

**Mark Scheme 4729  
January 2006**

<b>1</b>		$\tan\theta = \frac{1}{3}$ ( $\theta = 18.4^\circ$ at B)	B1		71.6° at C
		$3 \times T \sin\theta = 20 \times 1.5$ must	M1		M(A) ( $d=3/\sqrt{10}$ )
		have two distances and no g	A1		
		$T = 31.6$ N	A1	4	<b>4</b>

<b>2</b>	(i)	$0 = 50 \sin 25^\circ t - 4.9t^2$	M1		or $0=50\sin 25^\circ - 9.8t$ & $2t : 2 \times 2.16$	
			A1			
		$t = 4.31$ s	A1	3		
	(ii)	$d = 50 \cos 25^\circ \times 4.31$	M1		or $u^2 \sin(2 \times 25^\circ)/g$	
		195 m	A1✓	2	✓ $50 \cos 25^\circ \times$ their t	<b>5</b>

<b>3</b>	(i)a	100 J	B1	1		
	b	7500 Nm	B1	1		
	(ii)	$400 \cos \alpha \times 25 = 7500 + 100$	M1		sc N II gets M1A1 only. This M1	
		✓ for $a + b$	A1✓		for total M ( $a=0.08$ ) & A1 for $\alpha$	
		$\alpha = 40.5$	A1	3	or 0.707 rads	<b>5</b>

<b>4</b>	(i)	horiz comps in opp direct	B1		at E & F	
		Right at E + Left at F	B1	2		
	(ii)	$1.6 \times 9.8 \times 30 = 20X$ or	M1		or $10X + 1.6g \times 30 = 30X$ M(A)	
		$0.5 \times 30g + 0.7 \times 30g +$	A1		or $10X + (\dots = 470.4) = 30X$ M	
		$0.2 \times 60g = 20X$			mark ok without g but 3 parts	
		$X = 23.5$ N	A1	3		
	(iii)	$1.6 \bar{y} =$	M1		must be moments with vert dists	
		$20 \times 0.2 + 20 \times 0.2 + 40 \times 0.5$	A1		or $1.6 \bar{y} = 20 \times 0.2 \times 2 + 40 \times 0.7 (22.5)$	
		$\bar{y} = 17.5$ cm	A1	3		<b>8</b>

<b>5</b>	(i)	$6m = 3mx + 2my$	M1		- 3mx ok if clear on diagram	
		$6 = 3x + 2y$	A1		m must have been cancelled	
		$e = 1 = (y-x)/2$	M1		or $\frac{1}{2} \cdot 3m \cdot 2^2 = \frac{1}{2} \cdot 3mx^2 + \frac{1}{2} \cdot 2my^2$	
			A1		$6 = 3x^2/2 + y^2$ aef	
		$x = 0.4$ or $2/5$	A1		sc A1A0 if $x = 2, y = 0$ not rejected	
		$y = 2.4$ or $12/5$	A1	6		
	(ii)	$4.8m$ or $24m/5$	B1✓		✓ $2m \times$ their y or $3m(2 - \text{their } x)$	
		same as original dir. of A	B1	2	use their diagram (or dir. of B)	
	(iii)	$e = (2.8 - 1.0)/2.4$	M1			
		0.75 watch out for $\pm$ fiddles	A1✓	2	✓ $(1.8/\text{their } y)$ with $0 < e < 1$	<b>10</b>

<b>6</b>	(i)	$x = 7t$	B1			
		$y = -4.9t^2$ or $-\frac{1}{2}gt^2$	M1		some attempt at vertical motion	
			A1		sc $y = x \tan \theta - gx^2 / (2V^2 \cos^2 \theta)$	
		$y = -x^2/10$ <b>AG</b> (no fiddles)	A1	4	with $\theta=0$ M1 then A1 (max = 2)	
	(ii)	$-20 = -x^2/10$	M1		or $t = \sqrt{(20/4.9)}$ & $x=7t$	
		14.1 m	A1	2	sc B1 for 14.1 after wrong work	
	(iii)	$\frac{1}{2}mv^2 = \frac{1}{2}m7^2 + mgx20$ n.b. $v^2 = u^2$	M1		<b>OR</b> $v_h = 7$ (B1)	
		+2as gets M0	A1		$v_v = \pm 19.8$ (B1) $14\sqrt{2}, 2\sqrt{98}$ etc	
		$v = 21 \text{ ms}^{-1}$	A1		$v = 21$ (B1)	
		$dy/dx = -2x/10$ & $\tan \theta$	M1		<b>OR</b> $\tan \theta = 19.8/7$ or	
			A1		$\cos \theta = 7/21$ or $\sin \theta = 19.8/21$	
		70.5° to horizontal	A1	6	or 19.5° to vertical	<b>12</b>

<b>7</b>	(i)	$F = 300/12$	M1			
		$R = 25$	A1	2		
	(ii)	$P = 17.5 \times 12$ ( $R_2 = 17.5$ & $F_2 = 17.5$ )	M1		n.b. B1 only for 210 W	
		$P = 210 \text{ W}$	A1	2	without working	
	(iii)	$500 = Fx12$	M1			
		$F = 41.67$ or $500/12$ aef	A1			
		$41.67 - 25 - 75 \times 9.8 \sin 1^\circ = 75a$	M1			
			A1			
		$0.0512 \text{ ms}^{-2}$	A1	5	or 0.051	
	(iv)	$PE = 75 \times 9.8 \times 200 \sin 10^\circ$ (25530)	B1		<b>OR</b> $75 \times 9.8 \sin 10^\circ - 120 = 75a$	
		$WD = 200 \times 120$ (24000)	B1		(M1 + A1)	
		$\frac{1}{2} \cdot 75v^2 =$	M1		$a = 0.102$ (A1)	
		$\frac{1}{2} \cdot 75 \cdot 13^2 + 75 \times 9.8 \times 200 \sin 10^\circ - 200 \cdot 120$	A1		$v^2 = 169 + 2 \times 0.102 \times 200$ (M1)	
		$14.5 \text{ ms}^{-1}$	A1	5	$v = 14.5$	<b>14</b>

<b>8</b>	(i)	$R \cos 30^\circ = 0.1 \times 9.8$	M1		resolving vertically	
			A1			
		$R = 1.13 \text{ N}$	A1	3		
	(ii)	$r = 0.8 \cos 30^\circ = 0.693$ or $2\sqrt{3}/5$	B1		may be implied	
		$R \cos 60^\circ = 0.1 \times 0.693 \omega^2$	M1		or $0.1v^2/r$ & $\omega = v/r$	
			A1			
		$\omega = 2.86$	A1	4		
	(iii)	$T = 1.96 \text{ N}$	B1	1		
	(iv)	$R \cos 30^\circ = T \cos 60^\circ + 0.1 \times 9.8$	M1			
			A1			
		$R = 2.26 \text{ N}$	A1			
		$R \cos 60^\circ + T \cos 30^\circ = 0.1 \times v^2/r$	M1		or $m\omega^2$ & use of $v = r\omega$	
			A1		with $R=1.13$ can get M1 only	
		$4.43 \text{ ms}^{-1}$	A1	6		<b>14</b>
<b>or</b>	(iv)	LHS (or RHS)	M1*		method without finding R	
		$T + 0.1 \times 9.8 \cos 60^\circ$	A1		i.e. resolving along PA	
		RHS (or LHS)	M1*			
		$0.1 \times v^2/r \times \cos 30^\circ$	A1		r to be $0.8 \cos 30^\circ$ for A1	
		solve to find v	M1*		depends on 2* Ms above	
		$4.43 \text{ ms}^{-1}$	A1	(6)		