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GENERAL CERTIFICATE OF EDUCATION
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MARKING SCHEME

MATHEMATICS - C1-C4 & FP1-FP3
AS/Advanced

SUMMER 2008

Mathematics M2 (June 2008)

Markscheme

1.(a) Using $T = \dfrac{\lambda x}{l}$ with $T = 12$, $x = 0.55 - 0.3$, $l = 0.3$ M1

$12 = \dfrac{\lambda(0.55 - 0.3)}{0.3}$ A1

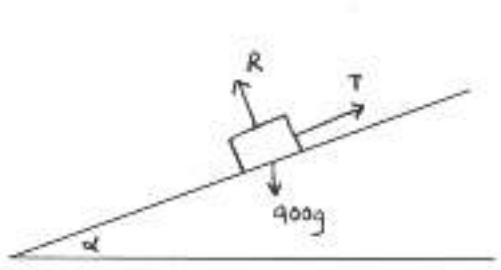
$\lambda = \dfrac{12 \times 0.3}{0.25}$

$= \underline{14.4 \text{ N}}$ cao A1

1.(b) Using EE $= \dfrac{1}{2} \times \dfrac{14.4 \times 0.25^2}{0.3}$ ft λ M1 A1

$= \underline{1.5 \text{ J}}$ ft λ A1

2.



$T = \dfrac{32 \times 1000}{16}$ si M1

$= 2000$ N

N2L up plane M1

$T - F - 900\,g \sin\alpha = 0$ A1

Resistive force $F = 2000 - 900 \times 9.8 \times \dfrac{8}{49}$

$= \underline{560 \text{ N}}$ cao A1

3.(a) Using $F = ma$ $\quad 5a = 15t^2 - 60t$ M1

$a = 3t^2 - 12t$

When $t = 2$ $\quad a = 12 - 24$

$= -12$

Therefore magnitude of acceleration = $\underline{-12\ \text{ms}^{-1}}$ A1

3.(b) $v = \int 3t^2 - 12t\ \mathrm{d}t$ M1

$= t^3 - 6t^2\ (+ C)$ A1

When $t = 0$, $v = 35$ m1

$C = 35$ A1

$v = \underline{t^3 - 6t^2 + 35}$

3.(c) Least value of v when $a = 0$ M1

$3t(t - 4) = 0$

$t = (0 \text{ or } 4)$ ft v A1

Therefore least value of $v = 4^3 - 6\times 4^2 + 35$

$= \underline{3\ \text{ms}^{-1}}$ ft v A1

3.(d) Required distance $= \int_2^8 t^3 - 6t^2 + 35\ \mathrm{d}t$ attempt to integrate v M1

$= \left[\frac{t^4}{4} - 2t^3 + 35t\right]_2^8$ correct integration A1

$= (16 \times 64 - 16 \times 64 + 35 \times 8) - (4 - 16 + 70)$ m1

$= 280 - 58$

$= \underline{222\ \text{m}}$ cao A1

4.(a) Difference in PE $= 2232 \times 90\ g - 2128 \times 90\ g +$ PE M1 A1

$= (1968624 - 1876896)$

$= 91728$ J

Difference in KE $= 0.5 \times 90 \times 35^2 - 0.5 \times 90 \times 2^2$ KE M1 A1

$= 55125 - 180$

$= 54945$ J

Work done against resistance $= 36783$ J M1 A1

4.(b) Work done $= 1335\ R = 36783$ M1

$R = \underline{27.55\ \text{N}}$ ft WD if M's gained in (a) A1

5.(a) Using $s = ut + 0.5at^2$ with $u = 14$, $a = (-)9.8$, $s = 8.4$ M1

$8.4 = 14t - 4.9t^2$ A1

$7t^2 - 20t + 12 = 0$ attempt to solve m1

$(7t - 6)(t - 2) = 0$

$t = 6/7, 2$ A1

As particle is on the way down, $t = 2$

Therefore horizontal distance of wall $= 2 \times 12$ M1

$= \underline{24 \text{ m}}$ cao A1

5.(b) Using $v = u + at$ with $u = 14$, $a = (-)9.8$, $t = 2$ M1

$v = 14 - 9.8 \times 2$ ft t A1

$= \underline{-5.6 \text{ ms}^{-1}}$ ft t A1

Therefore speed of motion $= \sqrt{5.6^2 + 12^2}$ M1

$= \underline{13.24 \text{ ms}^{-1}}$ ft v A1

$\theta = \tan^{-1}\left(\frac{5.6}{12}\right)$ M1

$= \underline{25°}$ to the horizontal. ft v A1

6.(a) $\underline{AB} = (3\mathbf{i} - \mathbf{j} + 2\mathbf{k}) - (2\mathbf{i} + \mathbf{j} + \mathbf{k})$ M1

