OCR GCSE GATEWAY PHYSICS A · J249

PHYSICS



EXAM QUESTION PACK

P2.1 MOTION

SCORE	PERCENTAGE
/253	%

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Gateway Physics A (9-1)

Motion

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

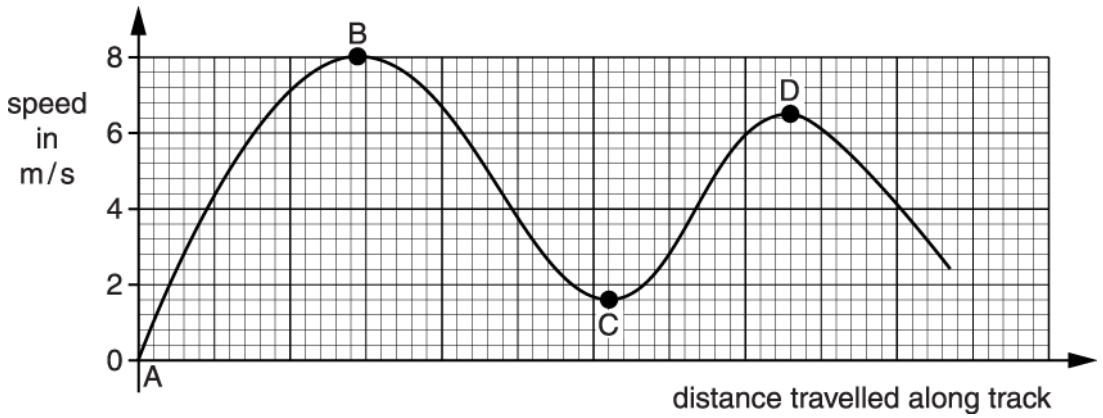
- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist 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 **253**.
- The total number of marks may take into account some 'either/or' question choices.

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1 This question is about the kinetic energy of a roller coaster car.



The graph shows how the speed of a 400 kg roller coaster car changes as it goes along part of a roller coaster track.

Describe how the kinetic energy of the car changes as it moves from A to D and calculate the kinetic energy of the car at B.

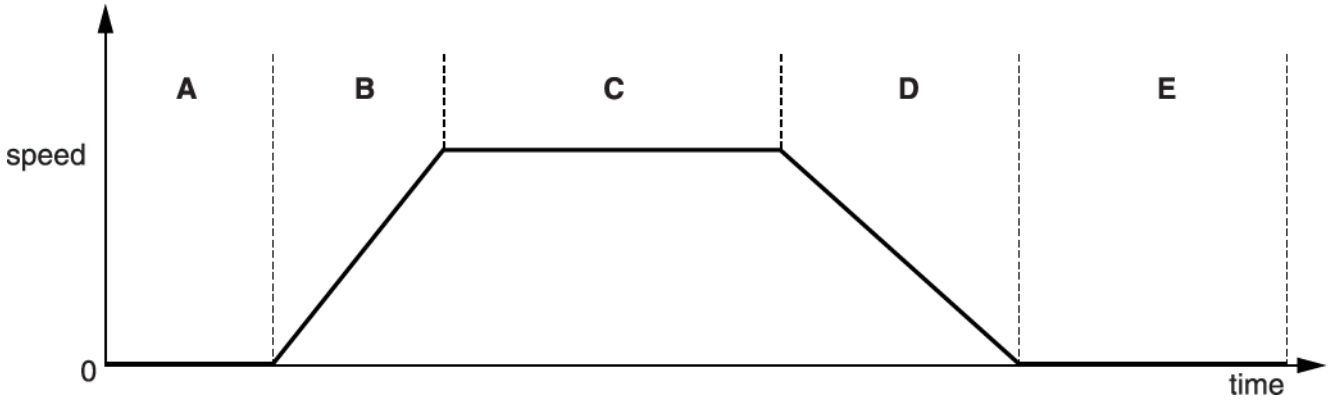
The quality of written communication will be assessed in your answer to this question.

[6]

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2 This question is about a car journey.

Look at the simple speed-time graph for the journey.



(i) Which part of the graph shows an increase in speed?

Choose from A B C D E

answer _____

[1]

(ii) Which part of the graph shows the car moving at a constant speed?

Choose from A B C D E

answer _____

[1]

3(a) Police can use average speed cameras to check the **average** speed of a car on many roads.

Explain how average speed cameras work.

_____

_____

_____

_____ [2]

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(b) A car travelling along a motorway takes 25 seconds to travel a distance of 800 metres.

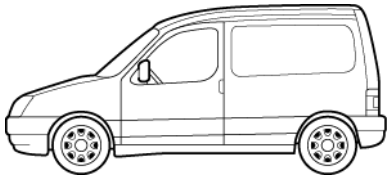
Calculate the speed of the car.

---

answer _____ m/s

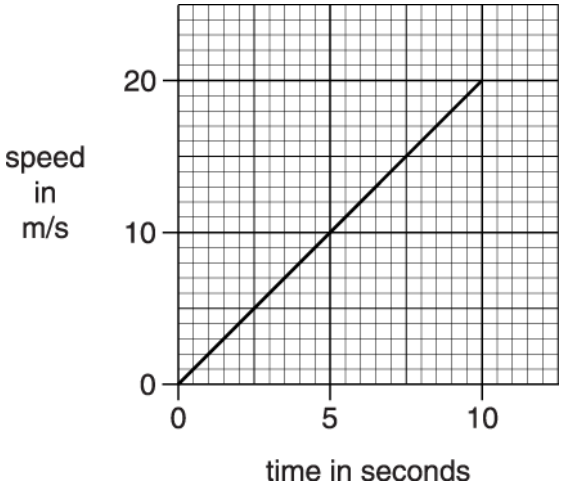
[2]

4(a) Emily has a van.



The van has a mass of 1400 kg.

Look at the speed–time graph for the first 10 seconds of her journey in the van.



Calculate the acceleration of the van in the first 10 seconds.

Choose your answer from:

0.5 m/s^2 **2 m/s^2** **10 m/s^2** **100 m/s^2** **200 m/s^2**

answer _____ m/s^2

[1]

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(b) The accelerating force on the van is 2800 N.

Use this force and information from the graph to calculate the work done to accelerate the van in the first 10 seconds.

answer _____ J

[3]

(c) The van now travels at a steady speed of 20 m/s.

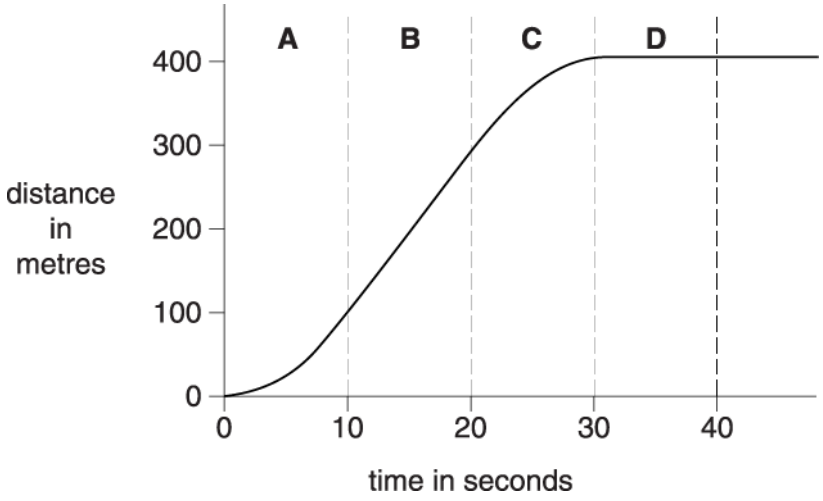
Use the force given in **(b)** to calculate the power developed by the engine when travelling at this speed.

answer _____ W

[2]

5 Dan travels on a bus to school each day.

Look at the distance–time graph of part of his journey between two bus stops.



Describe in detail what this graph shows about the speed and acceleration of the bus for the first 40 seconds of the journey.

You may use a calculation in your answer.

The quality of written communication will be assessed in your answer to this question.

[6]

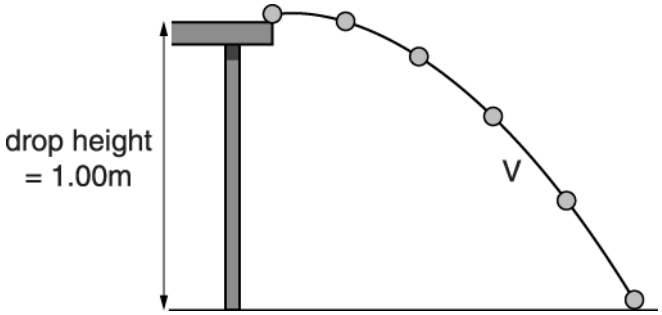
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6 Gita rolls a marble at a velocity V off the edge of a desk.

She uses a camera to show the path of the marble.

Look at the diagram.

It shows the position of the marble at equal time intervals.



The acceleration due to gravity (g) is 10 m / s^2.

Describe and explain the horizontal and vertical accelerations of the marble and calculate the time taken for the marble to fall.

The quality of written communication will be assessed in your answer to this question.

