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EDEXCEL GCSE PHYSICS: QUESTIONS BY TOPIC

Motion and Forces (2)

GCSE Physics (Foundation) Topic 2

15 questions · 151 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Physics 1PH0, Foundation Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

15 questions · 151 marks · lowest tariff first



7-MARK QUESTIONS

2 questions in this booklet



1 (a) Which of these speeds would be normal for a person walking?

(1)

- ☐ A 0.1 m/s
- ☐ B 1.0 m/s
- ☐ C 10 m/s
- ☐ D 100 m/s

(b) Figure 1 shows a block hanging from a spring balance.

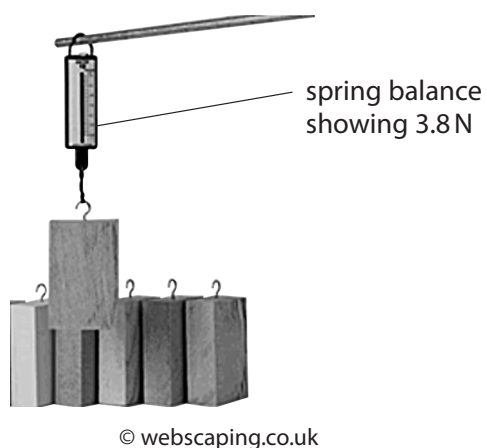


Figure 1

Use a word from the box to complete the sentence below.

density	mass	volume	weight
---------	------	--------	--------

The quantity measured by the spring balance in Figure 1 is

(1)

.....

- (c) A toy car has a mass of 0.10 kg.
The toy car accelerates at 2.0 m/s^2 .

Calculate the force producing this acceleration.
State the unit.

Use the equation

$$F = m \times a$$

(3)

force = ... unit = ...

- (d) Use words from the box to complete the sentences below.

direction	energy	mass	size
-----------	--------	------	------

(2)

Vectors have size and

Scalars have only

(Total for Question 1 = 7 marks)



2 (a) (i) Which of these is the correct equation that relates force, mass and acceleration? (1)

☐ A $F = m + a$

☐ B $F = m - a$

☐ C $F = m \times a$

☐ D $F = m \div a$

(ii) A cyclist has a mass of 70 kg.

Calculate the force needed to accelerate the cyclist at 2.0 m/s^2 .

State the unit.

(2)

force = ... unit = ...

(b) Another cyclist travels 1200 m in a time of 80 s.

Calculate the average speed of the cyclist.

Use the equation

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

(2)

average speed = ... m/s



(c) A student wants to measure the average speed of a cyclist.

The student estimates that one of his own steps is 1 m.

He counts 100 steps between two posts on a track.

He uses a stopwatch to measure the time the cyclist takes to travel between the two posts.

Figure 2 shows the set-up used to measure the average speed.

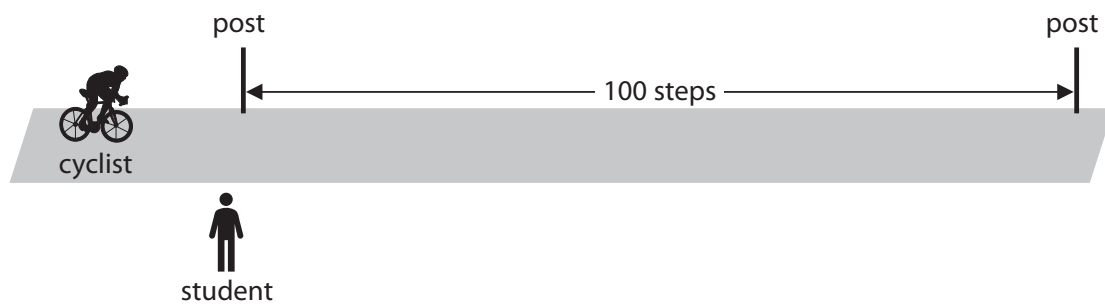


Figure 2

State **two** improvements the student could make to this method.

(2)

- 1.....
- 2.....

(Total for Question 2 = 7 marks)

8-MARK QUESTIONS

1 question in this booklet



3 Figure 5 shows a velocity / time graph for a car moving on a test track.

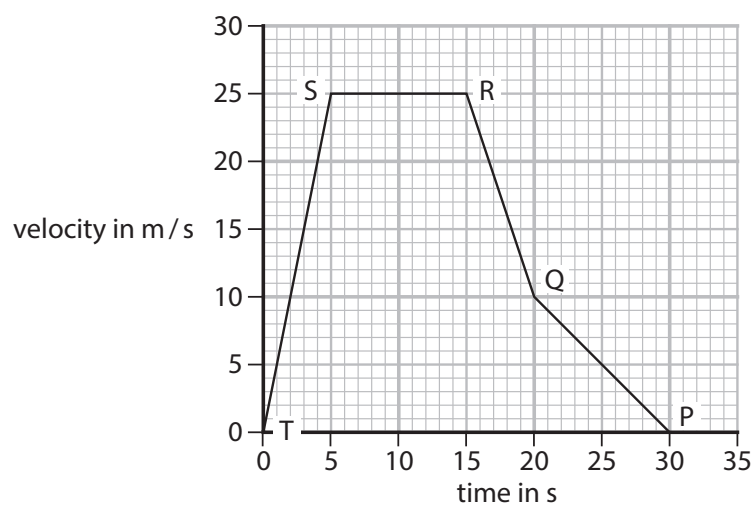


Figure 5

(a) (i) Use this graph to describe the velocity of the car in stages TS, SR and RQ.

(3)

TS

.....

.....

SR

.....

.....

RQ

.....

.....

(ii) State how the motion of the car is different in RQ compared with QP.

(1)

.....

.....

- (b) (i) Calculate the acceleration of the car in Figure 5 in the first 5 s.

Use the equation

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \quad (2)$$

$$\text{acceleration} = \dots\dots\dots \text{ m/s}^2$$

- (ii) Calculate the distance travelled by the car in Figure 5 from 5 s to 15 s.

(2)

$$\text{distance} = \dots\dots\dots \text{ m}$$

(Total for Question 3 = 8 marks)



9-MARK QUESTIONS

4 questions in this booklet



6 Quantities can be either scalar or vector.

(a) Which of these is a vector quantity?

(1)

- ☒ A mass
- ☒ B force
- ☒ C energy
- ☒ D distance

(b) Figure 7 shows a ball bearing as it falls slowly through a clear, dense liquid.

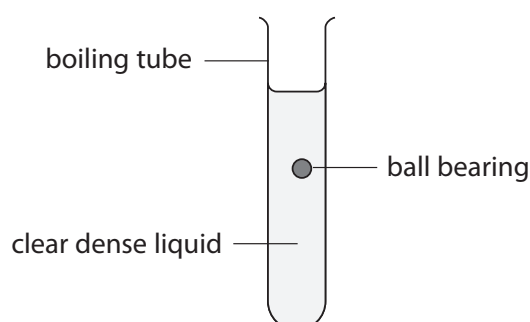


Figure 7

The apparatus in Figure 7 is used to find the average speed of the ball bearing as it falls.

(i) Devise an experiment to determine the average speed of the ball bearing as it falls through the liquid.

(4)

You should include:

- any extra apparatus you would use to take measurements
- the measurements you would take
- how you would calculate the speed.

.....

.....

.....

.....

.....

.....

.....

.....

- (ii) A student thinks that the ball bearing falls through the liquid at a constant speed.

Explain how you could develop this experiment to determine if the ball bearing falls through the liquid at constant speed.

You may draw a diagram to help your answer.

(2)

- (c) The ball bearing is now dropped through air.

The initial velocity of the ball bearing is zero.

The acceleration of the ball bearing is 10 m/s^2 .

The ball bearing falls 1.5 m.

Calculate the velocity of the ball bearing when it has fallen 1.5 m.

Use the equation

$$v^2 - u^2 = 2 \times a \times x$$

(2)

velocity of ball bearing = ... m/s

(Total for Question 6 = 9 marks)



- 3 (a) The graph in Figure 5 shows how the velocity of a car changes with time.

The car starts from rest and travels along a level, straight road for 50 s.

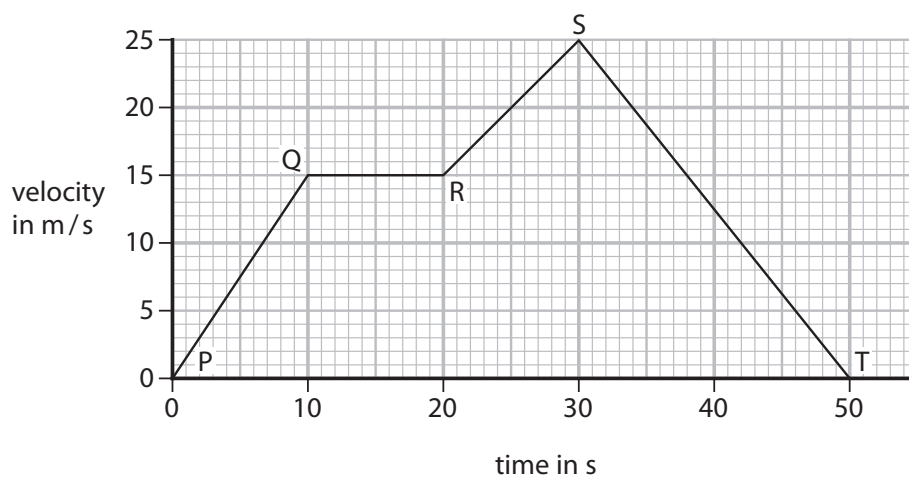


Figure 5

- (i) Which part of the graph shows when the car has constant velocity?