$= \mathbf{i} - 2\mathbf{j} + \mathbf{k}$ cao A1

6.(b) Work done by $\mathbf{F} = \mathbf{F}.\underline{AB}$

$= (\mathbf{i} - 4\mathbf{j} + \mathbf{k}).(\mathbf{i} - 2\mathbf{j} + \mathbf{k})$ M1

$= 1 + 8 + 1$ ft m1

$= \underline{10 \text{ J}}$ ft A1

7.(a) $\boldsymbol{a} = \frac{\mathrm{d}\boldsymbol{v}}{\mathrm{dt}}$ used M1

$= \underline{3\cos 3t\,\mathbf{i} - 10\sin 5t\,\mathbf{j} + 9t^2\,\mathbf{k}}$ A2

7.(b) $\boldsymbol{r}_A = (-8t - 2)\mathbf{i} + (3t + 3)\mathbf{j}$

$\boldsymbol{r}_B = (-16t + 11)\mathbf{i} + (9t - 8)\mathbf{j}$

$\boldsymbol{r}_A - \boldsymbol{r}_B = (8t - 13)\mathbf{i} + (-6t + 11)\mathbf{j}$ M1

$|r_A - r_B|^2 = (-13 + 8t)^2 + (11 - 6t)^2$ M1 A1

$= 169 - 208t + 64t^2 + 121 - 132t + 36t^2$

$= 290 - 340t + 100t^2$

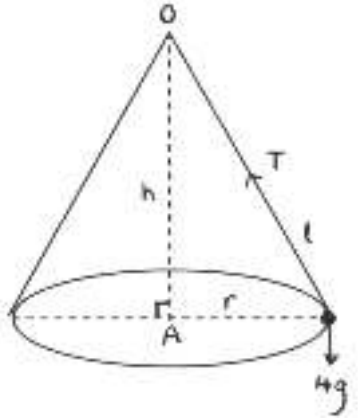
Minimum when $200t = 340$ m1

$t = \underline{1.7}$ cao A1

Minimum distance $= \sqrt{290 - 340(1.7) + 100(1.7)^2}$ M1

$= \underline{1}$ cao A1

8.



(a) N2L towards centre M1

$$T\sin\theta = \frac{mv^2}{r}$$ A1

$$= \frac{4\times 2^2}{\frac{3}{7}} = \frac{112}{3}$$

Resolve vertically M1

$$T\cos\theta = 4\times 9.8$$ A1

$$= 39.2$$

Dividing $\tan\theta = \frac{112}{3\times 39.2}$ m1

$$\angle AOP = \theta = \tan^{-1}\left(\frac{112}{3\times 39.2}\right)$$

$$= \underline{43.6^\circ}$$ cao A1

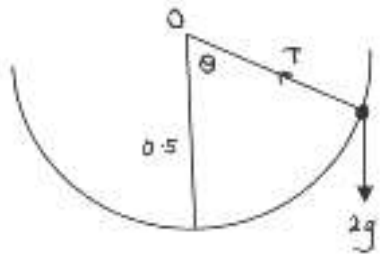
(b) $$T = \frac{39.2}{\cos(43.6^\circ)}$$

$$= \underline{54.13\text{ N}}$$ ft angle A1

(c) $$l = \frac{3}{7\sin(43.6^\circ)}$$

$$= \underline{0.62\text{ m}}$$ ft angle B1

9.



(a) Energy considerations M1

$-2g \times 0.5 \cos\theta + 0.5mv^2 = -2g \times 0.5 \cos 60° + 0.5 \times 2 \times 4^2$ A1A1

$v^2 = g\cos\theta - 0.5g + 16$

$v^2 = 16 + g(\cos\theta - 0.5)$ A1

$= \underline{g\cos\theta + 11.1}$

(b) N2L towards centre M1

$$T - mg\cos\theta = \frac{mv^2}{r}$$ A1

$$T = 2g\cos\theta + \frac{2}{0.5}\left(16 + g\cos\theta - \frac{1}{2}g\right)$$ m1

$= 2g\cos\theta + 64 + 4g\cos\theta - 2g$

$= 6g\cos\theta - 2g + 64$ A1

$T = \underline{58.8\cos\theta + 44.4}$