4729 Mechanics 2

1	200cos35° 200cos35° x d = 5000 d = 30.5 m	B1 M1 A1 **3**	**3**

2	$0.03R = ½x0.009(250^2 – 150^2)$ 0.03R	M1 B1	$150^2 = 250^2 + 2a$ x 0.03 $a = ±2x10^6/3$ or ±666,667 (A1)
	either K.E. R = 6000 N	B1 A1 ✓ **4**	F = 0.009a (M1) ✓ unit errors **4**

3 (i)	D = 12000/20 12000/20=k x 20 + 600 x 9.8 x 0.1 k = 0.6	B1 M1 A1 **3**	**AG**
(ii)	16000/v = 0.6v + 600 x 9.8 x 0.1 $0.6 v^2 + 588v – 16000 = 0$ $v = 26.5$ m s^{-1}	M1 M1 A1 **3**	attempt to solve quad. (3 terms)
(iii)	16000/32 – 0.6 x 32 = 600a $a = 0.801$ m s^{-2}	M1 A1 A1 **3**	0.80 or 0.8 **9**

4 (i)	$0 = 35\sin\theta$ x t – $4.9t^2$ t = 35sinθ/4.9 50sinθ/7 R = 35cosθ x t aef $R = 35^2\sin\theta.\cos\theta/4.9$ R = 125sin2θ	M1 A1 B1 M1 A1 **5**	$R=u^2\sin2\theta/g$ only ok if proved or 70sinθ/g aef their t eliminate t **AG**
(ii)	110 = 125sin2θ θ = 30.8° or 59.2° t = 3.66 s or 6.13 s	M1 A1+1 A1+1 **5**	**10**

5 (i)	3/8 x 3 (1.125) 0.53d = 5x0.02 + (10 + 3/8x3) x 0.5 d = 10.7	B1 M1 A1 A1 **4**	c.o.m. hemisphere 0.53e=3x5/8x0.5+8x0.02+13x .01 0.53f=3x3/8x0.5-5x0.02-10x0.01 **AG (**e = 2.316 f = 0.684**)**
(ii)	Attempt to calc a pair relevant to P,G OP=0.9 (pair) , p= 73.3° q=16.7° r=76.9° (77.2°) , s=13.1°(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	M1 A1 M1 A1 **4**	distance / angle not a complimentary pair make relevant comparison 0.7 < 0.9 (OG < OP) 10.7 < 10.9 **8**

6 (i)	$T\cos60° = S\cos60° + 4.9$	M1		Resolving vertically nb for M1:
		A1		(must be components – all 4 cases)
	$T\sin60° + S\sin60° = 0.5 \times 3^2/0.4$	M1		Res. Horiz. $mr\omega^2$ ok if $\omega \neq 3$
		A1		If equal tensions 2T=45/4 M1 only
	$(S + 9.8)\sin60° + S\sin60° = 45/4$	M1		
	$S = 1.60$ N	A1		
	$T = 11.4$ N	A1	**7**	
(ii)	$T\cos60° = 4.9$	M1		Resolving vertically (component)
	$T = 9.8$	A1		
	$T\sin60° = 0.5 \times 0.4\omega^2$	M1		Resolving horiz. (component)
		A1		
	$\omega = 6.51$ rad s^{-1}	A1	**5**	or 6.5 **12**

7 (i)	$u = 3$ m s^{-1}	B1		
	$6 = 2x + 3y$	M1		
		A1		
	$e = (y - x)/3$	M1		
		A1		($e = ⅔$) (equs must be consistent)
	$y = 2$	A1	**6**	**AG**
(ii)	$v_h = 2$	B1		or (B1) $½mx2^2$
	$v_v^2 = 2 \times 9.8 \times 4$	M1		(B1) $½mxv^2$
	$v_v = 8.85$ $(14\sqrt{10}/5)$	A1		
				(B1) $mx9.8x4$
	speed $= \sqrt{(8.85^2 + 2^2)}$	M1		$v = \sqrt{(2^2 + 2x9.8x4)}$
	9.08 m s^{-1}	A1		
	$\tan^{-1}(8.85/2)$	M1		or $\cos^{-1}(2/9.08)$
	77.3° to horizontal	A1	**7**	12.7° to vertical **13**

8 (i)	com of Δ 3 cm right of C	B1		
	$(48+27)\bar{x} = 48x4 + 27x11$	M1		
		A1		
	$\bar{x} = 6.52$	A1		
	com of Δ 2 cm above AD	B1		
	$(48+27)\bar{y} = 48x3 + 27x2$	M1		
		A1		
	$\bar{y} = 2.64$	A1	**8**	
(ii)	14F	B1		can be implied e.g. 7/sin30°. F
	$3g\cos30° \times 6.52$	B1		7.034 (AG) or (6.52-2.64tan30°)
	$3g\sin30° \times 2.64$	B1		52.0° (GAH) or (above)xcos30° (5.00)xcos30° (4.33)
	$14F = 3g\cos30° \times 6.52 - 3g\sin30° \times 2.64$	M1		$14F = 3x9.8x7.034x\cos52.0°$
	$F = 9.09$ N	A1	**5**	**13**