(1)

- ☐ A PQ
☐ B QR
☐ C RS
☐ D ST

- (ii) Which part of the graph shows when the car has the greatest acceleration?

(1)

- ☐ A PQ
☐ B QR
☐ C RS
☐ D ST

(iii) Calculate the acceleration of the car in the first 10 s shown on the graph.

(2)

Use the equation

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

$$\text{acceleration} = \dots\dots\dots \text{ m/s}^2$$

(iv) Calculate the distance the car travels in part QR shown on the velocity/time graph in Figure 5.

(3)

$$\text{distance} = \dots\dots\dots \text{ m}$$

(b) A different car has a mass of 1200 kg.

Calculate the force needed to give this car an acceleration of 2.4 m/s^2 .

(2)

Use the equation

$$F = m \times a$$

$$\text{force} = \dots\dots\dots \text{ N}$$

(Total for Question 3 = 9 marks)



- 4 (a) A car is being driven at a constant velocity.

The driver sees an obstacle in the road ahead.

The driver uses the brakes to stop as quickly as possible.

Figure 9 shows the velocity/time graph for the car from the time when the driver sees the obstacle.

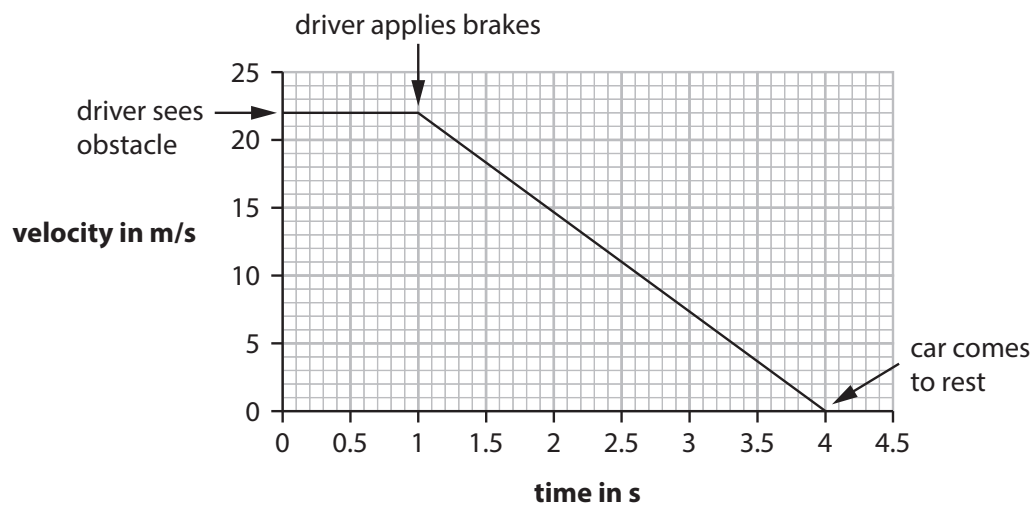


Figure 9

- (i) Which of these is the driver's reaction time shown in Figure 9?

(1)

- ☐ A 0 s
- ☐ B 1 s
- ☐ C 4 s
- ☐ D 22 s

- (ii) State **one** factor that might increase a driver's reaction time.

(1)

.....

.....

- (iii) Calculate the distance travelled between when the driver applies the brakes and when the car comes to rest in Figure 9.

Use the equation

distance = area under the sloping line of the graph in Figure 9

(3)

distance = ... m

- (b) The stopping distance of a car is the thinking distance plus the braking distance.

A car has a device that can detect an obstacle in the road ahead.

The device is linked to a computer that can apply the brakes.

It is claimed that, in an emergency, the computer-controlled car will have a shorter stopping distance than if the car is controlled by a human driver.

Explain why this claim could be true.

(2)

.....

.....

.....

.....

(c) A different car has a device that can detect rain.

This device is linked to a computer that can change the speed of the car.

In wet weather, the computer changes the speed of the car.

- (i) State the change in speed that the computer should make when the road is wet.

(1)

- (ii) Give a reason why this change in speed is necessary when the road is wet.

(1)

(Total for Question 4 = 9 marks)



5 (a) Which of these is a typical human reaction time?

(1)

- ☐ A 0.0027 s
- ☐ B 0.027 s
- ☐ C 0.27 s
- ☐ D 2.7 s

(b) There are several factors that affect the overall stopping distance of a van.

State **two** factors that may affect the overall stopping distance of a van.

(2)

1

2

(c) Figure 7 is a velocity / time graph for a van braking from an initial velocity of 25 m/s.

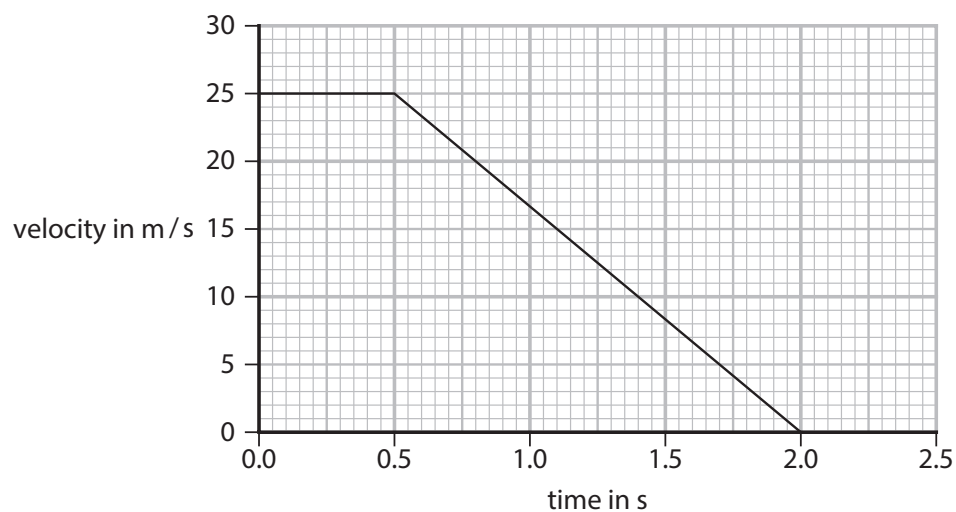


Figure 7

(i) On Figure 7 draw a similar graph for the same van braking from an initial velocity of 15 m/s.

Assume the thinking time and the braking force remain the same.

(2)



- (ii) The van's brakes are applied to stop a van in a distance of 21.5 m.

The work done by the brakes is 375 kJ.

Calculate the braking force in newtons.

Use the equation

$$\text{force} = \frac{\text{work done}}{\text{distance travelled}}$$

(3)

braking force = ... N

- (iii) The van is travelling along a horizontal road when the brakes are applied.

Which of these will have the same value as the work done by the brakes?

(1)

- ☐ **A** the kinetic energy of the van before braking
- ☐ **B** the kinetic energy of the van after braking
- ☐ **C** the gravitational potential energy of the van before braking
- ☐ **D** the gravitational potential energy of the van after braking

(Total for Question 5 = 9 marks)



10-MARK QUESTIONS

1 question in this booklet



- 6 (a) Figure 8 shows apparatus set up to investigate the speed of a falling object.

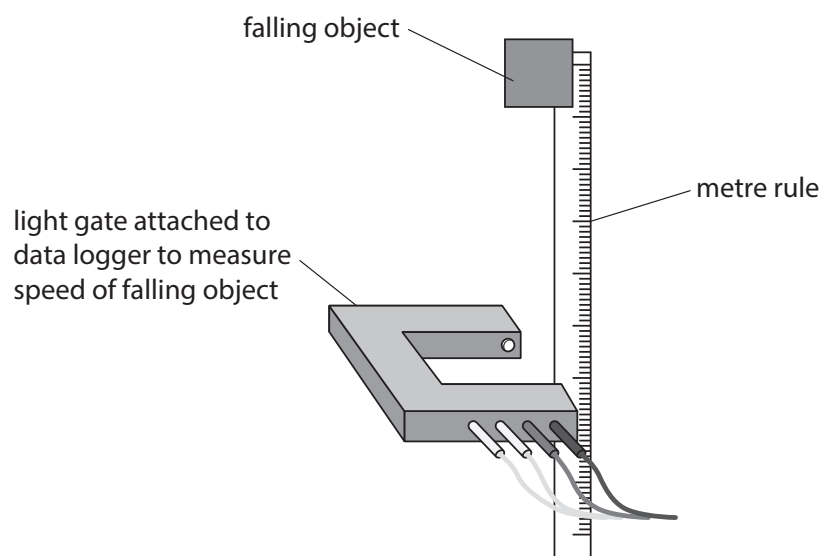


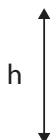
Figure 8

The object is dropped from rest at the position shown.
The object falls through the light gate.

