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# Mark Scheme (Results)
# January 2010

GCE

## Mechanics M1 (6677)

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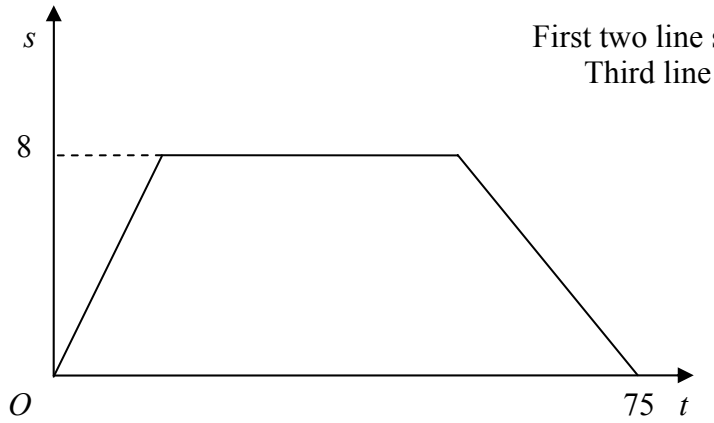
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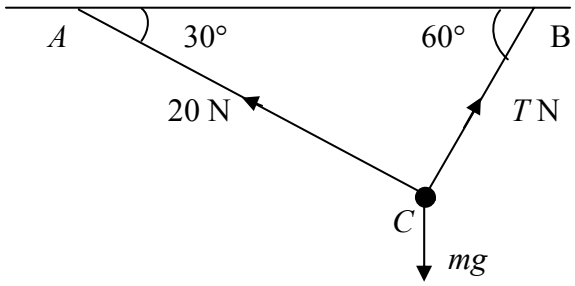
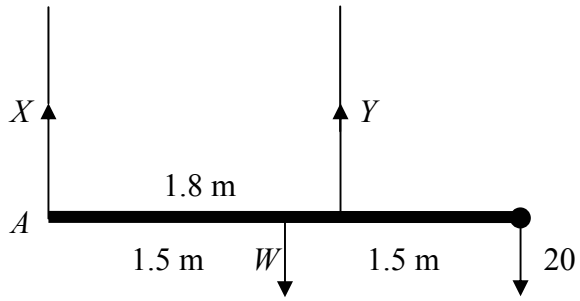
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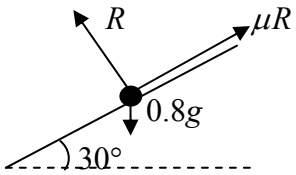
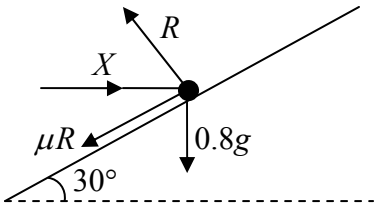
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# 6677 Mechanics M1
# Mark Scheme

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

| Question Number | Scheme | Marks |
|---|---|---|
| Q3. |  | |
| | (a) R($\rightarrow$) $20\cos 30° = T\cos 60°$<br>$T = 20\sqrt{3}$ , 34.6, 34.64,… | M1 A2 (1,0)<br>A1 (4) |
| | (b) R($\uparrow$) $mg = 20\sin 30° + T\sin 60°$<br>$m = \frac{40}{g} (\approx 4.1)$ ,4.08 | M1 A2 (1,0)<br>A1 (4)<br>**[8]** |
| Q4. | (a)<br> | |
| | M $(A)$ $W\times 1.5 + 20\times 3 = Y\times 1.8$<br>$Y = \frac{5}{6}W + \frac{100}{3}$ ✱ cso | M1 A2 (1, 0)<br>A1 (4) |
| | (b) $\uparrow$ $X + Y = W + 20$ or equivalent<br>$X = \frac{1}{6}W - \frac{40}{3}$ | M1 A1<br>A1 (3) |
| | (c) $\frac{5}{6}W + \frac{100}{3} = 8\left(\frac{1}{6}W - \frac{40}{3}\right)$<br>$W = 280$ | M1 A1 ft<br>A1 (3)<br>**[10]** |
| | Alternative to (b)<br>M(C) $X\times 1.8 + 20\times 1.2 = W\times 0.3$<br>$X = \frac{1}{6}W - \frac{40}{3}$ | M1 A1<br>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 |
| | $X = \frac{\mu 0.8g\sin 60° + 0.8g\cos 60°}{\cos 30° - \mu\sin 30°}$ | |
| | 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 $s_1 = \frac{1}{2} \times \frac{1}{4}g \times 1.2^2 = 0.18g \left(\approx 1.764\right)$ | M1 A1 |
| | Speed on reaching ground $v = \frac{1}{4}g \times 1.2 = 0.3g \left(\approx 2.94\right)$ | M1 A1 |
| | For $B$ under gravity $\left(0.3g\right)^2 = 2gs_2 \Rightarrow s_2 = \frac{\left(0.3\right)^2}{2}g \left(\approx 0.441\right)$ | 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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