MECHANICS 1 (A) TEST PAPER 6 : ANSWERS AND MARK SCHEME

1. $F = 0.34$ N at dist. d from X, where $0.34d = 0.2 \times 1.5 + 0.14 \times 2$ B1 M1 A1

   $0.34d = 0.58$ $d = 1.71$ m or 171 cm   A1 M1 A1   6

2. (a) At P, $v = 9 + 3.6t$ At Q, $v = 9 + 3.6t + 2t = 9 + 5.6t$ M1 A1

       $9 + 5.6t = 16$ $5.6t = 7$ $t = 1.25$ O to Q : 2.5 s   M1 A1

   (b) $\frac{1}{2} \times 1.25 \times (9 + 13.5 + 13.5 + 16) = 32.5$ m   M1 A1 A1   7

3. (a) Resolve : $F \sin 60° = T \sin 30°$, $F \cos 60° + T \cos 30° = 0.8g$ M1 A1 A1

       Hence $F\sqrt{3} = T$, $F + T\sqrt{3} = 1.6g$ $4F = 1.6g$ $F = 3.92$ N   M1 M1 A1

   (b) $T = 3.92\sqrt{3} = 6.79$ N   M1 A1

   (c) Modelled clay as a particle   B1   9

4. (a) Momentum : $7 \times 50 - 4y = 2.25(50 + y)$ $6.25y = 237.5$ $y = 38$ M1 A1 A1

       Impulse $= 0.05(7 - 2.25) = 0.238$ Ns   M1 A1

   (b) Momentum : $7 \times 50 - 4y = -5 \times 50 + 5y$ $9y = 600$ $y = 66\frac{2}{3}$ M1 A1 A1

       Impulse $= 0.05 \times 12 = 0.6$ Ns   M1 A1   10

5. (a) $0 = 7^2 - 2a(4)$ $a = \frac{49}{8}$ ms^{-2} M1 A1

   (b) Acc down plane $= g \sin 25° + \mu g \cos 25° = 9.8(\sin 25° + \mu \cos 25°)$ M1 A1

       Hence $\sin 25° + \mu \cos 25° = 0.625$ $\mu = 0.223$ M1 A1

   (c) Now down plane, acc. $= g \sin 25° - \mu g \cos 25° = 0.220g$ M1 A1

       $v^2 = 0 + 2(4)(0.220g) = 17.27$ $v = 4.16$ ms^{-1} M1 A1

   (d) Air resistance, which would make the answer smaller   B1 B1   12

6. (a) $\overrightarrow{AB} = -50i + 120j$, which has magnitude 130   M1 A1

       $\underrightarrow{v_C} = \frac{2.6}{130}(-50i + 120j) = (-i + 2.4j)$ ms^{-1} M1 A1

   (b) $OB = -20i + 60j$, of magnitude $\sqrt{4000} = 20\sqrt{10}$ M1 A1

       $v_D = \frac{k\sqrt{10}}{20\sqrt{10}}(-20i + 60j) = k(-i + 3j)$ ms^{-1} M1 A1

   (c) Posn. vectors at time t are $(30 - t)i + (2.4t - 60)j$ and $kt(-i + 3j)$ B1 B1

       When these are equal, $30 - t = -kt$ and $2.4t - 60 = 3kt$ M1

       $-60 + 2.4t = -3(30 - t)$ $t = 50$ $k = 0.4$ A1 M1 A1   14

7. (a) $4.5g - T = 4.5a$, $T - 4g = 4a$ Add : $0.5g = 8.5a$ $a = 0.576$ ms^{-2} M1 A1 A1 M1 A1

   (b) $v^2 = 2as = 2(0.576)(1.9) = 2.191$ $v = 1.48$ ms^{-1} M1 A1 A1

   (c) P has risen 1.9 m and has speed 1.48 ms^{-1} B1

       Under gravity P rises s m where $0 = 1.48^2 - 2(9.8)s$ M1 A1 A1

       $s = 0.112$ m < 1.1 m, so P does not hit the pulley   M1 A1

   (d) Momentum conserved : $4(1.48) + 4.5(0) = 8.5v$ $v = 0.697$ ms^{-1} M1 A1 A1   17