

Mark Scheme Projectiles Past Paper Questions

Jan 2002 to Jan 2009

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) $t = \frac{25}{9.81} = 2.5$ s ✓

Q8 Jan 2002

(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 ✓
 \therefore rate of change of momentum is less ✓
 [or work done on ball is the same but greater distance ✓ \therefore 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)

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})

Q6 Jan 2003

(a)(iii) $v = \sqrt{(70^2 + 19.6^2)} = 73 \text{ m s}^{-1}$ ✓

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

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

(allow C.E. for values of v from (i) and (ii))

[or use of correct scale drawing]

(5)

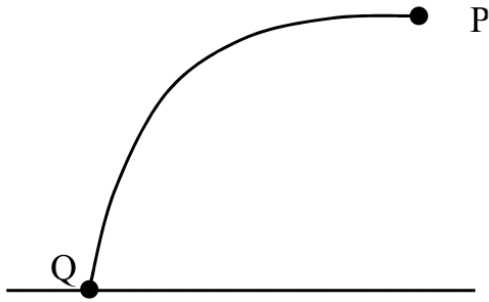
(b)(i) air resistance is greater than weight ✓
 (hence) resultant force is upwards ✓
hence deceleration (Newton's second law) ✓

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

(ii) (use of $s = \frac{1}{2}at^2$ gives) $52 = \frac{1}{2}9.81 \times t^2$ ✓
 $t = \sqrt{\left(\frac{104}{9.81}\right)} = 3.3 \text{ s}$ ✓ (3.26 s)

[or use of $v = u + at$ gives $32 = (0) + 9.81 \times t$ ✓
 $t = \frac{32}{9.81} = 3.3 \text{ s}$ ✓ (3.26 s)]

(iii) (use of $x = vt$ gives) $x (= QR) = 95 \times 3.26$ ✓
 $= 310 \text{ m}$ ✓

(use of $t = 3.3$ gives $x = 313.5 \text{ m}$)
 (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 ✓	Q4 Jan 2008 max 4
(b)	(i) (use of speed = distance/time) time = $2/8.0 = 0.25 \text{ s}$ ✓ (ii) (use of $v = u + at$) $v = 9.81 \times 0.25 = 2.45 \text{ m s}^{-1}$ ✓ (accept $g = 10 \text{ m/s}^2$) (iii) (use of $v^2 = v_h^2 + v_v^2$) $v^2 = 2.45^2 + 8.0^2$ ✓ $v = 8.37 \text{ m s}^{-1}$ ✓ angle below horizontal = $\tan^{-1}(2.45/8) = 17^\circ$ ✓ (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) $s = \frac{1}{2}gt^2$ gives $t = \sqrt{\frac{2y}{g}} = \sqrt{\frac{2 \times 24}{9.8(1)}} \checkmark = 2.2(1) \text{ s}$ ✓ (ii) $v (= s/t) = 27/2.2(1) \checkmark = 12(.2 \text{ m s}^{-1})$ or $12(.3) \checkmark$ (ecf from (b)(i)) (answer only gets both marks)	4
Total		6