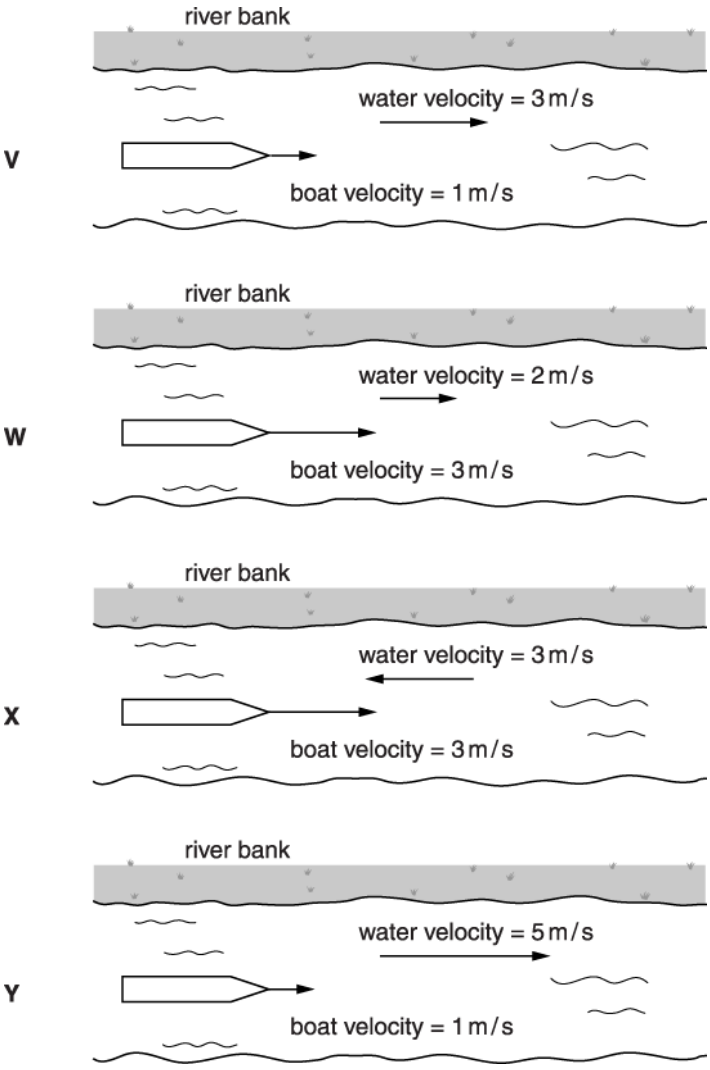
[6]

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7 Look at the diagrams, V, W, X and Y, each showing a rowing boat on different parts of a flowing river.



The diagrams show the **velocities** of the boat and the water flow.

(i) What is the **difference** between speed and velocity?

---

[1]

(ii) Which boat has the largest **resultant** velocity as seen from the river bank?

Choose from V, W, X or Y.

Explain your answer.

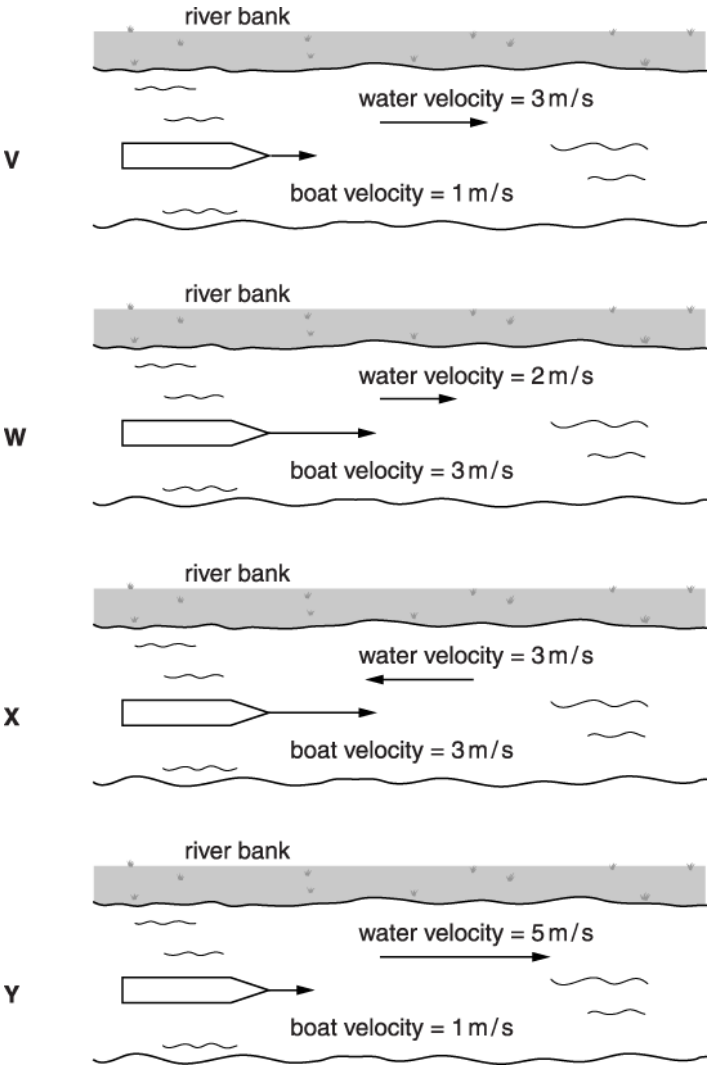
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[2]

8 Look at the diagrams, V, W, X and Y, each showing a rowing boat on different parts of a flowing river.



A horse and rider are training for a race in a field.

The horse accelerates steadily from 2 m / s to 6 m / s over a distance of 28 m.



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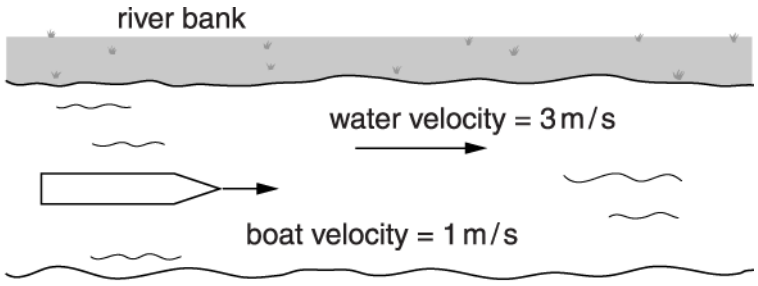
Calculate the time taken for the horse to accelerate over this distance.

---

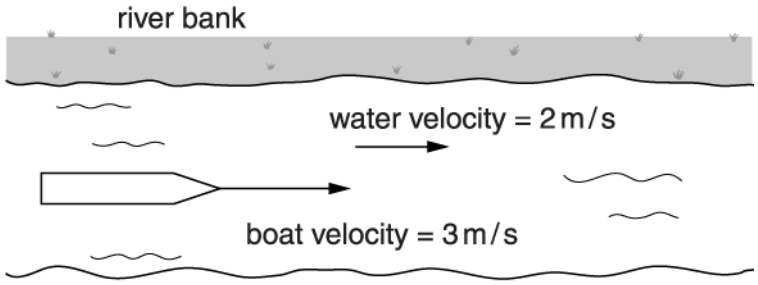
answer _____ s **[2]**

9(a) Look at the diagrams, **V**, **W**, **X** and **Y**, each showing a rowing boat on different parts of a flowing river.

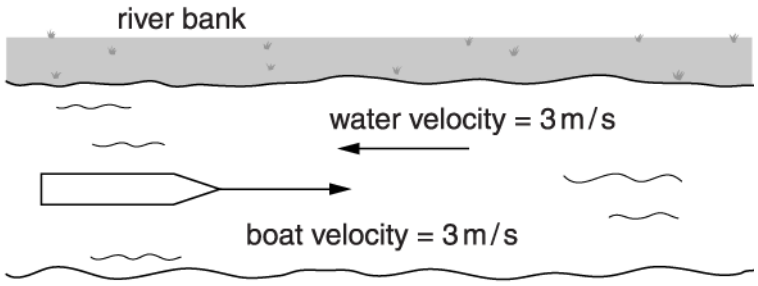
V



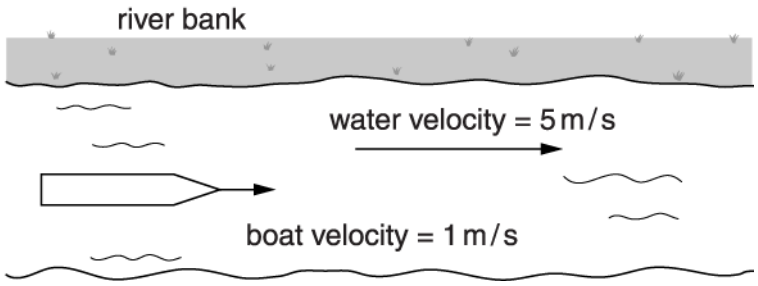
W



X



Y



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The diagrams show the **velocities** of the boat and the water flow.

(i) What is the **difference** between speed and velocity?

---

[1]

(ii) Which boat has the largest **resultant** velocity as seen from the river bank?

Choose from **V**, **W**, **X** or **Y**.

Explain your answer.

---

[2]

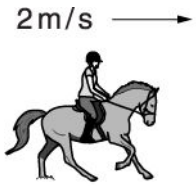
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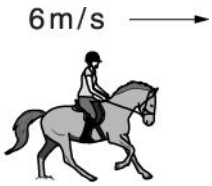
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(b) A horse and rider are training for a race in a field.

The horse accelerates steadily from 2 m / s to 6 m / s.



initial velocity



final velocity

It takes 7 s for the horse to accelerate.

Calculate the distance travelled by the horse for this acceleration.

answer _____ M [2]

10 Look at the information about four athletes.

	Nick	Steve	Sue	Julie
mass in kg	85	80	60	55
height in metres	1.7	1.9	1.6	1.5

They all run at the same speed.

Which athlete has the **greatest** kinetic energy?

