Mark Scheme Projectiles Past Paper Questions

Jan 2002 to Jan 2009

Q8 Jan 2002

8(a)(i) (use of $v^2 = u^2 + 2as$ gives) $0 = 25^2 - 2 \times 9.81 \times s$ ✓

$19.6\,s = 625$ and $s = 32$ m ✓

(ii) $t = \dfrac{25}{9.81} = 2.5$ s ✓

(iii) (use of $v^2 = u^2 + 2as$ gives) $v^2 = 25^2 - 2 \times 9.81 \times 16$ ✓

(allow C.E. from (a)(i))

and $v = 18\ \text{m s}^{-1}$ ✓ max(*4*)

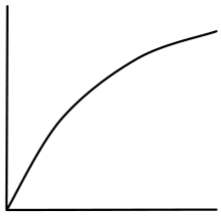
(b) time to stop the ball is greater ✓

∴ rate of change of momentum is less ✓

[or work done on ball is the same but greater distance ✓ ∴ less force ✓] (*2*)

(*6*)

Q6 Jun 2002

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

Q6 Jan 2003

6(a)(i) 70 m s^{-1} ✓

(a)(ii) $v = 9.81 \times 2.0$ ✓
$= 20 \text{ m s}^{-1}$ ✓ (19.6 m s^{-1})

(a)(iii) $v = \sqrt{(70^2 + 19.62^2)} = 73 \text{ m s}^{-1}$ ✓

direction: $\tan \theta = \dfrac{19.6}{70} = 0.28$

$\theta = 15.6^\circ$ ✓ $(\pm 0.1^\circ)$ (to horizontal) ✓

(allow C.E. for values of v from (i) and (ii))
[or use of correct scale drawing] (5)

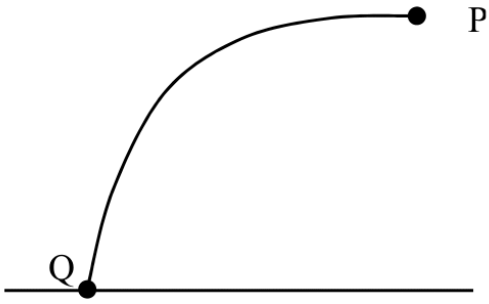
(b)(i) air resistance is greater than weight ✓
(hence) resultant force is upwards ✓
hence deceleration (Newton's second law) ✓

(b)(ii) air resistance decreases as speed decreases ✓
weight equals air resistance (hence constant speed)
(hence) resultant force is zero (Newton's first law) ✓ max (4)

(9)

1

(a)(i)



Q1 Jun 2004

✓

(ii) no **horizontal** force acting ✓
(hence) no (horizontal) acceleration ✓
[or correct application of Newton's First law] (*3*)

(b)(i) (use of $v^2 = u^2 + 2as$ gives) $32^2 = (0) + 2 \times 9.81 \times s$ ✓

$s = \dfrac{1024}{19.62}$ ✓ (= 52.2 m)

(ii) (use of $s = \frac{1}{2} at^2$ gives) $52 = \frac{1}{2} 9.81 \times t^2$ ✓

$t = \sqrt{\left(\dfrac{104}{9.81}\right)}$ = 3.3 s ✓ (3.26 s)

[or use of $v = u + at$ gives $32 = (0) + 9.81 \times t$ ✓

$t = \dfrac{32}{9.81}$ = 3.3 s ✓ (3.26 s)]

(iii) (use of $x = vt$ gives) x (= QR) = 95×3.26 ✓
= 310 m ✓
(use of $t = 3.3$ gives $x = 313.5$ m)
(allow C.E. for value of t from (ii)) (*6*)

(c) maximum height is greater ✓
because vertical acceleration is less ✓
[or longer to accelerate] (*2*)

(*11*)

Question 4		
(a)	dart moves at a constant speed horizontally ✓ as no horizontal force/air resistance ✓ but accelerates vertically downwards ✓ this results in a parabolic path ✓ dartboard accelerates vertically downwards ✓ at same rate as dart ✓ gravity acting on dart and/or dartboard at same rate as dart ✓ at a particular instant vertical (component of) velocity is the same for dart and dartboard at same rate as dart ✓	**max 4**
(b) (i)	(use of speed = distance/time) time = 2/8.0 = 0.25 s ✓	**5**
(ii)	(use of $v = u + at$) $v = 9.81 \times 0.25 = 2.45\,\text{m s}^{-1}$ ✓ (accept g = 10 m/s^2)	
(iii)	(use of $v^2 = v_h^2 + v_v^2$) $v^2 = 2.45^2 + 8.0^2$ ✓ v = 8.37 m s^{-1} ✓ angle below horizontal = tan^{-1} (2.45/8) = 17° ✓ (or 17.3°)	
	Total	**6**

Q4 Jan 2008

Q4 Jan 2009

Question 4		
(a)	velocity vector tangential to path and drawn from the ball, arrow in correct direction ✓ acceleration vector vertically downwards, arrow drawn and in line with ball ✓	**2**
(b) (i)	$s = \frac{1}{2} gt^2$ gives $t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2\times 24}{9.8(1)}}$ ✓ = 2.2(1) s ✓	**4**
(ii)	v (= s/t) = 27/2.2(1) ✓ = 12(.2 m s^{-1}) or 12(.3) ✓ (ecf from (b)(i)) (answer only gets both marks)	
	Total	**6**