

Mark Scheme Motion Graph Past Paper Questions

Jan 2002 to Jan 2009

1(a)(i) rate of change of velocity

$$\left[\text{or } a = \frac{\Delta v}{t} \right] \checkmark$$

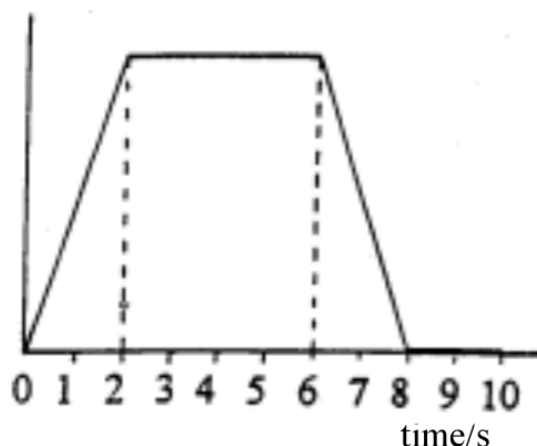
Q1 Jan 2002

(ii) (acceleration) has (magnitude and) direction \checkmark (2)

(b)(i) (acceleration) is the gradient (or slope) of the graph \checkmark

(ii) (displacement) is the area (under the graph) \checkmark (2)

(c) velocity



graph to show:

(linear) increase to $t = 2.0 \pm 0.2$ s \checkmark

uniform velocity between 2.0 s and 6.0 s \checkmark

(linear) decrease from 6.0 ± 0.2 s to 8.0 s \checkmark

zero velocity after $t = 8.0$ s \checkmark

(4)

(8)

Q1 Jun 2002

1(a) AB: (uniform) acceleration \checkmark
 BC: constant velocity/speed or zero acceleration \checkmark
 CD: negative acceleration or deceleration or decreasing speed/velocity \checkmark
 DE: stationary or zero velocity \checkmark
 EF ; (uniform) acceleration in opposite direction \checkmark (5)

(b) area under the graph \checkmark (1)

(c) distance is a scalar and thus is the total area under the graph
 [or the idea that the train travels in the opposite direction] \checkmark
 displacement is a vector and therefore the areas cancel \checkmark (2)

(8)

5

(a)(i) acceleration ✓

Q5 Jun 2003(a)(ii) both represent acceleration of free fall
[or same acceleration] ✓(a)(iii) height/distance ball is dropped from above the ground
[or displacement] ✓

(a)(iv) moving in the opposite direction ✓

(a)(v) kinetic energy is lost in the collision
[or inelastic collision] ✓

(5)

(b)(i) $v^2 = 2 \times 9.81 \times 1.2$ ✓
 $v = 4.9 \text{ m s}^{-1}$ ✓ (4.85 m s⁻¹)(b)(ii) $u^2 = 2 \times 9.81 \times 0.75$ ✓
 $u = 3.8 \text{ m s}^{-1}$ ✓ (3.84 m s⁻¹)(b)(iii) change in momentum = $0.15 \times 3.84 - 0.15 \times 4.85$ ✓
= -1.3 kg m s^{-1} ✓ (1.25 kg m s⁻¹)
(allow C.E. from (b)(i) and (b)(ii))(b)(iv) $F = \frac{1.3}{0.10}$ ✓
= 13 N ✓
(allow C.E. from (b)(iii))(8)
(13)**Question 4****Q4 Jan 2005**

(a)(i) car A: travels at constant speed ✓

(ii) car B: accelerates for first 5 secs (or up to 18 m s⁻¹) ✓
then travels at constant speed ✓

(3)

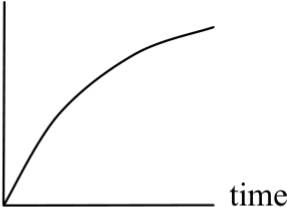
(b)(i) car A: distance = 5.0×16 ✓
= 80 m ✓(ii) car B: (distance = area under graph)
distance = $[5.0 \times \frac{1}{2} (18 + 14)]$ ✓
= 80 m ✓

(4)

(c) car B is initially slower than car A (for first 2.5 s) ✓
distance apart therefore increases ✓
cars have same speed at 2.5 s ✓
after 2.5 s, car B travels faster than car A (or separation decreases) ✓max (3)
(10)

Question 1	Q1 Jan 2006	
(a)	scales ✓ six points correctly plotted ✓ trendline ✓	3
(b)	average acceleration = $\frac{26}{25}$ ✓ = 1.0(4) ms ⁻² ✓ (allow C.E. for incorrect values used in acceleration calculation)	2
(c)	area under graph ✓ = 510 ± 30 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