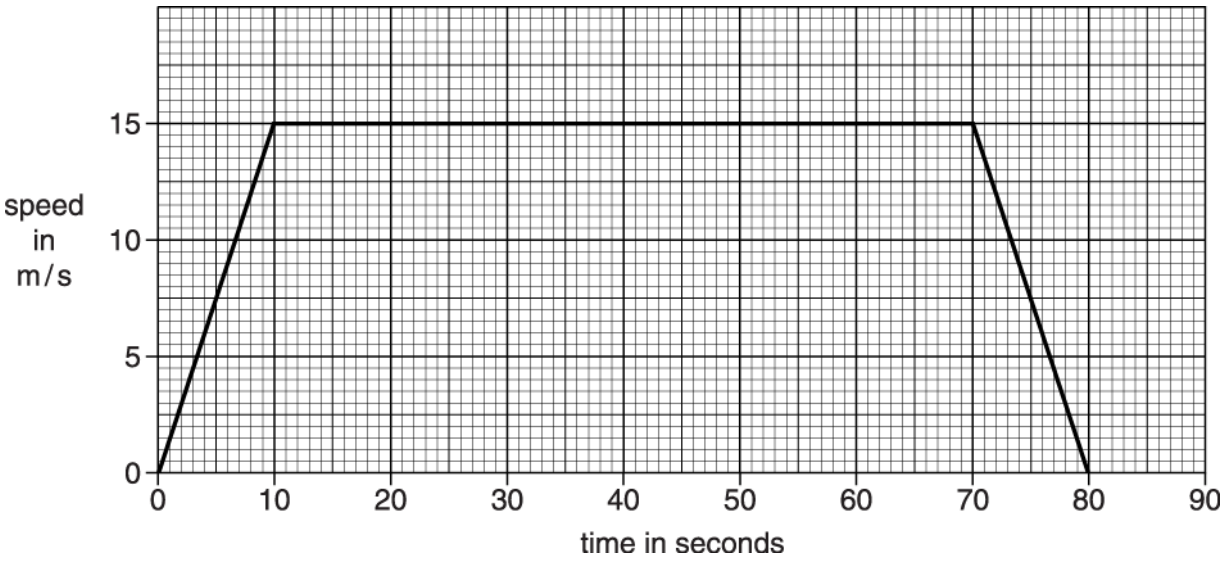
Choose from: **Nick** **Steve** **Sue** **Julie**

answer _____

[1]

11 Beth catches a bus to school each day.

Look at the speed–time graph of her journey between two bus stops.



Describe in detail the journey shown by the graph in terms of speed and acceleration over time.

The quality of written communication will be assessed in your answer to this question.

[6]

12(a) Adrian runs a 100 m race.

It takes him 12 seconds to run the race.

Calculate his average speed.

Give your answer to two significant figures.

answer _____ m/s

[2]

(b) At the start of the race it takes him 4 seconds to increase his speed by 10 m/s.

(i) Calculate his average acceleration.

answer _____ units _____

[3]

(ii) Adrian has a mass of 60 kg.

Calculate the average force needed at the start of the race to cause this acceleration.

answer _____ N

[2]

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13(a) Alex drives her car.

Alex wants to overtake the lorry in front of her.

She needs to accelerate to overtake the lorry in front.

As she overtakes the lorry, Alex accelerates steadily from 13 m/s to 27 m/s in a time of 6 s.

Calculate the distance travelled as she overtakes.

distance travelled _____ m

[2]

(b) Alex now drives her car on a road which has a speed limit of 27 m/s.

She starts from rest at some traffic lights.

The car steadily accelerates at 3 m/s^2 for 10 seconds.

Calculate the car's final speed to see if she goes faster than the speed limit.

Final speed _____ m/s

Does she go faster than the 27 m/s speed limit?

_____

[2]

14(a) Artificial satellites are put into space for scientific research.

The satellites are carried into space by rockets.

A rocket accelerates steadily from rest and reaches 8000 m/s after travelling 1 680 000 m.

Calculate the time, in minutes, it takes the rocket to reach this speed.

answer _____ minutes

[3]

(b)

(i) The rocket is now in a stable orbit.

To keep the rocket in this orbit its speed needs to stay at 8000 m/s.

Suggest, by using ideas about gravitational and centripetal forces, why this speed needs to be maintained to keep it in this stable orbit.

---

[3]

(ii) The rocket re-enters the Earth's atmosphere safely.

In the final part of the descent its speed reduces steadily from 2000 m/s to 120 m/s just before touchdown. This takes place over a distance of 5×10^5 m.

Calculate the average **deceleration** over this distance.

---

answer _____ m/s^2

[3]

15 Artificial satellites are put into space for scientific research.

The satellites are carried into space by rockets.

A rocket accelerates steadily from rest and reaches 6000 m/s after 5 minutes.

Calculate the average speed and the distance travelled in this time.

---

average speed _____ m/s

---

distance _____ m

[3]

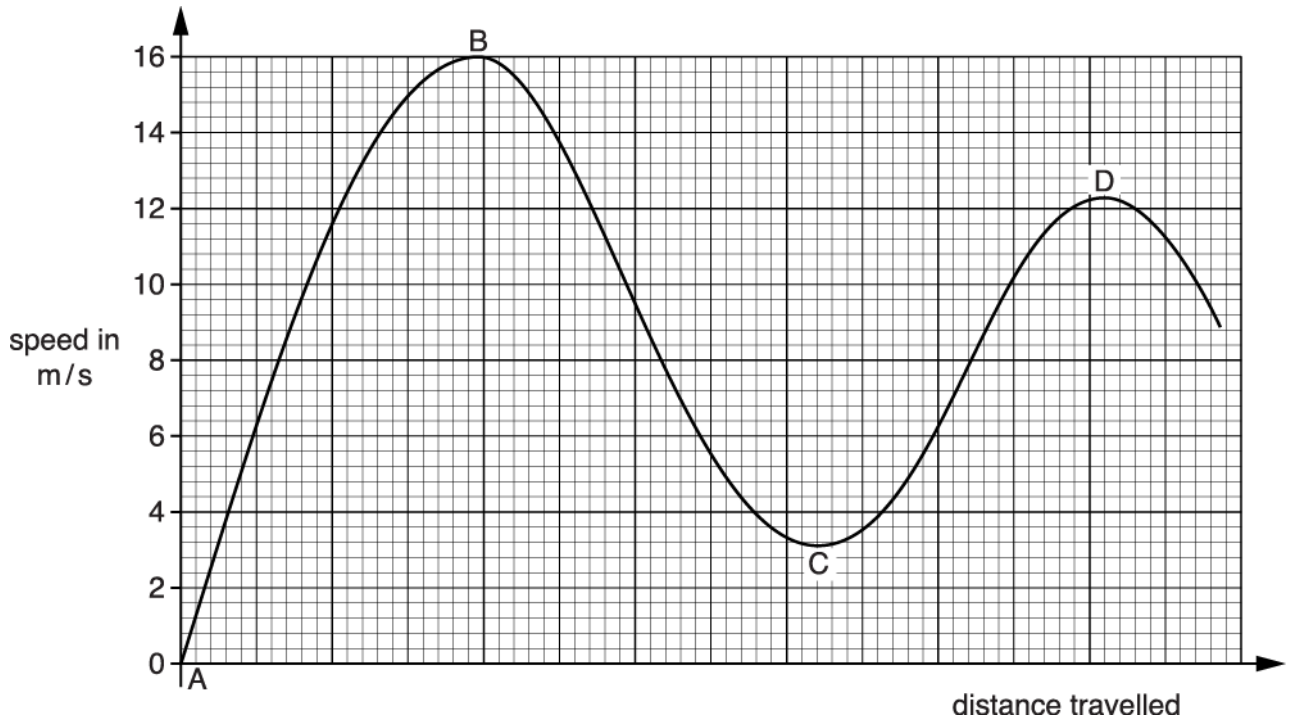
16 This question is about kinetic and gravitational potential energy.

Look at the graph.

It shows how the speed of a roller coaster car changes with the distance travelled along part of the track.

The roller coaster car starts from rest at the top of the track at **A**.

The car and its passengers have a total mass of 400 kg.



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Describe how the kinetic energy and the gravitational potential energy of the car change in sections AB and BC of the journey, and calculate the difference in height of the roller coaster between A and B assuming no energy is lost.

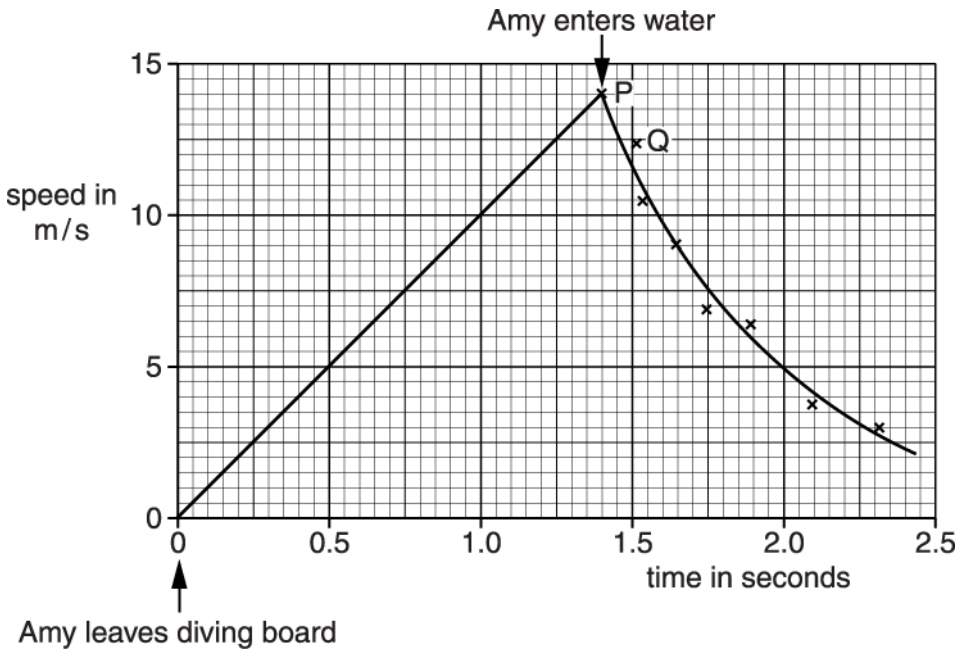
The acceleration due to gravity is 10 m/s^2.

The quality of written communication will be assessed in your answer to this question.

[6]

17(a) Amy dives from the high diving board at a swimming pool.

Look at the graph of her motion.



Calculate the height of the diving board above the water.

---

answer _____ m

[2]

(b)

(i) John thinks that he can find Amy's deceleration just after she enters the water by using points **P** and **Q** on the graph.

Elaine thinks it is better to find Amy's deceleration just after she enters the water by using the gradient of the graph at point P.

Explain why Elaine's method is better than John's to find the deceleration.

---

[2]

(ii) Amy has a mass of 60 kg.

Amy's deceleration as she enters the water is 20 m/s^2.

