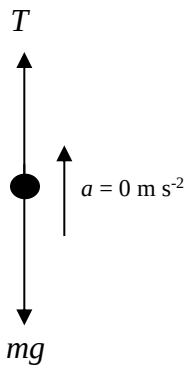
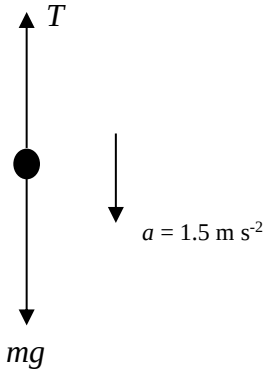
ANSWER SCHEME PRE-PSPM 1 SET 1

NO.	ANSWER SCHEME	MARK (S)
1	$[G] = \frac{[F][r^2]}{[m_1][m_2]} = \frac{(MLT^{-2})(L^2)}{(M)(M)}$ *symbol of [ ] is a must	**G1**
	$[G] = M^{-1}L^3T^{-2}$	**J1**
	TOTAL	**2**

NO.	ANSWER SCHEME	MARK (S)
2 (a)	$a = -3.5 \text{ms}^{-2}$	**K1**
	$v = u + at$ $= 30 + (-3.5)(4.5) = 14.25 \text{ m s}^{-1}$	**GJU1**
2 (b)	$v_x = v\cos 35 = 40\cos 35 = 32.77 \text{ m s}^{-1}$	**G1**
	$v_y = -v\sin 35 = -40\sin 35 = -22.94 \text{ m s}^{-1}$	**G1**
	v_y negative	**K1**
	$v_y^2 = u_y^2 - 2gS_y$ $(-22.94)^2 = u_y^2 - 2(9.81)(8)$ $u_y = 19.21 \text{ m s}^{-1}$	**G1**
	$v_x = u_x$	**K1**
	$u = \sqrt{u_x^2 + u_y^2}$	**K1**
	$u = \sqrt{(32.77)^2 + (19.21)^2}$ $u = 37.98 \text{ m s}^{-1}$	**G1** **JU1**
	TOTAL	**10**

NO.	ANSWER SCHEME	MARK (S)
3 (a)	Change of momentum = area under the (F versus t) graph from t = 0 to t = 8.0 s $\Delta p = m(v-u) = 5(v-0) = \frac{1}{2}(4+6)\times 10$ v = 10 m s^{-1}	**K1** **G1** **JU1**
3 (b)	x-component $\sum p_{xi} = \sum p_{xf}$ $m_1u_{1x} = m_1v_{1x} + m_2v_{2x}$ $(2m)(45) = (m)(v_1\cos 60°) + (m_2)(v_2\cos 30°)$ $90m = m(0.5v_1 + 0.87v_2)$ $90 = 0.5v_1 + 0.87v_2$ ……..(1) y-component $\sum p_{yi} = \sum p_{yf}$ $m_1u_{1y} = m_1v_{1y} + m_2v_{2y}$ $0 = (m)(v_1\sin 60°) + (m_2)(-v_2\sin 30°)$ $m(v_1\sin 60°) = m(v_2\sin 30°)$ $v_1 = 0.57v_2$ ……..(2) Subtitute (2) into (1): $90 = 0.5v_1 + 0.87v_2$ $90 = 0.5(0.57v_2) + 0.87v_2$ $v_2 = 77.92$ m s^{-1} Substitute $v_2 = 77.92$ m s^{-1} in (2) $v_1 = 0.57v_2 = 0.57(77.92) = 44.41$ m s^{-1}	**K1** **G1** **K1** **G1** **GJU1** **GJU1**

NO.	ANSWER SCHEME	MARK (S)
3 (c)(i)	when the vertical speed is constant, a = 0 m s^{-2}. Therefore, $\sum F = 0$ $T - mg = 0$ $T = mg$ = (4000) (9.81) = 3.92 × 10^4 N 	**K1** **GJU1**
3 (c)(ii)	$\sum F = ma$ $mg - T = ma$ $T = 4000(9.81-1.5) = 3.32 \times 10^4$ N 	**K1** **GJU1**
	TOTAL	**13**

NO.	ANSWER SCHEME	MARK (S)
4 (a)	$W = Fs\cos\theta$ $W = (3\times10^{-8})(850)\cos180^{\circ}$ $W = -2.55\times10^{-5}$ J	 **G1** **JU1**
4 (b)(i)	$\sum E_{initial} = \sum E_{final}$ $U_A + K_A = U_B + K_B$ $mgh_A + \frac{1}{2}mv_A{}^2 = mgh_B + \frac{1}{2}mv_B{}^2$ $0 + \frac{1}{2}(20)^2 = (9.81)(15) + \frac{1}{2}v_B{}^2$ $v_B = 10.28$ m s^{-1}	 **G1** **JU1**
4 (b)(ii)	To reach point D, $v_D \geq 0$ m s^{-1} $\sum E_A = \sum E_D$ $U_A + K_A = U_D + K_D$ $mgh_A + \frac{1}{2}mv_A{}^2 = mgh_D + \frac{1}{2}mv_D{}^2$ $0 + \frac{1}{2}(20)^2 = (9.81)(20) + \frac{1}{2}v_D{}^2$ $v_D = 2.76$ m s^{-1} Since v_D is greater than 0 m s^{-1}, the cart can reach point D. **OR** $E_A > E_D$ $E_A = 0 + \frac{1}{2}m(20)^2 = 200m$ J $E_D = m(9.81)(20) = 196.2m$ J Since E_A is greater than E_D , the cart can reach point D.	**K1** **G1** **JU1** **J1** **K1** **GJ1** **GJ1** **J1**
	TOTAL	**8**