- (i) The speed of the object, after it has fallen through a height, h , is measured by the light gate.

Label Figure 8 to show the height, h .
Your label should look like this

(1)



(ii) The speed is measured at least four times for each drop height.

Give **one** reason for repeating the measurements.

(1)

.....

.....

(iii) The metre rule shown in Figure 8 is used to measure the height, h .

Suggest **two** ways to make the measurement of h as accurate as possible.

(2)

1

.....

2

.....

(b) As the object in Figure 8 falls, energy is transferred.

These energy transfers are represented in Figure 9.

Complete the labels of the energy stores involved.

(3)

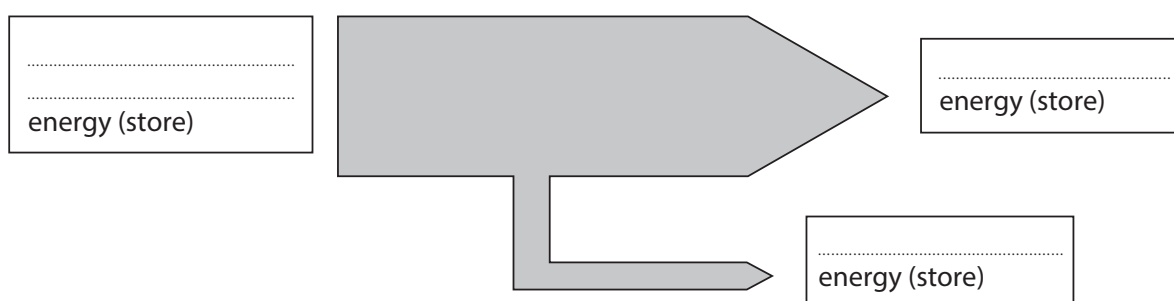


Figure 9

(c) Figure 10 shows wind power generation from the year 2000 onwards.

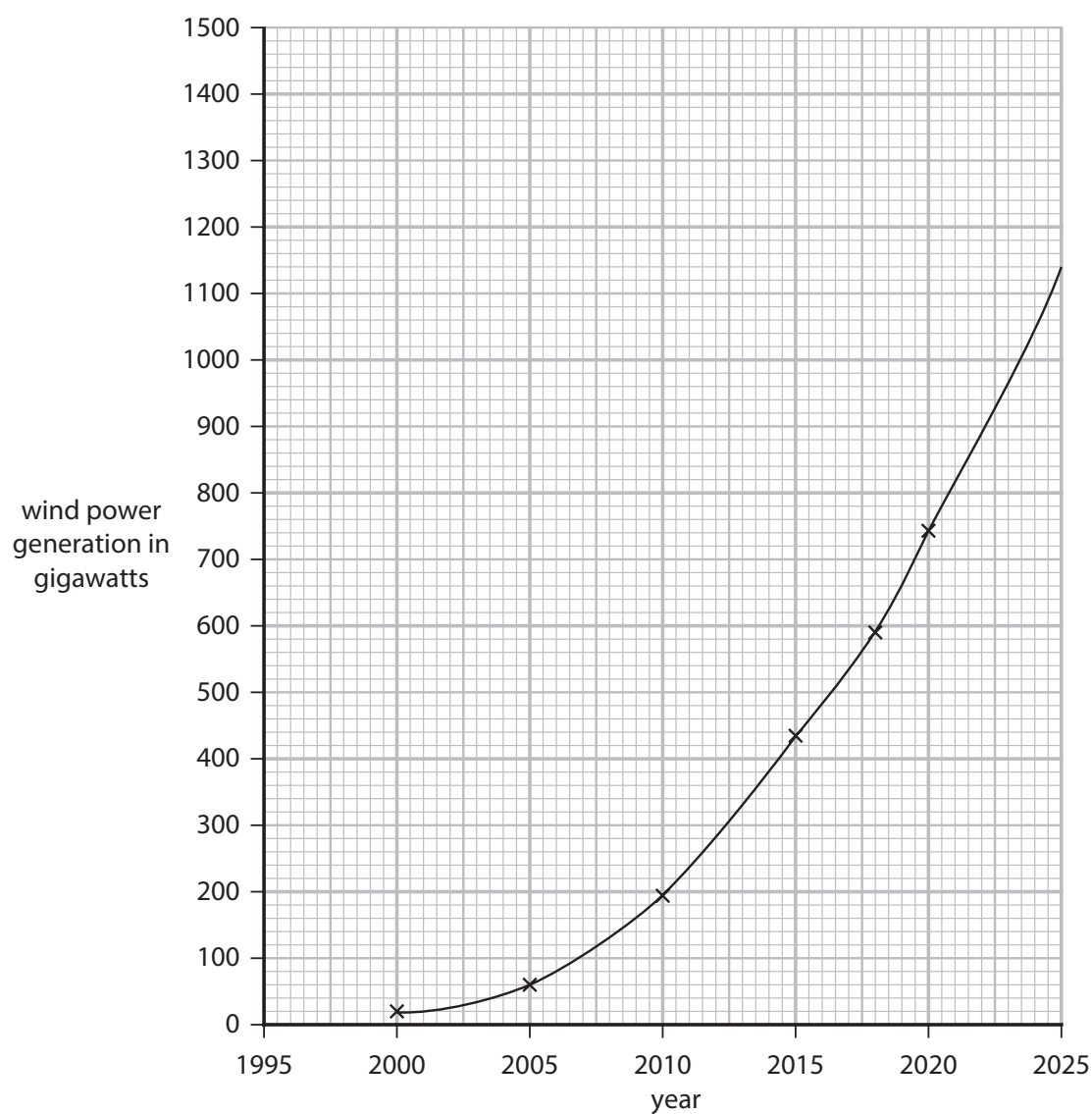


Figure 10

Estimate the percentage change in wind power generation from 2005 to 2020.

(3)

percentage change = ... %

(Total for Question 6 = 10 marks)



11-MARK QUESTIONS

4 questions in this booklet



5 (a) A car is travelling at 10 m/s.

The driver sees a danger and stops the car.

(i) The stopping distance for the car would be smaller if the car

(1)

- ☐ **A** had more passengers
- ☐ **B** had worn tyres
- ☐ **C** needed new brakes
- ☐ **D** was travelling more slowly

Figure 4 shows a speed-time graph for the driver stopping the car.

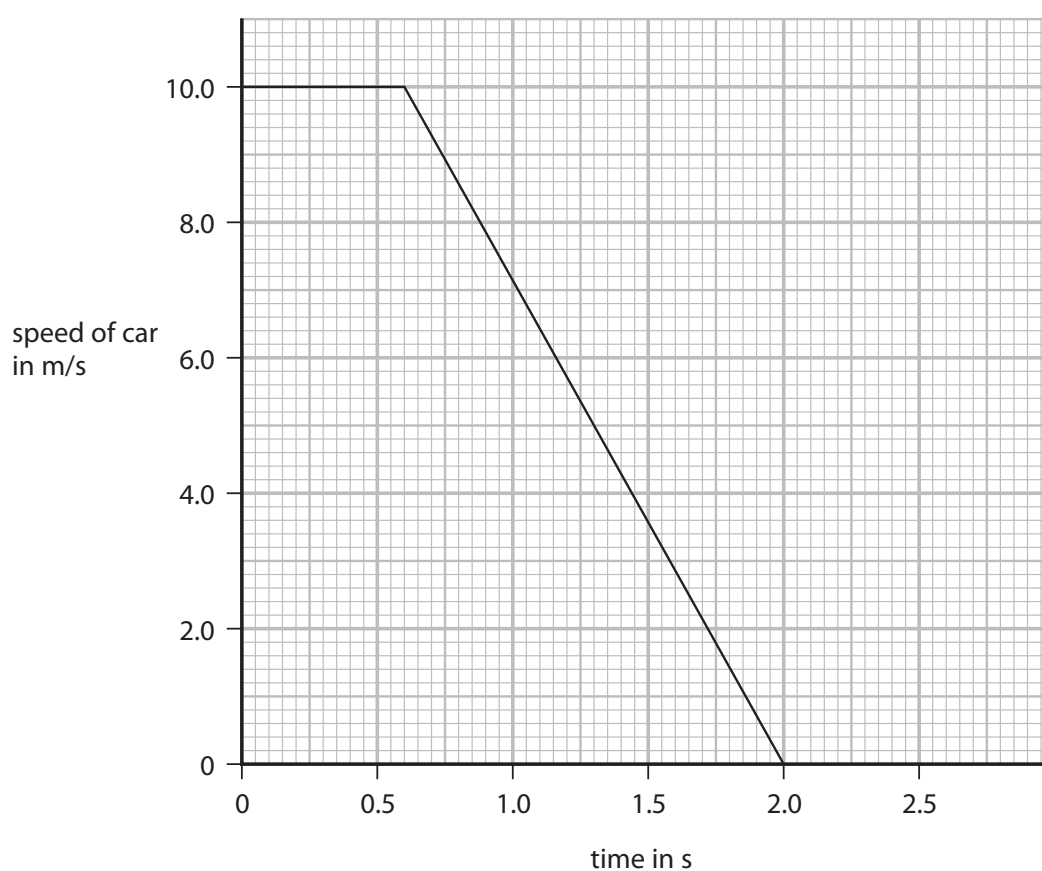


Figure 4

(ii) Use the graph to find the driver's reaction time.

