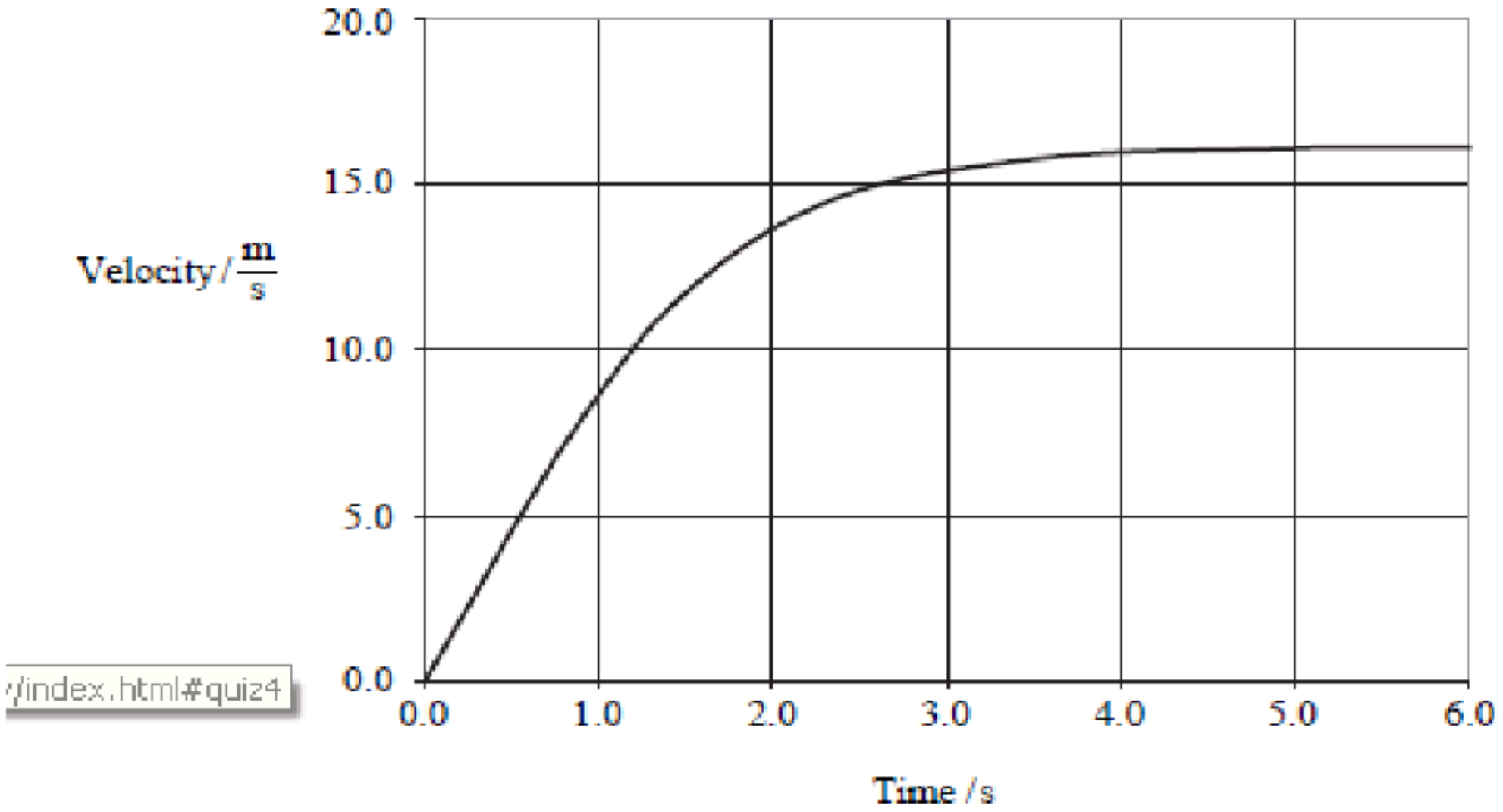
2. (a) What is the acceleration of any object at the start of its fall to the ground?

.....

(1)

(b) A small rubber ball is dropped from the top of a tall building and falls freely to the ground. The velocity–time graph shows the motion of the ball.



y/index.html#quiz4

(i) What quantity is represented by the slope of a velocity–time graph?

.....

(1)

(ii) Describe how the acceleration of the ball changes during the first six seconds of its fall.

.....

.....

.....

(2)

(c) What quantity is represented by the area under a velocity–time graph?

.....

