# MECHANICS 2 (A) TEST PAPER 2 : ANSWERS AND MARK SCHEME

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|---|---|---|---|
| 1. | $F = \frac{1}{4}(0{\cdot}2g) = 0.49$ N  $W = Fd = 0{\cdot}49 \times 0{\cdot}5 = 0{\cdot}245$ J | M1 A1 M1 A1 | 4 |
| 2. | $0 = 10^2 + 2a(37{\cdot}5)$  $a = -13{\cdot}3$ ms$^{-2}$ | M1 A1 | |
| | Resisting force $= 0{\cdot}9(13{\cdot}3 - 9{\cdot}8) = 3{\cdot}18$ N | M1 A1 A1 | 5 |
| 3. | (a) When $x = 0$, $t(3t + 8) = 0$  No solution for $t > 0$ | M1 A1 | |
| | (b) $v = 6t + 8$  When $v = 20$, $6t = 12$  $t = 2$ | M1 A1 A1 | |
| | (c) $a = 6$, constant  $F = 0{\cdot}4 \times 6 = 2{\cdot}4$ N | B1 M1 A1 | 8 |
| 4. | (a) Impulse $= 2m[(5\mathbf{i} + \mathbf{j}) - (3\mathbf{i} - \mathbf{j})] = 2m(2\mathbf{i} + 2\mathbf{j})$ | M1 A1 | |
| | Magnitude $= 4m\sqrt{2}$ Ns or $5{\cdot}66m$ Ns | M1 A1 | |
| | (b) $2m(3\mathbf{i} - \mathbf{j}) + 3m(4\mathbf{i} + \mathbf{j}) = 2m(5\mathbf{i} + \mathbf{j}) + 3m\mathbf{v}_B$ | M1 A1 | |
| | $3\mathbf{v}_B = 8\mathbf{i} - \mathbf{j}$  $\lvert \mathbf{v}_B \rvert = \frac{1}{3}\sqrt{65}$  Speed of $B = 2{\cdot}69$ ms$^{-1}$ | M1 A1 A1 | 9 |
| 5. | (a) $25000 = 15(900 + 850a)$  $a = 0{\cdot}902$ ms$^{-2}$ | M1 A1 A1 | |
| | (b) $25000 = 900\, v_{max}$  $v_{max} = 27{\cdot}8$ ms$^{-1}$ | M1 A1 A1 | |
| | (c) $25000 = v(85g + 900)$  $v = 14{\cdot}4$ ms$^{-1}$ | M1 A1 M1 A1 | 10 |
| 6. | (a) $\sin C = \frac{3}{5}$ so $\cos C = \frac{4}{5}$  (3, 4, 5 Δ) | M1 A1 | |
| | (b) (i) $3a(0) + 10a(5a) + 5a(8a) = 18a\bar{x}$  $\bar{x} = 5a$ | M1 A1 A1 | |
| | (ii) $3a(1{\cdot}5a) + 10a(0) + 5a(1{\cdot}5a) = 18a\bar{y}$  $\bar{y} = \frac{2a}{3}$ | M1 A1 A1 | |
| | (c) $\tan \alpha = \frac{2a}{3} \div 5a = \frac{2}{15}$  $\alpha = 7{\cdot}6°$ | M1 A1 M1 A1 | 12 |
| 7. | Momentum : $1{\cdot}2 + 0{\cdot}2u = 0{\cdot}3v + 0{\cdot}4$  $3v - 2u = 8$ | M1 A1 | |
| | Elasticity : $(2 - v)/(u - 4) = -\frac{1}{3}$  $3v - u = 2$ | M1 A1 | |
| | Solve : $u = -6$, $v = -\frac{4}{3}$ | A1 A1 | |
| | (a) $Q$ before collision : 6 ms$^{-1}$  (b) $P$ after collision : $\frac{4}{3}$ ms$^{-1}$ | A1 A1 | |
| | (c) K.E. before $= 0.15(16) + 0.1(36) = 6$ J | M1 A1 | |
| | K.E. after $= 0.15(\frac{16}{9}) + 0.1(4) = \frac{2}{3}$ J  Loss $= 5\frac{1}{3}$ J | M1 A1 | 12 |
| 8. | (a) $x = 8 \cos 30°\, t$  When $x = 6$, $t = 0{\cdot}866$ s | M1 A1 | |
| | (b) Then $y = 8 \sin 30°\, t - 4{\cdot}9t^2 = -0{\cdot}21$ m, so does not hit coconut | M1 A1 M1 A1 | |
| | (c) When $v_y = 0$, $8 \sin 30° - 9{\cdot}8t = 0$  $t = 0{\cdot}408$ | M1 A1 | |
| | Then $y = 4(0{\cdot}408) - 4.9(0{\cdot}408^2) = 0{\cdot}816$ m | M1 A1 | |
| | (d) Max range when projected at 45°  $y = 0$ when $t = 1{\cdot}154$ | B1 M1 | |
| | Then $x = 1{\cdot}154\,(8 \cos 45°) = 6{\cdot}53$ m | A1 | |
| | (e) Ball = particle; assumed gravity is only force acting on ball | B1 B1 | 15 |