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 $v = 18$ 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

6(a) (rate of change of horizontal) displacement is constant ✓ hence (horizontal) velocity is constant ✓
thus no (horizontal) force acting ✓ max(*2*)

(b) there is a vertical force
[or weight/force of gravity acting on ball] ✓ ball therefore accelerates (in vertical direction) ✓ acceleration is constant ✓ max(*2*)

(c)(i) (horizontal) displacement would be less ✓

(ii) (vertical) displacement or acceleration would be less ✓ effect would increase with time ✓
[or air resistance increases with speed until equals weight ✓
hence reaches terminal velocity/speed ✓] (*3*)
(*7*)

Q6 Jan 2003

6(a)(i) 70 m s^{-1} ✓

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

(a)(iii) $v = \sqrt{(70^2 + 19.62^2)} = 73$ 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 ✓
<u>hence</u> deceleration (Newton's second law) ✓

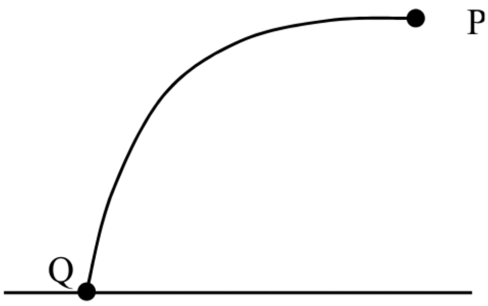
(b)(ii) air resistance decreases as speed decreases ✓
weight equals air resistance (hence constant speed)
(hence) resultant force is zero (Newton's first law) ✓ max*(4)*

(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) $32^2 = (0) + 2 \times 9.81 \times s$ ✓
$s = \frac{1024}{19.62}$ ✓ (= 52.2 m)

(ii) (use of $s = ½\,at^2$ gives) $52 = ½\,9.81 \times t^2$ ✓
$t = \sqrt{\left(\frac{104}{9.81}\right)} = 3.3$ s ✓ (3.26 s)
[or use of $v = u + at$ gives $32 = (0) + 9.81 \times t$ ✓
$t = \frac{32}{9.81} = 3.3$ 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*)

Q4 Jan 2008

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) (ii) (iii)	(use of speed = distance/time) time = 2/8.0 = 0.25 s ✓ (use of $v = u + at$) $v = 9.81 \times 0.25 = 2.45\ \text{m s}^{-1}$ ✓ (accept g = 10 m/s²) (use of $v^2 = v_h^2 + v_v^2$) $v^2 = 2.45^2 + 8.0^2$ ✓ $v = 8.37\ \text{m s}^{-1}$ ✓ angle below horizontal = $\tan^{-1}(2.45/8) = 17°$ ✓ (or 17.3°)	5
	Total	**6**

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) (ii)	$s = \frac{1}{2}gt^2$ gives $t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2\times 24}{9.8(1)}}$ ✓ = 2.2(1) s ✓ v (= s/t) = 27/2.2(1) ✓ = 12(.2 m s⁻¹) or 12(.3) ✓ (ecf from (b)(i)) (answer only gets both marks)	4
	Total	**6**