(1)

(d) On the same axes, draw a graph to show the motion of a different ball of the same diameter but having a smaller mass.

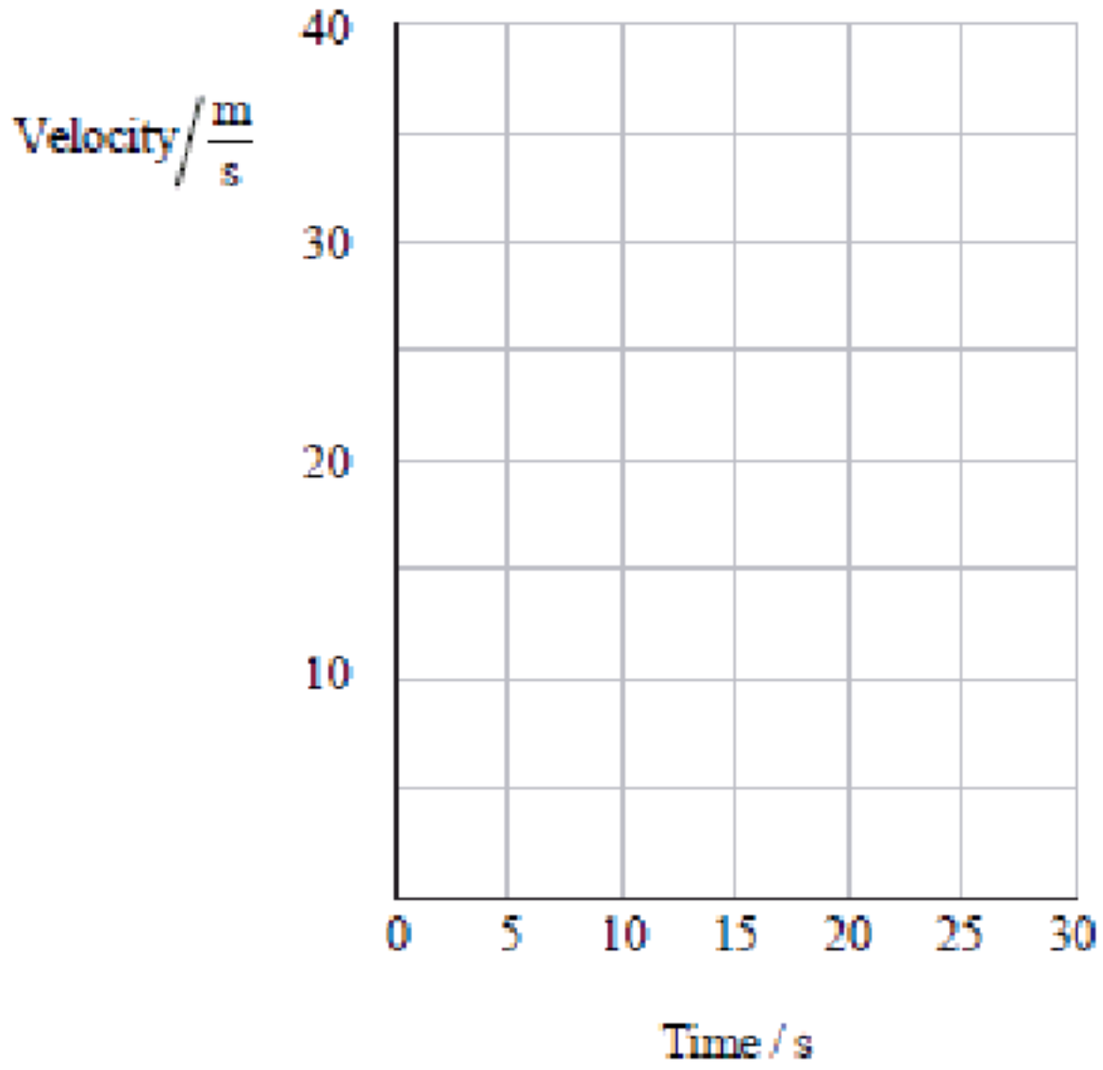
(2)

(Total 7 marks)

2.

(a)		10 m/s^2 UP / g Ignore minus sign e.g. - 10 m/s^{-2} ALLOW 9.8, 9.81, ms^{-2}, 980 cm/s^2		1
(b)	(i)	acceleration/(rate of)change of velocity/speed with time allow 'deceleration'		1
	(ii)	large/big/great/uniform/constant/maximum at start getting smaller/reducing/decreasing (with time) becoming zero /stops accelerating		1 1 1 Max 2
(c)		distance (travelled)/displacement		1
(d)		curve or line from origin on or below first levelling off below first line and above time axis		1 1
			Total 7 marks	

2. (a) A train moves with a constant velocity of 30 m/s for 10 s before decelerating uniformly to rest in a further 15 s.
Draw a velocity–time graph on the axes below.



