Mark Scheme Motion Graph Past Paper Questions

Jan 2002 to Jan 2009

Q1 Jan 2002

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

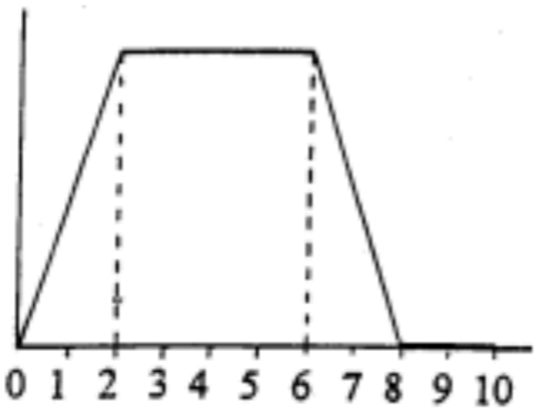
[or $a = \frac{\Delta v}{t}$] ✓

(ii) (acceleration) has (magnitude and) direction ✓ (*2*)

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

(ii) (displacement) is the area (under the graph) ✓ (*2*)

(c) velocity



graph to show:

(linear) increase to $t = 2.0 \pm 0.2$ s ✓
uniform velocity between 2.0 s and 6.0 s✓
(linear) decrease from 6.0 ± 0.2 s to 8.0 s ✓
zero velocity after $t = 8.0$ s ✓

(*4*)
(*8*)

Q1 Jun 2002

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

(b) area under the graph ✓ (*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] ✓
displacement is a vector and therefore the areas cancel ✓ (*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) $v^2 = 2 \times 9.81 \times 1.2$ ✓
$v = 4.9\ \mathrm{m\ s^{-1}}$ ✓ ($4.85\ \mathrm{m\ s^{-1}}$)

(b)(ii) $u^2 = 2 \times 9.81 \times 0.75$ ✓
$u = 3.8\ \mathrm{m\ s^{-1}}$ ✓ ($3.84\ \mathrm{m\ s^{-1}}$)

(b)(iii) change in momentum $= 0.15 \times 3.84 - 0.15 \times 4.85$ ✓
$= -1.3\ \mathrm{kg\ m\ s^{-1}}$ ✓ ($1.25\ \mathrm{kg\ m\ s^{-1}}$)
(allow C.E. from (b)(i) and (b)(ii))

(b)(iv) $F = \dfrac{1.3}{0.10}$ ✓
$= 13\ \mathrm{N}$ ✓
(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 $18\ \mathrm{m\,s^{-1}}$) ✓
then travels at constant speed ✓ (*3*)

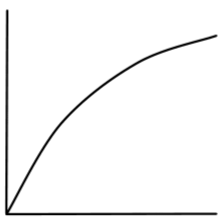
(b)(i) car A: distance $= 5.0 \times 16$ ✓
$= 80\ \mathrm{m}$ ✓

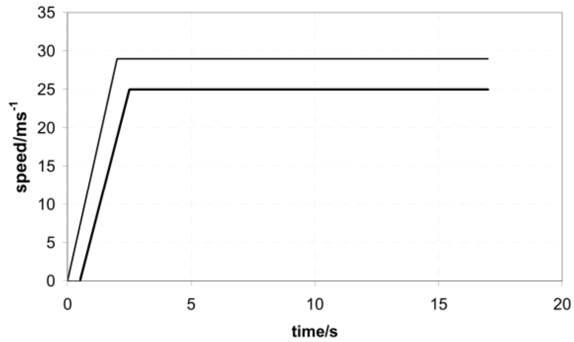
(ii) car B: (distance = area under graph)
distance $= [5.0 \times \tfrac{1}{2}(18 + 14)]$ ✓
$= 80\ \mathrm{m}$ ✓ (*4*)

(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 deceases) ✓ max(*3*)
(*10*)

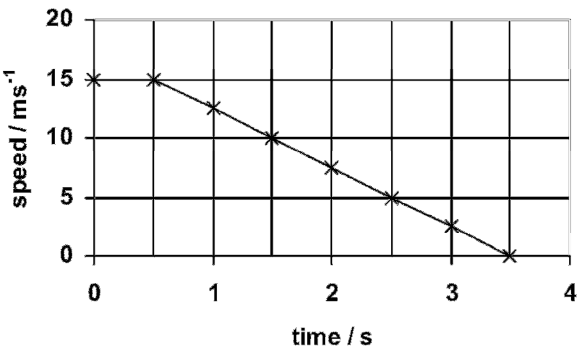
Question 1	**Q1 Jan 2006**	
(a)	scales ✓ six points correctly plotted ✓ trendline ✓	**3**
(b)	average acceleration = $\frac{26}{25}$ ✓ $= 1.0(4)\ \mathrm{m\,s^{-2}}$ ✓ (allow C.E. for incorrect values used in acceleration calculation)	**2**
(c)	area under graph ✓ $= 510 \pm 30\,\mathrm{m}$ ✓	**2**
(d)	(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) (ii)	(use of $a = \frac{\Delta v}{\Delta t}$ gives) $a = \frac{4.5}{3600}$ ✓ $= 1.25 \times 10^{-3}\ \mathrm{m\,s^{-2}}$ ✓ (use of $v^2 = u^2 + 2as$ gives) $0 = 4.5^2 - 2 \times 1.25 \times 10^{-3} \times s$ ✓ $s\left(= \frac{20.25}{2.5\times10^{-3}}\right) = 8.1 \times 10^3\,\mathrm{m}$ ✓	**4**
(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 ÷ 2.0 = 14.5 m s^{-2} **Q2 Jan 2007**	✓	**4**
(ii)	(use of $s = ut + \frac{1}{2}at^2$) $s = \frac{1}{2} \times 14.5 \times 2^2$ s = 29 m	✓✓	
(iii)	(use of *distance* = *speed* × *time* gives) s = 29 × 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**

Question 1		
(a)	gradient (or slope or steepness) is changing ✓ **or** graph a curve (**or** not a straight line)	**1**
(b)	25 ± 3 m ✓ **Q1 Jun 2007**	**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**

Question 1			
(a)		axes labelled correctly with correct units shown ✓ suitable scales ✓ 6 points plotted correctly ✓ all points plotted correctly ✓ both sections of line drawn correctly ✓ 	5
(b)	(i)	the gradient (of the slope section) represents the deceleration/ calculates $5\,m\,s^{-2}$ ✓ (deceleration is uniform because) the gradient is constant/line is straight ✓	
	(ii)	distance travelled = area under line (0 to 3.5 s or 0.5 to 3.5 s) ✓ (= 15.0 × 0.5) = 7.5 m in first 0.5 s ✓ (= 0.5 × 15.0 × 3.0) or $s = \frac{1}{2}(u + v)t$, etc) = 22.5 m (from 0.5 s to 3.5 s) ✓ (= ½(0.5 + 3.5) × 15 gets all three method marks) (total distance travelled = 7.5 + 22.5) = 30 m ✓	6
		Total	**11**

Q1 Jan 2009