

**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 <sup>-1</sup>	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 <sup>-2</sup>	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 $\Delta$ 4 cm above BD  $(324 + 108)(m)\bar{y} =$ $324(m) \times 9 + 108(m) \times (18+4)$ $432\bar{y}$ $324 \times 9$ (18 <sup>2</sup> 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 <sup>st</sup> term on right hand side 2916 2 <sup>nd</sup> term on right hand side 2376 $5292 \div 432$ or 49/4	9
	(ii)	$\tan \theta = 5.75/9$ $\theta = 32.6^\circ$ or $147.4^\circ$	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		<b>Alternative 1<sup>st</sup> 5 marks</b> substitute v and $50^\circ$ 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)	$10 - 5 = 2x + y$ ( $5 = -2a + b$ ) $(-5 = 2c + d)$  $e = 0.8 = (y-x)/10$ $y = x + 8$ ( $a + b = 8$ ) ( $c - d = 8$ ) $x = -1$ ( $a=1$ ) ( $c=1$ ) $y = 7$ ( $b=7$ ) ( $d=-7$ ) $\frac{1}{2} \cdot 2 \cdot 5^2 + \frac{1}{2} \cdot 1 \cdot 5^2 - \frac{1}{2} \cdot 2 \cdot 1^2 - \frac{1}{2} \cdot 1 \cdot 7^2$ 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	
		A1	8		(37.5 – 25.5)	<b>14</b>

$\pm 1$  in 3<sup>rd</sup> sig. fig. except where stated