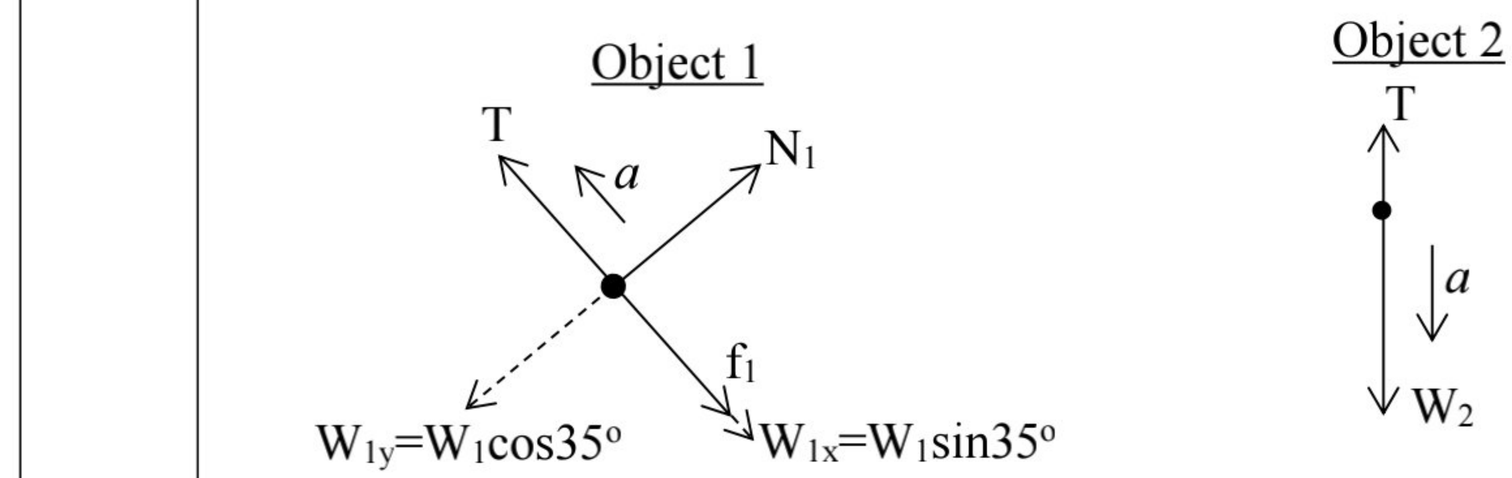
PRE PSPM SET 1 (ANSWER SCHEME)

NO.	ANSWER SCHEME	MARK (S)
1	$[J] = [F][t]$ $= [m][a][t]$ $= (M)(LT^{-2})(T)$ $= MLT^{-1}$ ∴ Unit of impulse $= kg\ m\ s^{-1}$	**K1** **J1**
	TOTAL	**2**

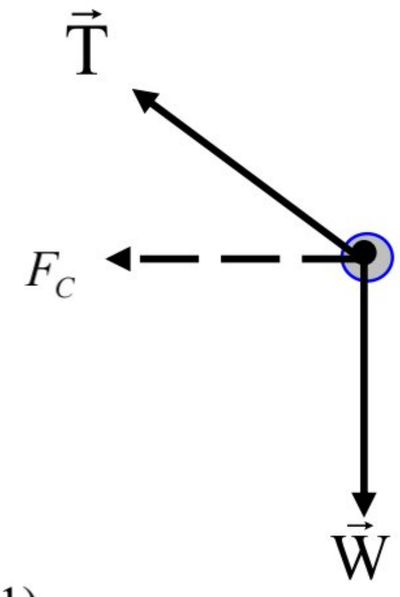
NO.	ANSWER SCHEME	MARK (S)
2(a)(i)	$u = 0\ m\ s^{-1}$ $v^2 = u^2 + 2as$ $v^2 = 0^2 + 2(2.0)850$ $v = 58.31\ m\ s^{-1}$	**K1** **GJU1**
(a)(ii)	$v = u + at$ $58.31 = 0 + 2.0t$ $t = 29.16\ s$	**G1** **JU1**
(b)(i)	$u_x = u\cos 45°, u_y = u\sin 45°$ $S_y = 3.05 - 2 = 1.05\ m$ $S_x = u_x t$ $S_x = (u\cos 45°)\ t$ $t = \frac{10}{u\cos 45°}$ ……(1)	**K1** **G1**

