Mark Scheme (Results)
January 2010

GCE

Mechanics M1 (6677)

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6677 Mechanics M1
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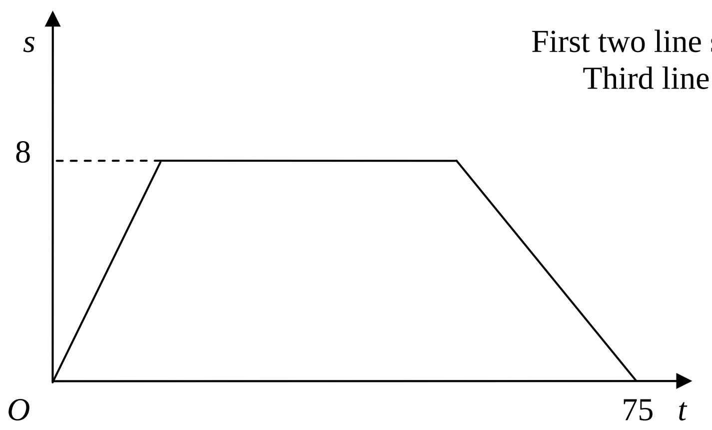
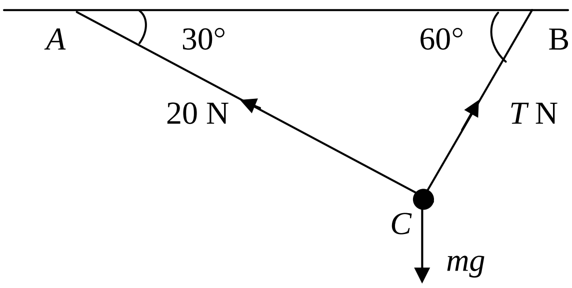
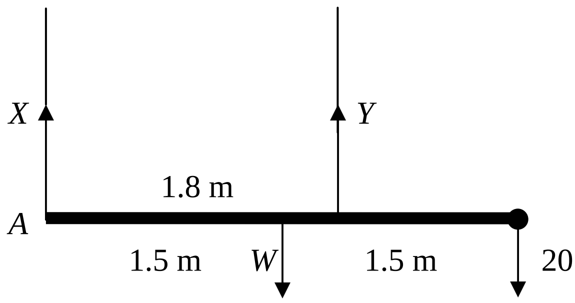
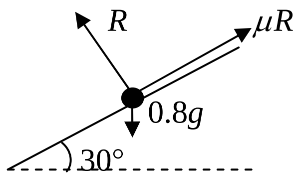
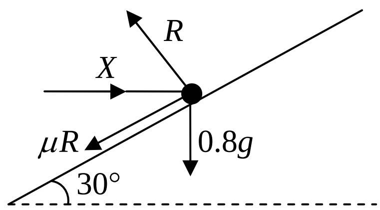
Question Number	Scheme	Marks
Q1.	(a) $I = 2\times12 - 2\times3 = 18$ (N s)	M1 A1 (2)
	(b) LM $2\times12 - 8m = 2\times3 + 4m$	M1 A1
	Solving to $m = 1.5$	DM1 A1 (4) **[6]**
	Alternative to (b)	
	$I = m(4-(-8)) = 18$	M1 A1
	Solving to $m = 1.5$	DM1 A1 (4)
Q2.	(a) 	
	First two line segments	B1
	Third line segment	B1
	8, 75	B1 (3)
	(b) $\frac{1}{2}\times8\times(T+75) = 500$	M1 A2 (1,0)
	Solving to $T = 50$	DM1 A1 (5)
		[8]

Question Number	Scheme	Marks
Q3.	 	
	(a) R($\rightarrow$) $20\cos 30° = T\cos 60°$	M1 A2 (1,0)
	$T = 20\sqrt{3}$, 34.6, 34.64,…	A1 (4)
	(b) R($\uparrow$) $mg = 20\sin 30° + T\sin 60°$	M1 A2 (1,0)
	$m = \frac{40}{g} (\approx 4.1)$,4.08	A1 (4)
		[8]
Q4.	(a)  	
	M (A) $W \times 1.5 + 20 \times 3 = Y \times 1.8$	M1 A2 (1, 0)
	$Y = \frac{5}{6}W + \frac{100}{3}$ * cso	A1 (4)
	(b) $\uparrow$ $X + Y = W + 20$ or equivalent	M1 A1
	$X = \frac{1}{6}W - \frac{40}{3}$	A1 (3)
	(c) $\frac{5}{6}W + \frac{100}{3} = 8\left(\frac{1}{6}W - \frac{40}{3}\right)$	M1 A1 ft
	$W = 280$	A1 (3) **[10]**
	Alternative to (b) M(C) $X \times 1.8 + 20 \times 1.2 = W \times 0.3$ $X = \frac{1}{6}W - \frac{40}{3}$	M1 A1 A1

