VELOCITY-TIME

1 **(a)** Underline the vectors in the following list of quantities.

density energy force mass velocity volume [2]

(b) A small metal ball is projected into the air with a velocity of 40 m/s vertically upwards.

The graph in Fig. 2.1 shows how the velocity changes with time until the ball reaches its maximum height.

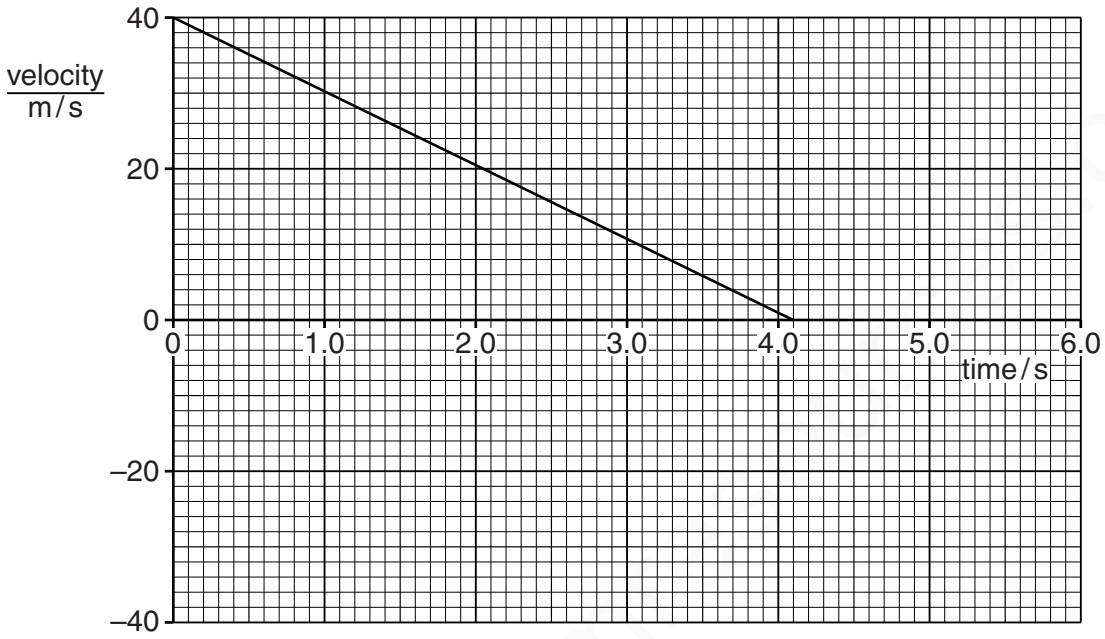

Fig. 2.1

Use the graph to find,

(i) the time at which the ball reaches its maximum height,

time = ...[1]

(ii) the deceleration of the ball,

deceleration = ...[2]

(iii) the maximum height reached by the ball.

maximum height = ...[2]

(c) On Fig. 2.1, add a line to the graph to show how the velocity of the ball changes after it reaches its maximum height. Your line should extend to time 6.0 s. [1]

[Total: 8]

MARKING SCHEME:

(a) underline or circle force — B1
underline or circle velocity — B1

(b) **(i)** 4.07 – 4.1 (s) — B1

(ii) $(v - u)/t$ OR $\Delta v/t$ OR in words OR use of 40 ÷ (ans. to **(b)(i)**)
OR other correct values from graph — C1
answer between 9.7 and 10 m/s^2 or m/s/s — A1

(iii) area under graph OR ½ $(u + v)t$ OR ½ × 40 × (ans. to **(b)(i)**) — C1
OR $s = ut + \frac{1}{2}at^2$ OR $v^2 = u^2 + 2as$ OR numbers substituted
82 m — A1

(c) graph continues in straight line to 6 s — B1

[Total 8]