(2)

(b) State the property of a velocity–time graph that can be used to determine the distance travelled by the train.

.....

(1)

(c) Calculate the distance travelled by the train.

.....

.....

.....

.....

(3)

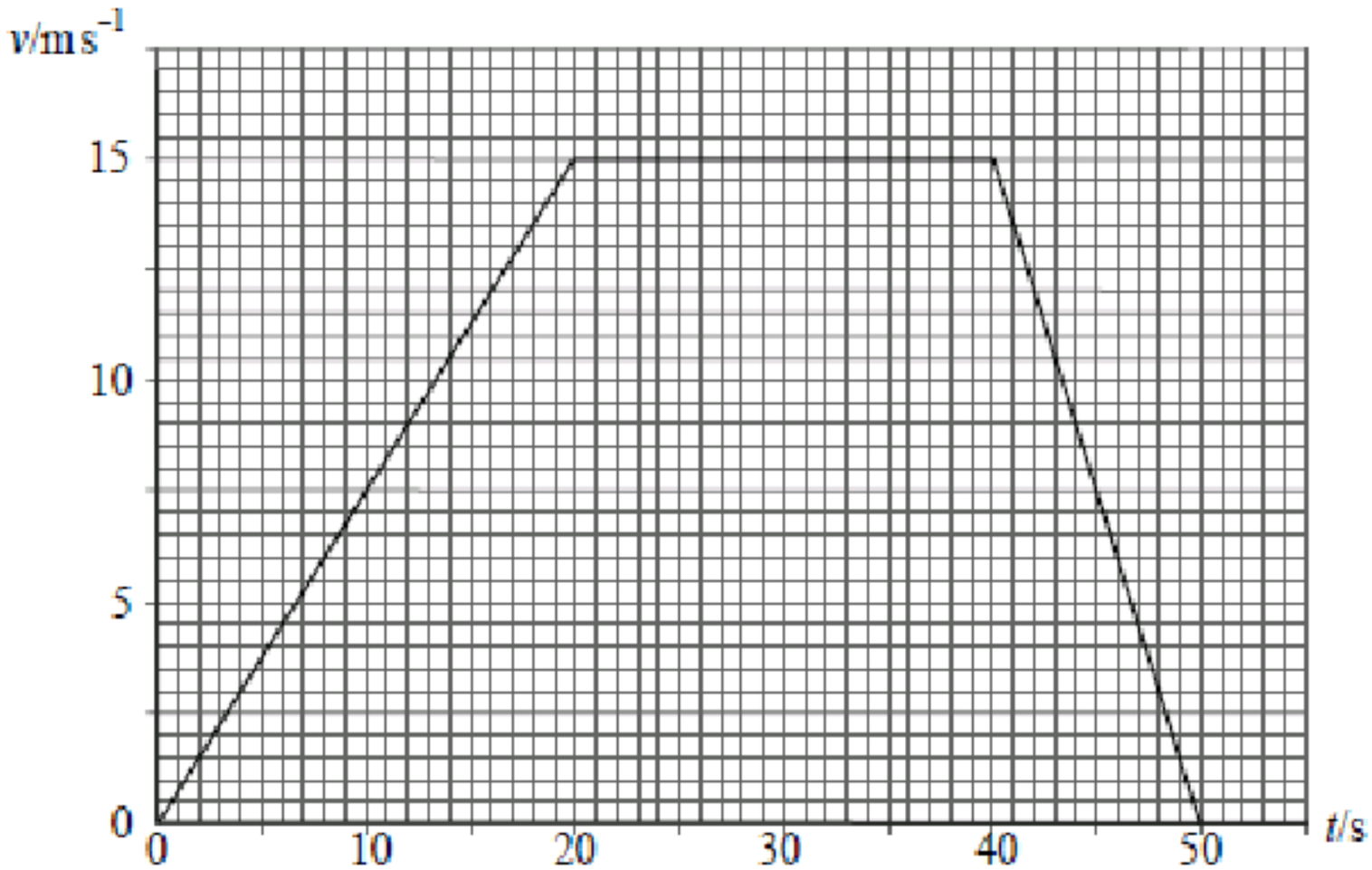
(Total 6 marks)