Question Number	Scheme	Marks
Q5.	(a) $s = ut + \frac{1}{2}at^2 \quad \Rightarrow \quad 2.7 = \frac{1}{2}a \times 9$	M1 A1
	$a = 0.6 \left(\text{m s}^{-2}\right)$	A1 (3)
	(b) 	
	↖ $R = 0.8g\cos 30° \left(\approx 6.79\right)$	B1
	Use of $F = \mu R$	B1
	↙ $0.8g\sin 30° - \mu R = 0.8 \times a$	M1 A1
	$\left(0.8g\sin 30° - \mu 0.8g\cos 30° = 0.8 \times 0.6\right)$	
	$\mu \approx 0.51$ accept 0.507	A1 (5)
	(c) 	
	↑ $R\cos 30° = \mu R\cos 60° + 0.8g$	M1 A2 (1,0)
	$\left(R \approx 12.8\right)$	
	→ $X = R\sin 30° + \mu R\sin 60°$	M1 A1
	Solving for X, $X \approx 12$ accept 12.0	DM1 A1 (7)
		[15]
	Alternative to (c)	
	↖ $R = X\sin 30° + 0.8 \times 9.8\sin 60°$	M1 A2 (1,0)
	↙ $\mu R + 0.8g\cos 60° = X\cos 30°$	M1 A1
	$X = \dfrac{\mu 0.8g\sin 60° + 0.8g\cos 60°}{\cos 30° - \mu\sin 30°}$	
	Solving for X, $X \approx 12$ accept 12.0	DM1 A1 (7)

Question Number	Scheme	Marks
Q6.	(a) N2L A: $5mg - T = 5m \times \frac{1}{4}g$	M1 A1
	$T = \frac{15}{4}mg$ ∗ cso	A1 (3)
	(b) N2L B: $T - kmg = km \times \frac{1}{4}g$	M1 A1
	$k = 3$	A1 (3)
	(c) The tensions in the two parts of the string are the same	B1 (1)
	(d) Distance of *A* above ground $s_1 = \frac{1}{2} \times \frac{1}{4}g \times 1.2^2 = 0.18g \; (\approx 1.764)$	M1 A1
	Speed on reaching ground $v = \frac{1}{4}g \times 1.2 = 0.3g \; (\approx 2.94)$	M1 A1
	For *B* under gravity $(0.3g)^2 = 2gs_2 \Rightarrow s_2 = \frac{(0.3)^2}{2}g \; (\approx 0.441)$	M1 A1
	$S = 2s_1 + s_2 = 3.969 \approx 4.0$ (m)	A1 (7) **[14]**

Question Number	Scheme	Marks
Q7.	(a)	
	$\mathbf{v} = \dfrac{21\mathbf{i}+10\mathbf{j}-(9\mathbf{i}-6\mathbf{j})}{4} = 3\mathbf{i}+4\mathbf{j}$	M1 A1
	speed is $\sqrt{(3^2+4^2)} = 5\ (\text{km h}^{-1})$	M1 A1 (4)
	(b) $\tan\theta = \dfrac{3}{4}\ (\Rightarrow \theta \approx 36.9°)$	M1
	bearing is 37, 36.9, 36.87, …	A1 (2)
	(c) $\mathbf{s} = 9\mathbf{i}-6\mathbf{j}+t(3\mathbf{i}+4\mathbf{j})$	M1
	$= (3t+9)\mathbf{i}+(4t-6)\mathbf{j}$ ∗ cso	A1 (2)
	(d) Position vector of *S* relative to *L* is	
	$(3T+9)\mathbf{i}+(4T-6)\mathbf{j}-(18\mathbf{i}+6\mathbf{j}) = (3T-9)\mathbf{i}+(4T-12)\mathbf{j}$	M1 A1
	$(3T-9)^2+(4T-12)^2 = 100$	M1
	$25T^2-150T+125=0$ or equivalent	DM1 A1
	$(T^2-6T+5=0)$	
	$T = 1, 5$	A1 (6)
		[14]

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