Calculate the decelerating force on Amy just as she enters the water.

---

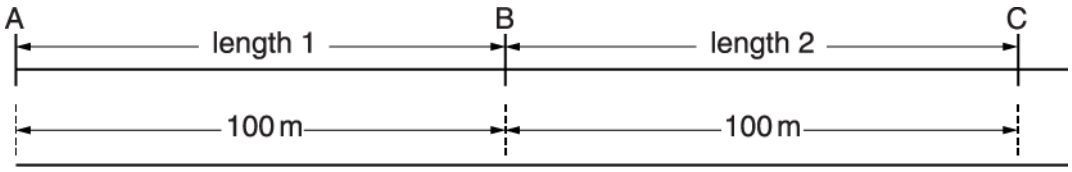
answer _____ N

[1]

18 This question is about speed.

Pupils at a school measure the time cars take to travel two 100 m lengths.

Look at the diagram.



Look at the results that they collect for four cars passing the school.

Type of car	Time taken to travel length 1 in seconds	Time taken to travel length 2 in seconds
Golf	9	8
Fiat	8	8
Jaguar	8	9
Skoda	7	7

(i) Which car's speed is increasing as it travels from **A** to **C**?

answer _____

[1]

(ii) The speed limit on the road in front of the school is 13 m/s.

Calculate the time it takes for a car travelling at a speed of 13 m/s to travel 100 m.

Use your answer to explain if any of the cars are travelling faster than the speed limit.

_____

_____

_____

_____ **[2]**

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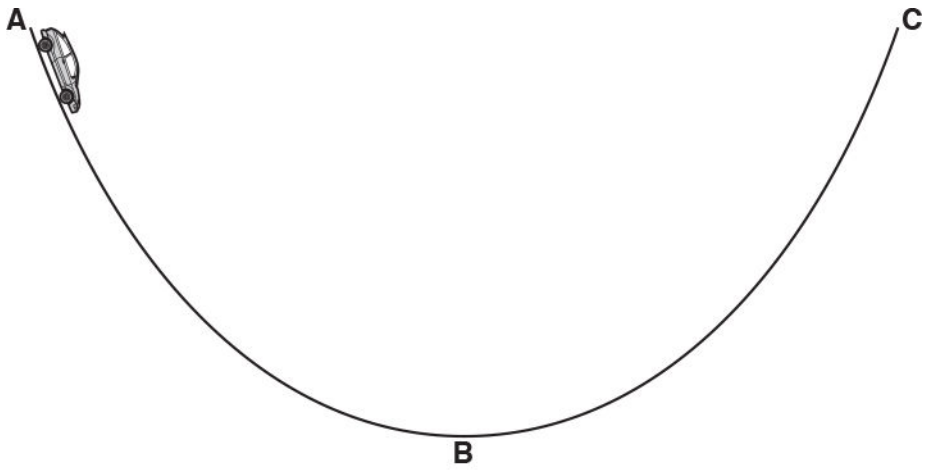
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19 Rosie investigates the motion of a toy car along a curved track.

Rosie releases the toy car from **A**.

Look at the diagram of the curved track.



Describe how the kinetic energy and the potential energy of the toy car change as it moves from **A** to **B** and from **B** to **C**.

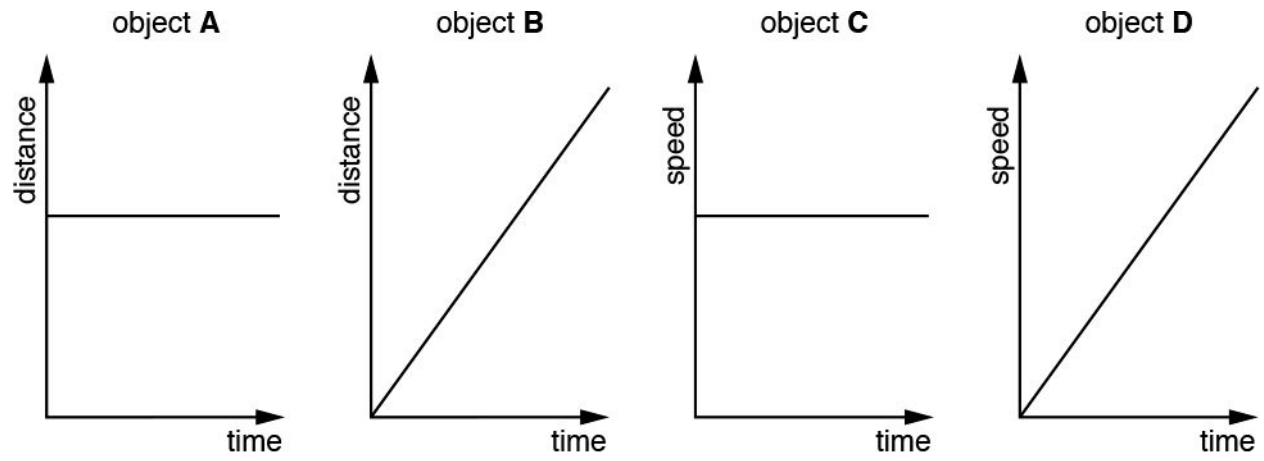
The quality of written communication will be assessed in your answer to this question.

[6]

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20(a) Gio draws motion graphs for objects **A**, **B**, **C** and **D**.

Look at her four graphs.



Which **two** objects move with constant speed?

---------- and ---------- [1]

(b) Which object increases speed?

---------- [1]

(c) Which object is **not** moving?

---------- [1]

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21 A ball is dropped from a cliff 20 m high.

Calculate the speed of the ball just before it hits the ground.

Acceleration due to gravity = 10 m/s^2.

Answer ..... m/s [2]

22(a) Speed and velocity are measurements.

Tick (✓) the **two** correct sentences about speed and velocity.

Direction is **not** important when measuring speed. ☐

Relative speed does **not** depend on the direction of movement. ☐

Speed and velocity are vector quantities. ☐

Speed is a scalar quantity. ☐

Velocity is always higher than speed. ☐ [2]

(b) The diagram shows a car accelerating.



The car accelerates at 0.6 m / s^2 for 10 s.

The car has a final velocity of 11 m / s.

Calculate the starting velocity.

---

answer ---------- m/s

[2]

23(a) Velocity is a vector quantity.

It can be calculated by using equations or by drawing scale diagrams.

Describe the difference between scalar and vector quantities.

---

[1]

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(b) The diagram shows a car accelerating.



The car accelerates at 0.6 m/s^2 for 10 s.

The car has a final velocity of 11 m/s.

Calculate the starting velocity.

answer _____. m/s **[2]**

24 Jim investigates the acceleration of his new car.

His car starts from rest and reaches 26 m/s in 13 seconds.

(i) Calculate the acceleration of his car.

Include the unit for acceleration with your answer.

Answer ---------- unit ---------- [3]

(ii) Jim finds that the acceleration of his car is less than advertised by the maker.

Why is it important that the person testing the car is **independent** from the maker?

---[2]

25(a) Sami rides a scooter at different speeds.

He calculates the kinetic energy of the scooter at four different speeds.

Look at the table.

Speed in metres per second	Kinetic energy in joules
5	1 250
10	5 000
15	11 250
20	20 000

Describe the pattern between the speed and the kinetic energy of the scooter.

---[2]

(b) Kinetic energy depends on speed.

Write down one **other** thing kinetic energy depends on.

---[1]

(c) Sami rides his scooter on a road with 'average speed cameras'.

Explain how average speed cameras work.

---[3]

26 An object travelled 800 m in 40 seconds.

Use the equation: distance travelled (m) = speed (m/s) × time (s)

What is the speed of the object?

A 0.05 m/s

B 20 m/s

C 840 m/s

D 32 000 m/s

Your answer ☐ [1]

27 Which is a scalar?

A Acceleration

B Displacement

C Force

D Speed

Your answer ☐ [1]

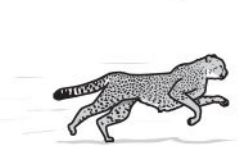
28 Which of the following has the **most** kinetic energy?

A



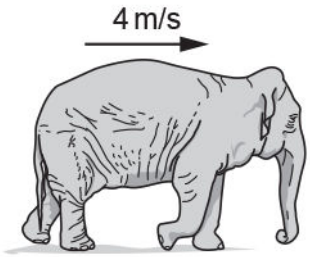
500 kg

B



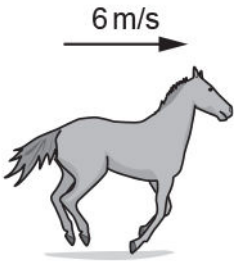
80 kg

C



3000 kg

D



750 kg

Your answer ☐ **[1]**

29 Which distances are the **same**?

A 1×10^{-3} m and 1 μm

B 1×10^{-6} m and 1 mm

C 1×10^{-9} m and 1 nm

D 1×10^{-12} m and 1 Gm

Your answer ☐ **[1]**

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30 * Four students run in different races.

Student	Race distance (m)	Time (s)
A	50	6
B	100	15
C	100	14
D	200	31

Use the information in the table to **describe** and **compare** the motion of the four students.

Use the data in your answer.

[6]

31 A presenter on a car TV programme says:

"The car maker has reduced the mass of this car and it now has better acceleration."

(i) Explain why the presenter is correct.