Q6 Jun 2006

Question 6			
(a) (i)	(use of $a = \frac{\Delta v}{\Delta t}$ gives) $a = \frac{4.5}{3600}$ ✓ = 1.25 × 10 ⁻³ ms ⁻² ✓	4	
(ii)	(use of $v^2 = u^2 + 2as$ gives) $0 = 4.5^2 - 2 \times 1.25 \times 10^{-3} \times s$ ✓ $s \left(= \frac{20.25}{2.5 \times 10^{-3}} \right) = 8.1 \times 10^3 \text{ m}$ ✓		
(b)	distance  time	increasing curve ✓ correct curve ✓	2
(c)	gradient (slope) of graph represents speed ✓ hence graph has decreasing gradient ✓		2
	Total		8

Question 2			
(a)	(i)	(use of $a = (v - u) \div t$ gives) acceleration = $29 \div 2.0 = 14.5 \text{ ms}^{-2}$	Q2 Jan 2007 ✓
	(ii)	(use of $s = ut + \frac{1}{2} at^2$) $s = \frac{1}{2} \times 14.5 \times 2^2$ $s = 29 \text{ m}$	✓✓
	(iii)	(use of <i>distance = speed × time</i> gives) $s = 29 \times 15 = 435 \text{ m}$	✓
(b)	(i)	<p>reaction time acceleration over 2.0 s constant speed</p>	✓✓✓
	(ii)	(use of <i>distance = average speed × time</i>) distance travelled by antelope = $2 \times 12.5 + 14.5 \times 25 = 387.5$ ✓	✓✓
	(iii)	distance = $100 + 387.5 - 464 = 23 \text{ m}$ ✓(23.5)	✓
Total			10

Question 1			
(a)	gradient (or slope or steepness) is changing ✓ or graph a curve (or not a straight line)		1
(b)	$25 \pm 3 \text{ m}$ ✓	Q1 Jun 2007	1
(c)	(use of <i>speed = distance ÷ time</i> gives) speed = $100 \div 11$ speed = $9.1 \pm 0.2 \text{ ms}^{-1}$ ✓		1
(d)	(i)	constant acceleration ✓ or acceleration stays the same or velocity increases uniformly with time	
	(ii)	(use of $s = ut + \frac{1}{2} at^2$ gives) $a = 2 \times 100 \div (11^2)$ ✓ $a = 1.7 \text{ ms}^{-2}$ ✓	3
Total			6

Question 1																				
(a)	<p>axes labelled correctly with correct units shown ✓</p> <p>suitable scales ✓</p> <p>6 points plotted correctly ✓</p> <p>all points plotted correctly ✓</p> <p>both sections of line drawn correctly ✓</p> <div style="text-align: right;">Q1 Jan 2009</div> <table border="1" style="margin-left: auto; margin-right: auto;"> <caption>Data points from the speed-time graph</caption> <thead> <tr> <th>time / s</th> <th>speed / ms⁻¹</th> </tr> </thead> <tbody> <tr><td>0</td><td>15</td></tr> <tr><td>0.5</td><td>15</td></tr> <tr><td>1</td><td>12.5</td></tr> <tr><td>1.5</td><td>10</td></tr> <tr><td>2</td><td>7.5</td></tr> <tr><td>2.5</td><td>5</td></tr> <tr><td>3</td><td>2.5</td></tr> <tr><td>3.5</td><td>0</td></tr> </tbody> </table>	time / s	speed / ms ⁻¹	0	15	0.5	15	1	12.5	1.5	10	2	7.5	2.5	5	3	2.5	3.5	0	5
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(b)	<p>(i) the gradient (of the slope section) represents the deceleration/ calculates 5 m s^{-2} ✓</p> <p>(deceleration is uniform because) the gradient is constant/line is straight ✓</p> <p>(ii) distance travelled = area under line (0 to 3.5 s or 0.5 to 3.5 s) ✓</p> <p>(= 15.0×0.5) = 7.5 m in first 0.5 s ✓</p> <p>(= $0.5 \times 15.0 \times 3.0$) or $s = \frac{1}{2}(u + v)t$, etc) = 22.5 m (from 0.5 s to 3.5 s) ✓</p> <p>(= $\frac{1}{2}(0.5 + 3.5) \times 15$ gets all three method marks)</p> <p>(total distance travelled = $7.5 + 22.5$) = 30 m ✓</p>	6																		
Total		11																		