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WELSH JOINT EDUCATION COMMITTEE
CYD-BWYLLGOR ADDYSG CYMRU

General Certificate of Education
Advanced Subsidiary/Advanced

Tystysgrif Addysg Gyffredinol
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MARKING SCHEMES

SUMMER 2007

MATHEMATICS

WJEC
CBAC

MATHEMATICS M2

1. *(a)* When P is at rest, $v = 0$. used M1

$3t^2 - 24t + 45 = 0$

$3(t-3)(t-5) = 0$

Therefore P first comes to rest when $t = 3$. A1

(b) $a = \dfrac{dv}{dt}$ used M1

$a = \underline{6t - 24}$ A1

(c) Displacement $s = \int v\,dt$ used M1

$s = t^3 - 12t^2 + 45t\ (+C)$ A1

When $t = 0$, $s = 0$, therefore C = 0

$s = t^3 - 12t^2 + 45t$ A1

(d) Distance travelled in the first 3 s $= 3^3 - 12(3)^2 + 45(3)$ M1

$= 27 - 108 + 135$

$= \underline{54\text{ m}}$ ft A1

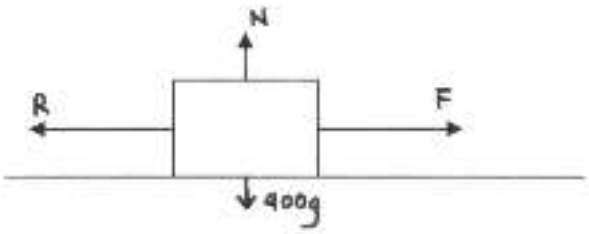
(e) Displacement after 4s $= 4^3 - 12(4)^2 + 45(4)$

$= \underline{52\text{ m}}$ B1

Distance travelled in 4 s $= 54 + (54-52)$

$= \underline{56\text{ m}}$ B1

2.



(a) At maximum speed $F = R$ used M1

$F = \dfrac{P}{V}$ used M1

Therefore $1800 = \dfrac{45\times1000}{V}$

$V = \underline{25\text{ ms}^{-1}}$ cao A1

(b) N2L all forces, dim. cor. M1

$F - R - mg\sin 4^\circ = ma$ A1

$F = \dfrac{45000}{15}$ $(= 3000)$ B1

$3000 - 1800 - 900\times 9.8\sin 4^\circ = 900\times a$ A1

$a = \underline{0.65\text{ ms}^{-2}}$ cao A1

(c) W.D. $= F.d$ used M1

$= 1800 \times 800 = \underline{1440000\text{ J}}$ cao A1

3. *(a)* PE at start of motion $= 3 \times 9.8 \times (0.8 + 0.4)$ M1 A1

$= 35.28$ J

EE at end of motion $= \frac{1}{2}\lambda\frac{(0.4)^2}{0.8}$ M1 A1

$= 0.1\ \lambda$

Energy consideration = M1

$0.1\ \lambda = 35.28$ A1

$\lambda = \underline{352.8\text{ N}}$ convincing A1

(b) Hooke's Law $T = \frac{\lambda x}{l}$ used M1

$= \frac{352.8 \times 0.4}{0.8}$

$= \underline{176.4\text{ N}}$ cao A1

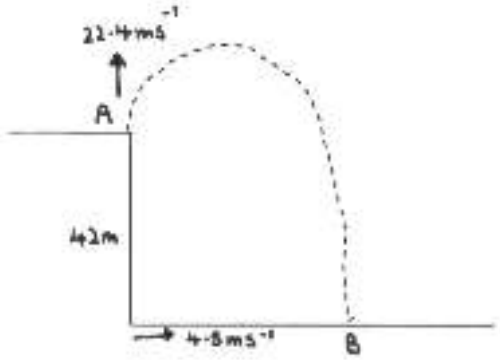
N2L dim cor. M1

$T - 3g = 3a$ A1

$176.4 - 3 \times 9.8 = 3a$

$a = \underline{49\text{ ms}^{-2}}$ A1

4.