Question Number	Acceptable Answers	Reject	Mark
2(a)	straight line from (0,30) to (10,30) straight line from (10,30) to(25,0) or line of correct slope from a point on the line v = 30 m/s		(1) (1)

Question Number	Acceptable Answers	Reject	Mark
2(b)	area (under graph)		(1)

Question Number	Acceptable Answers	Reject	Mark
2(c)	30 × 10 = 300 must e.c.f from (a) ½ × 30 × 15 = 225 must e.c.f. from (a) One of these areas must be correct for 1st mark 300 + 225 = 525 m UP for 3rd mark only e.c.f from previous two lines		(1) (1) (1)

3 The graph shows how the velocity, v, of a car varies with time, t.

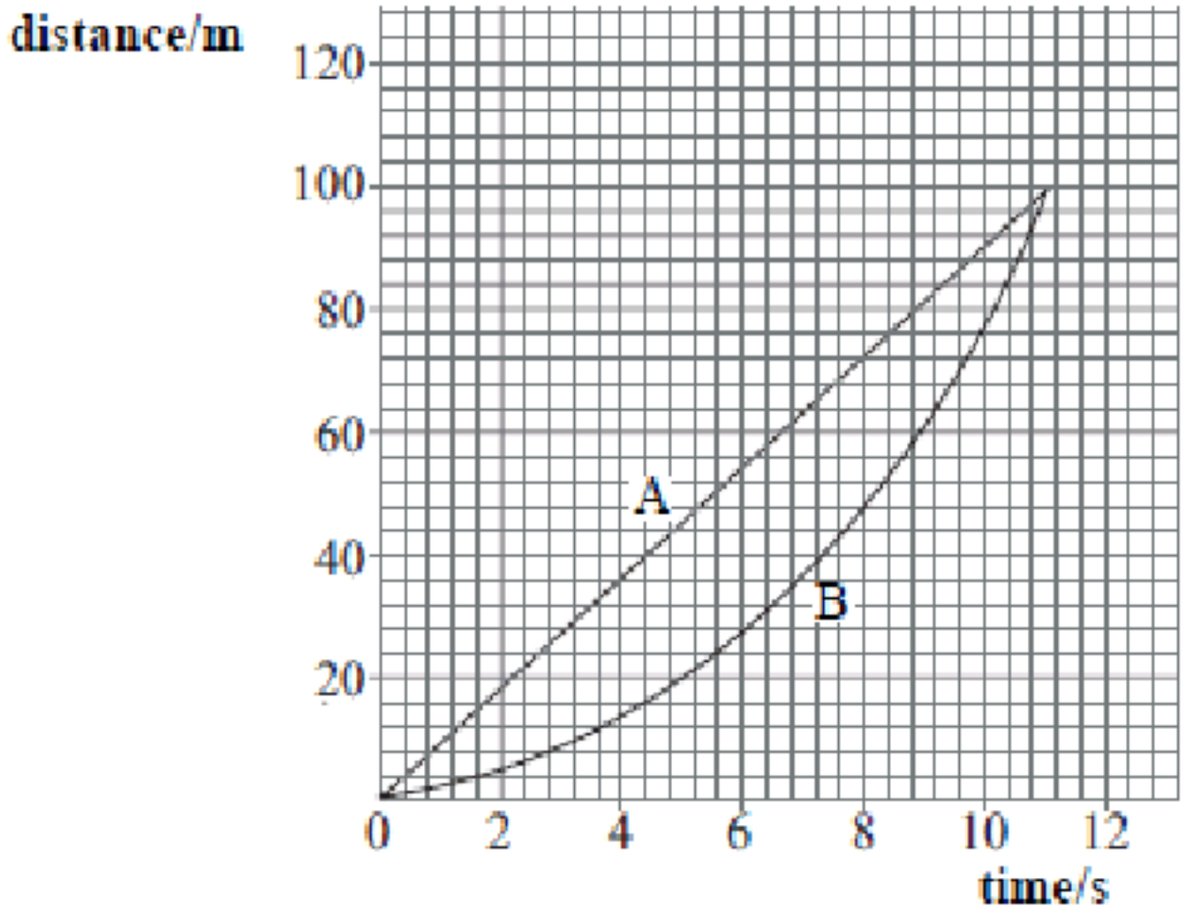


3 (a) Describe the motion of the car for the 50 s period.