(2)

reaction time = ... s

- (b) Figure 5 shows the apparatus a student uses to investigate how the stopping distance of a toy car depends on the type of surface that it is stopping on.

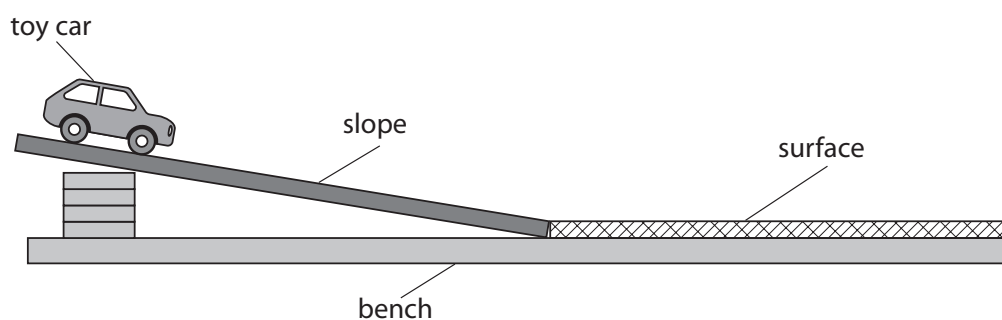


Figure 5

Describe an experiment to find out how the stopping distance depends on the surface that stops the toy car.

(2)

.....

.....

.....

.....

- (c) Figure 6 shows a set of results used to find the average stopping distance of the toy car on a surface.

test number	stopping distance in m
1	0.35
2	0.32
3	0.52
4	0.38
5	0.33

Figure 6

- (i) State the anomalous value of stopping distance given in the table in Figure 6.

(1)

- (ii) Use the results in Figure 6 to calculate the average stopping distance.

(2)

average stopping distance = ... m



(iii) State **one** way the student could increase the speed of the car as it reaches the flat surface.

(1)

(d) A car is travelling down a slope at 2.0 m/s.

The car accelerates for 4.0 s.

The speed of the car increases to 12 m/s.

Calculate the acceleration of the car.

Use the equation

$$a = \frac{(v - u)}{t}$$

(2)

acceleration of the car = ... m/s²

(Total for Question 5 = 11 marks)



7 (a) A rock on the surface of the Earth has a mass of 12 kg.

(i) Calculate the weight of this rock on the surface of the Earth.

The gravitational field strength on the surface of the Earth is 10 N/kg.

Use the equation

$$W = m \times g$$

(2)

weight on the Earth = ... N

(ii) The weight of the same rock on the surface of the Moon is 20 N.

Calculate the gravitational field strength on the surface of the Moon.

(3)

gravitational field strength on the Moon N/kg



*(b) Describe the Solar System in terms of the Sun, the planets, and the other objects which move in the Solar System.

Your answer should include the patterns of movement of the planets and the other objects in the Solar System.

You may draw a labelled diagram if it helps your answer.

(6)

(Total for Question 7 = 11 marks)



8 (a) Which of these is a scalar quantity?

(1)

- ☐ A acceleration
- ☐ B distance
- ☐ C force
- ☐ D weight

(b) A student has some cupcake cases.

One cupcake case is shown in Figure 14.



(Source: © Anton Starikov/Shutterstock)

Figure 14

The student drops a stack of cupcake cases with the base facing downwards, as shown in Figure 15.



(Source: © Elena Schweitzer/Shutterstock)

Figure 15

The speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.

- (i) The student also has a stop clock and a metre rule.

Describe an investigation to show how the speed of the falling stack of cupcake cases depends on the number of cupcake cases in the stack.

(4)

- (ii) A stack of cupcake cases has a mass of 0.005 kg.

Calculate the weight, in newtons, of the stack of cupcake cases.

Gravitational field strength = 10 N/kg

(2)

Use the equation

$$W = mg$$

weight = ... N



Figure 16 shows a cupcake case that is falling at a constant velocity.

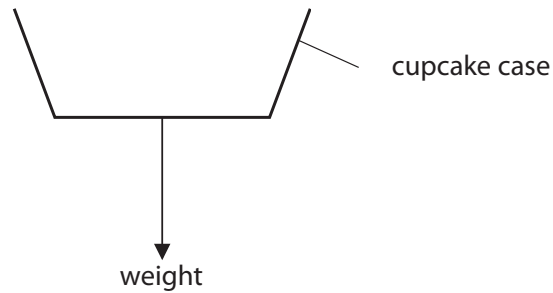


Figure 16

- (iii) Draw an arrow on Figure 16 to show the force due to air resistance on the cupcake case.

(1)

- (iv) State the value of the acceleration of the cupcake case when it is falling at a constant velocity

(1)

- (c) A car travels along a straight road.

The car accelerates at 3 m/s^2 for a time of 7 s.

Calculate the change in velocity of the car.

Use the equation

$$\text{change in velocity} = \text{acceleration} \times \text{time taken}$$

(2)

change in velocity = ... m/s

(Total for Question 8 = 11 marks)

8 (a) (i) Which row of the table shows the correct units of weight and of mass?

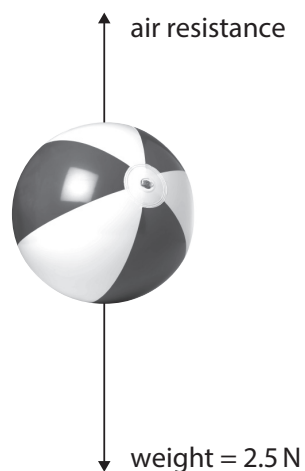
(1)

	unit of weight	unit of mass
☐ A	kilogram	newton
☐ B	newton	kilogram
☐ C	newton per kilogram	newton
☐ D	newton per kilogram	kilogram

(ii) State the name of a piece of equipment that can be used to measure mass.

(1)

(b) Figure 13 shows the two forces acting on a beach ball as it falls through the air.



(Source: © Stepan Bormotov/Shutterstock)

Figure 13

The resultant of these two forces is 0.92 N downwards.

(i) The mass of the beach ball is 0.25 kg.

Calculate the acceleration of the beach ball as it falls.

Use the equation

$$F = m \times a \quad (3)$$

acceleration = ... m/s²

(ii) Calculate the size of the air resistance force on the beach ball.

(1)

air resistance = ... N

(c) Some students are investigating forces.

They use a newton meter to keep a trolley stationary on a sloping runway, as shown in Figure 14.

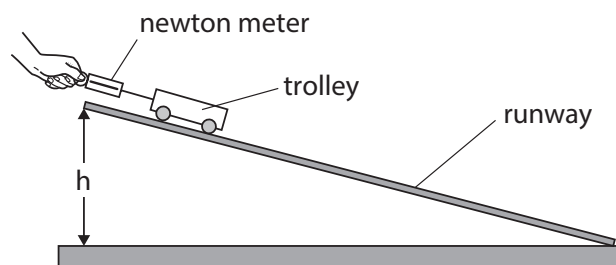


Figure 14

They measure the force needed to keep the trolley stationary on the sloping runway.

(i) They do this at four different places on the runway.

When the height, h , of the runway is 0.60 m, their four readings for force are

2.1 N 2.7 N 2.5 N 2.2 N

Calculate the mean value of these forces.

(1)

mean force = ... N

The students then measure values of the force, F , for several different values of h , the height of the runway.

Figure 15 is a graph of F against h .

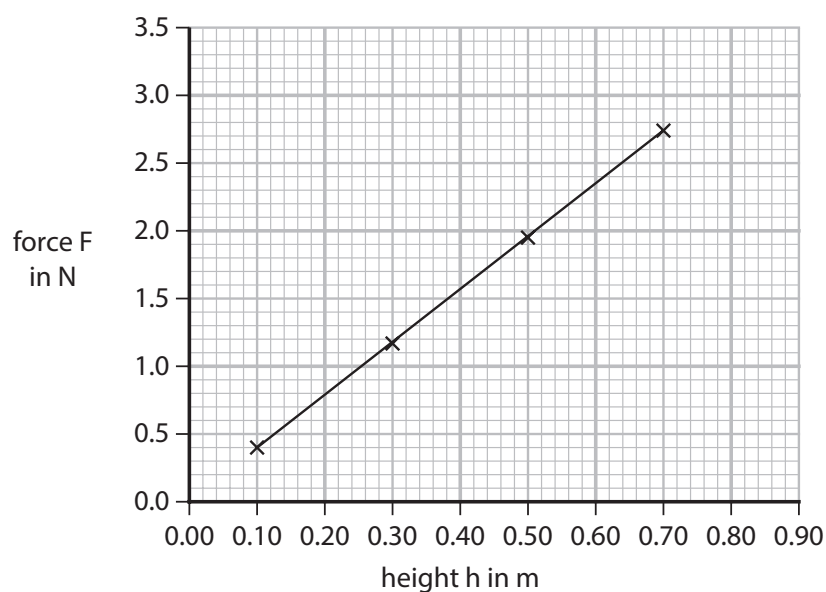


Figure 15

- (ii) Use the graph in Figure 15 to determine the value of F when $h = 0.80$ m.

