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GCE

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Mechanics M1 (6677)

January 2006

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Mark Scheme (Results)

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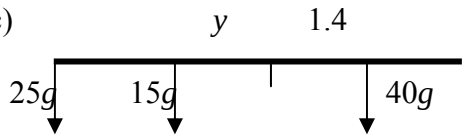
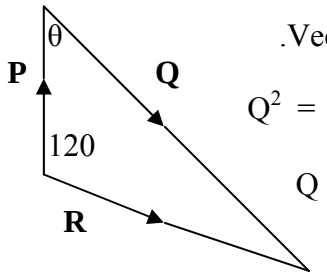
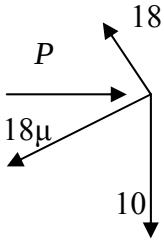
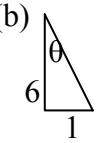
Question Number	Scheme	Marks
1.	(a) Distance after 4 s = $16 \times 4 - \frac{1}{2} \times 9.8 \times 4^2$	M1 A1
	$= -14.4 \Rightarrow h = (+)\ \underline{14.4\text{ m}}$	A1 (3)
	(b) $v = 16 - 9.8 \times 4$	M1 A1
	$= -23.2 \Rightarrow$ speed $= (+)\ \underline{23.2\text{ m s}^{-1}}$	A1 (3)
		6

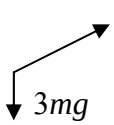
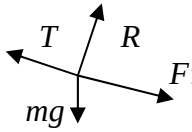
2.	(a) CLM: $3 \times 4 + 2 \times 1.5 = 5 \times v$ $\Rightarrow v = \underline{3 \text{ m s}^{-1}}$ (b) (i) CLM: $3 \times 4 - m \times 4 = -3 \times 2 + m (\times 1)$ $\Rightarrow m = \underline{3.6}$ (ii) $I = 3.6(4 + 1)$ [or $3(4 + 2)$] $= \underline{18 \text{ Ns}}$	M1 A1 A1 (3) M1 A1 A1 (3) M1 A1√ (2) **8**

Question Number	Scheme	Marks
3.	(a) M(C): $25g \times 2 = 40g \times x$	M1 A1
	$x = \underline{1.25 \text{ m}}$	A1 (3)
	(b) Weight/mass acts at mid-point; or weight/mass evenly distributed (o.e.)	B1 (1)
	(c)  M(C): $40g \times 1.4 = 15g \times y + 25g \times 2$	M1 A1
	Solve: $y = \underline{0.4 \text{ m}}$	M1 A1 (4)
		8

4.	$\mathbf{R} = 10\sqrt{3}/2\,\mathbf{i} - 5\mathbf{j}$	M1 A1
	Using $\mathbf{P} = 7\mathbf{j}$ and $\mathbf{Q} = \mathbf{R} - \mathbf{P}$ to obtain $\mathbf{Q} = 5\sqrt{3}\mathbf{i} - 12\mathbf{j}$	M1 A1
	Magnitude = $\sqrt{[(5\sqrt{3})^2 + 12^2]} \approx \underline{14.8\text{ N}}$ (AWRT)	↓ M1 A1
	angle with $\mathbf{i}$ = arctan $(12/5\sqrt{3}) \approx 64.2°$	M1 A1
	bearing $\approx \underline{144°}$ (AWRT)	A1 (9)
	Alternative method	
	 .Vector triangle correct	B1
	$Q^2 = 10^2 + 7^2 + 2 \times 10 \times 7 \cos 60$	M1 A1
	$Q \approx \underline{14.8\text{ N}}$ (AWRT)	A1
	$\frac{14.8}{\sin 120} = \frac{10}{\sin \theta}$	M1 A1 √
	$\Rightarrow \theta = 35.8, \Rightarrow$ bearing 144 (AWRT)	M1 A1, A1
		9

5.	 (a) R(perp to plane): $P \sin 30 + 10 \cos 30 = 18$ Solve: $P \approx \underline{18.7 \text{ N}}$ (b) R(// plane): $P \cos 30 = 10 \sin 30 + F$ $F = 18\mu$ used Sub and solve: $\mu = \underline{0.621 \text{ or } 0.62}$ (c) Normal reaction now $= 10 \cos 30$ Component of weight down plane $= 10 \sin 30$ (= 5 N) (seen) $F_{max} = \mu R_{new} \approx 5.37$ N (AWRT 5.4) $5.37 > 5 \Rightarrow$ does not slide	M1 A1 ↓ M1 A1 (4) M1 A1 M1 ↓↓ M1 A1 (5) M1 A1 B1 ↓ M1 A1 cso (5) **14**

6.	(a) Speed of $A = \sqrt{(1^2 + 6^2)} \approx \underline{6.08 \text{ m s}^{-1}}$	M1 A1 (2)
	(b)  $\tan\theta = 1/6 \Rightarrow \theta \approx 9.46°$ Bearing $\approx \underline{351}$	M1 A1 A1 (3)
	(c) P.v. of A at time $t = (2 - t)\mathbf{i} + (-10 + 6t)\mathbf{j}$ p.v. of B at time $t = (-26 + 3t)\mathbf{i} + (4 + 4t)\mathbf{j}$ (E.g.) **i** components equal $\Rightarrow 2 - t = -26 + 3t \Rightarrow t = 7$ **j** components at $t = 7$: A: $-10 + 6t = 32$ B: $4 + 4t = 32$ Same, so collide at $t = 7$ s at point with p.v. $(-5\mathbf{i} + 32\mathbf{j})$ m	B1 (either) M1 A1 ↓ M1 A1 cso (5)
	(d) New velocity of $B = \frac{8}{5}(3\mathbf{i} + 4\mathbf{j})$ m s^{-1} P.v. of B at 7 s $= -26\mathbf{i} + 4\mathbf{j} + 1.6(3\mathbf{i} + 4\mathbf{j}) \times 7 = 7.6\mathbf{i} + 48.8\mathbf{j}$ $\underline{PB} = \mathbf{b} - \mathbf{p} = 12.6\mathbf{i} + 16.8\mathbf{j}$ (in numbers) Distance $= \sqrt{(12.6^2 + 16.8^2)} = \underline{21 \text{ m}}$	B1 M1 A1 ↓ M1 ↓ M1 A1 (6)
		16

7.	(a)  A: $3mg \sin 30 - T = 3m.\frac{1}{10}g$	M1 A1
	$\Rightarrow T = \frac{6}{5}mg$	A1 (3)
	(b)  F: R(perp): $R = mg \cos 30$	M1 A1
	R(//): $T - mg \sin 30 - F = m.\frac{1}{10}g$	M1 A2, 1, 0
	Using $F = \mu R$	M1
	$\frac{6}{5}mg - \frac{1}{2}mg - \mu mg\frac{\sqrt{3}}{2} = \frac{1}{10}mg$	↓↓↓ M1
	$\rightarrow \quad \mu = \underline{0.693 \text{ or } 0.69 \text{ or } \frac{2\sqrt{3}}{5}}$	A1 (8)
	(c)  Magn of force on pulley = $2T \cos 60 = \frac{6}{5}mg$	M1 A1 √
	Direction is vertically downwards	B1 (cso) (3)
		14