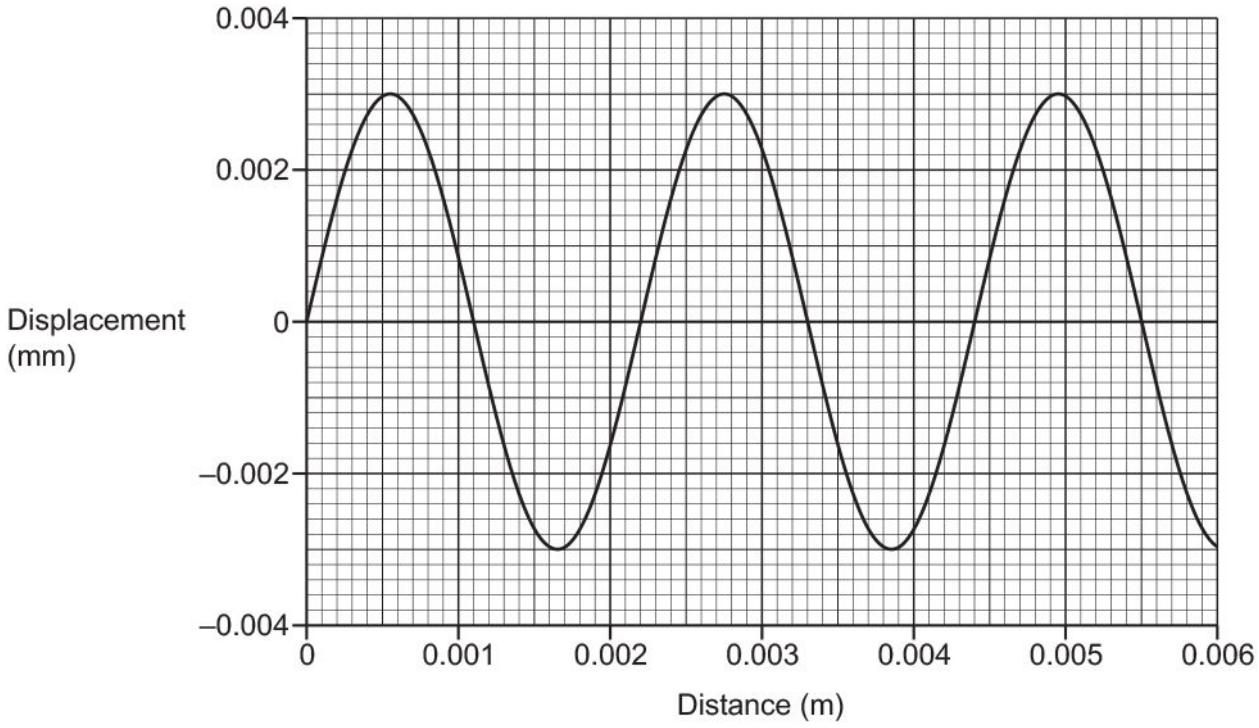


Fig. 19.1

(i) Use the graph in **Fig. 19.1** to determine the wavelength of an ultrasound wave.

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Wavelength = ... m **[1]**

(ii) The speed of ultrasound waves in **(i)** is 4500 m / s.

Calculate the frequency of the ultrasound wave in **Fig. 19.1**.

Use the equation: wave speed = frequency × wavelength

Give your answer in **standard form** and to **2** significant figures.