(2)

$F = \dots\dots\dots$ N

- (iii) Determine the gradient of the graph in Figure 15.

(2)

gradient = $\dots\dots\dots$ N/m

(Total for Question 8 = 11 marks)

13-MARK QUESTIONS

3 questions in this booklet



9 (a) Which of these is a vector?

(1)

- ☐ A energy
- ☐ B force
- ☐ C mass
- ☐ D work

(b) (i) State the equation that relates acceleration to change in velocity and time taken.

(1)

(ii) A van accelerates from a velocity of 2 m/s to a velocity of 20 m/s in 12 s.
Calculate the acceleration of the van.

(2)

acceleration = ... m/s²



(c) Figure 17 is a velocity / time graph for 15 s of a cyclist's journey.

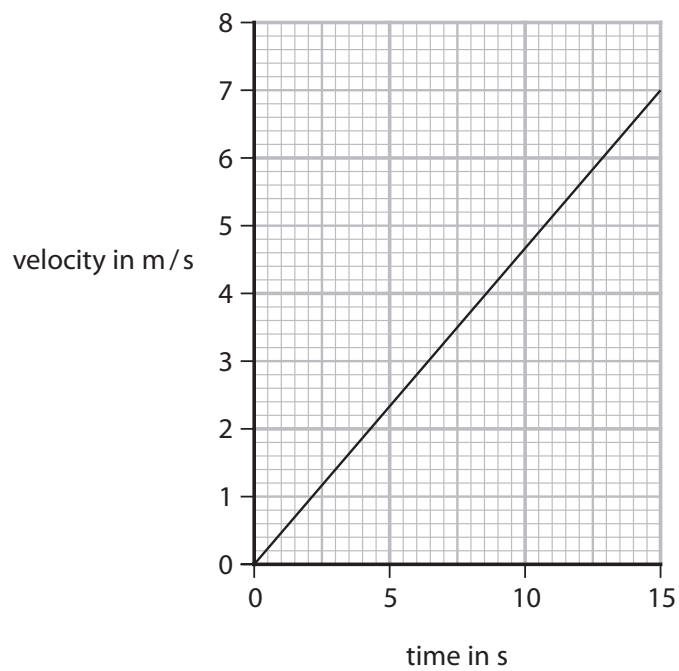


Figure 17

Calculate the distance the cyclist travels in the 15 s.

(3)

distance = ... m

*(d) Many factors can affect the stopping distance of a car.

Some of these factors involve the driver and some of these factors involve the car or the road.

Explain how the stopping distance of a car is affected by

- factors involving the driver
- factors involving the car or the road.

(6)

(Total for Question 9 = 13 marks)



- 9 (a) Figure 15 is a speed limit sign from a European motorway.

The speeds shown are in km/h (kilometres per hour).

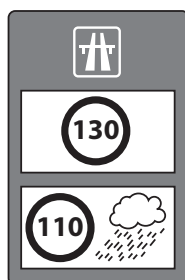


Figure 15

- (i) The sign tells drivers to drive at a slower speed in wet weather.

Explain why it is safer for drivers to drive at a slower speed in wet weather.

(2)

.....

.....

.....

.....

- (ii) Show that a speed of 31 m/s is less than a speed of 130 km/h.

(2)

(iii)

The driver's reaction time is the time between the driver seeing an emergency and starting to brake.

A car is travelling at a speed of 31 m/s.

The car travels 46 m between the driver seeing an emergency and starting to brake.

Calculate the driver's reaction time.

Give your answer to 2 significant figures.

(3)

driver's reaction time = ... s



- 9 (a) Two people, L and M, have a 100 m race.

L starts running before M.

Figure 20 shows a distance/time graph of the race.

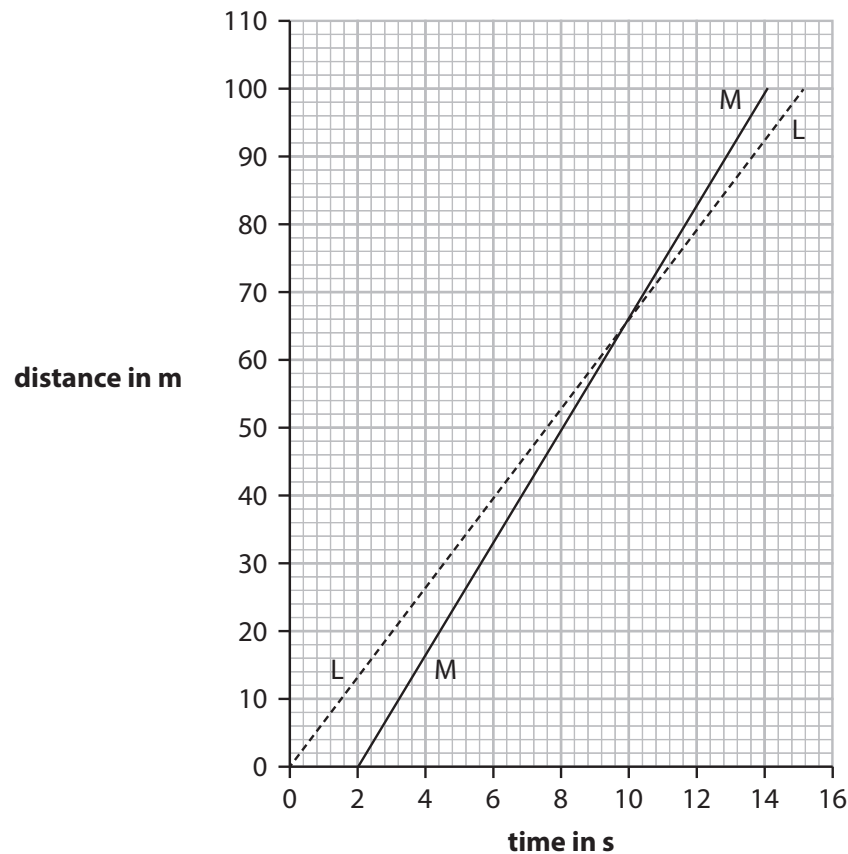


Figure 20

- (i) State the **distance** that L has run when M overtakes.

(1)

distance = ... m

- (ii) Calculate the velocity of L when running the 100 m race.

(2)

velocity = ... m/s

(b) A motorcycle is travelling at a velocity of 6.2 m/s.

The motorcycle accelerates at 2.5 m/s^2 until its velocity is 10 m/s.

(i) Calculate the time taken for this acceleration.

Use the equation

$$\text{time taken} = \frac{\text{change in velocity}}{\text{acceleration}} \quad (2)$$

time taken = ... s

(ii) The motorcycle now decelerates (slows down) from 10 m/s to a stop.

The deceleration is at a constant rate of 4.4 m/s^2 .

Calculate the distance the motorcycle travels as it slows down to a stop.

Use the equation

$$v^2 - u^2 = 2 \times a \times x \quad (2)$$

distance = ... m



(Total for Question 9 = 13 marks)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Mark
1(a)	B 1.0 m/s The only correct answer is B <i>A 0.1 m/s is incorrect, being 1 metre every 10s, insect crawling pace</i> <i>C 10 m/s is incorrect, being an Olympic sprinter's pace, much too fast for 'walking'</i> <i>D 100 m/s is incorrect, being a very fast sport's car's pace</i>	(1) AO 1 1

Question Number	Answer	Mark
1(b)	weight / force (accept circle around weight if not contradicted on answer line)	(1) AO 1 2

Question Number	Answer	Additional guidance	Mark
1(c)	substitution (1) $(F =) 0.10 \times 2.0$ evaluation (1) $0.2(0)$ unit (1) N	100×2 (using $0.10\text{kg} = 100\text{g}$) reject 0.10×2.0^2 and the follow up evaluation (equation given should be used) correct answer without working gets 2 marks allow 1 mark total for 2 with any other power of ten, so that includes 200 for example separate unit mark newtons / Newtons accept lowercase 'n' for the abbreviated unit accept kg ms^{-2} accept 200 g ms^{-2} for 3 marks	(3) AO 2 1

Question Number	Answer	Additional guidance	Mark
1(d)	• direction (1) • size (1)	answers only acceptable in given order or magnitude	(2) AO 2 1

(Total for Question 1 = 7 marks)

Question number	Answer	Mark
2(a)(i)	☒ C $F = m \times a$ A, B and D have incorrect mathematical operator	(1)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	140 (1) N (1)	no ecf from 2ai independent mark allow newton(s) n do not allow Ns ns	(2)

Question number	Answer	Additional guidance	Mark
2(b)	substitution (1) (average speed =) $\frac{1200}{80}$ evaluation (1) 15 (m/s)	award full marks for the correct answer without working	(2)

Question number	Answer	Additional guidance	Mark
2(c)	any two from: measure {distance / length of pace} (1) use marks on the track (1) use an electronic timer (1) stand midway between the posts/stand closer to a post (1) place posts further apart/increase distance used or measured (1) use 2 people in the timing (1)	Suitable measuring device including trundle wheel / tape/ GPS light gate(s) idea of reducing systematic error such as parallax Do NOT credit repeats	(2)