--- [2]

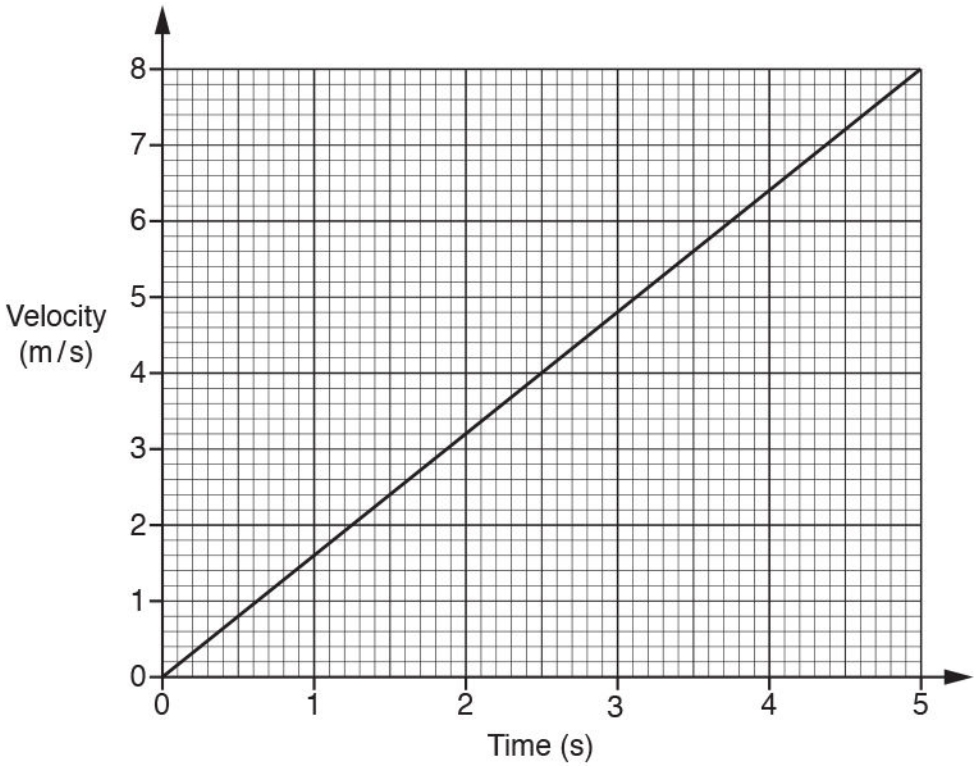
(ii) A car accelerates from 5 m/s to 25 m/s in 4 seconds.

Calculate the acceleration of the car.

Use the equation: Acceleration = Change in speed ÷ Time taken

Answer = ... m/s^2 **[3]**

32 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]

33 Two cars head towards each other on a road.



What velocity does the driver of car **Q** see car **P** travelling towards him at?

A 10 m/s

B 15 m/s

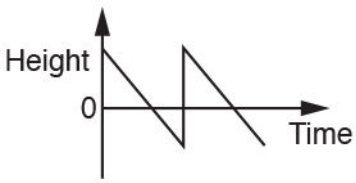
C 25 m/s

D 40 m/s

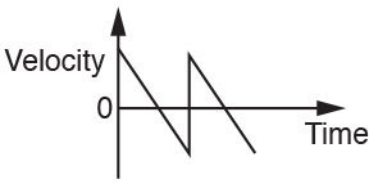
Your answer ☐ **[1]**

34 Which graph shows a bouncing ball?

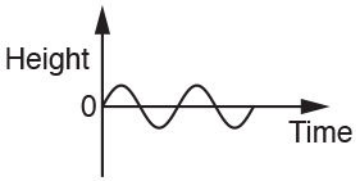
A



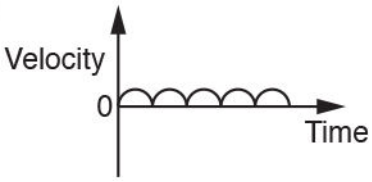
B



C



D



Your answer ☐ **[1]**

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35 A student wants to find out the depth of a well.

She thinks that she can calculate this by dropping a stone into the well and timing how long it takes to hear the stone splash at the bottom.

(i) Explain how she could use this measurement to find the depth of the well.

---

[3]

(ii) It takes 2.2 seconds for the stone to drop from rest and splash into the water at the bottom.

What is the speed of the stone when it hits the water?

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

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36 A student watches a ball game on the school field.

The student sees the ball being hit with a bat but he hears the sound a short time after. This is because the speed of light is much greater than the speed of sound.

Describe an experiment which measures the speed of **sound** in air. In your answer describe the measurements, calculations and procedures needed to gather **accurate** and **reliable** results.

You may draw a diagram as part of your answer.

[5]

37(a) A scientist uses different drivers to test the stopping distances of the same car.

Look at the results.

Driver	Speed (m/s)	Thinking distance (m)	Braking distance (m)
A	8	6	6
B	16	13	24
C	32	24	96
D	16	12	22
E	8	5	6
F	32	30	120

Which driver has the **quickest** reaction time?

Driver ..... has the **quickest** reaction time.

Calculate their reaction time.

Answer = ---------- s **[3]**

(b) Give two drivers that have the **same** reaction time.

Drivers ..... have the **same** reaction time.

Explain your answer.

---**[2]**

(c) Driver **C** travels at 32 m/s on the road and then stops. The car has a mass of 1200 kg.

(i) Show that the **kinetic energy** stored by the car at 32 m/s is 614 000 J.

[3]

(ii) Describe what happens to the kinetic energy of the car as it brakes and stops.

---**[2]**

(iii) The braking distance of the car is 96 m.

Calculate the **braking force** on the car.

Give your answer to **4** significant figures.

Answer = ---------- N **[3]**

38 A lorry has a mass of 3500 kg. It travels at a speed of 30 m/s.

Use the equation: Kinetic Energy = 0.5 × Mass × Speed^2

Calculate the kinetic energy of this lorry.

A 10 500 J

B 52 500 J

C 1 575 000 J

D 3 150 000 J

Your answer ☐ [1]

39(a) A student watches a ball game on the school field.

The student sees the ball being hit with a bat but he hears the sound a short time after. This is because the speed of light is greater than the speed of sound.

He decides to do an experiment to measure the speed of sound waves in air.

Describe which measurements he needs to measure this speed.

---

[2]

(b) Which equation is used to calculate speed?

---

[1]

(c) Describe one way he could get valid results for this experiment.

--- [1]

40 **Fig. 20.1** shows thinking, braking and stopping distances for the same car travelling at different speeds.

Speed (m/s)	Thinking distance (m)	Braking distance (m)	Stopping distance (m)
8	6	6	12
16	12	24	36
32	24	96	120

Fig. 20.1

Calculate the reaction time of the person driving the car.

Answer = ---------------------- s **[3]**

41 This question is about force, mass and acceleration.

A car starts from rest and accelerates at 3 m/s^2.

Use the equation: Acceleration = Change in velocity ÷ Time taken

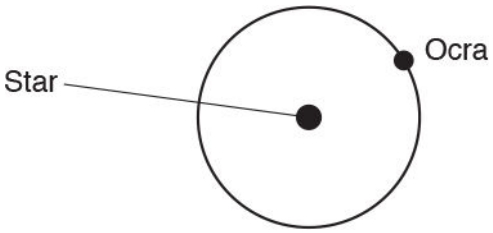
Calculate the **velocity** of the car after 4 s.

Answer = ---------------------- m/s **[2]**

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42 Planet Ocra is in a circular orbit around a star.



Which statement is correct?

A The acceleration of Ocra is zero.

B The speed of Ocra is changing.

C The velocity of Ocra is changing.

D The velocity of Ocra is zero.

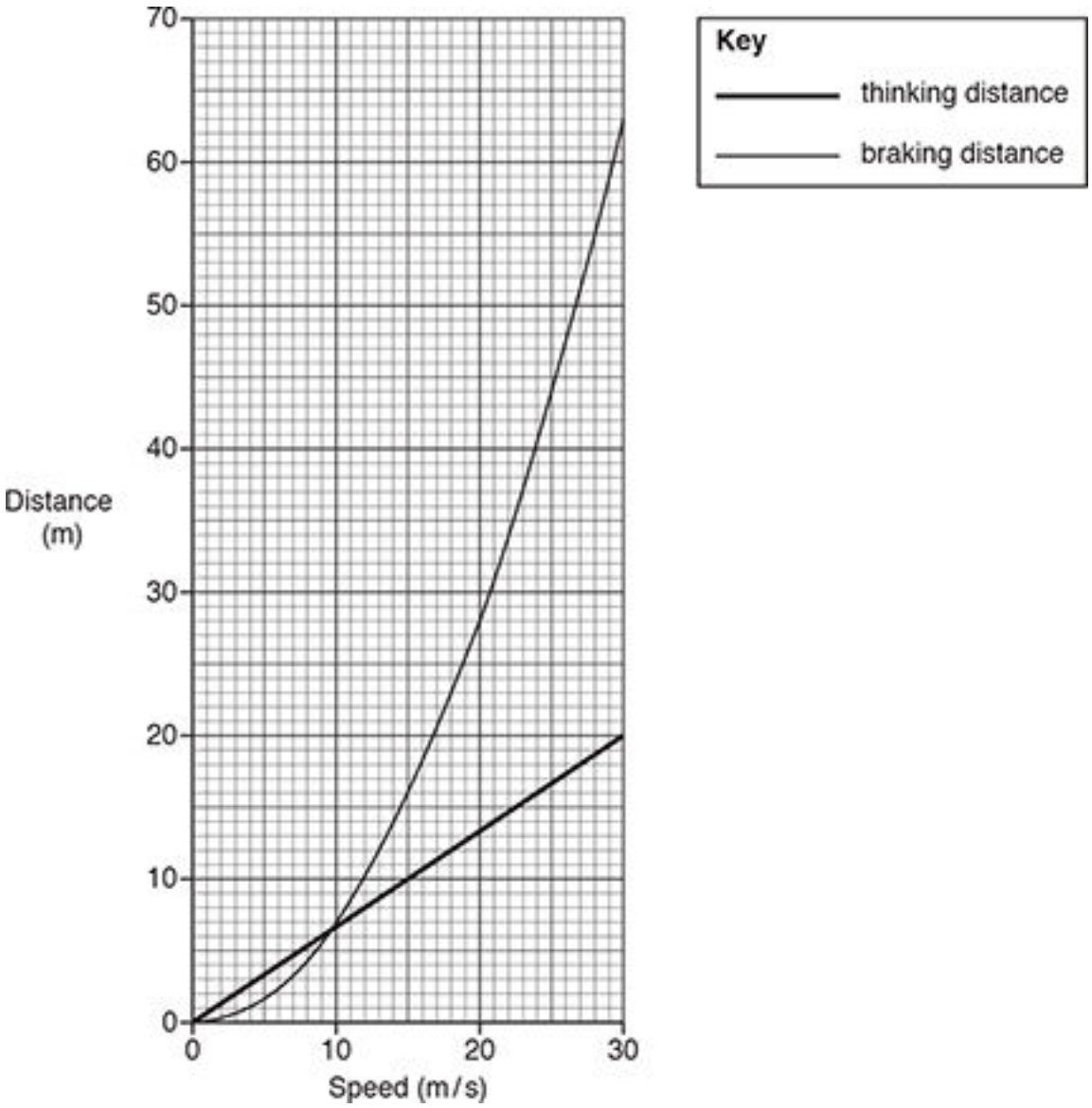
Your answer [ ] [1]

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43 The graph shows thinking and braking distances for a car at different speeds.



