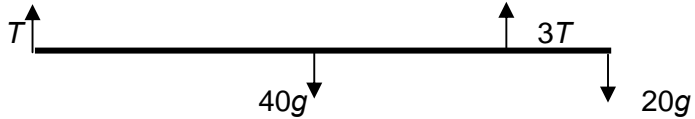


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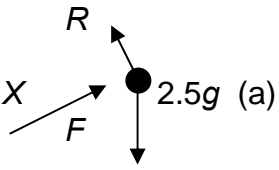
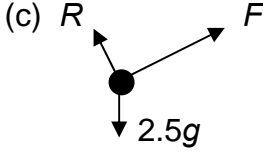
6677 Mechanics M1

Mark Scheme

| Question Number | Scheme | Marks |
|-----------------|--|--|
| 1 | <div style="text-align: center; margin-bottom: 10px;"> </div> <p>(a) CLM: $1.5 \times 3 - 2.5 \times 4 = -1.5 \times 2.5 + 2.5 \times v$</p> <p style="margin-left: 100px;">$\Rightarrow v = \underline{-0.7 \text{ m s}^{-1}}$ so speed = 0.7 m s^{-1}</p> <p>(b) Direction of Q unchanged</p> <p>(c) Impulse = $1.5 (3 + 2.5)$</p> <p style="margin-left: 100px;">$= \underline{8.25, \text{Ns}}$</p> | <p>M1 A1</p> <p style="text-align: right;">A1 (3)</p> <p style="text-align: right;">A1✓ (1)</p> <p>M1</p> <p style="text-align: right;">A1, B1 (3)</p> |

| Question Number | Scheme | Marks |
|-----------------|--|---|
| 2 |  <p>(a) $R(\uparrow): T + 3T = 40g + 20g$ $T = 15g$, so tension at C is <u>45g or 441 N or 440 N</u></p> <p>(b) $M(B) \quad 15g \times 3 + 45g \times d = 40g \times 1.5$ Solve: $d = \underline{1/3 \text{ or } 0.33 \text{ or } 0.333 \text{ m}}$</p> | <p>M1 A1 (2)</p> <p>M1 A2,1,0✓ ↓ M1 A1 (5)</p> |

| Question Number | Scheme | Marks |
|-----------------|---|-------------------------------|
| 3 | (a) Distance = $\frac{1}{2} \times 4 \times 9 + 16 \times 9$ or $\frac{1}{2} (20 + 16) \times 9$ = <u>162 m</u> | M1 A1 (2) |
| | (b) Distance over last 5 s = $\frac{1}{2}(9 + u) \times 5$ $162 + \frac{1}{2}(9 + u) \times 5 = 200$ $\Rightarrow u = \underline{6.2 \text{ m s}^{-1}}$ | M1 M1 A1√ A1 (4) |
| | (c) $6.2 = 9 + 5a$ $a = (-) \underline{0.56 \text{ m s}^{-2}}$ | M1 A1√ A1 (3) |

| Question Number | Scheme | Marks |
|-----------------|--|----------------------------------|
| 4 | <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 25%;">  <p>(a)</p> </div> <div style="width: 50%;"> $R = 2.5g \cos 20$ $\approx \underline{23.0 \text{ or } 23 \text{ N}}$ </div> <div style="width: 20%; text-align: right;"> <p>M1</p> </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 25%;"> <p>(b)</p> </div> <div style="width: 50%;"> $X = 0.4 \times 23.0 + 2.5g \sin 20$ $\approx \underline{17.6 \text{ or } 18 \text{ N}}$ </div> <div style="width: 20%; text-align: right;"> <p>M1 A2,1,0√</p> </div> </div> <div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="width: 25%;">  <p>(c)</p> </div> <div style="width: 50%;"> <p>In equil. $F = 2.5g \sin 20 \approx 8.38 \text{ or } 8.4 \text{ N}$</p> $\mu R = 0.4 \times 2.5g \cos 20 \approx 9.21 \text{ or } 9.2 \text{ N}$ $8.4 < 9.2 \text{ (using 'F < } \mu R' \text{ not } F = \mu R)$ <p>Since $F < \mu R$ remains in equilibrium</p> </div> <div style="width: 20%; text-align: right;"> <p>B1</p> <p>B1</p> <p>M1</p> <p>(cso) A1</p> </div> </div> | <p>(2)</p> <p>(4)</p> <p>(4)</p> |

