

MECHANICS 1 (A) TEST PAPER 3 : ANSWERS AND MARK SCHEME

1. (a) $(7\mathbf{i} + 24\mathbf{j}) \text{ ms}^{-1}$ (b) $\sqrt{7^2 + 14^2} = 7\sqrt{5}$ or 15.7 ms^{-1} M1 A1; M1 A1
 on bearing $\tan^{-1} 0.5 = 026.6^\circ$ (c) $2.5\sqrt{5} = 5.59 \text{ N}$ A1; M1 A1 7
2. (a) $M(A) : 1.4W = 3.15 \times 12$ $W = 27 \text{ N}$ M1 A1 M1 A1
 (b) $R + 12 = 27$ $R = 15 \text{ N}$ M1 A1
 (c) Bar stays rigid (in a straight line); weight not acting at centre B1 7
3. (a) Resolve perp. and // plane: $R = 1.2g \cos \alpha$, $8.4 = 1.2g \sin \alpha + \frac{1}{8}R$ M1 A1 M1 A1
 $1.2g(\sin \alpha + \frac{1}{8} \cos \alpha) = 8.4$ $7(8 \sin \alpha + \cos \alpha) = 40$ M1 A1
 (b) Acc. down plane $= g \sin 38^\circ - \frac{1}{8}g \cos 38^\circ = 5.07 \text{ ms}^{-2}$ M1 M1 A1 A1 10
4. (a) $420 = \frac{1}{2}(20 + 8)t$ $t = 30 \text{ s}$ M1 A1
 (b) $20 = 8 + 30a$ $30a = 12$ $a = 0.4 \text{ ms}^{-2}$ M1 A1
 (c) $s = ut + \frac{1}{2}at^2 : 240 = 8t + 0.2t^2$ $t^2 + 40t - 1200 = 0$ M1 A1
 $(t - 20)(t + 60) = 0$ $t = 20$ M1 A1
 (d) $F = ma : 900 - R = 1200(0.4)$ $R = 900 - 480 = 420 \text{ N}$ M1 A1 A1 11
5. (a) Momentum conserved : $6x = \pm 2x + 3y$ $4x = 3y$ or $8x = 3y$ M1 A1 A1
 $x : y = 3 : 4$ or $x : y = 3 : 8$ M1 A1 A1
 (b) Modelled as particles B1
 (c) $2x - ky = vx$ where $v < 0$. X moving towards Y , so $x : y = 3 : 4$ M1 A1
 Hence $2 - \frac{4}{3}k < 0$ $k > 1.5$ M1 A1 11
6. (a) $2g \cos 30^\circ - T = 2a$, $T - 3g \cos 60^\circ = 3a$ M1 A1 A1
 Add : $g(\sqrt{3} - 1.5) = 5a$ $a = 0.455 \text{ ms}^{-2}$ M1 A1
 (b) $T = 3a + 1.5g = 16.1 \text{ N}$ M1 A1
 (c) $v^2 = u^2 + 2as = 0 + 2a(0.8) = 0.728$ $v = 0.853 \text{ ms}^{-1}$ M1 A1 A1
 (d) String inextensible, so acceleration the same for both particles B1 B1
 Pulley smooth, so tension is constant throughout the string B1 B1 14
7. (a) $s_A = 98t - 4.9t^2$ $s_B = 24.5t$ M1 A1 B1
 (b) $d^2 = (4.9t(20 - t))^2 + (24.5t)^2 = 4.9^2(t^2(t^2 - 40t + 400) + (5t)^2)$ M1 A1 A1
 $= 24.01t^2(t^2 - 40t + 400 + 25) = 24.01(t^4 - 40t^3 + 425t^2)$ M1 M1 A1
 (c) $\frac{d}{dt}(d^2) = 24.01(4t^3 - 120t^2 + 850t) < 0$ for decreasing function M1 A1
 When $4t^2 - 120t + 850 = 0$, $t = 11.5$ or $t = 18.5$, so range is M1 A1 A1
 $11.5 \leq t \leq 18.5$ A1 15