(i) Use the graph to find the **thinking distance** at 24 m / s.

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

(ii) Calculate the **thinking time** at 24 m / s.

Use your answer to **(i)** and the equation: distance travelled = speed × time

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Give your answer to **2** decimal places.

Thinking time =..... s **[3]**

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44 **Fig. 21.1** is a speed-time graph for car **P**.

The driver of car **P** reacts to a traffic light at time = 0.00 s, then presses the brakes at time = 0.50 s.

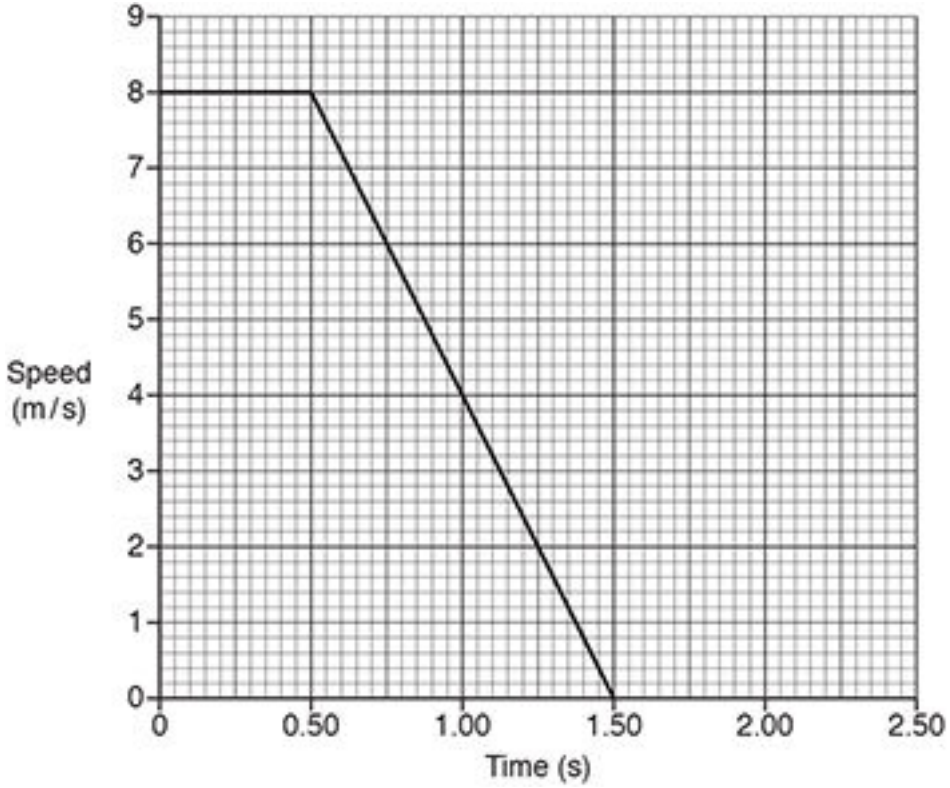


Fig. 21.1

(i) The braking distance is the same size as the thinking distance.

Explain how the graph in **Fig. 21.1** shows this.

---

[1]

(ii) Add another line to the graph in **Fig. 21.1** to show the journey of car **Q**.

- Car **Q** is travelling at 8 m / s.
- The driver of car **Q** reacts, then presses the brakes after 0.75 s.
- Car **Q** decelerates at the same rate as car **P**.

[2]

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45 Some students try to measure the speed of sound, as shown in **Fig. 24.1**.

One student makes a loud sound by clapping her hands.

The sound of the clap reflects from the gym wall causing an echo.

Another student measures the time between hearing the clap and hearing the echo.

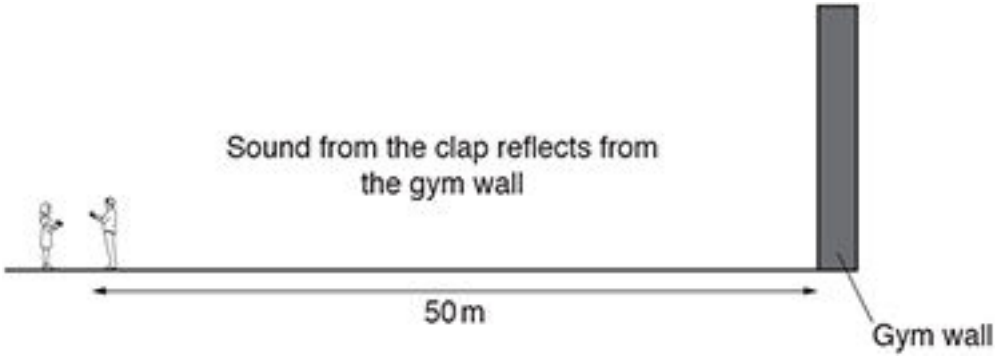


Fig. 24.1

They repeat the experiment three times and record their results in the table below.

Distance to wall (m)	Time 1 (s)	Time 2 (s)	Time 3 (s)	Mean time (s)
50	0.28	0.32	0.54	

(i) The student did not pay attention when recording **time 3**.

Calculate the **mean** time taken for the sound of the clap to return, using suitable values from the table.

Mean time taken = ... s **[1]**

(ii) Calculate the speed of sound for the clap.

Use your answer to **(i)** and the equation: distance travelled = speed × time

Give your answer to significant figures.

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Speed of sound = ... m / s **[4]**

(iii) Describe **two** ways to improve and develop their method.

1 .....

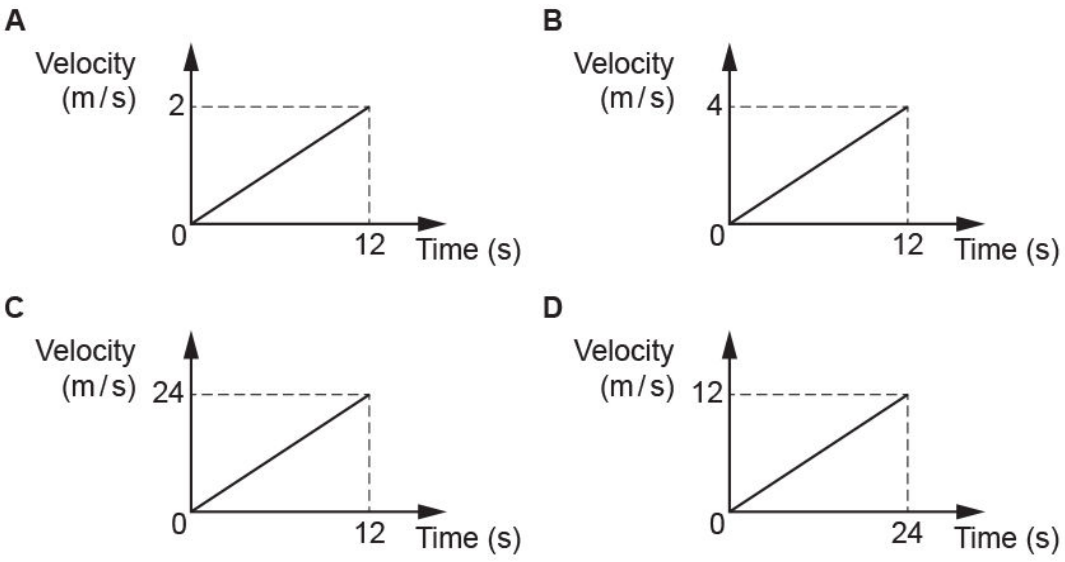
.....

2 .....

.....

[2]

46 Look at the motion graphs.



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

Your answer ☐ **[1]**

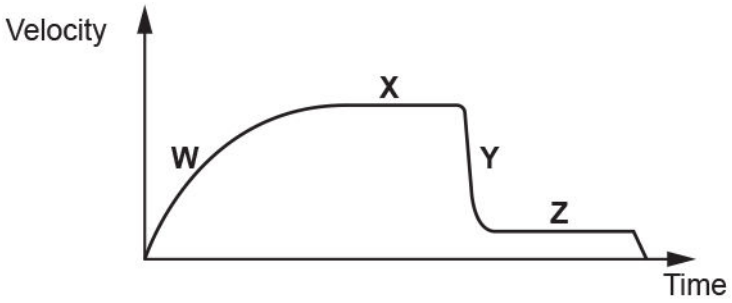
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47 A skydiver falls from a plane. His parachute opens and he lands safely.

