

Mark Scheme 4729 January 2007

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1		com directly above lowest point	B1			
		$\tan \alpha = 6/10$	M1			
		$\alpha = 31.0$	A1	3	or 0.540 rads	3
2		$e = 1 = (y-x)/4$	B1		or $\frac{1}{2}x0.2x^2 + \frac{1}{2}x0.1y^2 =$	
		$0.8 = 0.2x + 0.1y$	B1		$\frac{1}{2}x0.2x4^2$ (B1/B1 for any 2)	
		solving sim. equ.	M1		not if poor quad. soln.	
		$x = 4/3$ only	A1	4		4
3	(i)	$x^2 = 21^2 + 2x40x9.8$	M1			
		$x = 35$	A1			
		$0 = y^2 - 2x40x9.8$	M1			
		$y = 28$	A1		may be implied	
		$e = 28/35$	M1			
		$e = 0.8$	A1	6	aef	
	(ii)	$0.2x28 - - 0.2x35$	M1		must be double negative	
		$I = 12.6$	A1	2		8
4	(i)	$\frac{1}{2}x80x5^2$ or $\frac{1}{2}x80x2^2$ either KE	B1		1000/160	
		70×25	B1		1750	
		$80x9.8x25\sin20^\circ$	B1		6703.6	
		$WD = \frac{1}{2}x80x5^2 - \frac{1}{2}x80x2^2 + 70x25 + 80x9.8x25\sin20^\circ$	M1		4 parts	
		9290	A1	5		
	(ii)	$P\cos30^\circ x25$	B1		or $a=0.42$	
		$P\cos30^\circ .25 = 9290 / P\cos30^\circ - 70 - 80x9.8\sin20^\circ = 80a$	M1			
		$P = 429$ /if P found 1 st then $P\cos30^\circ x25 = 9290$ ok	A1	3		8
5	(i)	$D = 3000/5^2 = 120$	M1			
			A1	2	AG	
	(ii)	$120 - 75 = 100a$	M1			
		$a = 0.45 \text{ ms}^{-2}$	A1	2		
	(iii)	$100x9.8x1/98$	B1		weight component	
		$3000/v^2 = 3v^2 + 100x9.8x1/98$	M1			
		$3000 = 3v^4 + 10v^2$	A1		aef	
		solving quad in v^2	M1		$(v^2 = 30)$	
	$v = 5.48 \text{ ms}^{-1}$	A1	5	accept $\sqrt{30}$	9	
6	(i)	com of Δ 4 cm right of C	B1			
		$1.5 \times 10 + 7 \times 20 = \bar{x} \times 30$	M1			
			A1			
		$\bar{x} = 5.17$	A1		5 1/6 31/6	
		com of Δ 6 cm above E	B1		or 3 cm below C	
		$4.5 \times 10 + 6 \times 20 = \bar{y} \times 30$	M1			
			A1			
		$\bar{y} = 5.5$	A1	8		
	(ii)	$\tan\theta = 5.17/3.5$	M1		right way up and $(9 - \bar{y})$	
		55.9° or 124°	A1✓	2	✓ their $\bar{x}/(9 - \bar{y})$	
	(iii)	$d = 15\sin45^\circ$ (10.61)	B1		dist to line of action of T	
$Td = 30 \times 5.17$		M1		allow $Tx15$ i.e. T vertical		
$T = 14.6$		A1	3		13	

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7	(i)	$T\sin 30^\circ$	B1		
		$T\sin 30^\circ = 0.3 \times 0.4 \times 2^2$	M1		resolving horizontally
		$T = 0.96$	A1	4	
	(ii)	$R + T\cos 30^\circ = 0.3 \times 9.8$	M1		resolving vertically
		$R = 2.11$	A1✓	3	✓ their T (2.94 - $T\cos 30^\circ$)
		$T_1\sin 30^\circ = 0.3 \times v^2 / 0.4$	M1		or $0.3 \times 0.4 \times \omega^2$
	(iii)	$T_1\cos 30^\circ = 0.3 \times 9.8$	A1		($T_1 = 1.5v^2$)
		$R = 0$	B1		($T_1 = 1.96\sqrt{3} = 3.3948$)
		$\tan 30^\circ = v^2 / (0.4 \times 9.8)$ for elim of T_1	B1		may be implied or stated
		$v = 1.50$	M1		and $v = 0.4\omega$ ($\omega = 3.76$)
			A1	6	
	13				

8	(i)	$v_v = 42\sin 30^\circ (=21)$	B1			
		$0 = 21^2 - 2 \times 9.8 \times h$	M1			
		$h = 22.5$	A1	3		
	(ii)	$v_h = 42\cos 30^\circ (=36.4)$	B1			
		$v_v = \pm v_h \times \tan 10^\circ$	M1			
		$v_v = \pm 6.41$ or $21\sqrt{3} \tan 10^\circ$	A1		or $42\cos 30^\circ \cdot \tan 10^\circ$	
		$-6.41 = 42\sin 30^\circ - 9.8t$	M1	**	must be -6.41 (also see "or" x 2)	
		$t = 2.80$	A1	**		
		$y = 42\sin 30^\circ \times 2.8 - 4.9 \times 2.8^2$	M1	**		
		$y = 20.4$	A1✓	**	✓ their t	
		$x = 42\cos 30^\circ \times 2.80$	M1			
		$x = 102$	A1✓		✓ their t	
		$\sqrt{(x^2 + y^2)}$	M1			
		$d = 104$	A1	11		
		or	$6.41^2 = 21^2 + 2 \times -9.8s$	M1	**	vert dist first then time
			$s = 20.4$	A1	**	
			$20.4 = 21t + \frac{1}{2} \cdot -9.8t^2$	M1	**	
			$t = 2.80$	A1	**	
		or	$22.5 - s$ and $6.41^2 = 2 \times 9.8s$	M1	**	dist from top ($s = 2.096$)
			$y = 20.4$	A1	**	
		$22.5 \& 2.1 = \frac{1}{2} \cdot 9.8t^2$	M1	**	2 separate times (2.143, 0.654)	
		$t = 2.80$	A1	**	2.143 + 0.654	
	14					
	alternatively					
	(ii)	$y = x/\sqrt{3} - x^2/270$ aef	B1		$y = x \tan 30^\circ - 9.8x^2 / 2 \cdot 42^2 \cdot \cos^2 30^\circ$	
		$dy/dx = 1/\sqrt{3} - x/135$	M1		for differentiating	
			A1		aef	
		$dy/dx = -\tan 10^\circ$	M1		must be $-\tan 10^\circ$	
		$1/\sqrt{3} - x/135 = -\tan 10^\circ$	A1			
		solve for x	M1			
		$x = 102$	A1✓		✓ on their dy/dx	
		$y = x/\sqrt{3} - x^2/270$	M1			
		$y = 20.4$	A1✓		✓ their x	
$\sqrt{(x^2 + y^2)}$		M1				
$d = 104$		A1	(11)			