(a) Consider vertical motion

Using $v = u + at$ with $u = 22.4$, $a = (-)9.8$, $t = 2$. M1

$v = 22.4 - 9.8 \times 2$ A1

$v = 2.8\text{ms}^{-1}$ cao A1

Speed $= \sqrt{4.5^2 + 2.8^2}$ M1

$= \underline{5.3\text{ ms}^{-1}}$ ft v A1

(b) Using $s = ut + 0.5at^2$ with $s = (-)42$, $u = 22.4$, $a = (-)9.8$ M1

$-42 = 22.4t - 4.9t^2$ A1

$0.7t^2 - 3.2t - 6 = 0$

$t = \frac{3.2 \pm \sqrt{3.2^2 + 4 \times 0.7 \times 6}}{2 \times 0.7}$ m1

$T = \underline{6\text{ s}}$ (other solution negative) A1

(c) Horizontal distance between A and B $= 4.5 \times 6$ M1

$= \underline{27\text{ m}}$ ft (b) A1

5. *(a)* **a**, **b** perpendicular $\Rightarrow$ $\mathbf{a}.\mathbf{b} = 0$ M1

$\mathbf{a}.\mathbf{b} = -2 + 13y - 50$ M1 A1

$-2 + 13y - 50 = 0$

$y = \underline{4}$ A1

(b) **a**, **b** parallel $\Rightarrow$ $\mathbf{a} = -2\mathbf{b}$ M1

$-2y = 13$

$y = \underline{-6.5}$ A1

6. *(a)* Angular velocity $\omega = \frac{v}{r}$ used M1

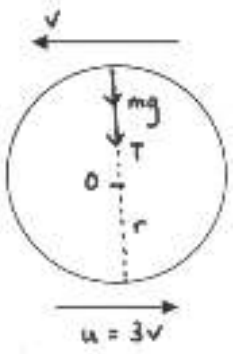
$\omega = \frac{3}{0.4}$

$\omega = \underline{7.5 \text{ rad s}^{-1}}$ cao A1

(b) Tension in the string $T = \frac{mv^2}{r}$ oe M1

$T = \frac{0.8 \times 3^2}{0.4} = \underline{18 \text{ N}}$ cao A1

7.



(a) Conservation of energy M1

$0.5mu^2 = 0.5mv^2 + mg \times 2r$ A1 A1

$9v^2 = v^2 + 9.8 \times 2 \times 0.9 \times 2$ $u = 3v$ B1

$8v^2 = 35.28$

$v = 2.1$

and $u = 6.3$ convincing A1

(b) N2L towards centre *O* M1

$T + mg = \frac{mv^2}{r}$ A1

$T = \frac{3 \times 2.1^2}{0.9} - 3 \times 9.8$ A1

$T = \underline{-14.7 \text{ N}}$ cao A1

(c) Object would not move in complete circles as T is negative,
i.e. rod exerted a thrust which a string cannot exert. B1 E1

8. *(a)* $\mathbf{r_A} = (0\mathbf{i} + 3\mathbf{j} - 140\mathbf{k}) + t(3\mathbf{i} - 2\mathbf{j} + 5\mathbf{k})$ M1 A1

$\mathbf{r_B} = (-9\mathbf{i} - 4\mathbf{j} - 6\mathbf{k}) + t(-2\mathbf{i} + 6\mathbf{j} + 3\mathbf{k})$ A1

(b) $\mathbf{r_A} - \mathbf{r_B} = (9 + 5t)\mathbf{i} + (7 - 8t)\mathbf{j} + (2t - 134)\mathbf{k}$ si M1 A1

$AB^2 = (9 + 5t)^2 + (7 - 8t)^2 + (2t - 134)^2$ ft B1

$AB^2 = 93t^2 - 558t + 18086$

(c) At minimum distance $\dfrac{\mathrm{d}AB^2}{\mathrm{d}t^2} = 0$ M1

$\dfrac{\mathrm{d}AB^2}{\mathrm{d}t^2} = 2(9 + 5t)(5) + 2(7 - 8t)(-8) + 2(2t - 134)(2)$ m1 A1

$45 + 25t - 56 + 64t + 4t - 268 = 0$

$93t - 279 = 0$

$t = \underline{3\text{ s}}$ cao A1