

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

1. (a) Impulse = change in momentum : $12 = 25m - (-15m)$ M1 A1
 $40m = 12 \quad m = 0.3$ (b) ball = particle, wall vertical M1 A1; B1 B1 6
2. Net force south = $8 \cos 30^\circ - 4 = 2.928$; net force east = $5 - 4 = 1$ M1 A1 A1
 Res. = $\sqrt{(2.928^2 + 1^2)} = 3.09$ N; bearing = $90^\circ + \tan^{-1}(2.928) = 161^\circ$ M1 A1 M1 A1 7
3. (a) $T - 260g = 0 \quad T = 2550$ N $R - 60g = 0 \quad R = 588$ N M1 A1 A1
 (b) $T - 260g = 1.2 \times 260 \quad T = 2548 + 312 = 2860$ N M1 A1
 $R - 60g = 1.2 \times 60 \quad R = 588 + 72 = 660$ N M1 A1
 (c) Modelled lift and case as particles, cable as light string B1 B1 9
4. (a) $P = 3 + 2 + 6 = 11$ 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
 $15 + 12 = 6k + 12 \quad 6k = 15 \quad k = 2.5$ A1 M1 A1 12
5. (a) $5m = 2mv \quad v = 2.5$ B1
 (b) Smooth pulley B1
 (c) $F = ma$ for each sphere : $T + \frac{2}{7}(2mg) = 2ma, \quad mg - T = ma$ M1 A1 A1
 Add : $3ma = \frac{11}{7}mg \quad a = \frac{11g}{21} = 5.13$ ms⁻² M1 A1
 $v = u + at : 0 = 2.5 - 5.13t \quad t = 0.487$ s M1 A1
 (d) $v^2 = u^2 + 2as : 0 = 2.5^2 - 10.27s \quad s = 0.609$ m M1 A1 M1 A1 13
6. (a) Sum of areas = $3x + 5.5x + 2.5x = 792 \quad 11x = 792 \quad x = 72$ M1 A1 M1 A1
 Acc. = $6 \div 72 = \frac{1}{12}$ ms⁻² M1 A1
 (b) Area under new graph = $\frac{1}{2}(3t + t)(\frac{1}{11}t) = 792 \quad 4t^2 = 22 \times 792$ M1 M1 A1
 $t^2 = 4356 \quad t = 66 \quad$ 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) $\vec{XY} = 8\mathbf{i} + 6\mathbf{j} \quad XY = \sqrt{(8^2 + 6^2)} = 10$ m M1 A1
 (b) $\mathbf{v}_p = (8\mathbf{i} + 6\mathbf{j}) \div 4 = (2\mathbf{i} + 1.5\mathbf{j})$ ms⁻¹ M1 A1 A1
 (c) $4\mathbf{i} - 5\mathbf{j} + t(2\mathbf{i} + 1.5\mathbf{j})$ or $(4 + 2t)\mathbf{i} + (1.5t - 5)\mathbf{j}$ M1 A1
 (d) $4 + 2t = 16$ and $1.5t - 5 = 4$ when $t = 6$ M1 A1
 (e) Momentum : $2(2.5) + 4(0) = 6v \quad v = \frac{5}{6}$ M1 A1
 $\mathbf{v} = \frac{5}{6}(2\mathbf{i} + 1.5\mathbf{j}) \div 2.5 = \frac{2}{3}\mathbf{i} + \frac{1}{2}\mathbf{j}$ M1 A1 A1 14