You may be awarded additional marks to those shown in brackets for the quality of written communication in your answer.

Question 3		
(a)	accelerates uniformly/constantly for first 20 s ✓ (quoting numerical value ok) travels at constant speed (of 15 m s^{-1}) ✓ decelerates (to rest) ✓ (or negative acceleration) (n.b. only need to see uniformly/constant once)	3
(b) (i)	(use of $p = mv$) $p = 1200 \times 15$ ✓ $p = 18000$ N s ✓	
(ii)	rate of change of momentum = 18000/20 = 900 N ✓	4
(iii)	(use of *distance = average speed × time*) distance = (15 + 0)/2 × 20 distance = 150 m ✓	
	Total	7

1 The distance-time graphs for two runners, A and B, in a 100 m race are shown.



(a) Explain how the graph shows that athlete B accelerates throughout the race.

.....

.....

(1 mark)

(b) Estimate the maximum distance between the athletes.

.....

(1 mark)

(c) Calculate the speed of athlete A during the race.

.....

(1 mark)

(d) The acceleration of athlete B is uniform for the duration of the race.

(i) State what is meant by uniform acceleration.

.....

(ii) Calculate the acceleration of athlete B.

.....

.....

(3 marks)

Question 1		
(a)	gradient (or slope or steepness) is changing ✓ or graph a curve (or not a straight line)	1
(b)	25 ± 3 m ✓	1
(c)	(use of *speed* = *distance* ÷ *time* gives) speed = 100 ÷ 11 speed = 9.1 ± 0.2 m s^{-1} ✓	1
(d) (i)	constant acceleration ✓ or acceleration stays the same or velocity increases uniformly with time	3
(ii)	(use of $s = ut + \frac{1}{2}at^2$ gives) $a = 2 \times 100 \div (11^2)$ ✓ $a = 1.7$ m s^{-2} ✓	
	Total	6

2 (a) A cheetah accelerating uniformly from rest reaches a speed of 29 m s^{-1} in 2.0 s and then maintains this speed for 15 s. Calculate

(i) its acceleration,

.....

.....

(ii) the distance it travels while accelerating.

.....

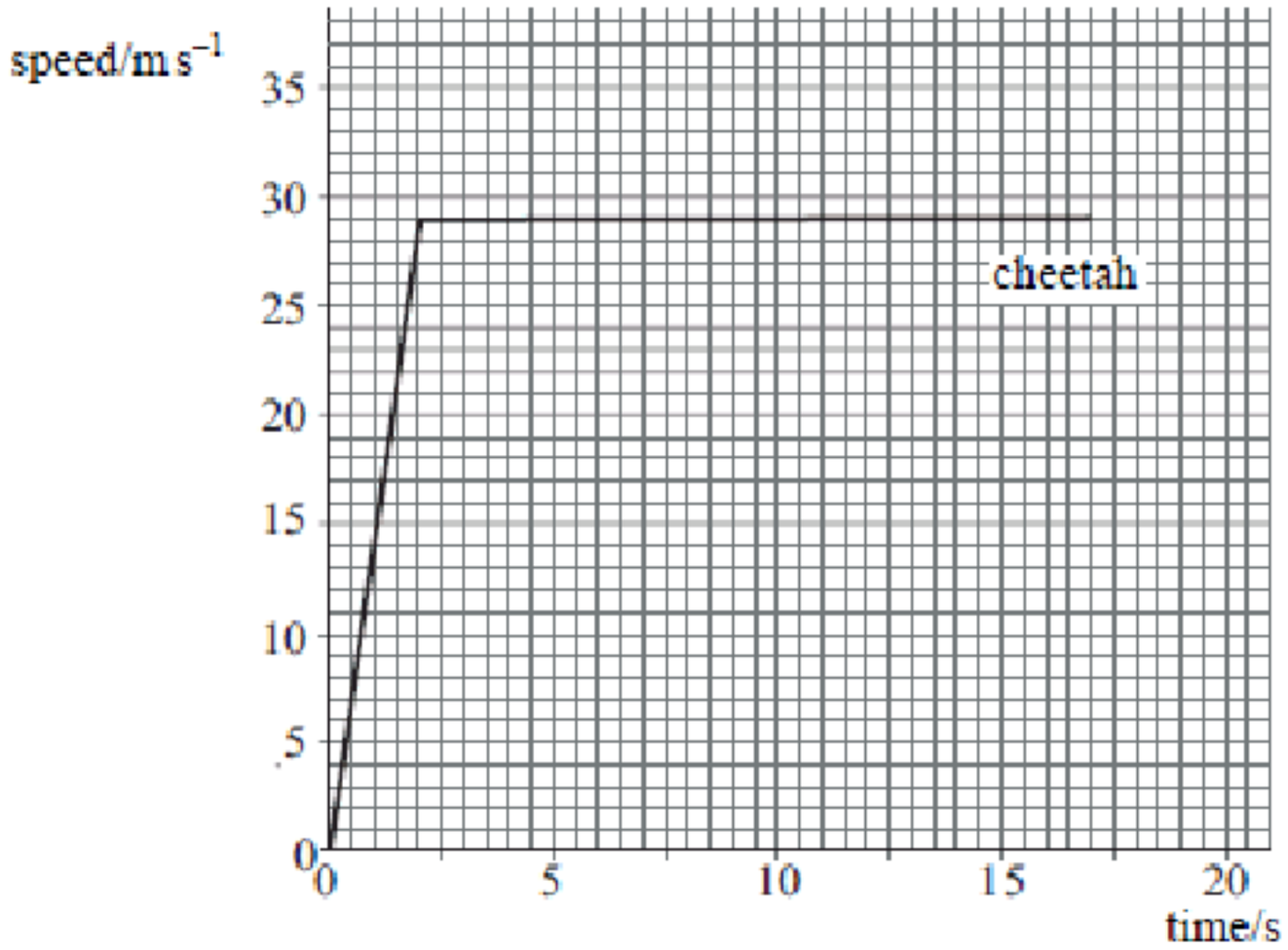
.....