(Total for Question 2 = 7 marks)

Question number	Answer	Additional guidance	Mark
3 (a) (i)	TS (speed/velocity/it) increases (1) SR constant (speed/velocity) (1) RQ (speed/velocity/it) decreases (1)	acceleration / accelerating no acceleration / zero acceleration deceleration / decelerating / negative acceleration	(3) A03.2

Question number	Answer	Additional guidance	Mark
3 (a) (ii)	deceleration (between R and Q) is greater (than deceleration between Q and P) (1)	allow reverse argument throughout comparison needed accept (RQ) decelerates / slows down faster (than QP) accept (a=) 3 (m/s ²) for RQ with (a=) 1 (m/s ²) for QP accept accelerate for decelerate ignore any reference to braking / gradient of slope	(1) A03.2

Question number	Answer	Additional guidance	Mark
3 (b) (i)	substitution (1) $a = \frac{25(-0)}{5}$ evaluation (1) 5(.0) (m/s ²)	 award full marks for correct answer without working.	(2) A02.1

Question number	Answer	Additional guidance	Mark
3 (b) (ii)	selection and substitution (1) (distance = speed x time =) 25×10 evaluation (1) 250 (m)	award full marks for correct answer without working	(2) AO2.1

Total for Question 3 = 8 marks

Question number	Answer	Additional guidance	Mark
6 (a)	B force A is incorrect, mass is a scalar quantity C is incorrect, energy is a scalar quantity D is incorrect, distance is a scalar quantity		(1) AO1

Question number	Answer	Additional guidance	Mark
6 (b)(i)	A plan including four of the following measurement of appropriate distance (1) measurement of appropriate time (1) use of speed = $\frac{\text{distance}}{\text{Time}}$ (1) detail (1) e.g. repeat and average, use ruler/stop clock, mark a line near the top and bottom of liquid		(4) AO3

Question number	Answer	Additional guidance	Mark
6(b)(ii)	An explanation linking two from: add more lines (at equal distances)(1) measure the time of fall for each distance (1) compare the times (1)	use longer test tube / use different heights of liquid / use different sections of the liquid e.g. {equal times = constant speed} / {shorter time = acceleration}	(2) AO3

Question number	Answer	Additional guidance	Mark
6 (c)	substitution (1) $(v^2 - 0 =) 2 \times 10 \times 1.5$ evaluation (1) 5.5(m/s)	accept numbers that round to 5.5 e.g. 5.477 30(m/s) gains 1 mark for correct substitution but no square root taken award full marks for correct answer without working.	(2) AO2

Total marks for question 6 = 9

Question Number	Answer	Additional guidance	Mark
3 (a)(iv)	indication that distance travelled = area under graph (1) substitution (1) (distance travelled =) 10×15 evaluation (1) 150 (m)	may be seen on graph accept (distance=)speed x time ignore speed = $\frac{\text{distance}}{\text{time}}$ award full marks for the correct answer with no working award 2 marks for 10×15 seen anywhere if no other marks awarded, 1 mark for use of 15 (m/s) or 10 (s)	(3) AO3

Question Number	Answer	Additional guidance	Mark
3 (b)	substitution (1) (F=) 1200×2.4 evaluation (1) 2900 (N)	accept 2880 (N) award one mark for power of ten error award full marks for the correct answer with no working	(2) AO2

Total for question 3 = 9marks



Question number	Answer	Additional guidance	Mark
4 (a)(i)	B 1s A is incorrect because this is before the driver reacts. C is incorrect because this is the braking time D is incorrect because 22 is a value of the initial velocity		1 AO2.1

Question number	Answer	Additional guidance	Mark
4 (a)(ii)	Any one from - tiredness - distraction - drugs / alcohol (old) age	accept similar descriptions any named drug	1 AO1.1

Question number	Answer	Additional guidance	Mark
4 (a)(iii)	attempt to use the correct part of the graph (1) attempt to find area under graph(1) $\frac{1}{2} \times b \times h$ evaluation (1) 33 (m)	values of 22(± 0.5) and 4 or 22(± 0.5) and 3 seen $0.5 \times 4 \times 22(\pm 0.5)$ or $0.5 \times 3 \times 22(\pm 0.5)$ accept values between 32 and 34 for 3 marks accept values between 43 and 45 for 2 marks accept values between 64.5 and	3 AO2.1

Question number	Answer	Additional guidance	Mark
4b	an explanation linking any two from shorter reaction time (of computer-controlled car) (1) shorter thinking distance (1)	allow reverse arguments computer (reaction time) not affected by other relevant factors shorter distance (travelled) before brakes applied	2 A03.1

Question number	Answer	Additional guidance	Mark
4(c)(i)	speed should be reduced (1)	slower accept specified numerical reduction e.g. from 40 to 20	1 A03.1

Question number	Answer	Additional guidance	Mark
4(c)(ii)	any one from friction (between wheel and road) is reduced (1) braking distance would be longer (on wet road) (1)	allow reverse argument idea that (road) more slippery / car could skid less traction	1 A03.1

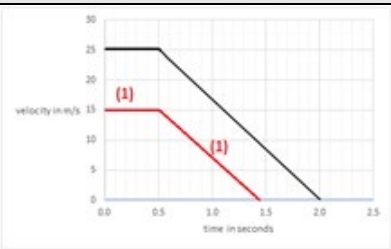
	(overall) stopping distance would be longer (on wet road) (1)	longer (time/distance) to stop ignore crash / collision/ accident ignore changes to thinking distance	
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Total for question 4 = 9 marks



Question number	Answer	Mark
5 (a)	C 0.27 s (1) A and B are incorrect – much too small for human reaction times D is incorrect because it's a much longer time than is reasonable	(1) AO1.1

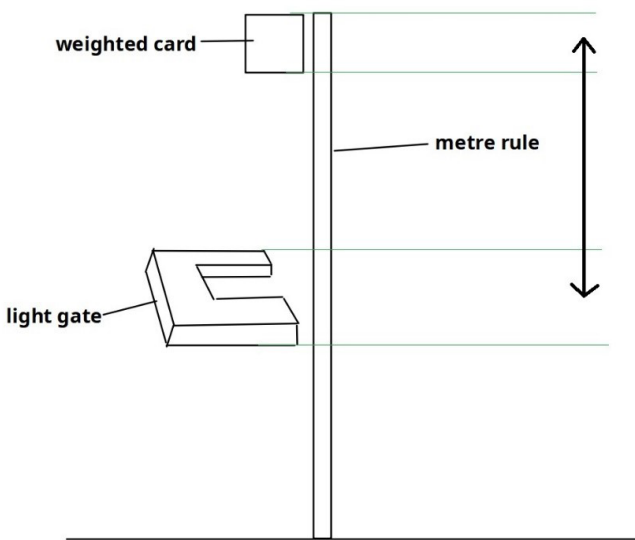
Question number	Answer	Additional guidance	Mark
5 (b)	Any two named factors from mass / weight of the van (1) speed / velocity of van (1) state of (the van's) brakes (1) state of the road (1) friction (between the tyre and the road surface) (1) (idea of driver's) reaction time (1) tiredness (1) alcohol / drugs / energy drink (1)	affecting thinking or braking distance worn brakes accept wet / dry / weather	(2) AO1.1

Question number	Answer	Additional guidance	Mark
5 (c) (i)	 lower level 15 m/s section up to 0.5s (1) deceleration section same gradient (parallel to braking line shown) (1)	judge by eye	(2) AO3.2

Question number	Answer	Additional guidance	Mark
5 (c)(ii)	substitution (1) $(\text{force}) = \frac{375\,000}{21.5}$ use of 375 000 (1) evaluation (1) 17 400 (N)	17 441.86. . . award full marks for correct answer without working 17(.44) scores 2 marks	(3) AO2.1

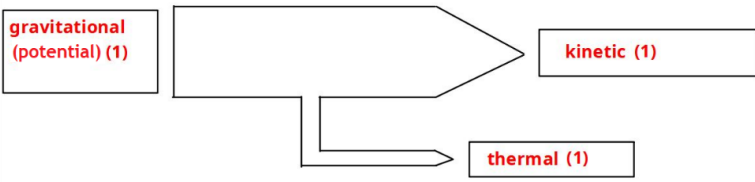
Question number	Answer	Mark
5 (c) (iii)	A the kinetic energy of the car before braking C and D are incorrect – GPE doesn't change, doesn't apply B is incorrect – final KE = 0, not equal to work done	(1) AO3.1

Total for Question 5 = 9 marks

Question number	Answer	Additional guidance	Mark
6 (a) (i)	line drawn anywhere between the two ranges shown(1)  The diagram shows a vertical metre rule. A small rectangular weighted card is attached to the rule. Below the card, a light gate is positioned. A vertical double-headed arrow indicates the distance between the card and the light gate. Labels include 'weighted card', 'metre rule', and 'light gate'.	upper end of drawn line/arrow between the top limits lower end of drawn line/arrow between the bottom limits accept drawn line without arrow heads or "h".	(1) AO1.2

