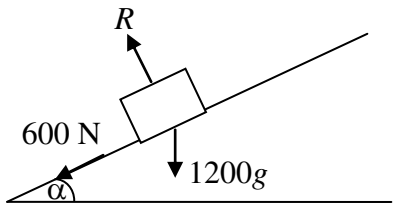
GCE MARKING SCHEME

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

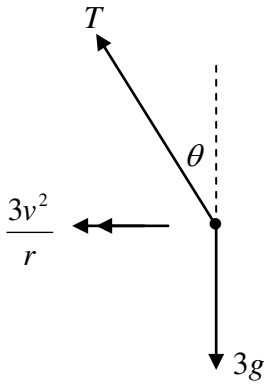
SUMMER 2012

M2

Q	Solution	Mark	Notes
1.	$s = \int_0^{\frac{\pi}{6}} 4\cos 2t \, dt$	M1	limits not required
	$s = [2\sin 2t]$	A1	correct integration
	$s = 2\sin\frac{\pi}{3} - 0$		
	$s = \sqrt{3} = \underline{1.732}$	A1	cao
2(a)	N2L $T = 7.5g$	B1	
	Hooke's Law $T = \frac{245x}{5/3}$ $(= 147x)$	M1	
	$7.5 \times 9.8 = 147x$		
	$x = \underline{0.5}$	A1	cao
2(b)	Elastic Energy $= \frac{1}{2} \times \frac{x^2}{l}$	M1	used
	$EE = \frac{1}{2} \times \frac{245 \times 0 \cdot 5^2}{5/3}$		
	$EE = \underline{18.375 \text{ (J)}}$	A1	ft c's x value
3(a).	$\underline{v} = \frac{d\underline{r}}{dt}$	M1	used
	$\underline{v} = (1 + 4t)\underline{i} + (3t - 2)\underline{j}$	A1	
	we required $\underline{v}.(-\underline{i} + 2\underline{j}) = 0$	M1	
	$-(1 + 4t) + 2(3t - 2) = 0$	m1	
	$-1 -4t + 6t -4 = 0$		
	$2t = 5$		
	$t = \underline{2.5}$	A1	cao
3(b)	$\underline{a} = \frac{d\underline{v}}{dt}$	M1	used
	$\underline{a} = 4\underline{i} + 3\underline{j}$	A1	ft c's **v** provided constant
	$\underline{a}$ is independent of t and constant.		
	$\lvert a \rvert = \sqrt{4^2 + 3^2} = \underline{5}$	A1	ft constant **a=x**$\underline{i}$**+y**$\underline{j}$

Q	Solution	Mark	Notes
4.			
4(a)	$T = \frac{P}{v} = \frac{75\times1000}{25}$ $T = 3000$ N	M1	
	N2L up plane $T - 1200g\sin\alpha - 600 = 1200a$ $1200a = 3000 - 1200 \times 9.8 \times 0.1 - 600$ $a = \underline{1.02\ (ms^{-2})}$	M1 A1	dim correct, all forces A2 -1 each error cao
4(b)	$T = \frac{90\times1000}{v}$	M1	
	N2L up plane $T - 1200g\sin\alpha - 600 = 1200a$ $a = 0$ $\frac{90000}{v} = 1776$ $v = \underline{50.7\ (ms^{-1})}$	M1 m1 A1	dim correct, all forces si cao
5.	KE at A $= 0.5 \times 0.1 \times v^2$ PE at A $= 0.1 \times 9.8 \times 0.5$ PE at B $= 0.1 \times 9.8 \times 1.4$ WD against resistance $= 6 \times 1.2$	B1 M1 A1 B1	 both or difference
	Work-energy principle $0.05\ v^2 = 7.2 + 0.1 \times 9.8 \times 0.9$ $v^2 = 161.64$ $v = \underline{12.7\ (ms^{-1})}$	M1 A1 A1	all terms included correct equation cao

Q	Solution	Mark	Notes
6(a).	$u_H = V\cos\alpha$ (= 0.8V) $u_V = V\sin\alpha$ (= 0.6V)	M1 A1	attempt to resolve both answers correct
6(b)	Consider horizontal motion $0.8V \times T = 12$ $VT = 15$	 M1 A1	 correctly obtained
6(c)	Consider vertical motion $s = ut + 0.5at^2$ with s=(±)5.4, u=0.6V, t=T a=(±)9.8 $-5.4 = 0.6VT - 4.9T^2$ $-5.4 = 0.6 \times 15 - 4.9T^2$ $4.9T^2 = 14.4$ $T = \frac{12}{7}$ $\frac{12}{7}V = 15$ $V = \underline{8.75}$	 M1 A1 A1 A1	 cao cao
6(d)	Using v = u + at with u=5.25, a=(±)9.8, $t=\frac{12}{7}$ $v = 5.25 - 9.8 \times \frac{12}{7}$ $v = -11.55$ $u_H = 0.8 \times 8.75 = 7$ Speed = $\sqrt{11.55^2 + 7^2}$ Speed = $\underline{13.5\ (ms^{-1})}$	 M1 A1 B1 M1 A1	 si, cao

