

## 4729 Mechanics 2

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

<p><b>6 (i)</b></p> <p><math>T\cos 60^\circ = S\cos 60^\circ + 4.9</math></p> <p><math>T\sin 60^\circ + S\sin 60^\circ = 0.5 \times 3^2/0.4</math></p> <p><math>(S + 9.8)\sin 60^\circ + S\sin 60^\circ = 45/4</math></p> <p><math>S = 1.60 \text{ N}</math></p> <p><math>T = 11.4 \text{ N}</math></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>A1</p> <p><b>7</b></p>	<p>Resolving vertically nb for M1: (must be components – all 4 cases) Res. Horiz. <math>m\omega^2</math> ok if <math>\omega \neq 3</math> If equal tensions <math>2T=45/4</math> M1 only</p>	<p><b>12</b></p>
<p><b>(ii)</b></p> <p><math>T\cos 60^\circ = 4.9</math></p> <p><math>T = 9.8</math></p> <p><math>T\sin 60^\circ = 0.5 \times 0.4\omega^2</math></p> <p><math>\omega = 6.51 \text{ rad s}^{-1}</math></p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>A1</p> <p><b>5</b></p>	<p>Resolving vertically (component)</p> <p>Resolving horiz. (component)</p>	<p>or 6.5</p> <p><b>13</b></p>
<p><b>7 (i)</b></p> <p><math>u = 3 \text{ m s}^{-1}</math></p> <p><math>6 = 2x + 3y</math></p> <p><math>e = (y - x) / 3</math></p> <p><b>(ii)</b></p> <p><math>y = 2</math></p> <p><math>v_h = 2</math></p> <p><math>v_v^2 = 2 \times 9.8 \times 4</math></p> <p><math>v_v = 8.85 \quad (14\sqrt{10}/5)</math></p> <p>speed = <math>(8.85^2 + 2^2)</math></p> <p><math>9.08 \text{ m s}^{-1}</math></p> <p><math>\tan^{-1}(8.85/2)</math></p> <p><math>77.3^\circ</math> to horizontal</p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p><b>6</b></p> <p>B1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p><b>7</b></p>	<p>(<math>e = 2/3</math>) (equus must be consistent)</p> <p><b>AG</b></p> <p>or (B1) <math>\frac{1}{2}mx^2</math></p> <p>(B1) <math>\frac{1}{2}m xv^2</math></p> <p>(B1) <math>mx9.8x4</math></p> <p><math>v = \sqrt{(2^2 + 2x9.8x4)}</math></p> <p>or <math>\cos^{-1}(2/9.08)</math></p> <p><math>12.7^\circ</math> to vertical</p>	<p><b>13</b></p>
<p><b>8 (i)</b></p> <p>com of <math>\Delta</math> 3 cm right of C</p> <p><math>(48+27)\bar{x} = 48x4 + 27x11</math></p> <p><math>\bar{x} = 6.52</math></p> <p>com of <math>\Delta</math> 2 cm above AD</p> <p><math>(48+27)\bar{y} = 48x3 + 27x2</math></p> <p><math>\bar{y} = 2.64</math></p> <p><b>(ii)</b></p> <p>14F</p> <p><math>3g\cos 30^\circ \times 6.52</math></p> <p><math>3g\sin 30^\circ \times 2.64</math></p> <p><math>14F = 3g\cos 30^\circ \times 6.52 - 3g\sin 30^\circ \times 2.64</math></p> <p><math>F = 9.09 \text{ N}</math></p>	<p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p>A1</p> <p><b>8</b></p> <p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>A1</p> <p><b>5</b></p>	<p>can be implied e.g. <math>7/\sin 30^\circ \cdot F</math></p> <p><math>7.034 \text{ (AG) or } (6.52 - 2.64\tan 30^\circ)</math></p> <p><math>52.0^\circ \text{ (GAH) or (above) } x\cos 30^\circ</math></p> <p><math>(5.00)x\cos 30^\circ \quad (4.33)</math></p> <p><math>14F = 3 \times 9.8 \times 7.034 \times \cos 52.0^\circ</math></p>	<p><b>13</b></p>