

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

**Advanced Subsidiary General Certificate of Education
Advanced General Certificate of Education**

MATHEMATICS

4729

Mechanics 2

MARK SCHEME

Specimen Paper

MAXIMUM MARK	72
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This mark scheme consists of 4 printed pages.

<p>1 (i) Work done is $500 \cos 15^\circ \times 400 \approx 193\,000 \text{ J}$</p> <hr/> <p>(ii) Power applied is $\frac{193\,185}{600} \approx 322 \text{ W}$</p>	<p>M1 A1 A1</p> <p>3</p>	<p>For attempt to use Force \times distance For correct unsimplified product For correct answer 193 000</p> <hr/> <p>For relevant use of $\frac{\text{work}}{\text{time}}$ or force \times velocity For correct answer 322</p>
<p>2 (i) CM is vertically above lowest point of base Hence $\tan \alpha = \frac{6}{7.5} \Rightarrow \alpha = 38.7^\circ$</p> <hr/> <p>(ii) Cylinder slides when $\tan \theta = \frac{3}{4}$ But $\frac{3}{4} < 0.8$, so $\theta < \alpha$ Hence it slides first (at inclination 36.9°)</p>	<p>B1 M1 A1</p> <p>3</p> <p>B1 M1 A1 A1</p> <p>4</p> <p>7</p>	<p>For stating or implying correct geometry For appropriate trig calculation For correct answer 38.7</p> <hr/> <p>For stating or implying limiting friction case For comparing $\tan \alpha$ to $\tan \theta$, or equivalent For correct comparison of the angles For correct conclusion of sliding first</p>
<p>3 (i) CG of triangle is $\frac{2}{3}a$ horizontally from A Moments: $\frac{1}{3}W \times \frac{2}{3}a + \frac{2}{3}W \times \frac{3}{2}a = W \times \bar{x}$ Hence $\bar{x} = \frac{11}{9}a$</p> <hr/> <p>(ii) $R_A \times 2a = W \times \frac{7}{9}a \Rightarrow R_A = \frac{7}{18}W$ $R_A + R_D = W \Rightarrow R_D = \frac{11}{18}W$</p>	<p>B1 M1 A1 A1</p> <p>4</p> <p>M1 A1 M1 A1 \checkmark</p> <p>4</p> <p>8</p>	<p>For equating moments about A, or equivalent For a correct unsimplified equation Given answer correctly shown</p> <hr/> <p>For one moments equation For one correct answer For resolving, or a second moments equation For a second correct answer</p>
<p>4 Horiz distances of B from A and C are 5 cm and 16 cm $21T_A = 13 \times 18.5 + 20 \times 8$ $T_A + T_C = 33$ Hence $T_A = 19.1 \text{ N}$ and $T_C = 13.9 \text{ N}$</p>	<p>M1 A1 M1 A1 \checkmark A1 \checkmark M1 A1 A1</p> <p>8</p> <p>8</p>	<p>For appropriate use of Pythagoras For both distances correct For any moments equation for the system For any one relevant term correct For a completely correct equation For resolving, or using another moments eqn For correct answer 19.1 For correct answer 13.9</p>
<p>5 (i) Gain in KE is $\frac{1}{2} \times 80 \times 5^2 = 1000 \text{ J}$ Gain in PE is $80 \times 9.8 \times 4 = 3136 \text{ J}$</p> <hr/> <p>(ii) $8000 = 1000 + 3136 + 70d$ Hence distance AB is 55.2 m</p> <hr/> <p>(iii) $\frac{720}{5} - 70 = 80a$ Hence acceleration is 0.925 m s^{-2}</p>	<p>M1 M1 A1</p> <p>3</p> <p>M1 M1 A1</p> <p>3</p> <p>B1 M1 A1 A1</p> <p>4</p> <p>10</p>	<p>For use of formula $\frac{1}{2}mv^2$ For use of formula mgh For both answers 1000 and 3136 correct</p> <hr/> <p>For equating work done to energy change For relevant use of force \times distance For correct answer 55.2</p> <hr/> <p>For driving force $\frac{720}{5}$ For use of Newton II with 3-term equation For a completely correct equation For correct answer 0.925</p>