Q	Solution	Mark	Notes
7.			
7(a)	Resolve vertically $T\cos\theta = mg$ $\theta = \cos^{-1}\left(\frac{3\times 9\cdot 8}{88\cdot 2}\right)$ $\theta = \underline{70.5°}$	M1 A1 A1	 cao
7(b)	N2L towards centre $T\sin\theta = ma$ $a = r\omega^2$ $r = \frac{T\sin\theta}{m\omega^2}$ length of string $= l$ $l\sin\theta = r$ $l = \frac{r}{\sin\theta}$ $l = \frac{T}{m\omega^2} = \frac{88\cdot 2}{3\times 2\cdot 8^2}$ $l = \underline{3.75\text{ (m)}}$	M1 A1 m1 m1 A1	attempted used cao
	<u>Alternative Solution</u> N2l towards centre $T\sin\theta = ma$ $a = r\omega^2$ $88.2\sin\theta = 3\times r\times 2.8^2$ $r = 3.53553$ m $AP = \frac{r}{\sin\theta}$ $AP = \underline{3.75\text{ (m)}}$	M1 A1 m1 m1 A1	attempted used cao

Q	Solution	Mark	Notes
8(a)	$\underline{v} = \frac{1}{3}[(14\underline{i} - 5\underline{j}) - (8\underline{i} + 7\underline{j})]$	M1	
	$\underline{v} = \frac{1}{3}(6\underline{i} - 12\underline{j})$		
	$\underline{v} = (2\underline{i} - 4\underline{j})$	A1	
8(b)	$\underline{r}_S = (8\underline{i} + 7\underline{j}) + (2\underline{i} - 4\underline{j})t$	M1 A1	
	$\underline{r}_S = (8 + 2t)\underline{i} + (7 - 4t)\underline{j}$		
8(c)	$\underline{r}_B = (x\underline{i} + y\underline{j})(t - 10)$	M1 A1	
	$\underline{r}_B = x(t - 10)\underline{i} + y(t-10)\underline{j}$		
	At t = 50 $\underline{r}_S = \underline{r}_B$	M1	
	$8 + 2t = x(t - 10)$	m1	
	$40x = 108$		
	$x = \underline{2.7}$	A1	cao
	$7 - 4 \times 50 = 40y$		
	$y = \underline{-4.825}$	A1	cao
	Alternative solution		
	At t = 50		
	$\underline{r}_S = 108\underline{i} - 193\underline{j}$		
	$\underline{r}_B = 40x\underline{i} + 40y\underline{j}$	M1 A1	
	$\underline{r}_S = \underline{r}_B$	M1	si
	$40x = 108$	m1	
	$x = \underline{2.7}$	A1	cao
	$40y = -193$		
	$y = \underline{-4.825}$	A1	cao

Q	Solution	Mark	Notes
9(a).	Conservation of energy	M1	
	$\frac{1}{2}mu^2 = \frac{1}{2}mv^2 + mgl(1 - \cos\theta)$	A1 A1	
	At max height, v=0, $\cos\theta=\frac{2}{3}$, l=1.2	m1	
	$\frac{1}{2}u^2 = 9.8 \times 1.2(1 - \frac{2}{3})$		
	$u^2 = 2 \times 9.8 \times 1.2 \times \frac{1}{3}$		
	$u = \underline{2.8\ (ms^{-1})}$	A1	cao
	$v^2 = u^2 - 2gl(1 - \cos\theta)$		
	$v^2 = 2.8^2 - 2 \times 9.8 \times 1.2(1- \cos\theta)$		
	$\underline{v^2 = 23.52\cos\theta - 15.68}$	A1	cao
9(b)	N2L towards centre	M1	
	$T - mg\cos\theta = mv^2/l$	A1	
	$T = 3 \times 9.8\cos\theta + \frac{3}{1\cdot 2}(23.52\cos\theta - 15.68)$	m1	
	$T = 29.4\cos\theta + 58.8\cos\theta - 39.2$		
	$T = \underline{88.2\cos\theta - 39.2}$	A1	cao
9(c)	Greatest value of T when $\cos\theta = 1$		
	$T = 88.2 - 39.2$		
	$T = \underline{49\ (N)}$	B1	
	Least value of T when $\cos\theta = \frac{2}{3}$		
	$T = 88.2 \times \frac{2}{3} - 39.2$		
	$T = \underline{19.6\ (N)}$	B1	