

EDEXCEL - LONDON EXAMINATIONS

Stewart House 32 Russell Square London WC1B 5DN

January 2001

Advanced Supplementary/Advanced Level

General Certificate of Education

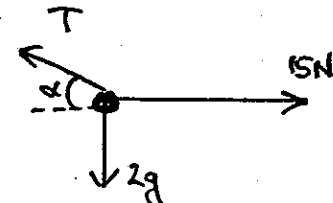
FINAL

HMK

17-01-01

Subject MECHANICS 6677

Paper No. M1

Question number	Scheme	Marks
1. (a)	Resolving vertically e.g. $R_p + R_Q = 70$ $R_p = 20 \Rightarrow R_Q = 50$	M1 A1 (2)
(b)	A valid moments equation e.g. $R_p \times 0.5 + R_Q \times x = 70 \times \frac{3}{2}$ $20 \times 0.5 + 50 \times x = 70 \times \frac{3}{2}$ Completing method to find AQ $AQ = 1.9$	M1 A1 ft DM1 A1 cao (4)
2. (a)	 <p>ONE resolution equation e.g. $T \cos \alpha = 15$ or $T \sin \alpha = 2g$ are most likely but $T = 15 \cos \alpha + 2g \sin \alpha$, $2g \cos \alpha = 15 \sin \alpha$ also possible as is also Lami's theorem. One equation correct; second independent eqn. correct (omission of g loses A1 only) $\tan \alpha = \frac{2g}{15}$ or $\frac{2}{15}$ [$\tan \alpha = \frac{15}{2g}$ scores M1 A0] Answer for α as 53° or 52.6°</p>	M1 A1 + A1 M1 A1 ft A1 (6)
(b)	Using valid equation (line 1 M1 required) to extract value of T (or eliminating α from valid eqns) $T = 24.7$ or 25	M1 A1 (2)

("Over accurate" answers in (a) or (b) or both which round to correct answer receive a penalty of -1 once overall)

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3.(a)	<p>For particle A $T - 3mg = 3ma$</p> <p>(Note $T - mg = ma$ or $T - m = ma$ etc scores M_1)</p> <p>$T - 3mg = 3m\left(\frac{2}{5}g\right) \rightarrow T = \frac{21}{5}mg$</p>	<p>M_1</p> <p>$A_1 \rightarrow A_1(3)$</p>
(b)	<p>String is inextensible</p>	<p>B_1 (1)</p>
(c)	<p>For particle B $kmg - T = km a$</p> <p>(or system) $kmg - 3mg = (km + 3m) a$</p> <p>$kg - \frac{21}{5}g = \frac{2}{5}kg$ (or equivalent equation in k only)</p> <p>Solving DM_1 dependent on first M_1 in (c)</p> <p>$k = 7$</p>	<p>M_1</p> <p>A_1 f.t.</p> <p>DM_1</p> <p>A_1 cas (4)</p>
(d)	<p>Tension is of same magnitude throughout the string</p>	<p>B_1 (1)</p>
4.(a)	<p>At $t=0$ $\underline{r}_P = 2\underline{i} - \underline{j}$; At $t=2$, $\underline{r}_P = 6\underline{i} + \underline{j}$</p> <p>Velocity of P constant $\Rightarrow \underline{v}_P = \frac{(6\underline{i} + \underline{j}) - (2\underline{i} - \underline{j})}{2}$</p> <p>$\underline{v}_P = 2\underline{i} + \underline{j}$ (one slip in \underline{i} or \underline{j} only)</p>	<p>$M_1 A_1$</p> <p>A_1 f.t. (3)</p>
(b)	<p>$\arctan \frac{1}{2}$ (or $\arctan 2$ allowed for M_1)</p> <p>26.6° only</p>	<p>M_1</p> <p>A_1 (2)</p>
(c)	<p>$\vec{OC} = 2\underline{i} - \underline{j} + 5(2\underline{i} + \underline{j})$ OR $6\underline{i} + \underline{j} + 3(2\underline{i} + \underline{j})$</p> <p>$\vec{OC} = 12\underline{i} + 4\underline{j}$</p> <p>$\vec{OC} = \sqrt{12^2 + 4^2}$</p> <p>$OC = 12.6$ only or equivalent f.t. answer given to <u>1 decimal place</u> also depends on $M_1 + M_1$</p>	<p>M_1</p> <p>A_1 f.t.</p> <p>M_1</p> <p>A_1 f.t. (4)</p>