	$S_y = u_y t - \frac{1}{2} g t^2$ $1.05 = (u \sin 45°)t - \frac{1}{2}(9.81)t^2 \ldots\ldots\ldots\ldots (2)$ $1.05 = (u \sin 45°)\left(\frac{10}{u \cos 45°}\right) - \frac{1}{2}(9.81)\left(\frac{10}{u \cos 45°}\right)^2$ $u = 10.47 \text{ m s}^{-1}$	**G1** **JU1**
(b)(ii)	$S_x = (u \cos 45°)\, t$ $10 = (10.47 \cos 45°)\, t$ $t = 1.35 \text{ s}$	**G1** **JU1**
	TOTAL	**10**

NO.	ANSWER SCHEME	MARKS
3(a)	$m = 40\ kg, u = 6.2\ m\ s^{-1}, v = 5.7\ m\ s^{-1}$ $\Delta P = m(v - u)$ $\Delta P = area\ under\ F - t\ graph$ $40(7 - 6.2) = \frac{1}{2} \times F_{max} \times (6 + 10)$ $F_{max} = 4 \text{ N}$	**K1** **GJU1**
3(b)	$m_A = m_B = m, u_A = 55\ m\ s^{-1}, u_{Ax} = 55 \sin 20^o\ , u_{Ay} = 55 \cos 20^o$ $u_B = 55\ m\ s^{-1}, u_{Bx} = 55\ m\ s^{-1}, u_{By} = 0$ $\sum P_{ix} = \sum P_{fx}$ $m_A u_{Ax} + m_B u_{Bx} = (m_A + m_B) v_x$ $m(55 \sin 20^o) + m(55) = (m + m) v_x$ $v_x = 36.91\ m\ s^{-1}$ $\sum P_{iy} = \sum P_{fy}$ $m_A u_{Ay} + m_B u_{By} = (m_A + m_B) v_y$ $m(55 \cos 20^o) + m(0) = (m + m) v_y$ $v_y = 25.84\ m\ s^{-1}$ $v = \sqrt{v_x^2 + v_y^2}$ $v = \sqrt{36.91^2 + 25.84^2} = 45.06\ m\ s^{-1}$	**K1** **G1** **G1** **GJU1**

	$\theta = tan^{-1}\left(\frac{v_y}{v_x}\right)$ $\theta = tan^{-1}\left(\frac{25.84}{36.91}\right) = 35^o$	**GJU1**
3(c)	$m_1 = 8\ kg, m_2 = 4\ kg, \theta = 35^o, \mu_k = 0.2$  $\sum F_y = 0$ $N_1 = W_1\cos35^o = (4)(9.81)\cos35^o = 32.14$ N $\sum F_x = m_1 a$ $T - f_1 - W_1\sin35^o = m_1 a$ $T - (0.2)(32.14) - (4)(9.81)\sin35^o = 4a$ $T - 4a = 28.94$ $\sum F_y = m_2 a$ $W_2 - T = m_2 a$ $(8)(9.81) - T = 8a$ $T + 8a = 78.48$ $T = 45.44$ N $a = 4.13$ m s^{-2}	**G1** **K1** **G1** **G1** **JU1** **JU1**
	TOTAL	**13**

NO.	ANSWER SCHEME	MARK (S)
4 (a)	$work\ done = area\ under\ Force - displacement\ graph$ $W = \frac{1}{2}(0.02)(200) + \frac{1}{2}(0.06 - 0.02)(200 + 300) + \frac{1}{2}(0.08 - 0.06)(300 + 500) + \frac{1}{2}(0.14 - 0.08)(500) = 35$ J	**K1** **GJU1**
4(b)(i)	$mgh_A = \frac{1}{2}mv_B{}^2$ **OR** $U_A = K_B$ $(0.14)(9.81)(0.7) = \frac{1}{2}(0.14)v_B{}^2$ $v_B = 3.71$ m s^{-1}	**K1** **GJU1**
4(b)(ii)	$potential\ energy\ at\ point\ C = mgh_c$ $h_c = L - L\cos 35°$ $h_c = 0.7 - 0.7\cos 35° = 0.13\ m$ $U_c = mgh_c = (0.14)(9.81)(0.13) = 0.179$ J	**G1** **GJU1**
4(c)	$P_{AV} = \frac{\text{energy}}{\text{time}} = \frac{\text{mgh}}{\text{t}}$ $P_{AV} = \frac{(65)(9.81)(342)}{(30)(60)}$ $P_{AV} = 121.15$ W	**G1** **JU1**
	TOTAL	**8**

