# EDEXCEL FOUNDATION

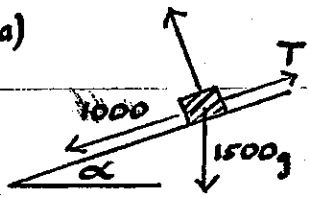
Stewart House 32 Russell Square London WC1B 5DN

**January 2002**

**Advanced Supplementary/Advanced Level**

General Certificate of Education

Subject **MECHANICS 6678** Paper No. **M2**

| Question number | Scheme | Marks |
|---|---|---|
| 1. | Work done = Loss in K.E.<br>$R \times 200 = \frac{1}{2} \times 4 \times 25^2$<br>$R = 6{\cdot}25$ | M1 A1=A1<br>A1 4 (4) |
| 2. | (a)  $T = \frac{P}{v} = \frac{60\,000}{30} (=2000)$<br>N2L: $2000 - 1000 - 1500 \times 9{\cdot}8 \times \frac{1}{12}$<br>$= 1500a$<br>$a = (-)\ 0{\cdot}15\ (ms^{-2})$ cao | B1<br>M1 A1<br>A1 4 |
| | (b) $\nearrow$ $T' = 1000 + 1500 \times 9{\cdot}8 \times \frac{1}{12} (=2225)$<br>$P = Tv$ $80\,000 = 2225v$<br>$v \approx 36\ (ms^{-1})$ accept 36·0 | M1 A1<br>M1<br>A1 4 |
| | (c) The resistance is likely to increase with speed | B1 1 (9) |
| 3. | (a) $\underset{\sim}{a} = 6t\underset{\sim}{i} + 6\underset{\sim}{j}$<br>$t=2$ $\underset{\sim}{a} = 12\underset{\sim}{i} + 6\underset{\sim}{j}$<br>N2L $\underset{\sim}{F} = m\underset{\sim}{a} = 3{\cdot}6\underset{\sim}{i} + 1{\cdot}8\underset{\sim}{j}$<br>$\lvert\underset{\sim}{F}\rvert = \sqrt{(3{\cdot}6^2 + 1{\cdot}8^2)} \approx 4{\cdot}02$ (accept 4·03) cao | M1<br>A1<br>M1<br>M1A1 5 |
| | (b) $\underset{\sim}{r} = (t^3 + c_1)\underset{\sim}{i} + (3t^2 - 4t + c_2)\underset{\sim}{j}$ ignore constants<br>Using $t=0$, $\underset{\sim}{r} = (t^3 + 3)\underset{\sim}{i} + (3t^2 - 4t - 4)\underset{\sim}{j}$<br>$t=4$, $\underset{\sim}{r} = 67\underset{\sim}{i} + 28\underset{\sim}{j}$ (m) | M1 A1+A1<br>M1<br>A1 5 (10) |

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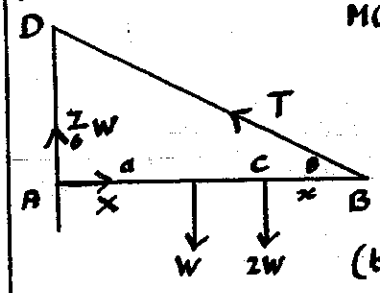
| 4 | (a) ABC WXYZ Template<br>mass ratio $48a^2$ $4a^2$ ; $44a^2$<br>c.m. $\frac{8a}{3}$ $2a$ $\bar{x}$<br>M(AB) $44a^2\bar{x} + 8a^3 = 48a^2 \times \frac{8a}{3}$<br>solving to $\bar{x} = \frac{30}{11}a$ * cso<br>(b)<br>M(AB) or M(ZY)<br>$K M \times 8a + M \times \frac{30}{11}a = M(1+K)3a$ $KM \times 5a = M(3a - \frac{30}{11}a)$<br>solving to $K = \frac{3}{55}$ $K = \frac{3}{55}$ or awrt 0.055 | B1; B1√<br>B1 B1<br>M1 A1<br>A1 7<br><br>M1 A2(1,0)<br>A1 4 |
| 5. | (a)<br>  <br><br>M(A) $T \times 2a\sin\theta = Wa + 2W(2a-x)$<br>$T \times \frac{6}{5}a = 5Wa - 2Wx$<br>$T = \frac{5(5a-2x)}{6a}W$ * cso<br>(b) M(B) $\frac{7}{6}W \times 2a = Wa + 2Wx$<br>$x = \frac{2}{3}a$ o.e.<br>(c) R(→) $X = T\cos\theta = \frac{5}{6}(5 - \frac{4}{3})W \times \frac{4}{5}$ ✓<br>$= \frac{22}{9}W$ | M1 A2(1,0)<br><br>M1 A1 5<br><br>M1 A1<br>A1 3<br>M1 A1√<br>M1 A1 4 |
| | Alternative to (b)<br>R(↑) $\frac{7}{6}W + T\sin\theta = 3W$<br>$\frac{7}{6}W + \frac{5(5a-2x)W}{6a} \times \frac{3}{5} = 3W$<br>$x = \frac{2}{3}a$ | M1 A1<br>A1 3 |

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| Question number | Scheme | Marks |
|---|---|---|
| 6. | $\rightarrow u$ P (m) Q (2m) $\rightarrow x$ $\rightarrow y$ | |
| | (a) LM $mu = mx + 2my$ | B1 |
| | NEL $x - y = -eu$ | M1 A1 |
| | Solving to $y = \frac{1}{3}(1+e)u$ * cso. | M1 A1 5 |
| | (b) Obtaining $x = \frac{1}{3}(1-2e)u$ allow angular | M1 A1 |
| | Direction unchanged implies $x > 0$ | M1 |
| | $e < \frac{1}{2}$ ignore $e \geq 0$ | A1 4 |
| | (c) $y = \frac{5}{12}u$, $x = \frac{1}{6}u$ | |
| | Final K.E $= \frac{1}{2}m(\frac{1}{6}u)^2 + \frac{1}{2}2m(\frac{5}{12}u)^2$ $(= \frac{27}{144}mu^2)$ | M1 A1 |
| | Loss in K.E $= \frac{1}{2}mu^2 - \frac{27}{144}mu^2 = \frac{5}{16}mu^2$ | M1 A1 4 |
| | (d) Heat, sound, (work done by) internal forces | B1 1 (14) |
| 7. | (a) (↑) $u_y = 80\sin 60°$, $v_y = 0$ | B1, B1 |
| | $0^2 = (80\sin 60)^2 - 2\times 9.8\times s$ | M1 |
| | $s \approx 244.9$ | |
| | Height is 260 m. Accept 265 | A1 4 |
| | (b) $0 = 80\sin 60° - 9.8t$ | M1 |
| | $t = 7.1$ (s) Accept 7.07 | A1 2 |
| | (c) (→) $u_x = 80\cos 60°$ $(= 40)$ | B1 |
| | LM $100\times 40 = 40\times v + 60\times 80$ | M1 |
| | $v = (-)20$ * cso | A1 3 |
| | (d) Let N be point on ground vertically below B | |
| | $ON = 80\cos 60° \times$ their (b) $(= 282.79)$ | M1 |
| | ↓ $264.9 = \frac{1}{2}\times 9.8\times t^2 \Rightarrow t \approx 7.35$ awrt | M1 A1 |
| | $CN = 20\times 7.35 \approx 147$ awrt | M1 A1 |
| | $OC = 140$ (m) accept 136 | A1 6 (15) |