(iii) the distance it travels while it is moving at constant speed.

.....

(4 marks)

(b) The cheetah and an antelope are both at rest and 100 m apart. The cheetah starts to chase the antelope. The antelope takes 0.50 s to react. It then accelerates uniformly for 2.0 s to a speed of 25 m s^{-1} and then maintains this speed. The graph shows the speed-time graph for the cheetah.



(i) Using the same axes plot the speed-time graph for the antelope during the chase.

(ii) Calculate the distance covered by the antelope in the 17 s after the cheetah started to run.

.....

.....

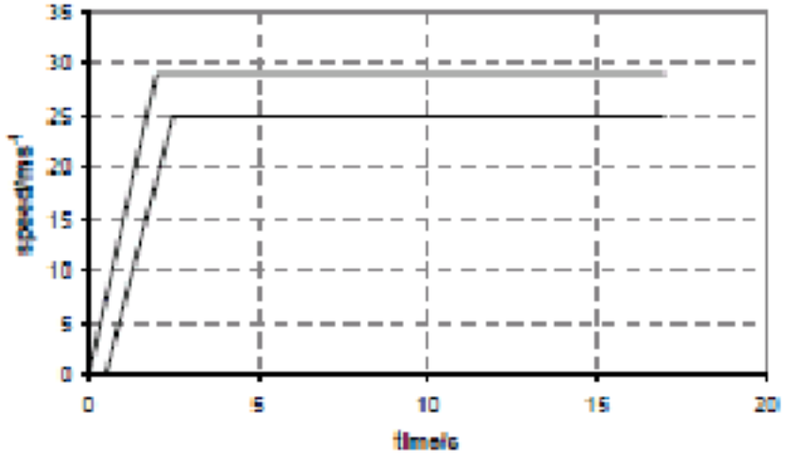
.....

(iii) How far apart are the cheetah and the antelope after 17 s?

.....

.....