2 Fig. 1.1 shows the graph of speed v against time t for a train as it travels from one station to the next.

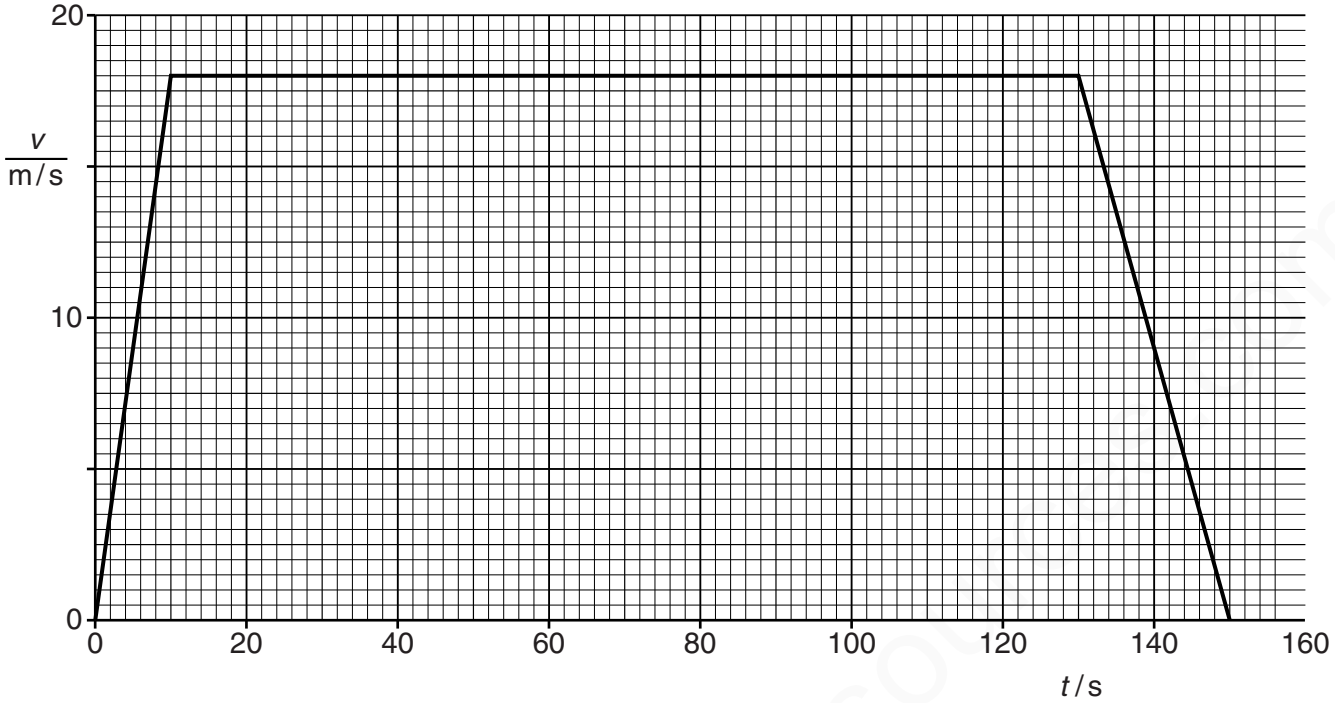

Fig. 1.1

(a) Use Fig. 1.1 to calculate

(i) the distance between the two stations,

distance = ... [4]

(ii) the acceleration of the train in the first 10 s.

acceleration = ... [2]

(b) The mass of the train is 1.1×10^5 kg.

Calculate the resultant force acting on the train in the first 10 s.

resultant force = ... [2]

(c) The force generated by the engine of the train is called the driving force.

Write down, in words, an equation relating the driving force to any other forces acting on the train during the period $t = 10$ s to $t = 130$ s.

..... [1]

[Total: 9]

MARKING SCHEME:

(a)	**(i)**	s = area under graph, stated or clearly used	C1	
		= (½ × 18 × 10) + (120 × 18) + (½ × 18 × 20) Award if at least one term correct	C1	
		= 90 + 2160 +180	C1	
		= 2430 m / 2.43 km at least 2 significant figures. *Unit penalty applies	A1	
	(ii)	v = u + at in any form OR (a=) gradient OR 18/10	C1	
		= 1.8 m/s^2 *Unit penalty applies	A1	
(b)		(F=) ma OR 1.1 × 10^5 × 1.8 ecf from **(a)(ii)**	C1	
		= 1.98 × 10^5 N at least 2 significant figures. *Unit penalty applies	A1	
(c)		driving force = friction/air resistance/drag	B1	**[9]**

*Apply unit penalty once only

3 A brick is dropped from the top of a very tall building as it is being constructed.

Fig. 1.1 is the speed/time graph for the brick as it falls to the ground.

