

## 4: Mechanics 1 – Topic questions

## Paper 4

The questions in this document have been compiled from a number of past papers, as indicated in the table below.

Use these questions to formatively assess your learners' understanding of this topic.

Question	Year	Series	Paper number
1	2016	June	41
1	2016	March	42
1	2016	November	41

The mark scheme for each question is provided at the end of the document.

You can find the complete question papers and the complete mark schemes (with additional notes where available) on the School Support Hub at [www.cambridgeinternational.org/support](http://www.cambridgeinternational.org/support)

- 1 (a) A bus travels at a constant speed. It stops for a short time and then travels at a higher constant speed.

Using the axes in Fig. 1.1, draw a distance-time graph for this bus journey.



Fig. 1.1

[3]

- (b) A lift (elevator) starts from rest at the ground floor of a building.

Fig. 1.2 is the speed-time graph for the motion of the lift to the top floor of the building.

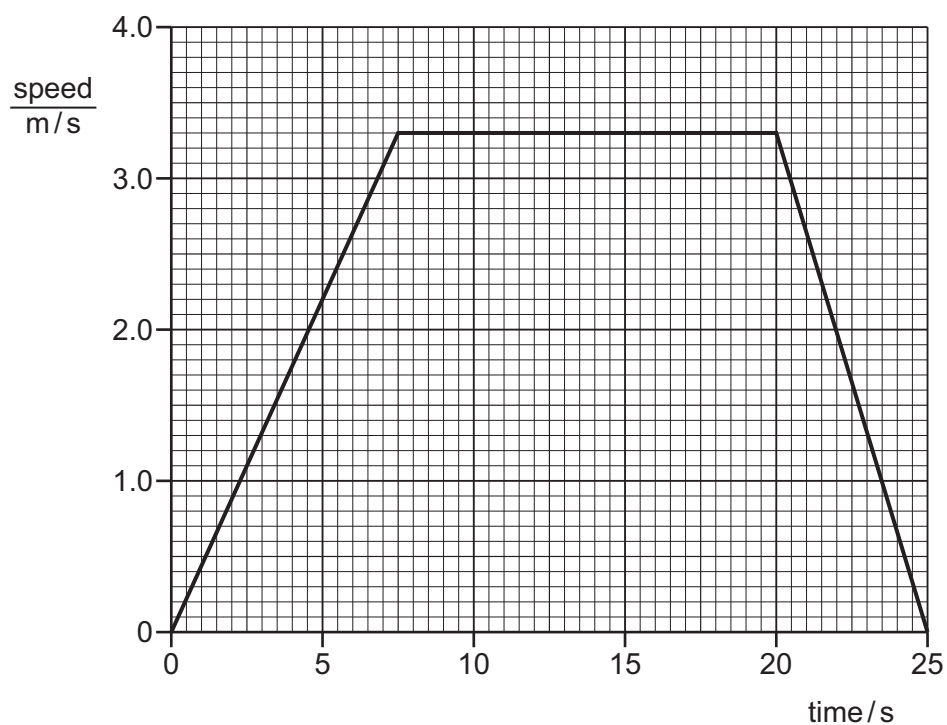


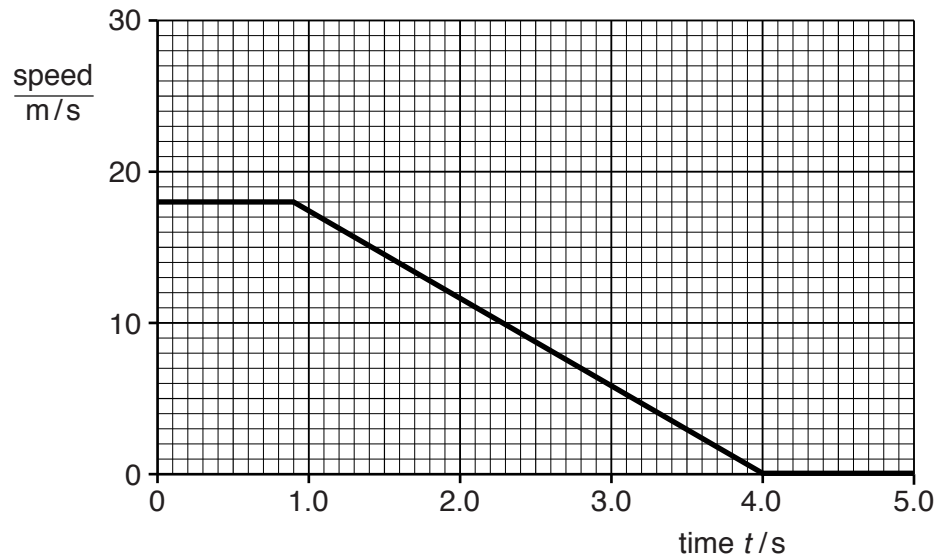
Fig. 1.2

Use the graph to determine the distance from the ground floor to the top floor of the building.

distance = ..... [4]

[Total: 7]

- 1 A driving instructor gives a student a sudden order to stop the car in the shortest possible time. Fig. 1.1 shows the speed-time graph of the motion of the car from the moment the order is given.



**Fig. 1.1**

- (a) The order to stop is given at time  $t = 0$  s.

- (i) State the speed of the car at  $t = 0$  s.

speed = .....[1]

- (ii) Suggest why the car continues to travel at this speed for 0.9 s.

.....  
 .....[1]

- (b) Calculate

- (i) the deceleration of the car between  $t = 0.9$  s and  $t = 4.0$  s,

deceleration = .....[2]

- (ii) the total distance travelled by the car from  $t = 0$  s.

distance = .....[3]

**(c)** Describe and explain a danger to a driver of not wearing a safety belt during a sudden stop.

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.....