Frequency = ... Hz **[4]**

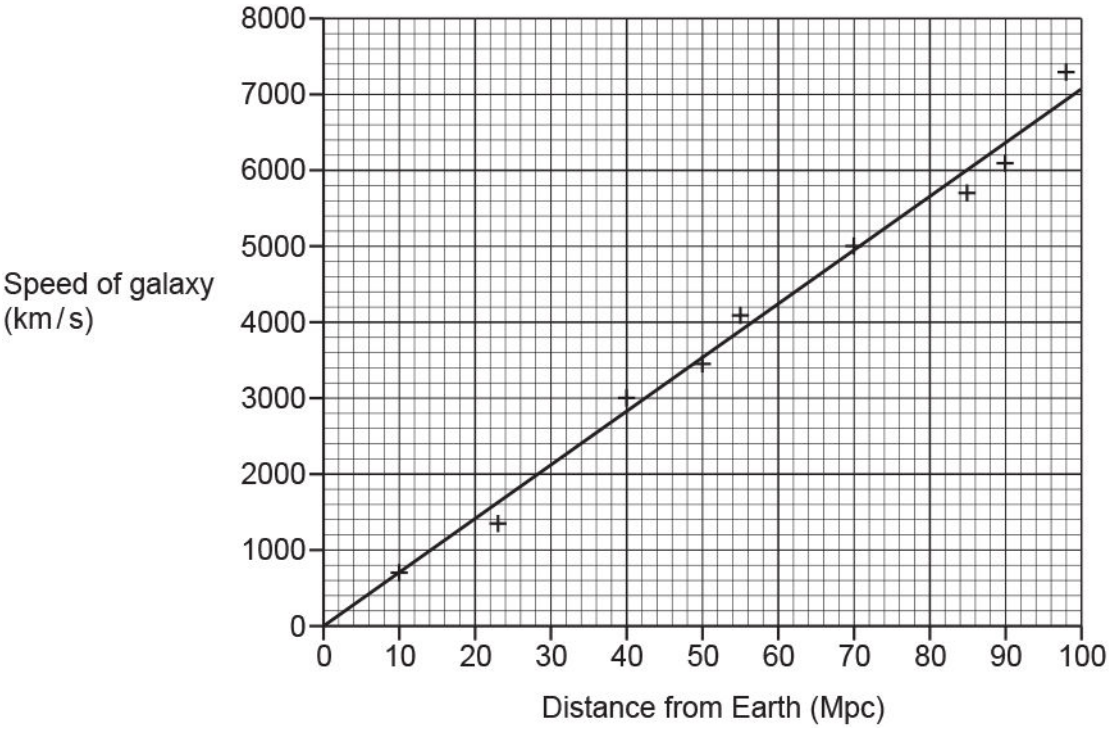
32(a) Edwin Hubble discovered that all distant galaxies were moving away from the Earth.

Explain how he could tell that all distant galaxies were moving away from the Earth.

---

[2]

(b) This graph shows how the speed of a galaxy changes with distance from the Earth.



(i) Use data from the graph to show that the speed of the galaxy is proportional to the distance from the Earth.

---

[2]

(ii) Explain how data from the graph provides evidence for the Big-Bang.

---

[1]

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(c) Before Edwin Hubble could publish his results, his work was peer reviewed.

Suggest why peer review is important.

---

[1]

(d) The parsec (pc) is a unit used for measuring large distances in the Universe.

(i) A galaxy is at a distance of 82 Mpc from the Earth.

Use the graph to determine the speed of this galaxy.

Give your answer in metres per second (m / s).

Speed = ... m / s **[2]**

(ii) Calculate the time it takes for the galaxy to travel 2.53×10^{24} m.

Use your answer to **(i)** to help you.

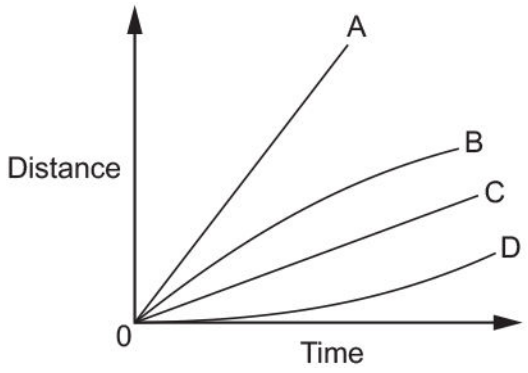
Time = ... s **[3]**

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33 Look at the distance-time graph.



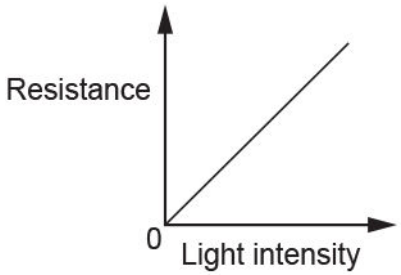
Which line shows the largest average speed?

Your answer [1]

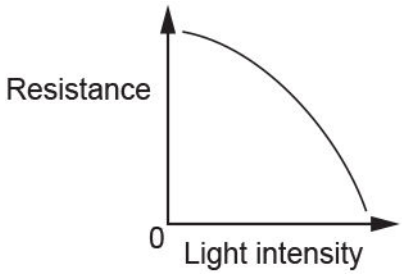
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34 A student investigates how the resistance of a light dependent resistor (LDR) changes with light intensity.