<p>6 (i) $0 = (19\sin 11^\circ)^2 - 2gh$</p> <p>Hence max height is $\frac{(19\sin 11^\circ)^2}{19.6} + 1.53 = 2.20$ m</p> <hr/> <p>(ii) EITHER: Time to top point is $\frac{19\sin 11^\circ}{g} \approx 0.3699$</p> <p>Time to fall is $\sqrt{\frac{2 \times 2.20}{9.8}} \approx 0.6701$</p> <p>Total time of flight is 1.04</p> <p>Horiz dist is $19\cos 11^\circ \times 1.04 \approx 19.4$ m</p> <p>OR: $-1.53 = x \tan 11^\circ - \frac{gx^2}{2 \times (19\cos 11^\circ)^2}$</p> <p>Hence $x = 19.4$</p>	<p>M1 B1 A1 A1</p> <hr/> <p>M1 M1 A1 A1 M1 A1</p> <p>M1 B1 A1 M1 A2</p>	<p>For use of relevant const acc equation for h</p> <p>For correct vertical component $19\sin 11^\circ$</p> <p>For correct expression for h (≈ 0.67)</p> <p>4 For correct answer 2.20</p> <hr/> <p>For use of relevant const acc equation for t_{up}</p> <p>For use of relevant const acc eqn for t_{down}</p> <p>For a correct expression for t_{down}</p> <p>For correct value (or expression)</p> <p>For any use of $x = (19\cos 11^\circ)t$</p> <p>For correct answer 19.4</p> <p>[Alternative approaches for the first four marks are equally acceptable; e.g. the use of $s = ut - \frac{1}{2}gt^2$ to find $t = 1.04$]</p> <p>For relevant use of trajectory equation</p> <p>For $y = -1.53$ correctly substituted</p> <p>For completely correct equation for x</p> <p>For attempt to solve relevant quadratic</p> <p>6 For correct answer 19.4</p> <p style="text-align: center;">10</p>
<p>7 (i) $T_1 \times \frac{7}{25} = 0.08g$</p> <p>Hence tension in upper string is 2.8 N</p> <p>$T_1 \times \frac{24}{25} + T_2 = 0.08 \times \frac{10.5^2}{2.4}$</p> <p>Hence tension in horizontal string is 0.987 N</p> <hr/> <p>(ii) $2.8 \times \frac{2.4}{2.5} = 0.08 \times \frac{v^2}{2.4}$</p> <p>Hence $v = 8.98$</p>	<p>M1 B1 A1 M1 B1 A1 A1</p> <hr/> <p>M1 A1✓ M1 A1</p>	<p>For resolving vertically</p> <p>For $\frac{7}{25}$ or $\sin 16.3^\circ$ or equivalent</p> <p>For correct value 2.8</p> <p>For correct use of Newton II horizontally</p> <p>For any use of $\frac{10.5^2}{2.4}$, or equivalent</p> <p>For correct horizontal equation</p> <p>7 For correct value 0.987</p> <hr/> <p>For new horizontal equation with $T_2 = 0$</p> <p>For correct equation for v</p> <p>For solving for v correctly</p> <p>4 For correct value 8.98</p> <p style="text-align: center;">11</p>

<p>8 (i) Change of momentum of A is 0.24×2</p> <p>Hence magnitude of impulse is 0.48 N s</p>	<p>M1 A1 A1</p>	<p>For considering momentum of A For correct expression for change in mom For correct answer 0.48</p>
<p>(ii) $mv_B = 0.48$ $v_B \geq 6$</p> <p>Hence $m \leq \frac{0.48}{6} = 0.08$</p>	<p>M1 M1 A1</p>	<p>For considering momentum of B For using the inequality $v_B \geq v_A$ For showing given answer correctly</p>
<p>(iii) $m = 0.06 \Rightarrow v_B = 8$ Hence $8 - 6 = e(8 - 0)$ i.e. $e = \frac{1}{4}$</p>	<p>B1 M1 A1</p>	<p>For correct speed of B For correct use of Newton's law For correct answer $\frac{1}{4}$ or equivalent</p>
<p>(iv) $0.24 \times 4 - 0.06 \times 4 = 0.24a + 0.06b$ $b - a = \frac{1}{4}(4 + 4)$</p> <p>Hence speeds of A and B are 2 m s^{-1} and 4 m s^{-1}</p>	<p>B1 B1✓ M1 A1</p>	<p>For a correct momentum equation For a correct restitution equation For solution of relevant simultaneous eqns For both answers correct</p>
<p>13</p>		