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]

48(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
40	3.52	3.51	3.50	3.51

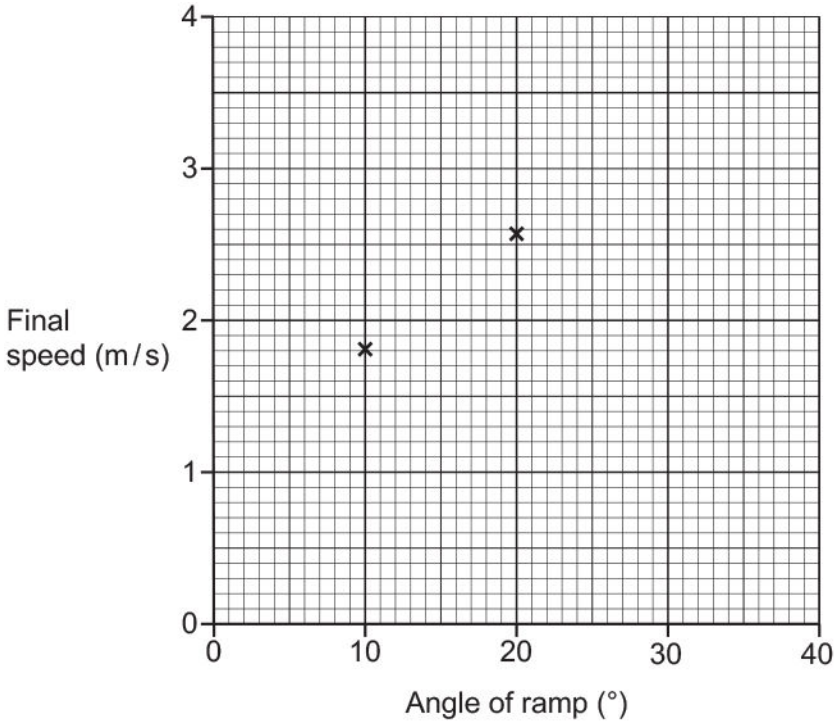
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(i) Plot the results on the graph and draw a line of best fit.

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.

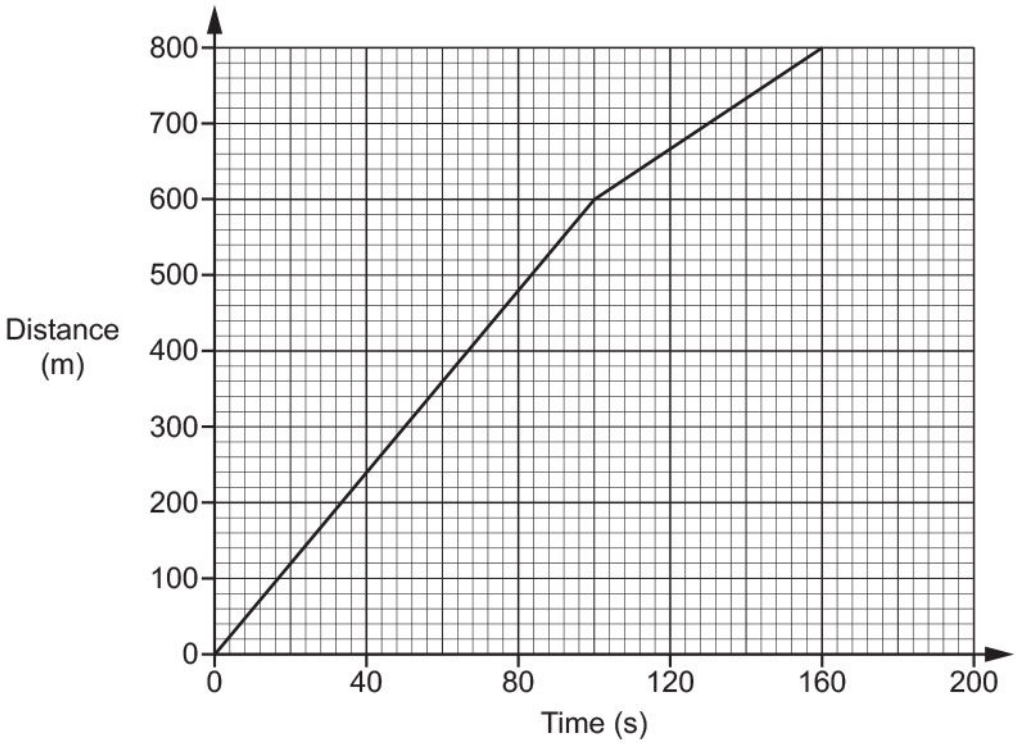
Kinetic energy = ... J **[3]**

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



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]**

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50 A car travels at 72 km / h.

How fast is this in metres per second (m / s)?

A 1.2 m/s

B 20 m/s

C 120 m/s

D 1200 m/s

Your answer [ ] **[1]**

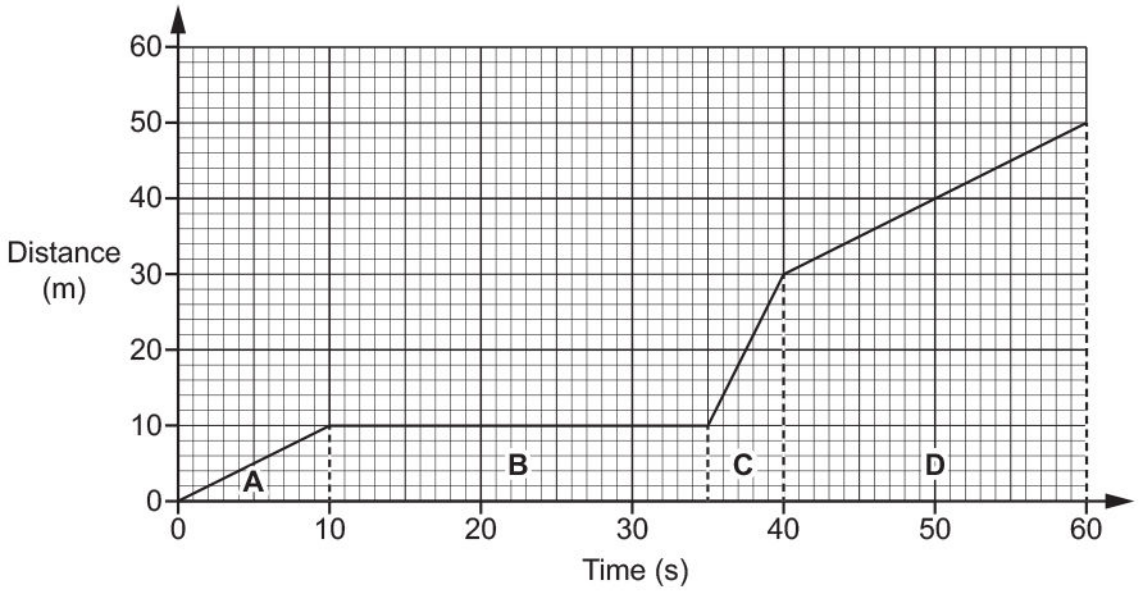
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51(a) A student investigates motion graphs.

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 ☐

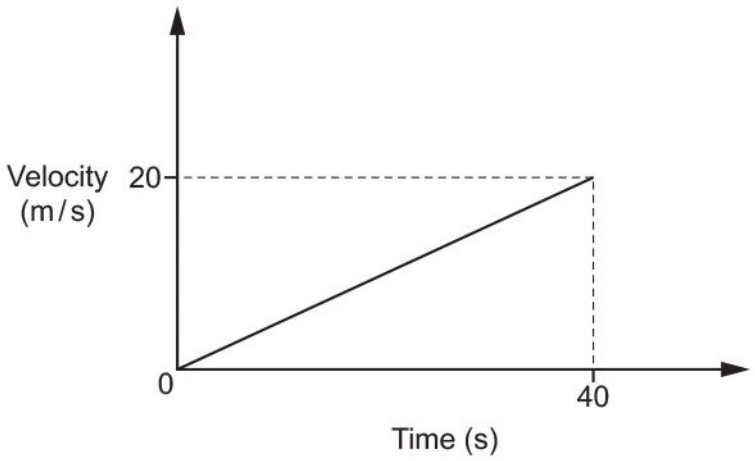
Explain your answer.

---

[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.

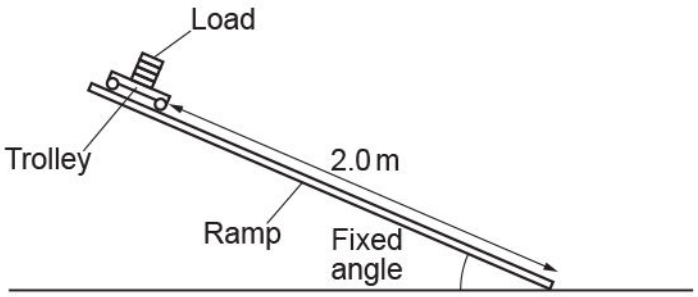
Calculate the acceleration of the boat.

Use the equation: acceleration = change in velocity ÷ time

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

52(a) A student investigates the average speed at which a trolley with different loads travels down a ramp.

Look at the diagram of her experiment.



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She releases the trolley from a distance of 2.0 m from the bottom of the ramp.

The student uses a stop-clock to measure the time it takes to reach the bottom of the ramp.

She calculates the average speed. Look at her results.

Load (N)	Time taken (s)	Average speed (m / s)
20	2.3	0.87
40	2.4	0.83
60	2.3	0.87
80	2.4	0.83

* Describe the trend shown by the results, identify problems with the experiment and describe any improvements that you would make to the experiment.

[6]

(b) For one experiment the trolley starts from rest and reaches a final speed of 2 m / s.

The ramp length is 2.0 m.

Calculate the acceleration of the trolley.

Acceleration = ... m / s^2 **[4]**

53 A teacher measures the speed of water waves in a ripple tank.

What apparatus should she use?