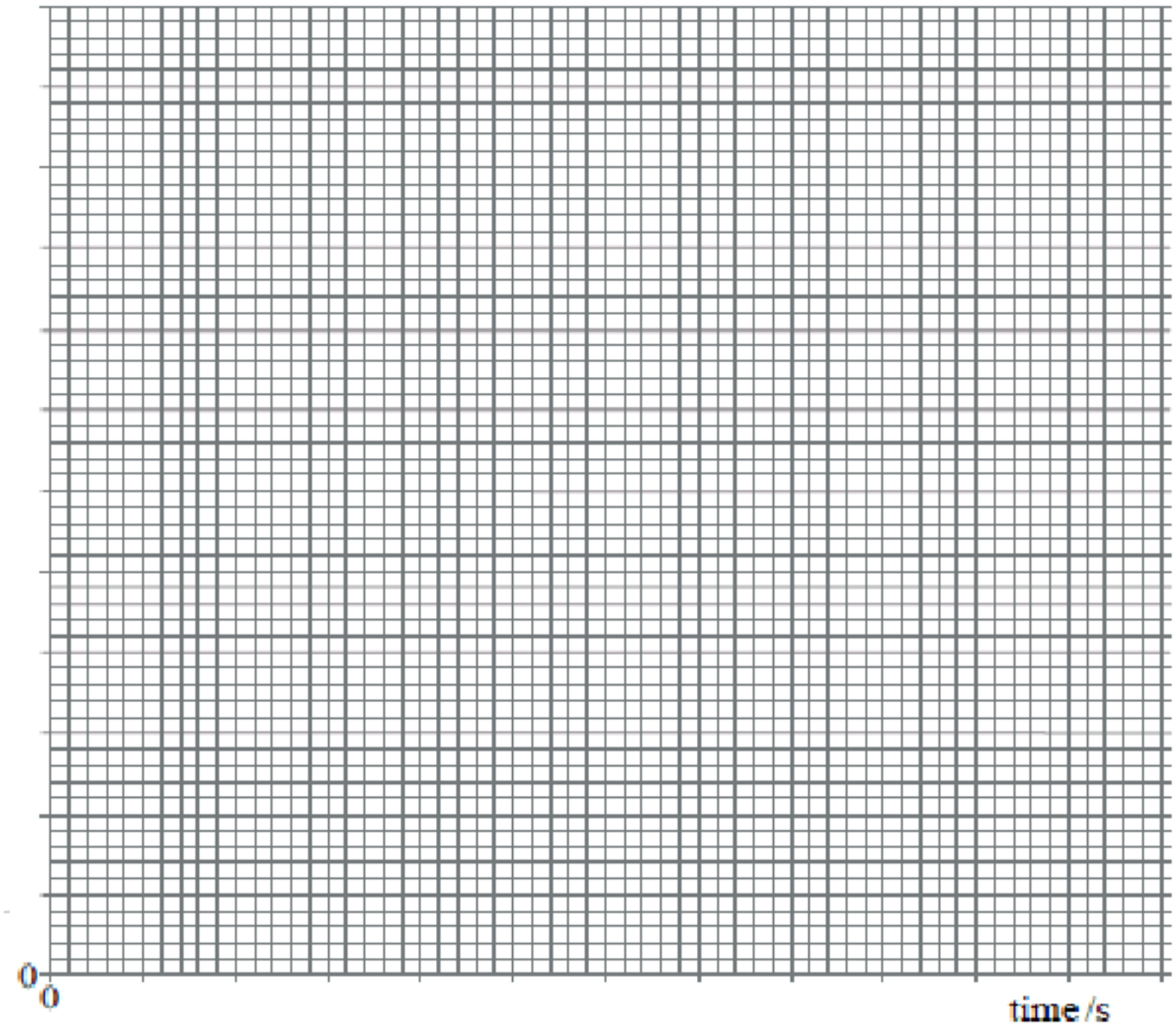
(6 marks)

Question 2				
(a)	(i)	(use of $a = (v - u) \div t$ gives) acceleration = $29 \div 2.0 = 14.5\,m\,s^{-2}$	✓	
	(ii)	(use of $s = ut + \frac{1}{2}at^2$) $s = \frac{1}{2} \times 14.5 \times 2^2$ $s = 29\,m$	✓✓	4
	(iii)	(use of *distance* = *speed* × *time* gives) $s = 29 \times 15 = 435\,m$	✓	
(b)	(i)	 reaction time acceleration over 2.0 s constant speed	✓✓✓	6
	(ii)	(use of distance = average speed × time distance travelled by antelope = 2 × 12.5 + 14.5 × 25 = 387.5 ✓	✓✓	
	(iii)	distance = 100 + 387.5 – 464 = 23 m ✓(23.5)	✓	
			Total	**10**

1 A car accelerates from rest to a speed of 26 m s^{-1}. The table shows how the speed of the car varies over the first 30 seconds of motion.

time/ s	0	5.0	10.0	15.0	20.0	25.0	30.0
speed/ m s^{-1}	0	16.5	22.5	24.5	25.5	26.0	26.0

(a) Draw a graph of speed against time on the grid provided.



(b) Calculate the average acceleration of the car over the first 25 s.

.....

.....

(2 marks)

(c) Use your graph to estimate the distance travelled by the car in the first 25 s.

.....