Question number	Answer	Additional guidance	Mark
6 (a)(ii)	to check for anomalies (1)	improve reliability / improve precision / (check for) consistency / (reduce) random error / calculate an average ignore accuracy / reproducible	(1) AO1.2

Question number	Answer	Additional guidance	Mark
6 (a)(iii)	Any two from use a clamp to hold the ruler / light-gate (1) ensure eye is level (with the edge being measured and the rule) (1) use a set square (to aid the measurement) (1) make sure the rule is vertical (1) use a ruler with an improved resolution (1)	look at straight (on) use of (horizontal) marker/pointer stand the ruler upright use a ruler with small(er) divisions ignore references to human error / repeat reading (by others)	(2) AO1.2

Question number	Answer	Mark
6 (b)	 The diagram shows a box on the left labeled 'gravitational (potential) (1)'. A line leads from this box to a large arrow pointing right. This arrow splits into two paths: one leading to a box labeled 'kinetic (1)' and another leading to a box labeled 'thermal (1)'. accept heat or sound for thermal accept kinetic or thermal in either order in the right-hand boxes accept GPE or GP for gravitational (potential) accept KE for kinetic	(3) AO3.1

Question number	Answer	Additional guidance	Mark
6 (c)	reading both graph values(1) 2005 → 60 AND 2020 → 740 substitution (1) % change = $\frac{740 - 60}{100} \times 60$ evaluation (1) 1130 (%)	accept 59 to 61 accept 740 to 750 accept any value between 1110(%) and 1180(%) award full marks for correct answer without working ignore any negative sign award 2 marks for any number that rounds to 92(%) (taking wrong denominator)	(3) A02.1

Total for Question 6 = 10 marks

5(a)(i)	D travelling more slowly A is incorrect, more passengers would increase the stopping distance B is incorrect, worn tyres would increase the stopping distance C is incorrect, if the car needed new brakes this would increase the stopping distance		(1) AO1
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Question number	Answer	Additional guidance	Mark
5(c)(i)	0.52		(1) AO3

Question number	Answer	Additional guidance	Mark
5 (c)(ii)	addition and division (1) $\frac{0.35 + 0.32 + 0.38 + 0.33}{4}$ evaluation (1) 0.35 (m)	$\frac{0.35 + 0.32 + 0.52 + 0.38 + 0.33}{5}$ accept 0.345 (m) award full marks for correct answer without working. accept 0.38 for 2 marks (five results included in average)	(2) AO2

Question number	Answer	Additional guidance	Mark
5c(iii)	Any one from make the slope steeper(1) add more books/blocks (1) push/pull the trolley (1)	accept 'higher slope/high slope' accept means of reducing friction e.g. use lubricant	(1) AO1

Question number	Answer	Additional guidance	Mark
5(d)	substitution (1) $(a =) \frac{12 - 2(.0)}{4(.0)}$ evaluation (1) 2.5 (m/s ²)	award full marks for correct answer without working.	(2) AO2

Total marks for question5 = 11



Question number	Indicative content	Mark
*7(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 • planet names: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune • planet(s) orbit the Sun • all planets orbit the Sun • each planet in its own orbit • (all) planet orbits are in the same plane • planets spin (on own axis) • moons orbit planets • some planets have multiple moons • dwarf planets orbit the Sun • asteroids orbit the Sun • comets orbit the Sun • comet orbits not in the same plane as planets	(6) AO1

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents a description with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents a description that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)



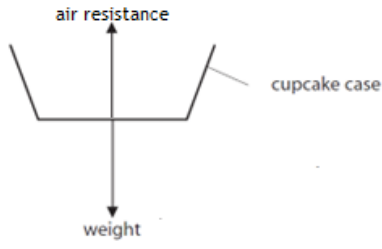
Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> isolated facts about the objects or the patterns of movement	<u>Possible candidate responses</u> names at least 2 planets
Level 2	3–4	<u>Additional guidance</u> Detailed description of pattern of movement for one set of objects. OR limited description of pattern of movement for two set of objects	<u>Possible candidate responses</u> planets orbit the Sun AND moons orbit planets
Level 3	5–6	<u>Additional guidance</u> Detailed descriptions of pattern of movement for two sets of objects. OR Detailed description of pattern of movement for one set of objects plus limited description for two sets.	<u>Possible candidate responses</u> <u>all</u> planets orbit the Sun, comets orbit the Sun, asteroids orbit the Sun

(Total for Question 7 = 11 marks)

Question Number	Answer	Additional guidance	Mark
8 (a)	B distance A, C, and D are incorrect as these are vector quantities		(1) AO1

Question number	Answer	Additional guidance	Mark
8 (b)(i)	A description to include any 4 from: measure height (1) measure time of fall (1) use (average) speed = distance ÷ time (1) repeat with different number of cupcake cases in the stack/more cupcake cases (1) repeat and average time (of fall for each stack of cupcake cases) (1) plot a graph (speed of fall against number of cupcake cases dropped) (1)	allow 'keep same height' allow in this context hold against (fixed point on) metre rule allow 'time it' accept cupcakes for cupcake cases	(4) AO1

Question Number	Answer	Additional guidance	Mark
8 (b)(ii)	substitution (1) (W=)0.005 x 10 evaluation (1) 0.05 (N)	5×10^{-2} (N) do not allow power of ten error award full marks for the correct answer with no working give full credit for use of $g=9.8$ or 9.81 N/kg	(2) AO2

Question number	Answer	Additional guidance	Mark
8 (b)(iii)	 air resistance arrow (1)	judge by eye any vertical upward arrow outside or inside the cupcake case ignore length of arrow arrow need not touch cupcake holder ignore label on arrow	(1) AO2

Question number	Answer	Additional guidance	Mark
8 (b)(iv)	zero / there is none / 0 / it has no acceleration	ignore 'constant' ignore units	(1) AO2

Question number	Answer	Additional guidance	Mark
8(c)	substitution (1) (change in velocity=) 3×7 evaluation (1) 21 (m/s)	award full marks for the correct answer with no working	(2) AO2

Total for question 8 = 11marks



Question number	Answer	Additional guidance	Mark
8 (a) (i)	B newton kilogram A, C and D are incorrectly associated units		(1) AO1.1

Question number	Answer	Additional guidance	Mark
8 (a) (ii)	(mass) balance (1)	accept spring balance OR (weighing) scale(s)	(1) AO1.2

	Answer	Additional guidance	Mark
8(b)(i)	use of $(F=)0.92$ (N) (1) substitution and rearrangement (1) (acceleration) = $\frac{0.92}{0.25}$ evaluation (1) (acceleration) = 3.7 (m/s²)	allow 0.92×0.25 OR $\frac{0.25}{0.92}$ allow MP2 for use of incorrect force giving $\frac{2.5}{0.25}$ OR $\frac{3.42}{0.25}$ OR $\frac{1.58}{0.25}$ OR $\frac{0.46}{0.25}$ allow values that round to 3.7 e.g. 3.68 allow values that round to 3.7×10^{-3} or 0.0037 for 2 marks (g instead of kg) allow for 2 marks an evaluation of 10(.0) OR 14 OR 13.7 OR 6.3(2) OR 1.8(4) (use of incorrect force) award full marks for the correct answer without working ignore negative values throughout if no other marks scored allow 1 mark for $a = \frac{F}{m}$	(3) AO2.1

	Answer	Additional guidance	Mark
8(b)(ii)	1.6 (N) OR 1.58 (N)		(1) AO3.1

	Answer	Additional guidance	Mark
8(c)(i)	2.4 (N) OR 2.375 (N) OR 2.38 (N)		(1) AO2.2

	Answer	Additional guidance	Mark
8(c)(ii)	straight line extended to meet $h = 0.80$ m axis (1) 3.1 (N) (1)	judge by eye allow 3.05 to 3.20 inclusive award full marks for the correct answer without working	(2) AO2.2

	Answer	Additional guidance	Mark
8(c)(iii)	select two points on the line (1) evaluation (1) 3.90 ± 0.10 (N/m)	allow triangle drawn on graph award full marks for the correct answer without working	(2) AO2.2

Total for Question 8 = 11 marks

	Answer	Additional guidance	Mark
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Question number	Answer	Mark
9 (a)	☒ B force Options A, C and D are all scalars.	(1)

Question number	Answer	Additional guidance	Mark
9 (b)(i)	acceleration = $\frac{\text{change in velocity}}{\text{time (taken)}}$	$a = \frac{v-u}{t}$ $a = \frac{\Delta v}{t}$ $\frac{v}{t}$ allow correct rearrangements seen here or in bii	(1)

Question number	Answer	Additional guidance	Mark
9 (b)(ii)	substitution (1) $\frac{20 - 2}{12}$ evaluation (1) 1.5 (m/s ²)	$\frac{18}{12}$ -1.5 (m/s ²) award full marks (1 in bi and 2 in bii) for the correct answer without working, award 1 mark if 20-2 or 18 or 2-20 is seen and no other marks are scored If (incorrectly) $a = \frac{v^2 - u^2}{t}$ given in 3bi $a = \frac{20^2 - 2^2}{12}$ OR = 33 scores 1 mark	(2)