| Question Number | Scheme | Marks |
|-----------------|--|---|
| 5 | <p>(a) 's = ut + ½at²' for B: $0.4 = \frac{1}{2} a(0.5)^2$ $a = \underline{3.2 \text{ m s}^{-2}}$</p> <p>(b) N2L for B: $0.8g - T = 0.8 \times 3.2$ $T = \underline{5.28 \text{ or } 5.3 \text{ N}}$</p> <p>(c) A: $F = \mu \times 0.5g$ N2L for A: $T - F = 0.5a$ Sub and solve $\mu = \underline{0.75 \text{ or } 0.751}$</p> <p>(d) Same acceleration for A and B.</p> | <p>M1 A1 A1 (3)</p> <p>M1 A1√ ↓ M1 A1 (4)</p> <p>B1</p> <p>M1 A1 ↓ M1 A1 (5)</p> <p>B1 (1)</p> <hr/> |

| Question Number | Scheme | Marks |
|-----------------|--|---|
| 6 | <p>(a) $16^2 = 20^2 - 2 \times a \times 24 \Rightarrow a = \underline{3 \text{ m s}^{-2}}$</p> <p>(b) $v^2 = 20^2 - 2 \times 3 \times 30$ $v = \underline{\sqrt{220} \text{ or } 14.8 \text{ m s}^{-1}}$</p> <p>(c) $0.3 = m \times 3 \Rightarrow m = 0.1 \text{ kg (*)}$</p> <p>(d) $0.1(w + \sqrt{220}) = 2.4$ $w = 9.17$ $0 = 9.17 - 3 \times t$ $t \approx \underline{3.06 \text{ s}}$</p> | <p>M1 A1 (2)</p> <p>M1 A1√ A1 (3)</p> <p>M1 A1 (2)</p> <p>M1 A1√ A1 ↓ M1 A1√ A1 (6)</p> |

| Question Number | Scheme | Marks |
|-----------------|---|--|
| 7 | <p>(a) $\mathbf{v}_P = \{(29\mathbf{i} + 34\mathbf{j}) - (20\mathbf{i} + 10\mathbf{j})\}/3 = \underline{(3\mathbf{i} + 8\mathbf{j}) \text{ km h}^{-1}}$</p> <p>(b) $\mathbf{p} = (20\mathbf{i} + 10\mathbf{j}) + (3\mathbf{i} + 8\mathbf{j})t$ $\mathbf{q} = (14\mathbf{i} - 6\mathbf{j}) + 12t\mathbf{j}$</p> <p>(c) $\mathbf{q} - \mathbf{p} = (-6 - 3t)\mathbf{i} + (-16 + 4t)\mathbf{j}$ $d^2 = (-6 - 3t)^2 + (-16 + 4t)^2$ $= 36 + 36t + 9t^2 + 16t^2 - 128t + 256$ $= 25t^2 - 92t + 292$ (*)</p> <p>(d) $25t^2 - 92t + 292 = 225$ $25t^2 - 92t + 67 = 0$ $(t - 1)(25t - 67) = 0$ $t = 67/25$ or 2.68 time \approx 161 mins, or 2 hrs 41 mins, or 2.41 am, or 0241</p> | <p>M1 A1 (2)</p> <p>M1 A1✓</p> <p>M1 A1 (4)</p> <p>M1 A1 ↓ M1 ↓ M1 A1 (cso) (5)</p> <p>M1 A1 ↓ M1 A1</p> <p>A1 (5)</p> |