MECHANICS 1 (A) TEST PAPER 4 : ANSWERS AND MARK SCHEME

1. (a) Impulse = change in momentum : $12 = 25m - (-15m)$ M1 A1
   $40m = 12$ $m = 0{\cdot}3$ (b) ball = particle, wall vertical M1 A1; B1 B1 6

2. Net force south = $8\cos 30° - 4 = 2{\cdot}928$; net force east = $5 - 4 = 1$ M1 A1 A1
   Res. = $\sqrt{(2{\cdot}928^2 + 1^2)} = 3{\cdot}09$ N; bearing = $90° + \tan^{-1}(2{\cdot}928) = 161°$ M1 A1 M1 A1 7

3. (a) $T - 260g = 0$ $T = 2550$ N $R - 60g = 0$ $R = 588$ N M1 A1 A1
   (b) $T - 260g = 1{\cdot}2 \times 260$ $T = 2548 + 312 = 2860$ N M1 A1
   $R - 60g = 1{\cdot}2 \times 60$ $R = 588 + 72 = 660$ N M1 A1
   (c) Modelled lift and case as particles, cable as light string B1 B1 9

4. (a) $\mathbf{P} = 3 + 2 + 6 = 11$ N B1
   (b) Let $AB = 11x$ M(A) : $11AC = 3x + 10x + 42x = 55x$ M1 A1 A1
   $AC = 5x$, so $AC : CB = 5 : 6$ M1 A1
   (c) M(C) : $3(5x) + 6(2x) = k(6x) + 3(4x)$ M1 A1 A1
   $15 + 12 = 6k + 12$ $6k = 15$ $k = 2{\cdot}5$ A1 M1 A1 12

5. (a) $5m = 2mv$ $v = 2{\cdot}5$ B1
   (b) Smooth pulley B1
   (c) $F = ma$ for each sphere : $T + \frac{2}{7}(2mg) = 2ma$, $mg - T = ma$ M1 A1 A1
   Add : $3ma = \frac{11}{7}mg$ $a = \frac{11g}{21} = 5{\cdot}13$ ms^{-2} M1 A1
   $v = u + at$: $0 = 2{\cdot}5 - 5{\cdot}13t$ $t = 0{\cdot}487$ s M1 A1
   (d) $v^2 = u^2 + 2as$: $0 = 2{\cdot}5^2 - 10{\cdot}27s$ $s = 0{\cdot}609$ m M1 A1 M1 A1 13

6. (a) Sum of areas = $3x + 5{\cdot}5x + 2{\cdot}5x = 792$ $11x = 792$ $x = 72$ M1 A1 M1 A1
   Acc. = $6 \div 72 = \frac{1}{12}$ ms^{-2} M1 A1
   (b) Area under new graph = $\frac{1}{2}(3t + t)(\frac{1}{11}t) = 792$ $4t^2 = 22 \times 792$ M1 M1 A1
   $t^2 = 4356$ $t = 66$ Total time = $3t = 198$ s M1 A1 A1
   (c) $v_{max} = 66 \times \frac{1}{11} = 6$ ms^{-1}, as for first cyclist M1 A1 14

7. (a) $\overrightarrow{XY} = 8\mathbf{i} + 6\mathbf{j}$ $XY = \sqrt{(8^2 + 6^2)} = 10$ m M1 A1
   (b) $\mathbf{v}_P = (8\mathbf{i} + 6\mathbf{j}) \div 4 = (2\mathbf{i} + 1{\cdot}5\mathbf{j})$ ms^{-1} M1 A1 A1
   (c) $4\mathbf{i} - 5\mathbf{j} + t(2\mathbf{i} + 1{\cdot}5\mathbf{j})$ or $(4 + 2t)\mathbf{i} + (1{\cdot}5t - 5)\mathbf{j}$ M1 A1
   (d) $4 + 2t = 16$ and $1{\cdot}5t - 5 = 4$ when $t = 6$ M1 A1
   (e) Momentum : $2(2{\cdot}5) + 4(0) = 6v$ $v = \frac{5}{6}$ M1 A1
   $\mathbf{v} = \frac{5}{6}(2\mathbf{i} + 1{\cdot}5\mathbf{j}) \div 2{\cdot}5 = \frac{2}{3}\mathbf{i} + \frac{1}{2}\mathbf{j}$ M1 A1 A1 14