

Question 2 (Answer: **B**)

- Average speed is *total distance* divided by *total time* – never the average of the two speeds.
- Distance = $(8 \times 10) + (6 \times 12)$.
- Total time = $10 + 12 = 22$ s, so divide that distance by 22.

Question 2 (Answer: **B**)

- A speed–time graph's *gradient* is the rate at which speed changes – the acceleration.
- A negative gradient is a deceleration.
- The *area* under the graph gives the distance travelled instead.

Question 2 (Answer: **C**)

- The car comes to rest, so the final speed is zero.
- Its initial speed was $at = 4.0 \times 8.0 = 32$ m/s.
- With constant deceleration the average speed is $(32 + 0)/2 = 16$ m/s.

Question 3 (Answer: **D**)

- Released from rest, the object speeds up, so its velocity increases.
- As it speeds up the air resistance grows, so the resultant force – and the acceleration – falls.
- At terminal velocity the forces balance: the velocity is constant and the acceleration is zero.

1(a)(i)	constant acceleration
1(a)(ii)	area under the graph OR $\frac{1}{2}bh$ OR <u>average</u> speed $\times$ time $0.5 \times 5.9 \times 0.6$ OR 1.77 (to ≥ 3 sf)
1(a)(iii)	9.5 J $(\Delta E_p =) mg(\Delta)h$ OR $0.54 \times 9.8 \times 1.8$
1(a)(iv)	candidate's 1(a)(iii) value $\times 0.5$ (2sf)
1(b)	any three from: • (initially there is acceleration due to) an unbalanced force OR resultant force OR downward force OR weight OR gravitational force acting on the ball • as speed increases the <u>air</u> resistance increases • (as air resistance increases) resultant force downwards decreases OR acceleration decreases • (eventually) ball falls with constant speed when air resistance = weight OR ball falls with terminal velocity when air resistance = weight
1(c)	(some of the) energy is: transferred to the thermal energy (store) of the ground (when ball hits ground) OR converted / transferred to thermal energy (store) of the air OR used to deform ball / transferred to the elastic energy (store) of the ball (as it contacts the ground) gravitational potential energy (in the store at C) will be less (than at A) OR (ball has) less kinetic energy (in its store just after B)

Question 1 (Answer: **C**)

- On a speed–time graph a rising line is acceleration and a falling line is deceleration.
- A horizontal line is constant speed, and the graph touching zero means at rest.
- A crash shows as a very steep fall to zero, so look for the steepest downward section.

Question 7 (Answer: **B**)

- Use $v^2 = 2gh$; the mass is irrelevant for a falling object.
- $v^2 = 2 \times 9.8 \times 50 = 980$.
- $v = 31$ m/s.

1(a)	(acceleration is) rate of change in velocity OR change in velocity per unit time OR $(a =) \Delta v / \Delta t$
1(b)	0.021 N $F = ma$ OR $(F =) ma$ OR 0.0075×2.8
1(c)(i)	any four from: • (acceleration) decreases • (acceleration decreases) to zero (at approximately 0.03 s) • resistive force increases / resistance increases (as speed / velocity increases) • resultant force (downwards) decreases • (until) terminal velocity / constant speed (is reached) • (when) resistive force = weight OR resultant force is zero OR forces are balanced
1(c)(ii)	tangent drawn at $t = 0.010$ s $1.2 \text{ m/s}^2 \leq \text{acceleration} \leq 1.8 \text{ m/s}^2$ $(a =) \text{gradient of tangent}$ OR $(a =) \{\Delta y / \Delta x\}$

Question 2 (Answer: **D**)

- Deceleration means the speed is falling.
- On a speed–time graph that is a section sloping *downwards*.
- A horizontal section is constant speed and an upward slope is acceleration.

Question 3 (Answer: **C**)

- Distance travelled is the *area* under a speed–time graph.
- The line rises from rest to 20 m/s over 400 s, so that area is a triangle.
- $\frac{1}{2} \times 400 \times 20 = 4000$ m; 8000 m would be the area if the speed had been 20 m/s throughout.

2(a)(i)	(speed =) 38 m/s $a = \Delta v / \Delta t$ OR $(\Delta v =) a\Delta t$ OR $(\Delta v =) 7.2 \times 5.3$
2(a)(ii)	(resultant force =) 1 700 N $F = ma$ OR $(F =) ma$ OR $(F =) 240 \times 7.2$
2(b)(i)	(vector) has direction (as well as magnitude) OR scalar does not have direction

2(b)(ii)	(velocity) changes (as direction of motion changes) OR direction (of velocity) changes
2(b)(iii)	any two from: • because there is an acceleration / change in velocity / change in direction / change in momentum (which needs a resultant force) • motorcyclist accelerates / changes momentum (because velocity / direction changes) • (resultant) force is perpendicular to the motion (of the motorcycle) OR $a \propto F$