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

1. $F = \frac{1}{4}(0\cdot2g) = 0.49$ N $W = Fd = 0\cdot49 \times 0\cdot5 = 0\cdot245$ J   M1 A1 M1 A1   4

2. $0 = 10^2 + 2a(37\cdot5)$ $a = -13\cdot3$ ms^{-2} M1 A1

     Resisting force $= 0\cdot9(13\cdot3 - 9\cdot8) = 3\cdot18$ 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 $F = 0\cdot4 \times 6 = 2\cdot4$ 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 $5\cdot66m$ 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

       $3\mathbf{v}_B = 8\mathbf{i} - \mathbf{j}$ $|\mathbf{v}_B| = \frac{1}{3}\sqrt{65}$ Speed of $B = 2\cdot69$ ms^{-1} M1 A1 A1   9

5.   (a) $25000 = 15(900 + 850a)$ $a = 0\cdot902$ ms^{-2} M1 A1 A1

     (b) $25000 = 900 v_{\text{max}}$ $v_{\text{max}} = 27\cdot8$ ms^{-1} M1 A1 A1

     (c) $25000 = v(85g + 900)$ $v = 14\cdot4$ ms^{-1} M1 A1 M1 A1   10

6.   (a) $\sin C = \frac{3}{5}$ so $\cos C = \frac{4}{5}$ $(3, 4, 5\ \Delta)$ M1 A1

     (b) (i) $3a(0) + 10a(5a) + 5a(8a) = 18a\bar{x}$ $\bar{x} = 5a$ M1 A1 A1

        (ii) $3a(1\cdot5a) + 10a(0) + 5a(1\cdot5a) = 18a\bar{y}$ $\bar{y} = \frac{2a}{3}$ M1 A1 A1

     (c) $\tan \alpha = \frac{2a}{3} \div 5a = \frac{2}{15}$ $\alpha = 7\cdot6°$ M1 A1 M1 A1   12

7.   Momentum : $1\cdot2 + 0\cdot2u = 0\cdot3v + 0\cdot4$ $3v - 2u = 8$ 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 $x = 6, t = 0\cdot866$ s   M1 A1

     (b) Then $y = 8 \sin 30° \, t - 4\cdot9t^2 = -0\cdot21$ m, so does not hit coconut   M1 A1 M1 A1

     (c) When $v_y = 0$, $8 \sin 30° - 9\cdot8t = 0$ $t = 0\cdot408$ M1 A1

       Then $y = 4(0\cdot408) - 4.9(0\cdot408^2) = 0\cdot816$ m   M1 A1

     (d) Max range when projected at $45°$ $y = 0$ when $t = 1\cdot154$ B1 M1

       Then $x = 1\cdot154 (8 \cos 45°) = 6\cdot53$ m   A1

     (e) Ball $=$ particle; assumed gravity is only force acting on ball   B1 B1   15