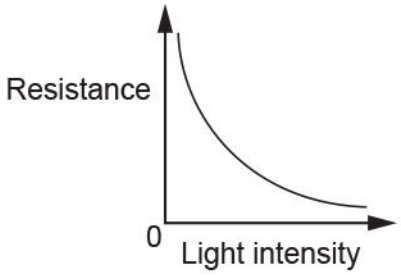
A



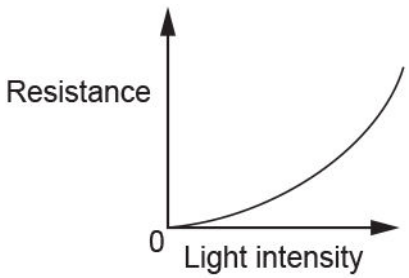
B



C



D

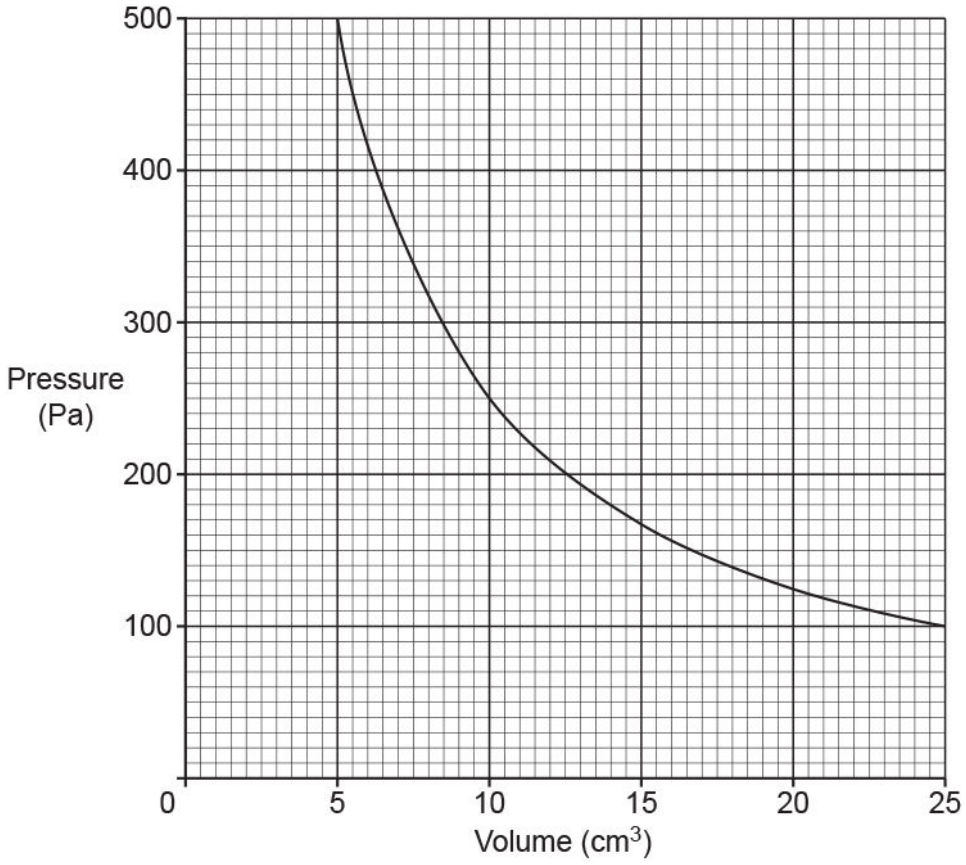


Which graph shows the correct relationship between the resistance of an LDR and light intensity?

Your answer ☐ [1]

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35(a) A student investigates the link between the volume and pressure of a gas. The student uses a fixed mass of gas in a closed container. The student plots a graph of the results.



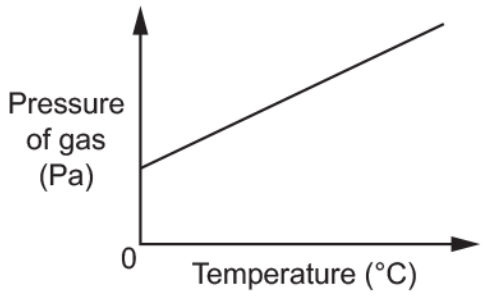
The student thinks that pressure multiplied by volume is always equal to the same number.

Explain why the student is correct.

Use data from the graph to support your answer.

[2]

(b) A student investigates how temperature and pressure of a gas are linked. The student measures the pressure of a gas as its temperature increases. The results are plotted on a graph.



Explain how temperature and pressure are linked.

Use the graph to support your answer.

[2]

END OF QUESTION PAPER