NO.	ANSWER SCHEME	MARK (S)
5(a) (i)	$a_c = \frac{v^2}{R} = \frac{5^2}{0.5} = 50 \text{ m s}^{-2}$	**GJU1**
5(a)(ii)	$\sum F = F_C$ $T = ma_c$ $T = (0.2)(50) = 10 \text{ N}$	**GJU1**
5(b)	 $T \sin\theta = \frac{mv^2}{R} \ldots\ldots\ldots\ldots (1)$ $T \cos\theta = mg \ldots\ldots\ldots\ldots (2)$ (2) ÷(1) $\tan\theta = \frac{v^2}{\text{Rg}} = \frac{(3^2)}{(40\times10^{-2})(9.81)}$ $\theta = 66.4^\circ$	**K1** **G1** **JU1**
	TOTAL	**5**

NO.	ANSWER SCHEME	MARK (S)
6(a)(i)	$y = 4\sin 1.2t = 4\sin 1.2(3) = -1.77$ cm	**GJU1**
6(a)(ii)	$v = \omega A\cos\omega t$ $= (1.2)(4)\cos 1.2(3)$ $= -4.30$ cm s^{-1} **OR** $y = A\sin\omega t$ $y = 4\sin 1.2t$ $\omega = 1.2$ rad s^{-1} and $A = 4$ cm $v = \pm\ \omega\sqrt{A^2 - y^2}$ $v = \pm\ (1.2)\sqrt{(4)^2 - (-1.77)^2}$ $v = \pm\ 4.30$ cm s^{-1}	**G1** **JU1**
6(a)(iii)	$a = -\ \omega^2 A\sin\omega t$ $= -\ (1.2)^2 4\sin 1.2(3)$ $a = 2.55$ cm s^{-2} **OR** $a = -\ \omega^2 y$ $= -\ (1.2)^2(-1.77)$ $= 2.55$ cm s^{-2}	**G1** **JU1**
6(b)(i)	$T = 2\pi\sqrt{\frac{\text{m}}{\text{k}}} \quad = 2\pi\sqrt{\frac{0.25}{50}}$ $= 0.44$ s $f = \frac{1}{T} = \frac{1}{0.44}$ $= 2.27$ Hz	**G1** **GJU1**
6(b)(ii)	$E = \frac{1}{2}kA^2$ $= \frac{1}{2}(50)(0.06)^2$ $= 0.09$ J	**G1** **JU1**

6(c) (i)	$y = 2A\cos kx \sin \omega t$ $y = 2(0.04)\cos\frac{x}{2}\sin 20t$ $y = 0.08\cos\frac{x}{2}\sin 20t$ where y and x in metre and t is in seconds.	**G1** **JU1**
6(c)(ii)	$k = \frac{1}{2}$ $k = \frac{2\pi}{\lambda}$ $\frac{1}{2} = \frac{2\pi}{\lambda} \rightarrow \lambda = 4\pi\,\text{m}$	**K1** **GJU1**
6(d) (i)	$l = 1.5\lambda \rightarrow 2.5 = 1.5\lambda$ $\lambda = 1.67\ \text{m}$	**K1** **JU1**
6(d)(ii)	$v = \sqrt{\frac{T}{\mu}}$ and $\mu = \frac{m}{L}$ $v = \sqrt{\frac{TL}{m}} = \sqrt{\frac{100 \times 2.5}{0.005}}$ $= 223.61\ \text{m s}^{-1}$	**G1** **JU1**
6(d) (iii)	$f = \frac{nv}{2L}$ $= \frac{3(223.61)}{2(2.5)}$ $= 134.17\ \text{Hz}$ **OR** $f = \frac{v}{\lambda} = \frac{223.61}{1.67}$ $= 133.90\ \text{m s}^{-1}$	**G1** **JU1**
6(e)(i)	$f_a = \left(\frac{v \pm v_o}{v \pm v_s}\right) f$ ← -O S+	

