Mark Scheme 4729
January 2006

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

2	(i)	$0 = 50 \sin 25° \, t - 4.9t^2$	M1		or $0=50\sin 25° - 9.8t$ &2t :2x2.16	
			A1			
		t = 4.31 s	A1	3		
	(ii)	d = 50cos25° x 4.31	M1		or $u^2\sin(2x25°)/g$	
		195 m	A1√	2	√ 50cos25° x their t	**5**

3	(i)a	100 J	B1	1		
	b	7500 Nm	B1	1		
	(ii)	400cosα x 25 =7500 + 100	M1		sc N II gets M1A1only.This M1 for total M (a=0.08)&A1for α	
		√ for = a + b	A1√			
		α = 40.5	A1	3	or 0.707 rads	**5**

4	(i)	horiz comps in opp direct	B1		at E & F	
		Right at E + Left at F	B1	2		
	(ii)	1.6x9.8x30 = 20X or	M1		or 10X + 1.6gx30 = 30X M(A)	
		0.5x30g + 0.7x30g + 0.2x60g = 20X	A1		or 10X + (. . . = 470.4) = 30X M 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	
		20x0.2 + 20x0.2 +40x0.5	A1		or 1.6 $\bar{y}$ =20x0.2x2+40x0.7(22.5)	
		$\bar{y}$ = 17.5 cm	A1	3		**8**

5	(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** ½.3m.2^2 = ½.3mx^2 + ½.2my^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 x their y or 3m(2-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 ± fiddles	A1√	2	√(1.8/their y) with 0 ≤ e < 1	**10**

6	(i)	x = 7t	B1			
		y = - 4.9t^2 or -½gt^2	M1		some attempt at vertical motion	
			A1		sc y=xtanθ ─gx^2 /(2V^2cos^{2}θ)	
		y = - x^2/10 **AG** (no fiddles)	A1	4	with θ=0 M1 then A1 (max = 2)	
	(ii)	-20 = -x^2/10	M1		or t=√(20/4.9) & x=7t	
		14.1 m	A1	2	sc B1 for 14.1 after wrong work	
	(iii)	½mv^2 = ½m7^2 + mgx20 n.b. v^2 =u^2	M1		**OR** v_h = 7 (B1)	
		+2as gets M0	A1		v_v = ±19.8 (B1) 14√2,2√98 etc	
		v = 21 ms^{-1}	A1		v = 21 (B1)	
		dy/dx = -2x/10 & tanθ	M1		**OR** tanθ = 19.8/7 or	
			A1		cosθ=7/21 or sinθ=19.8/21	
		70.5° to horizontal	A1	6	or 19.5° to vertical	**12**

7	(i)	F = 300/12	M1			
		R = 25	A1	2		
	(ii)	P=17.5x12 (R_2=17.5 & F_2 = 17.5)	M1		n.b. B1 only for 210 W	
		P = 210 W	A1	2	without working	
	(iii)	500 = Fx12	M1			
		F = 41.67 or 500/12 aef	A1			
		41.67 – 25 – 75x9.8sin1°= 75a	M1			
			A1			
		0.0512 ms^{-2}	A1	5	or 0.051	
	(iv)	PE = 75x9.8x200sin10° (25530)	B1		**OR** 75x9.8sin10° -120= 75a	
		WD = 200x120 (24000)	B1		(M1 + A1)	
		½.75v^2 =	M1		a = 0.102 (A1)	
		½.75.13^2+75x9.8x200sin10°-200.120	A1		v^2 =169+2x0.102x200 (M1)	
		14.5 ms^{-1}	A1	5	v = 14.5	**14**

8	(i)	R cos30° = 0.1 x 9.8	M1		resolving vertically	
			A1			
		R = 1.13 N	A1	3		
	(ii)	r = 0.8cos30° = 0.693 or 2√3/5	B1		may be implied	
		Rcos60° = 0.1 x 0.693 ω^2	M1		or 0.1v^2 /r & ω = v/r	
			A1			
		ω = 2.86	A1	4		
	(iii)	T = 1.96 N	B1	1		
	(iv)	Rcos30° = Tcos60° + 0.1x9.8	M1			
			A1			
		R = 2.26 N	A1			
		Rcos60° + Tcos30° = 0.1 x v^2/r	M1		or mrω^2 & use of v = rω	
			A1		with R=1.13 can get M1 only	
		4.43 ms^{-1}	A1	6		**14**
or	(iv)	LHS (or RHS)	M1*		method without finding R	
		T + 0.1x9.8cos60°	A1		i.e. resolving along PA	
		RHS (or LHS)	M1*			
		0.1 x v^2 /r x cos30°	A1		r to be 0.8 cos30° for A1	
		solve to find v	M1*		depends on 2* Ms above	
		4.43 ms^{-1}	A1	(6)		