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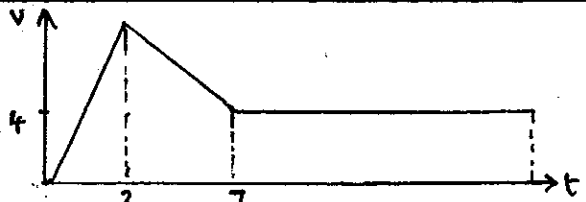
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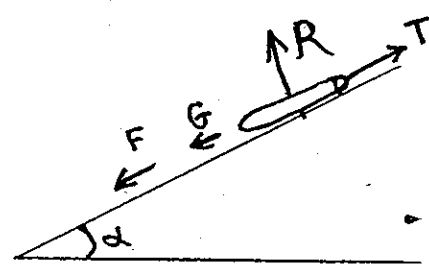
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Paper No. M1

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5.(a)	<p>Before $\rightarrow 4.5$ $\leftarrow 3$</p> <p style="text-align: center;">Momentum conserved on system</p> <p>After $\frac{v}{2} \rightarrow$ $v \rightarrow$</p> $0.6 \times 4.5 - 0.2 \times 3 = 0.6 \times \frac{v}{2} + 0.2 \times v$ <p style="text-align: center;">Solving for $v \rightarrow v = 4.2$</p>	<p>M1</p> <p>A1</p> <p><u>M1</u> A1 (4)</p>
(b)	<p>Change in momentum of A or B attempted</p> $0.2(3+4.2) \text{ or } 0.6(4.5-2.1) \rightarrow \underline{1.44} \text{ units } \underline{\underline{Ns}}$	<p>M1</p> <p><u>A1ft</u> <u>B1</u> (3)</p>
(c)	<p>$R = mg$</p> <p>$\mu R = \mu mg = \text{retarding force or deceleration } \underline{\mu g}$</p> <p>$v^2 = u^2 + 2as$ applied (or equivalent work) $0 = 4.2^2 - 2\mu g \times 2$</p> $\mu = \frac{4.2^2}{4g} = 0.45$ <p style="text-align: center;">(DMI depends on M1+1)</p>	<p>B1</p> <p>M1</p> <p>M1 A1ft</p> <p><u>DM1</u> A1 (6)</p>
6 (a)	 <p style="text-align: right;">G1 2 stages \checkmark slope G2 3 stages \checkmark slope +G1 for 2, 7, 4 on axes.</p>	<p>G3, 2, 1, 0 (3)</p>
(b)	<p>Using $v = u + at \rightarrow v = 9.8 \times 2 = 19.6$</p>	<p>M1A1 (2)</p>
(c)	<p>Stage 1 distance $\frac{1}{2} \times 9.8 \times 4$ or $\frac{1}{2} \times 2 \times 19.6 = 19.6$</p> <p>Stage 2 distance $\frac{1}{2} (19.6 + 4) \times 5$ (or equivalent two stage method)</p> <p style="text-align: center;">= 59 (acceleration = 3.12 M1A1, 59A1)</p> <p>Minimum height for H = 59 + 19.6 = 78.6 m</p>	<p>B1ft</p> <p>M1A1ft</p> <p>A1cao</p> <p>A1ft. (5)</p>
(d)	<p>From a height of 125m, there are 46.4m to fall at 4 ms^{-1}</p> <p>Time for stage 3 = $\frac{46.4}{4} \text{ s} \rightarrow (11.6 \text{ s})$</p> <p>Total time = 2 + 5 + (11.6) $\rightarrow 18.6 \text{ s}$</p>	<p>M1</p> <p>M1A1ft</p> <p>A1cao (4)</p>
(e)	<p>Air resistance in (a) or equivalent sound reason</p>	<p>B1 (1)</p>

Question number	Scheme	Marks
7. (a)	$\alpha = \arctan \frac{5}{12}$ $\cos \alpha = \frac{12}{13}, \quad \sin \alpha = \frac{5}{13}$ <div style="border: 1px solid black; padding: 5px; display: inline-block;"> $\alpha = 22.6^\circ$ $\cos \alpha = 0.923$, $\sin \alpha = 0.384$ </div> $R = 78g \cos \alpha$ $F = 78g \cos \alpha (0.25)$ $G = 78g \sin \alpha$  <p>Newton II along slope attempted with T, F, G included</p> $T - F - G = 78 (0.5)$ <p>Solving for T (dependent on M1)</p> $T = 509.4 \quad (\text{accept this or } 510 \text{ or } 2 \text{ s.f. or } 509 \text{ or } 3 \text{ s.f. result only})$	<p>M1 A1</p> <p>B1</p> <p>M1 A1 ft.</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>(9)</p>
(4)	<p>Accelerating force down slope is $G - F$ (or Friction reversed and T no longer included)</p> <p>Newton II $G - F = 78 a$</p> $a = g \sin \alpha - \mu g \cos \alpha$ $= 9.8 \left(\frac{5}{13} - \frac{3}{13} \right)$ $= 1.5, 1.50, 1.51 \quad \text{or } \frac{2}{13} g \quad \text{Score A2}$ <p>other answers which round to 1.5 Score A1</p>	<p>M1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A2, 5, 0 (6)</p>