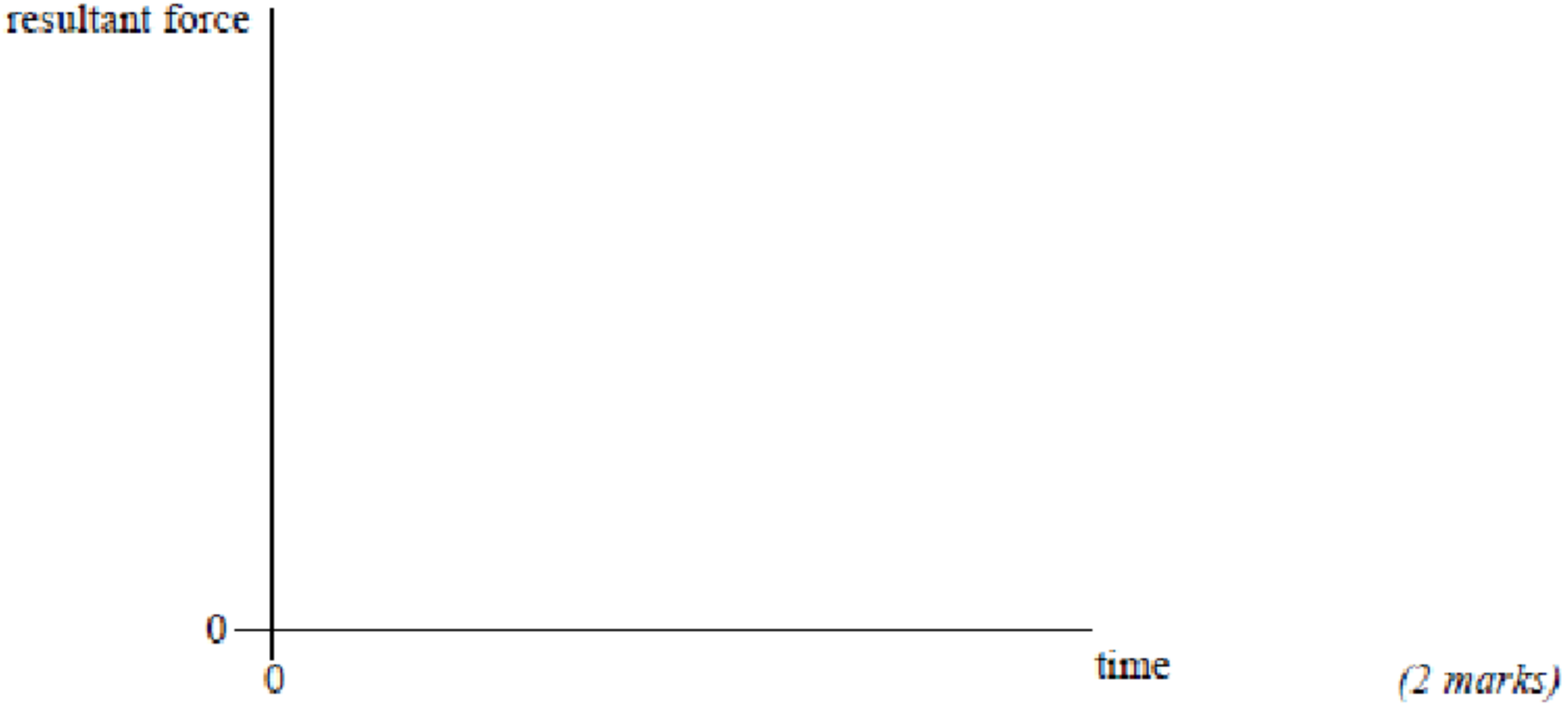
.....

.....

.....

(2 marks)

(d) Using the axes below, sketch a graph to show how the resultant force acting on the car varies over the first 30 s of motion.



(2 marks)

(e) Explain the shape of the graph you have sketched in part (d), with reference to the graph you plotted in part (a).

.....

Question 1		
(a)	scales ✓ six points correctly plotted ✓ trendline ✓	**3**
(b)	average acceleration = $\frac{26}{25}$ ✓ $= 1.0(4)\ \text{m s}^{-2}$ ✓ (allow C.E. for incorrect values used in acceleration calculation)	**2**
(c)	area under graph ✓ $= 510 \pm 30\ \text{m}$ ✓	**2**
(d)	(graph to show force starting from y-axis) decreasing (not a straight line) ✓ to zero (at end of graph) ✓	**2**
(e)	(since) gradient of a velocity-time graph gives acceleration ✓ first graph shows acceleration is decreasing ✓	**2**
	Total	**11**