Question number	Answer	Additional guidance	Mark
9 (c)	distance = area under graph (1) $\frac{1}{2} \times 7 \times 15$ (1) 52(.5) (m) (1)	attempt to find area seen on graph correct area(s) identified including calculation 53 (m) allow 7×15 or 105 for 1 mark only award full marks for the correct answer with no working	(3)

Question number	Indicative content	Mark
*9(d)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 strand 1 (6 marks) factors concerning driver • change in reaction time • tiredness • effect of drugs • type of footwear • how hard the driver presses the pedal effect of any of the above on stopping distance, • increased stopping distance • increased thinking distance • increased reaction time factors concerning car or road • mass / weight of car • speed of car • state of brakes • state of tyres • state of road effect of any of the above on stopping distance, e.g. • increased thinking/braking distance • increased stopping distance	(6)

Level	Mark	Descriptor
	0	• No rewardable material.
Level 1	1-2	• Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) • Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	• Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) • Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	• Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) • Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)



SUMMARY, for guidance

Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> Elements of physics, i.e. isolated factor(s) about either car or driver	<u>Possible candidate responses</u> worn tyres / tired driver worn tyres and icy road
Level 2	3–4	<u>Additional guidance</u> Some understanding shown, i.e. either link between factor and effect or a driver factor and a car factor	<u>Possible candidate responses</u> worn tyres cause increased stopping distance. or worn tyres and tired driver
Level 3	5–6	<u>Additional guidance</u> Understanding is detailed and fully developed, i.e. link between factor and effect - both for driver AND for car	<u>Possible candidate responses</u> worn tyre causes increased stopping distance. and tired driver causes increased stopping distance

(Total for Question 9 = 13 marks)

9 (a)(i)	an explanation linking two from: (wet road means) less / no friction (between tyres and road) (1) (wet weather means) increased stopping distance (1) (slower speed means) shorter braking / stopping distance (1) (dry weather / slower speed) reduces possibility of skidding / sliding / idea of losing control / crashing (1)	accept reverse arguments throughout accept road more slippery / less grip accept idea of reduced visibility accept braking or thinking distance in this context accept takes longer to slow down / stop ignore harder to brake	(2) AO1
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	Answer	Additional guidance	Mark
9(a)(ii)	convert either distance or time (1) $(31 \text{ m} =) \frac{31}{1000} \text{ (km)}$ or 0.031 (km) OR $(1 \text{ s} =) \frac{1}{3600} \text{ (h)} = \frac{1}{60 \times 60} \text{ (h)}$ or 0.000 28 (h) evaluation (1) $(31 \text{ m/s} =) 110 \text{ (km/h)}$	$(130 \text{ km} =) 130 \times 1000 \text{ (m)}$ or 130 000 (m) OR $(1 \text{ h} =) 60 \times 60 \text{ (s)}$ or 3600 (s) $(130 \text{ km/h} =) 36(.1) \text{ (m/s)}$ accept 111.6 or 112 (km/h) for 2 marks if no other marks awarded accept <u>1860 m/min</u> and <u>2167 m/min</u> for 1 mark each award full marks for the correct answer without working	(2) AO2

	Answer	Additional guidance	Mark
9(a)(iii)	select and substitute into distance travelled = average speed x time (1) $46 = 31 \times t$ rearrangement and evaluation (1) $(t =) 1.48(3) \text{ (s)}$ evaluation given to 2 sf (1) (t =) 1.5 (s)	$31 = \frac{46}{t}$ $(t =) \frac{46}{31}$ award two marks for the correct evaluation without working any answer written to 2 sf independent mark 1.5 scores 3 marks 1.4 scores 2 marks 1.50 scores 2 marks 0.67 scores 2 marks 1400 scores 2 marks 0.673(9) scores 1 mark 1426 scores 1 mark	(3) AO2

Question number	Indicative content	Mark
*9(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. A03 - graph starts at zero - graph increases to a maximum at 2 s - graph stays constant for 2.6 s - graph decreases to zero at 6 s - graph stays at zero after 6 s - graph decreases steeply until 5 s - graph decreases less steeply until 6 s - graph at zero between 6 and 7 s A02 - velocity is zero at time zero - velocity increases/train accelerates until 2 s - velocity is constant for 2.6 s - velocity decreases/train decelerates until 6 s - deceleration changes at 5 s - acceleration is gradient of graph - velocity zero between 6 and 7 s	(6) A02 A03

Level	Mark	Descriptor
	0	No awardable content
Level 1	1–2	- Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (A03) - The description attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (A02)
Level 2	3–4	- Interpretation and evaluation of the information on both variables, synthesising mostly relevant understanding. (A03) - The description is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (A02)
Level 3	5–6	Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (A03)



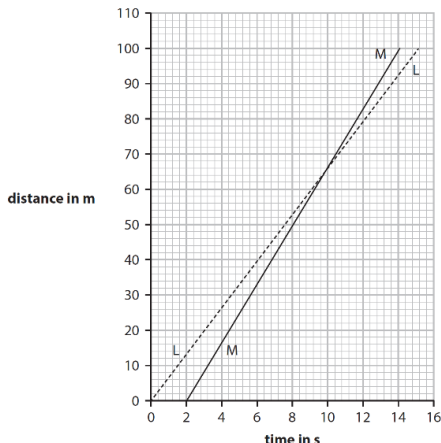
		The description is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2)
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Level	Mark	Additional Guidance	General additional guidance – the decision within levels e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> isolated facts about the movement of the train or the shape of the graph	<u>Possible candidate responses</u> the train speeds up and slows down
Level 2	3–4	<u>Additional guidance</u> Description of motion in at least 2 parts of the graph. At least one of those parts linked to data from the graph.	<u>Possible candidate responses</u> the train speeds up for the first 2 seconds then stays at a constant speed
Level 3	5–6	<u>Additional guidance</u> Description of motion in at least 3 parts of the graph. At least two of those parts linked to data from the graph.	<u>Possible candidate responses</u> the train speeds up for the first 2 seconds then stays at a constant speed for 2.6 seconds then slows down

Total for Question 9 = 13 marks



Question number	Answer	Additional guidance	Mark
9 (a)(i)	66 (m)	allow values between 64 and 68 inclusive allow values between 32 and 36 as the distance L has to run after M overtakes in this context	1 A03.2

Question number	Answer	Additional guidance	Mark
9 (a)(ii)	select (1) $v = \frac{x}{t}$	allow any identifiable distance from graph divided by any identifiable time from graph e.g. $\frac{100}{15.2}$ 	2 A02.1
	evaluation (1) 6.6 (m/s)	allow values that round to between 6.5 (m/s) and 6.7 (m/s) for example 6.666 (m/s) or 6.579 (m/s) award full marks for correct answer without working	

Question number	Answer	Additional guidance	Mark
9 (b)(i)	substitution (1) $(t =) \frac{10 - 6.2}{2.5}$ evaluation (1) $(t =) 1.5 \text{ (s)}$	$\frac{3.8}{2.5}$ allow $\frac{6.2 - 10}{2.5}$ or $\frac{-3.8}{2.5}$ 1.52 (s) allow $-1.5(2) \text{ (s)}$ award full marks for correct answer without working	2 AO2.1

Question number	Answer	Additional guidance	Mark
9 (b)(ii)	substitution OR rearrangement (1) $(-)10^2 = 2 \times (-) 4.4 \times x$ evaluation (1) $(x =) 11 \text{ (m)}$	$(x) = \frac{v^2 - u^2}{2 \times a}$ $(x =) \frac{(-)10^2}{2 \times (-) 4.4}$ allow values that round to 11 (m) e.g. 11.36 (m) ignore negative sign in answer line	2 AO2.1

Question number	Indicative content	Mark
*9(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive, and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. measurement of distance using a rule or similar to find • height of the ramp • travelled length of ramp / distance x to Y • width of card (if used) • distance between light gates (if used) • distance between dots on tape (if used) measurement of time such as • use of ticker-tape • use of a single light gate connected to electronic timer with a card fixed to the trolley • use of two light gates connected to electronic timer with a means of interrupting the light beams • use of (manually operated) stop clock /watch / timer	6 A01.2
	determination of speed • detail about which distance and time measurements are being used • repeat and average • repeat using different heights of the ramp	



Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1-2	- Demonstrates elements of physics understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) - Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3-4	- Demonstrates physics understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) - Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant physics understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) - Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)

Level	Mark	Additional Guidance	General additional guidance – the decision within levels
	0	No rewardable material.	e.g. - At each level, as well as content, the scientific coherency of what is stated will help place the answer at the top, or the bottom, of that level.
Level 1	1-2	<u>Additional guidance</u> Limited description of measurement of distance and time	<u>Possible candidate responses</u> Measure the distance down the ramp. determine the time it took.
Level 2	3-4	<u>Additional guidance</u> Partial description including two from measurement of a relevant distance measurement of relevant time calculation of speed	<u>Possible candidate responses</u> Use the light gates to measure the time it took to go down. Measure the distance down the ramp with a ruler.
Level 3	5-6	<u>Additional guidance</u> Detailed description of measurements of relevant distances and associated times to find speed	<u>Possible candidate responses</u> Use light gates to measure the time to go from X to Y Use a ruler to measure the distance between the light gates. Divide distance between the light gates by the time taken to travel from X to Y.

Total for question 9 = 13 marks