	$f_a = \left(\frac{v}{v - v_s}\right) f_s$ $= \left(\frac{340}{340 - 46}\right) 550$ $= 636.05$ Hz	**G1** **JU1**
6(e)(ii)	$f_a = \left(\frac{v \pm v_o}{v \pm v_s}\right) f$ -O S+ $\longrightarrow$ $f_a = \left(\frac{v}{v + v_s}\right) f_s$ $= \left(\frac{340}{340 + 46}\right) 550$ $= 484.46$ Hz	**G1** **JU1**
	TOTAL	**23**

NO.	ANSWER SCHEME	MARK (S)
7.(a)(i)	$\left(\frac{Q}{t}\right)_{brick} = \left(\frac{Q}{t}\right)_{concrete}$ $-KA\left(\frac{T-40}{0.12}\right) = -KA\left(\frac{20-T}{0.24}\right)$ $-(0.6)\left(\frac{T-40}{0.12}\right) = -(0.8)\left(\frac{20-T}{0.24}\right)$ $5(T-40) = 3.33(20-T)$ $T = 32℃$	**K1** **G1** **JU1**
7.(a)(ii)	$\left(\frac{Q}{t}\right)_{concrete} = -KA\left(\frac{\Delta T}{L}\right)$ $\left(\frac{Q}{1\times 60\times 60}\right) = -0.6(55)\left(\frac{32-40}{0.12}\right)$ $Q = 7.92\times 10^{6}\text{J}$	**G1** **JU1**
7(b)	$V_t = V_\circ(1+\gamma\Delta T)$ $V_t = 3(1+3\alpha\Delta T)$ $V_t = 3(1+3(1.1\times 10^{-4}(18-32))$ $V_t = 2.98614\ m^3$ $V_g = V_\circ(1+\gamma\Delta T)$ $V_g = 3(1+(4.8\times 10^{-4}(18-32))$ $V_g = 2.97984\ m^3$ $\Delta V = 2.98614 - 2.97984)$ $\Delta V = 0.0063\ m^3$ **OR**	**G1** **G1** **JU1**

	$\Delta V_t = 3\alpha_t V_{ot}\Delta T$ $= 3(1.1\times10^{-4})(3.0)(18-32)$ $= -0.01386\,\text{m}^3$ $\Delta V_g = \gamma_g V_{og}\Delta T$ $= (4.8\times10^{-4})(3.0)(18-32)$ $= -0.02016\,\text{m}^3$ $\Delta V_{add} = \Delta V_t - \Delta V_g$ $= -0.01386-(-0.02016)$ $= 0.0063\,\text{m}^3$	
	TOTAL	**8**

NO.	ANSWER SCHEME	MARK (S)
8.(a)	$v_{rms} = 600\ \text{m s}^1$ $v_{rms} = \sqrt{\frac{3RT}{M}}$ $600 = \sqrt{\frac{3(8.31)T}{28\times10^{-3}}}$ $T = 404.33\ \text{K}$ $f = 5$ $U = \frac{1}{2}fnRT$ $= \frac{1}{2}(5)(0.2)(8.31)(404.33)$ $= 1680\ \text{J}$	**G1** **K1** **G1** **JU1**

(b)	$P = \frac{1}{3}\rho {v_{rms}}^2$ $= \frac{1}{3}(0.1)(1.85 \times 10^3)^2$ $= 1.14 \times 10^5$ N m^{-2}or Pa	**G1** **JU1**
8(c)	$\Delta U = 0$ J $W = nRT\ ln\left(\frac{V_f}{V_i}\right)$ $= (2)(8.31)(295)\ ln\left(\frac{0.050}{0.025}\right)$ $= 3.398 \times 10^3$ J $\Delta U = Q - W$ $Q = 0 + (3.398 \times 10^3)$ $= 3.398 \times 10^3$ J System absorb heat	**K1** **G1** **G1** **JU1** **J1**
	TOTAL	**11**