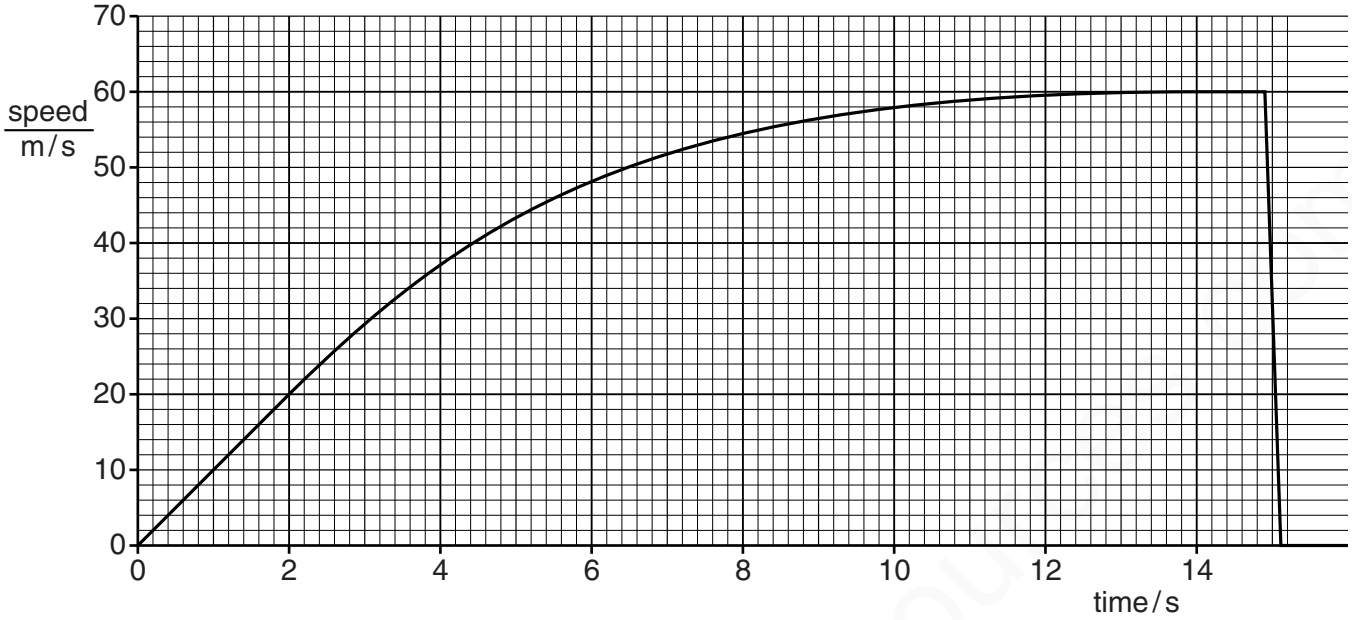

Fig. 1.1

(a) State a time at which the acceleration of the brick is

(i) zero,

time = ... [1]

(ii) constant but not zero,

time = ... [1]

(iii) not constant.

time = ... [1]

(b) Explain in terms of the forces acting on the brick why, between 0 and 14.0 s, its speed varies in the way shown by the graph.

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..... [4]

(c) State the direction of the resultant force acting on the brick at time 15.0 s.

..... [1]

MARKING SCHEME:

(a)	**(i)**	a time from 12.5 – 14.9 s **or** 15.1 – 16.0 s *Unit penalty applies	B1	
	(ii)	a time from 0 – 2.5 s **or** 14.9 – 15.1 s *Unit penalty applies	B1	
	(iii)	a time from 2.5 – 12.5 s *Unit penalty applies	B1	
(b)		(initially) weight/force of gravity **and** air friction/resistance act	B1	
		it speeds up/accelerates **and** (air) friction/resistance increases	B1	
		reaches terminal/constant velocity	B1	
		(air) friction/resistance = weight **or** no resultant (force) **or** forces in equilibrium	B1	
(c)		upwards	B1	**[8]**

*Apply unit penalty once only