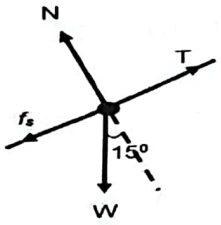
KMK (Set 1)

NO	ANSWER SCHEME	MARKS
1	$[G] = \frac{[F_g][r^2]}{[m_1][m_2]}$ $= \frac{(MLT^{-2})(L^2)}{M(M)}$ $= L^3T^{-2}M^{-1}$	G1 J1

NO	SCHEME	MARK(S)
2(a)	i) Acceleration = gradient of the graph $= \frac{20-0}{20-0}$ $= 1.0\ ms^{-2}$	K1 JU1
	ii) The car first come to stop when t = 30 s Distance = area under the graph = ½ (30)(20) = 300 m *Distance travelled = Area under graph V against t* $Distance = 1/2(20 \times 20) + \frac{1}{2}(20)(10)$ $Distance = 200 + 100 = 300$ m	K1 G1 JU1
2(b)	$u_x = u\cos\theta = 30\cos 37^\circ = 24.0\ m\ s^{-1}$ $u_y = u\sin\theta = 30\sin 37^\circ = 18.1\ m\ s^{-1}$	
	i) At the maximum height, $v_y = 0$ and $s_y = H$ thus. $v_y^2 = u_y^2 - 2gs_y$ $0 = (18.1)^2 - (2)(9.81)H$ $H = 16.7$ m	K1 GJU1
	ii) When the ball return to the ground level, $s_y = 0$ thus the time of flight, t is $s_y = u_y t - \frac{1}{2}gt^2$ $0 = (18.1)t - \frac{1}{2}(9.81)t^2$ $t = 3.69$ S	K1 GJU1

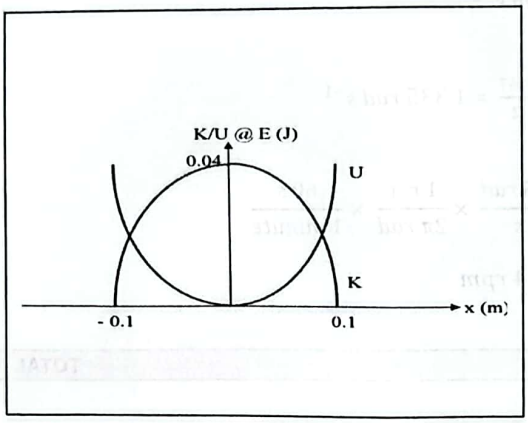
	iii) $R = u_x t$ $= (24)(3.69)$ $= 88.6\,\text{m}$	GJU1
	TOTAL	**10**

NO	ANSWER SCHEME	MARKS
3a (i)	$J = Ft = (20)(15) = 300\text{Ns}$	GJU1
(ii)	$J = \Delta p = 300\text{Ns}$	JU1
(iii)	$J = p_f - p_i$ $300 = p_f - (-30)$ $p_f = 270\ \text{kgms}^{-1}$	G1 JU1
(iv)	$p_f = m\ v$ $270 = (8)v$ $v = 33.75\text{ms}^{-1}$	JU1
		5M
3b (i)	 All correct – 3M 3 Corrrect -2M	All correct 3M 3 Corrrect -2M
(ii)	$\Sigma F_x = 0$ $T - f_s - W\sin\theta = 0$ $T = mg\sin 15^0 + \mu_s N$ $T = 80(9.81)\sin 15^0 + 0.2(80)(9.81)\cos 15^0$ $T = 354.73N$	K1 G1 JU1
	$\Sigma F_y = 0$ W - T = 0 T= mg m=36.16kg 	K1 JU1
		8M
	TOTAL	13 marks

NO	ANSWER SCHEME	MARK(S)
4	a) $W = F_{net} \cdot s$ $W = (5x10^6 \cos 30 + 5x10^6 \cos 30)(0.75x10^3)$ $W = 6.77x10^9\ J$	G1 JU1
	b) $W = area\ under\ the\ graph$ $712.5 = \left(\frac{1}{2}(40+50)(Y-5.0)\right) + \left(\frac{1}{2}(40)(25.0-Y)\right)$ $Y = 17.5\ m$	G1 JU1
	c) $E = K + U$ $E = \left(\frac{1}{2}(70)(4.5)^2\right) + ((70)(9.81)(2000 \sin 25°))$ $E = 5.81x10^5\ J$	G1 JU1
	d) $W = \Delta K$ $E = \left(\frac{1}{2}(0.118)(150)^2\right) - 0$ $E = 1.33x10^6\ J$	GJU1
	e) $P = T.v$ $68 = T(0.25)$ $T = 272\ N$	GJU1
	TOTAL	**8 marks**

NO	ANSWER SCHEME	MARKS
5	$m = 22 + 6 = 28\,kg \quad r = 2\,m \quad T = 100\,N$	
	a) $\sum F_x = F_c = T = \frac{mv^2}{r}$	K1
	$100 = \frac{(28)v^2}{2}$	G1
	$v = 2.67\,m\,s^{-2}$	JU1
	b) $\omega = \frac{v}{r} = \frac{2.67}{2} = 1.335\,rad\,s^{-1}$	GJ1
	$\omega = \frac{1.335\,rad}{1\,s} \times \frac{1\,rev}{2\pi\,rad} \times \frac{60\,s}{1\,minute}$	
	$\omega = 12.74\,rpm$	GJU1
	TOTAL	5 marks

