

4729 Mechanics 2

1 (i)	$12 \times \cos 55^\circ$ 6.88 m s^{-1}	M1 A1 2	
(ii)	$12 \times \cos 55^\circ \times 0.65$ $(\pm) 4.47 \text{ m s}^{-1}$ ✓	M1 A1 2	✓ $0.65 \times \text{their (i)}$ 4
2	$F = 0.2 \text{ mg} \cos 30^\circ$ $0.2 \text{ mg} \cos 30^\circ \times d$ $\text{mg} \times d \times \sin 30^\circ$ $d = \frac{1}{2} \times 25 / (0.2 \times 9.8 \cos 30^\circ + 9.8 \times \sin 30^\circ)$ 1.89 m	M1 A1 B1 B1 M1 A1 6	= = $(1.6974 \text{ m}) (49\sqrt{3}/50 \text{ m})$ $a = 0.2g \cos 30^\circ + g \sin 30^\circ$ $a = (\pm) 6.60$ $0 = 5^2 - 2 \times 6.60d$ 6
3	direction of R perp. to wall R at 70° to rod $0.8 \times 25 \cos 60^\circ = 1.6 \times R \sin 70^\circ$ $0.8 \times 25 \cos 60^\circ$ $1.6 \times R \sin 70^\circ$ R = 6.65 N	B1 B1 M1 A1 A1 A1 6	10° to horiz. moments about A 6
4 (i)	$45\,000/v = kv$ k = 50	M1 A1 2	AG
(ii)	$45\,000/20 - 50 \times 20 = 1200a$ $a = 1.04 \text{ m s}^{-2}$	M1 A1 A1 3	
(iii)	$P/15 = 50 \times 15 + 1200 \times 9.8 \sin 10^\circ$ 41 900 W	M1 A1 A1 3	8
5 (i)	$2mu - 3kmu = -mu + kmv$ $v = \dots$ $v = 3u(1 - k)/k$ $(0 <) k < 1$	M1 M1 A1 A1 4	attempting to make v the subject $3u/k - 3u$ not ≤ 1
(ii)	$I = mu - - 2mu$ $3mu$	M1 A1 2	or $km(3u/k - 3u + 3u)$ + only
(iii)	$v = \pm 3u$ $e = (u/2 + 3u)/4u$ $e = 7/8$ or 0.875	B1 M1 A1 3	9

6 (i)(a)	$T \cos 45^\circ = 2.94$ $T = 4.16 \text{ N}$	M1 A1 2	Resolving vertically AG	
(b)	$T \cos 45^\circ + T = 0.3 \times 1.96 \omega^2$ (res. horiz.) $\omega = 3.47 \text{ rad s}^{-1}$	M1 A1 A1 3	calculates $v = 6.81$ (Max 2/3)	
(ii)(a)	$T \cos 30^\circ + T \cos 60^\circ = 2.94$ $T = 2.15 \text{ N}$	M1 A1 A1 3	Resolving vertically	
(b)	$T \cos 30^\circ + T \cos 60^\circ = 0.3v^2/1.5$ (res. horiz.) $v = 3.83 \text{ m s}^{-1}$	M1 A1 A1 3	calculates $\omega = 2.56$ (Max 2/3)	11
7 (i)	$0 = (175 \sin \theta)^2 - 2 \times 9.8 \times 650$ $\theta = 40.2^\circ$	M1 A1 A1 3		
(ii)	Attempt at t_1, t_2, t_{top} or t_{total} 5.61, 23.65, 14.63, 29.26 $t_2 - t_1$ or $2(t_{\text{top}} - t_1)$ or $t_{\text{total}} - 2t_1$ time difference = 18.0	M1 A1 M1 A1 A1 5	$650 = 175 \sin 55^\circ \cdot t - 4.9t^2$ etc	
(iii)	$v_h = 175 \cos 55^\circ$ (100.4) $v_v = 175 \sin 55^\circ - 9.8 \times 5.61$ speed = $\sqrt{(88.4^2 + 100.4^2)}$ 134 m s^{-1}	B1 M1 M1 A1 4	or KE $\frac{1}{2}mv^2$ (B1) PE $mx9.8 \times 650$ $v = \sqrt{(175^2 - 2 \times 9.8 \times 650)}$	12
8 (i)	$(2 \times 4 \times \sin \Pi/2) / 3 \times \Pi/2$ 1.70	M1 A1 2	or $4r/3\Pi$ AG	
(ii)(a)	$\bar{x} \times d(8 \times 20 - \Pi \times 4^2/2) = 10 \times 8 \times 20d - 12 \times \Pi \times 4^2/2 \times d$ $10 \times 8 \times 20(d)$ (1600) $(8 \times 20 - \Pi \times 4^2/2)(d)$ (134.9) $(12 \times \Pi \times 4^2/2)(d)$ (301.6) $\bar{x} = 9.63 \text{ cm}$	M1 A1 A1 A1 A1 5	or $134.9 \bar{x} = 64 \times 4 + 38.9 \times 12 + 32 \times 18$ (1298.8) 64×4 38.9×12 32×18 AG	
(ii)(b)	$\bar{y} \times d(8 \times 20 - \Pi \times 4^2/2) = 4 \times 8 \times 20d - 1.7 \times \Pi \times 4^2/2 \times d$ $4 \times 8 \times 20(d)$ $1.7d \times \Pi \times 4^2/2$ (13.6\Pi) $\bar{y} = 4.43 \text{ cm}$	M1 A1 A1M1 A1 4	or $64 \times 4 = 42.7 + 38.9 \bar{y}$ $\bar{y} = 5.49$ $135 \bar{y} = 32 \times 4 + 38.9 \times 5.49 + 64 \times 4$	
(iii)	$20 \cos 10^\circ \times T$ $15 \cos 10^\circ \times 9.63$ $15 \sin 10^\circ \times 4.43$ $20 \cos 10^\circ \cdot T = 15 \cos 10^\circ \times 9.63 - 15 \sin 10^\circ \times 4.43$ (needs 3 parts) $T = 6.64 \text{ N}$	B1 B1 B1 M1 A1 5	= or 10.6 (A to com) $34.7^\circ \angle \text{comAH}$ $= 15 \times 10.6 \times \cos 34.7^\circ$	16