

Mark Scheme 4729

June 2006

1		$mgh = 35 \times 9.8 \times 4$ $mgh/t = 1372/10$ 137 W	M1 A1 M1 A1	4	watch out for extras or 0.137 kW	4
2		$v^2 = 2gh$ $u = \sqrt{4g}$ or $\sqrt{39.2}$ or 6.26 $v = \sqrt{2.8g}$ or $\sqrt{27.44}$ (5.24) $I = \rho 0.3(6.26 + 5.24)$ 3.45 Ns	M1 A1 A1 M1 A1✓	5	kinematics or energy speed of impact (\pm) speed of rebound (\pm) must be sum of mags. of vels. ✓ must be positive	5
3	(i)	$d = 2.25$ $h = 1.125$ or 1.12 or 1.13 or 9/8	B1 B1	2	3/8x6 OG (be generous) horizontal distance	7
	(ii)	$T_1 + T_2 = 12$ resolving vertically $T_1 \times 6\cos 30^\circ = 12xh$ (their h) mom(O) (their h ok for A1) $T_1 = 2.60$ N or $3\sqrt{3}/2$ $T_2 = 9.40$ N ✓ ($12 - T_1$) above ✓ depends on at least one of the M marks ($T_s > 0$)	M1 M1 A1 A1 A1✓	5	if not then next M1 ok or $\text{mom}(A)T_2 \times 6\cos 30^\circ =$ $12(6\cos 30^\circ - h)$ or $T_2 = 9.40$ or $T_1 = 2.60$ or ✓($12 - T_2$)	
4	(i)	$P = 13500$ W	B1	1	or 13.5 kW	9
	(ii)	$500 = 13500/v$ $v = 27$ ms ⁻¹	M1 A1	2		
	(iii)	$15000/25 - 500 = 950a$ $a = 0.105$ or 2/19	M1 A1 A1	3	2 parts to F A0 for 900a or 100/950	
	(iv)	$15000/26 - 500 -$ $950.9.8\sin 5^\circ = 950a$ $a = (-) .773$ ms ⁻²	M1 A1 A1	3	3 parts to F A0 for 900a s.c. accept 0.77	
5	(i)	$\bar{x} = 9$ c of m of Δ 4 cm above BD $(324 + 108)(m)\bar{y} =$ $324(m) \times 9 + 108(m) \times (18+4)$ $432\bar{y}$ 324×9 (18 ² x 9) $108 \times (18+4)$ $\bar{y} = 12.25$	B1 B1 M1 A1 A1 A1 A1	7	ignore any working 8 cm below C/see their diagram $432\bar{y} = 108 \times 8 + 18^2(12+9)$ from C left hand side 1 st term on right hand side 2916 2 nd term on right hand side 2376 $5292 \div 432$ or 49/4	9
	(ii)	$\tan \theta = 5.75/9$ $\theta = 32.6^\circ$ or 147.4°	M1 A1✓	2	must be .../9 ✓ $\tan^{-1}((18 - \text{their } \bar{y})/9)$ or $180^\circ..$	

6	(i)	$T = 4.9 \text{ N}$ $T = 0.3 \times 0.2 \times \omega^2$ $\omega = 9.04 \text{ rads}^{-1}$	B1 M1 A1 A1	4	B0 for 0.5g or $0.3v^2/0.2$ and $\omega = v/0.2$	6
	(ii)	$\cos\theta = \sqrt{0.6/0.8}$ (0.968) $T\cos\theta = 0.5 \times 9.8$ $T = 5.06 \text{ N}$	B1 M1 A1 A1	4	$(\theta=14.5^\circ)$ angle to vert. or equiv. angle consistent with diagram can be their angle	
	(iii)	$T\sin\theta = 0.5 \times v^2/0.2$ $v = 0.711 \text{ ms}^{-1}$	M1 A1 A1	3	must be a component of T $(\sin\theta = 1/4)$ can be their angle	11
7	(i)	$v\sin 50^\circ$ $0 = v^2\sin^2 50^\circ - 2 \times 9.8 \times 13$ (must be 13) $v = 20.8 \text{ ms}^{-1}$	B1 M1 A1	3	initial vertical component or $m \times 9.8 \times 13 = \frac{1}{2}m(v\sin 50^\circ)^2$ sin/cos mix ok for above M1	13
	(ii)	$45 = v\cos 50^\circ \cdot t$ $t = 3.36$ ✓ their v (3.13 for $v=22.4$) $s = v\sin 50^\circ \times t - \frac{1}{2} \times 9.8 \times t^2$ $s = -1.6$ to -2.0 inclusive (-1.68) ht above ground = 0.320 m	M1 A1 ✓ M1 A1 A1 A1	6	see alternative below other methods include other t_s ignore ht adjustments can be their v and their t can be implied from next A1	
	(iii)	$v_v = v\sin 50^\circ - 9.8 \times t$ $v_v = -17.0$ ✓ their v, t (-13.5 for 22.4) $\text{speed} = \sqrt{(v_v)^2 + (v\cos 50^\circ)^2}$ $\text{speed} = 21.6 \text{ ms}^{-1}$ ✓ their v and v_v (19.7 for $v = 22.4$)	M1 A1 ✓ M1 A1 ✓	4	or $v_v^2 = 2g(15 - \text{their ans to ii})$ ✓ above for v_v or $\frac{1}{2}mv^2 - mgx1.68 = \frac{1}{2}m \times 20.8^2$ (4 marks) M1/A1 ✓ s, v /M1 solve/ A1 ✓	
	(ii)	$y = x\tan\theta - gx^2/2v^2\cos^2\theta$ $y = 45\tan 50^\circ - 9.8 \cdot 45^2 / 2 \cdot v^2 \cos^2 50^\circ$ calculate y $y = -1.6$ to -2.0 inclusive	B1 M1 A1 M1 A1		Alternative 1st 5 marks substitute v and 50° and $x=45$ can be their v should be -1.68	

8	(i)	$10 = 4 + m \cdot x$ $e = \dots$ or rationale for $x = 2$ $m = 3$	M1 M1 A1	3	conservation of momentum
	(ii)	$v = 6$ $e = 4/5$ or 0.8	B1 M1 A1		
	(iii)	$10 - 5 = 2x + y$ ($5 = -2a + b$) $(-5 = 2c + d)$ $e = 0.8 = (y-x)/10$ $y = x + 8$ ($a + b = 8$) ($c - d = 8$) $x = -1$ ($a=1$) ($c=1$) $y = 7$ ($b=7$) ($d=-7$) $\frac{1}{2} \cdot 2.5^2 + \frac{1}{2} \cdot 1.5^2 - \frac{1}{2} \cdot 2.1^2 - \frac{1}{2} \cdot 1.7^2$ 12 J	M1 A1 M1 A1 A1 A1 M1 A1	8	look for consistency or 1 in opp. direction to 1st K.E. lost. Must be 4 parts (37.5 – 25.5)

± 1 in 3rd sig. fig. except where stated