NO	ANSWER SCHEME	MARKS
6 (a)	m = 175 g = 0.175 kg $k = 8\ N\ m^{-1}$ $x = A = 10\ cm = 0.1\ m$	
	(i) $T = 2\pi\sqrt{\frac{m}{k}}$ $= 2\pi\sqrt{\frac{0.175}{8}}$ $= 0.93\ s$	G1 JU1
	(ii) $E = \frac{1}{2}kA^2$ $= \frac{1}{2}(8)(0.1)^2$ $= 0.04\ J$	G1 JU1
	(iii) $U = \frac{1}{2}ky^2$	

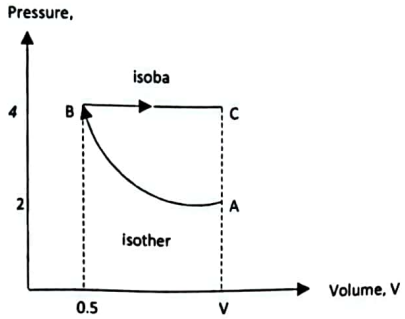
	$= \frac{1}{2}(8)(0.05)^2$ $= 0.01$ J $K = E - U = 0.04 - 0.01 = 0.03$ J	G1 JU1 JU1
	(iv) Shape – 2 Label - 1  	D3
6 (b)	$y = 3\cos(0.1\pi x)\sin(100\pi t)$ $y = 2A\cos kx \sin \omega t$ (i) $amplitude = 2A\cos kx$ $= 3\cos(0.1\pi)(2)$ $= 2.43$ cm	K1 GJU1
	(ii) $\lambda = \frac{2\pi}{k}$ $= \frac{2\pi}{0.1\pi}$ $= 20$ cm	G1 JU1
	(iii) $f = \frac{\omega}{2\pi}$ $= \frac{100\pi}{2\pi}$ $= 50$ Hz	G1 JU1
	(iv) $v = f\lambda$ $= (20)(50) = 1000$ cm s^{-1}	GJU1

6 (c)	$l = 0.92$ m $f_o = \frac{nv}{4l} = \frac{(1)(330)}{(4)(0.92)}$ $f_o = 89.67$ Hz $f_{2\ overtone} = f_5 = 5f_o$ $= (5)(89.67)$ $= 448.35\ Hz$	G1 JU1 K1 JU1
6 (d)	$v_s = 55$ m s^{-1} $f = 1125$ Hz $v = 330$ m s^{-1} $f_a = \left(\frac{v}{v - v_s}\right) f$ $= \left(\frac{330}{330 - 55}\right)(1125)$ $= 1350$ Hz	G1 JU1
	TOTAL	23 marks

NO	ANSWER SCHEME	MARK(S)
7(a)	$Y = \frac{Fl_o}{Ae}$ $Y = \frac{(mg)l_o}{Ae}$ $200 \times 10^9 = \frac{(10 \times 9.81)(1.8)}{A(0.6 \times 10^{-3})}$ $A = 1.47 \times 10^{-6} m^2$ $Y = \frac{Fl_o}{Ae}$ $200 \times 10^9 = \frac{(2 \times 9.81)(1.8006)}{(1.47 \times 10^{-6})e}$ $e = 1.2 \times 10^{-4} m$	G1 G1 GJU1
7(b)	$\left(\frac{dQ}{dt}\right)_{brick} = \left(\frac{dQ}{dt}\right)_{concrete}$ $\left(-kA\frac{dT}{dx}\right)_{brick} = \left(-kA\frac{dT}{dx}\right)_{concrete}$	K1

	$(0.6)(55)\frac{(T_s - 40)}{0.12} = (0.8)(55)\frac{(20 - T_s)}{0.24}$ $T_s = 32^oC$	G1 JU1
7(c)	$\Delta V_{additional} = \Delta V_{glycerin} - \Delta V_{steel}$ $= \gamma_{glycerin} V_o \Delta T - \gamma_{steel} V_o \Delta T$ $= [(4.8 \times 10^{-4})(3)(18 - 32)] - [3(1.1 \times 10^{-5})(3)(18 - 32)]$ $= -0.0188 m^3$ 0.0188 m^3 additional volume can be filled into the tank.	G1 JU1
	TOTAL	**8 marks**

NO	ANSWER SCHEME	MARKS
8 (a)	Density: $\rho = \frac{m}{V} = \frac{345\ x10^{-3}}{0.55} = 0.627\ kgm^{-3}$ Pressure : $P = \frac{1}{3}\rho\langle v^2 \rangle$ $\langle v^2 \rangle = \frac{3P}{\rho}$ $\langle v^2 \rangle = \frac{3(1.7x10^5)}{0.627}$ $\langle v^2 \rangle = 8.13x10^5\ m^2s^{-2}$ $v_{rms} = \sqrt{\langle v^2 \rangle}$ $v_{rms} = \sqrt{\langle 8.13x10^5 \rangle}$ $v_{rms} = 901.67\ ms^{-1}$	G1 G1 J1 JU1
8 (b)		

	Shape B-C = 1M shape A-B = 1M label axes = 1M	J3
		
	ii. Work done: Work done for isothermal process: $W = nRTln\frac{V_2}{V_1}$ $W = (32)(8.31)(273.15 + 30)(ln\frac{0.5V_0}{V_0})$ $\boldsymbol{W = -5.58\ x\ 10^4 J}$	GJU1
	Work done for isobaric expansion: $W = p\Delta V$ $W = (4\ x\ 1.01\ x\ 10^5)(0.4 - (0.5\ x\ 0.4))$ $\boldsymbol{W = 8.08\ x\ 10^4 J}$	GJU1
	Total work done: $W_T = W_{isotherma} + W_{isobaric}$ $W_T = (\boldsymbol{-5.58\ x\ 10^4}) + (\boldsymbol{8.08\ x\ 10^4})$ $\boldsymbol{W_T = 2.5\ x\ 10^4 J}$	K1 GJU1
	TOTAL	11 Marks