A Ammeter and stopwatch

B Newton-meter and ruler

C Ruler and protractor

D Ruler and stopwatch

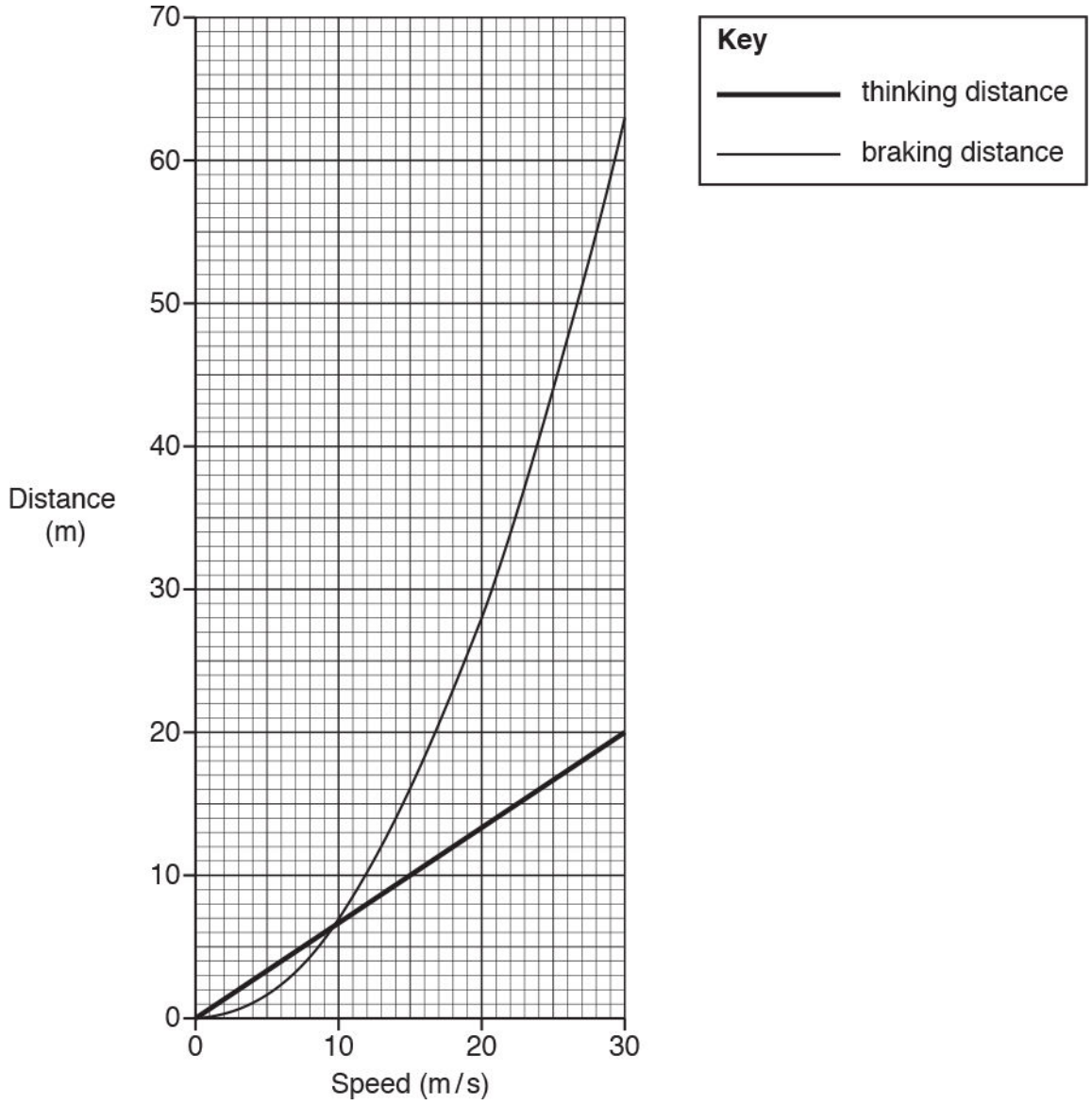
Your answer ☐ **[1]**

54 The graph shows thinking and braking distances for a car at different speeds.

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(i) State **one** factor that could **increase** thinking distance.

[1]

(ii) Calculate the **stopping distance** at 15 m / s.

Use the graph to help you.

Stopping distance = ... m **[2]**

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55 The kinetic energy of motorbike **X** is 10 kJ.

Motorbike **Y** has the same speed but double the mass.

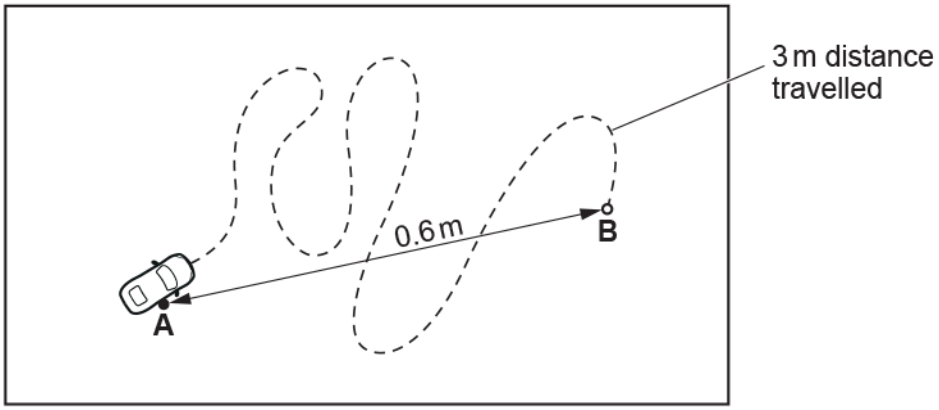
What is the kinetic energy of motorbike **Y**?

Use the equation: kinetic energy = 0.5 × mass × (speed)^2

A 5 kJ
B 10 kJ
C 20 kJ
D 40 kJ

Your answer ☐ **[1]**

56 * A toy car moves randomly on a table.



It moves from position **A** to position **B** in 0.5 minutes, covering a distance of 3.0 m. The start and finish positions are 0.6 m apart.

Explain why the average speed and average velocity of the moving toy car are different from one another.

You should include calculations in your answer.

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[6]

57 A boy of mass 70 kg stands on the end of a diving board.

The boy dives vertically into the swimming pool. The water in the pool is 3.2 m below the diving board.

Calculate the velocity of the boy when he enters the water.

Use an equation from the data sheet to help you.

Gravitational field strength on Earth = 10 N / kg.

Velocity = ... m / s **[4]**

58 A car has a mass of 1000 kg and is travelling at a speed of 20 m / s.

Calculate the kinetic energy of the car.

A 10 000 J
B 20 000 J
C 200 000 J
D 400 000 J

Your answer ☐ [1]

59 A car travels at a speed of 70 mph (miles per hour).

1 mile is approximately 1600 metres.

Convert 70 mph into m / s (metres per second).

A 2.6 m / s
B 31 m / s
C 112 m / s
D 160 m / s

Your answer ☐ [1]

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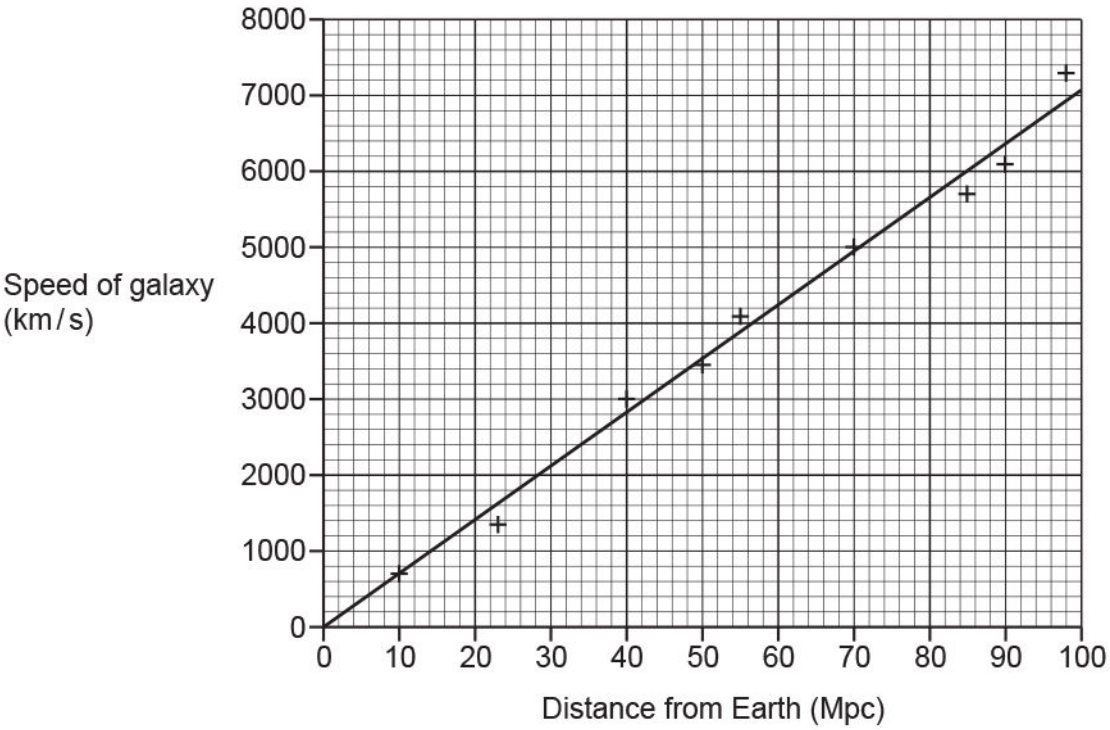
60(a) Edwin Hubble discovered that all distant galaxies were moving away from the Earth.

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]

(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.

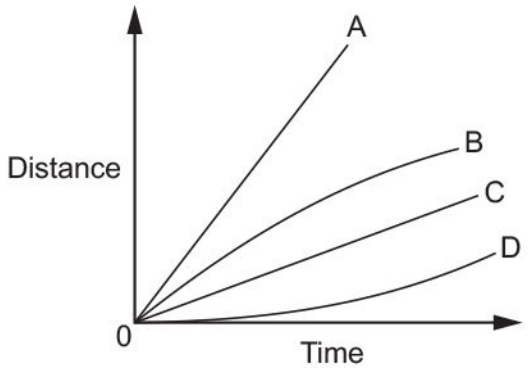
Time = ... s **[3]**

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61 Look at the distance-time graph.



Which line shows the largest average speed?

Your answer ☐ [1]

62 A cyclist travels 750 m in 50 seconds.

Calculate the speed of the cyclist.

Use the equation: speed = distance / time

A 0.015 m / s
B 15 m / s
C 37.5 m / s
D 375 m / s

Your answer ☐ [1]

63 A girl runs twice around a 400 m circular track. What is the final displacement of the girl from her starting point?

A 0 m
B 200 m
C 400 m
D 800 m

Your answer ☐ [1]

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64 A toy car travels around a race track. After one lap it is back at the start position.

Explain why the velocity of the toy car is different from its speed as it travels around the track.

---

[2]

END OF QUESTION PAPER

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