.....

.....[2]

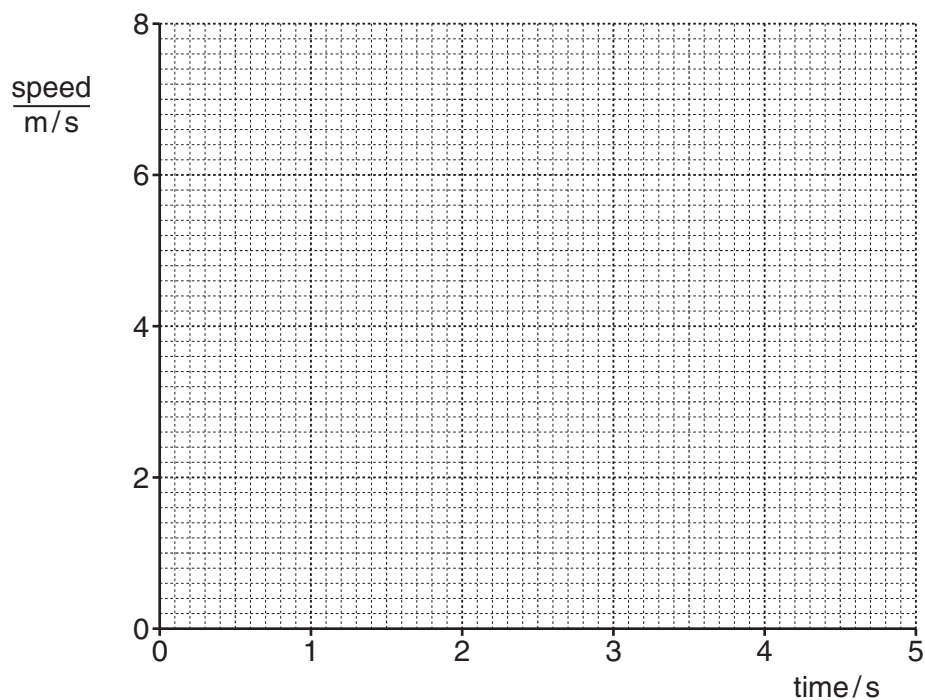
[Total: 9]

An astronaut on the Moon drops a feather from rest, off the top of a small cliff. The acceleration due to gravity on the Moon is  $1.6 \text{ m/s}^2$ . There is no air on the Moon.

**(a)** The feather falls for 4.5 s before it hits the ground.

**(i)** On Fig. 1.1, draw the speed-time graph for the falling feather.

[2]



**Fig. 1.1**

**(ii)** Determine the distance fallen by the feather.

distance = ..... [2]

- (b) On Fig. 1.2, sketch the shape of a speed-time graph for the same feather falling on Earth.



Fig. 1.2

[2]

- (c) Explain the difference between speed and velocity. Include the words *vector* and *scalar* in your answer.

.....

.....

.....

..... [2]

[Total: 8]

Question	Answer	Mark
1 (a)	from time zero, line of constant positive gradient, not necessarily from origin horizontal line from end of sloping line line of steeper positive gradient from end of horizontal line	B1 B1 B1
1 (b)	(distance =) area under graph stated $0.5 \times 7.5 \times 3.3 (= 12.375)$ $+ 12.5 \times 3.3 (= 41.25)$ $+ 0.5 \times 5 \times 3.3 (= 8.25)$ <b>OR</b> $\frac{1}{2} (a + b)h$ $= 0.5 \times (25 + 12.5) \times 3.3$ <b>OR</b> $(25 \times 3.3) - (0.5 \times 12.5 \times 3.3)$ 62 m	C1 C2  (C1) (C1) (C2) A1
		Total: 7
1 (a) (i)	8 m/s	B1
1 (a) (ii)	(0.90s is) driver's time to react	B1
1 (b) (i)	(a =) $(v - u) / t$ <b>OR</b> $\Delta v / t$ <b>OR</b> either in words <b>OR</b> $(18 - 0) / 3.1$ <b>OR</b> $18 / 3.1$ $5.8 \text{ m} / \text{s}^2$ <b>OR</b> Values from any correct points on graph Answer dependent on accuracy of chosen points	C1 A1 (C1) (A1)
1 (b) (ii)	Evidence of use of: (distance =) area under graph e.g. $1 / 2bh$ $(18 \times 0.9) + (0.5 \times 3.1 \times 18)$ 44 m	C1 C1 A1
1 (c)	(Without seat belt, driver:) e.g. keeps moving (forwards) / does not stop / has inertia / has momentum (Driver) hits steering wheel / windscreen / dashboard	B1 B1
		Total: 9
1 (a) (i)	Straight line from origin to (4.5 s, 7.2 m/s) Tolerance in plotting: $\frac{1}{2}$ a square	B2
1 (a) (ii)	Use of area stated or implied by numbers used <b>OR</b> average speed $\cdot$ time <b>OR</b> $s = (u+v) / t / 2$ <b>OR</b> $vt / 2$ <b>OR</b> $0.5 \cdot 4.5 \cdot 7.2$ $16(.2) \text{ m}$	C1 A1
1 (b)	Rises from origin and curves with decreasing gradient Finishes horizontal	B1 B1
1 (c)	Speed is scalar Velocity is vector Speed has magnitude / size / value (only) Velocity has magnitude / size / value and direction <b>OR</b> velocity has direction; speed does not	B1 B1
		Total: 8

Notes about the mark scheme are available separately.