

4729 Mechanics 2

1	$200\cos 35^\circ$ $200\cos 35^\circ \times d = 5000$ $d = 30.5 \text{ m}$	B1 M1 A1 3	3
2	$0.03R = \frac{1}{2} \times 0.009(250^2 - 150^2)$ $0.03R$	M1 B1	$150^2 = 250^2 + 2a \times 0.03$ $a = \pm 2 \times 10^6/3$ or $\pm 666,667$ (A1)
	either K.E. $R = 6000 \text{ N}$	B1 A1  4	$F = 0.009a$ (M1)  unit errors 4
3 (i)	$D = 12000/20$ $12000/20 = k \times 20 + 600 \times 9.8 \times 0.1$ $k = 0.6$	B1 M1 A1 3	AG
(ii)	$16000/v = 0.6v + 600 \times 9.8 \times 0.1$ $0.6v^2 + 588v - 16000 = 0$ $v = 26.5 \text{ m s}^{-1}$	M1 M1 A1 3	attempt to solve quad. (3 terms)
(iii)	$16000/32 - 0.6 \times 32 = 600a$ $a = 0.801 \text{ m s}^{-2}$	M1 A1 A1 3	0.80 or 0.8 9
4 (i)	$0 = 35\sin\theta \times t - 4.9t^2$ $t = 35\sin\theta/4.9$ $50\sin\theta/7$ $R = 35\cos\theta \times t$ aef $R = 35^2\sin\theta.\cos\theta/4.9$ $R = 125\sin 2\theta$	M1 A1 B1 M1 A1 5	$R = u^2\sin 2\theta/g$ only ok if proved or $70\sin\theta/g$ aef their t eliminate t
(ii)	$110 = 125\sin 2\theta$ $\theta = 30.8^\circ$ or 59.2° $t = 3.66 \text{ s}$ or 6.13 s	M1 A1+1 A1+1 5	AG 10
5 (i)	$3/8 \times 3$ (1.125) $0.53d = 5 \times 0.02 + (10 + 3/8 \times 3) \times 0.5$	B1 M1 A1	c.o.m. hemisphere
(ii)	$d = 10.7$ Attempt to calc a pair relevant to P,G $OP = 0.9$ (pair), $p = 73.3^\circ$ $q = 16.7^\circ$ $r = 76.9^\circ$ (77.2°) , $s = 13.1^\circ$ (12.8°) $AC = 0.86$, $BC = 0.67$, $AD = 10.4$ $BD = 10.2$ $r > p$, $s < q$, $p + s < 90$, $0.67 < 0.86$, $10.2 < 10.4$ it is in equilibrium	A1 4 M1 A1 M1 A1 4	$0.53e = 3 \times 5/8 \times 0.5 + 8 \times 0.02 + 13 \times .01$ $0.53f = 3 \times 3/8 \times 0.5 - 5 \times 0.02 - 10 \times 0.01$ AG ($e = 2.316$ $f = 0.684$) distance / angle not a complimentary pair make relevant comparison $0.7 < 0.9$ ($OG < OP$) $10.7 < 10.9$

6 (i)	$T\cos 60^\circ = S\cos 60^\circ + 4.9$	M1	Resolving vertically nb for M1: (must be components – all 4 cases) Res. Horiz. $m\omega^2$ ok if $\omega \neq 3$ If equal tensions $2T=45/4$ M1 only
	$T\sin 60^\circ + S\sin 60^\circ = 0.5 \times 3^2/0.4$	A1	
(ii)	$(S + 9.8)\sin 60^\circ + S\sin 60^\circ = 45/4$	M1	Resolving vertically (component)
	$S = 1.60 \text{ N}$	A1	
(ii)	$T = 11.4 \text{ N}$	A1	Resolving horiz. (component)
	$T\cos 60^\circ = 4.9$	M1	
(ii)	$T = 9.8$	A1	or 6.5
	$T\sin 60^\circ = 0.5 \times 0.4\omega^2$	M1	
(ii)	$\omega = 6.51 \text{ rad s}^{-1}$	A1	12
		A1	

7 (i)	$u = 3 \text{ m s}^{-1}$	B1	
	$6 = 2x + 3y$	M1	
(ii)	$e = (y - x) / 3$	A1	(e = 2/3) (equs must be consistent)
	$y = 2$	M1	
(ii)	$v_h = 2$	A1	AG
	$v_v^2 = 2 \times 9.8 \times 4$	B1	
(ii)	$v_v = 8.85$ (14√10/5)	M1	(B1) $\frac{1}{2}mv^2$
	speed = $\sqrt{(8.85^2 + 2^2)}$	A1	
(ii)	9.08 m s^{-1}	M1	(B1) $mx9.8x4$
	$\tan^{-1}(8.85/2)$	A1	
(ii)	77.3° to horizontal	M1	$v = \sqrt{(2^2 + 2 \times 9.8 \times 4)}$
		A1	
(ii)		M1	or $\cos^{-1}(2/9.08)$
		A1	
(ii)		A1	12.7° to vertical
		A1	

8 (i)	com of Δ 3 cm right of C	B1	
	$(48+27)\bar{x} = 48 \times 4 + 27 \times 11$	M1	
(ii)	$\bar{x} = 6.52$	A1	
	com of Δ 2 cm above AD	A1	
(ii)	$(48+27)\bar{y} = 48 \times 3 + 27 \times 2$	B1	
	$\bar{y} = 2.64$	M1	
(ii)	14F	A1	8
	$3g\cos 30^\circ \times 6.52$	B1	
(ii)	$3g\sin 30^\circ \times 2.64$	B1	can be implied e.g. $7/\sin 30^\circ \cdot F$
	$14F = 3g\cos 30^\circ \times 6.52 - 3g\sin 30^\circ \times 2.64$	B1	
(ii)	$F = 9.09 \text{ N}$	M1	7.034 (AG) or $(6.52 - 2.64\tan 30^\circ)$
		A1	
(ii)		M1	52.0° (GAH) or $(\text{above})x\cos 30^\circ$
		A1	
(ii)		M1	(5.00) $x\cos 30^\circ$ (4.33)
		A1	
(ii)		M1	14F = $3 \times 9.8 \times 7.034 \times \cos 52.0^\circ$
		A1	