NO.	ANSWER SCHEME	MARK (S)
5 (a)	$r = l\sin 30 = 0.8(\sin 30) = 0.4$ m Vertical component, $\Sigma F_y = 0$ $T\cos\theta = mg$ $T\cos 30 = mg$ --------- (1) Horizontal component, $\Sigma F_x = F_{\text{net}}$ $T\sin\theta = F_{\text{c}}$ $T\sin 30 = \frac{mv^2}{r}$ ---------- (2) (2) ÷ (1) : $\frac{T\sin 30}{T\cos 30} = \frac{\frac{mv^2}{r}}{mg} \rightarrow \tan 30 = \frac{v^2}{r}$ $v = \sqrt{rg\tan 30} = \sqrt{0.4(9.81)\tan 30}$ $v = 1.51$ m s^{-1}	**K1** **K1** **G1** **JU1**
5 (b)	$T\cos 30 = mg \rightarrow T = \frac{mg}{\cos 30} = \frac{0.2(9.81)}{\cos 30} = 2.27$ N	**GJU1**
	TOTAL	**5**

NO.	ANSWER SCHEME	MARK (S)
6 (a)(i)	$A = 6.0$ cm or 0.06 m $\omega = 2\pi$ rad s^{-1} $\omega = \frac{2\pi}{T} \rightarrow 2\pi = \frac{2\pi}{T} \rightarrow T = 1$ s	**JU1** **K1** **GJU1**
6 (a)(ii)	$a_{\max} = \omega^2 A \rightarrow a_{\max} = (2\pi)^2 0.06$ $a_{\max} = 2.37$ m s^{-2} or 236.87 cm s^{-2}	**G1** **JU1**
6 (a)(iii)	$y = 6.0 \sin 2(\pi \times 5) \rightarrow y = 0$ cm $K = \frac{1}{2} m\omega^2 (A^2 - y^2) \rightarrow K = \frac{1}{2}(2.0)(2\pi)^2 (0.06^2 - 0^2)$ $K = 0.14$ J $U = \frac{1}{2} m\omega^2 y^2 \rightarrow U = \frac{1}{2} m\omega^2 0^2 \rightarrow U = 0$ J	**G1** **G1** **JU1** **GJU1**
6 (b)	$T = \frac{20}{10} = 2$ s $T = 2\pi\sqrt{\frac{m}{k}} \rightarrow 2 = 2\pi\sqrt{\frac{m}{100}} \rightarrow m = 10.13$ kg $W = mg \rightarrow W = 10.13(9.81)$ $W = 99.38$ N	**K1** **G1** **G1** **JU1**
6 (c)(i)	$\mu = \frac{m}{L} \rightarrow \mu = \frac{0.200}{2.5} \rightarrow \mu = 0.08$ kg m^{-1} $v = \sqrt{\frac{T}{\mu}} \rightarrow v = \sqrt{\frac{125}{0.08}}$ $v = 39.53$ m s^{-1} and $v = f\lambda \rightarrow 39.53 = 100\lambda$ $\lambda = 0.40$ m	**G1** **G1** **JU1** **G1** **JU1**
6 (c)(ii)	$f_n = \frac{n}{2L}\sqrt{\frac{T}{\mu}} \rightarrow 100 = \frac{n}{2(2.5)}\sqrt{\frac{125}{0.08}}$ $n = 12$ Or $f_n = \frac{nv}{2L} \rightarrow 100 = \frac{n(39.53)}{2(2.5)}$ $n = 12$	**G1** **JU1**

6 (d)	$f_a = \left(\frac{v}{v + v_s}\right) f$ $450 = \left(\frac{340}{340 + v_s}\right) 500$ $v_s = 37.78 \text{ m s}^{-1}$	**K1** **G1** **JU1**
	TOTAL	**23**

NO.	ANSWER SCHEME	MARK (S)
7 (a)(i)	$Y = \frac{FL_{\mathrm{O}}}{A\Delta L} \rightarrow 2.8 \times 10^{11} = \frac{(720 \times 10^3)35}{(0.0085)\Delta L}$ $\Delta L = 0.01$ m	**G1** **JU1**
7 (a)(ii)	$U = \frac{1}{2}F\Delta L \rightarrow\ U = \frac{1}{2}(720 \times 10^3)0.01$ $U = 3600$ J	**G1** **JU1**
7 (b)(i)	$\left(\frac{Q}{t}\right)$ for Aluminium $= \left(\frac{Q}{t}\right)$ for Brass $-(k_{Al})\mathrm{A}\left(\frac{\Delta T_{Al}}{L_{\mathrm{Al}}}\right) = -k_{\mathrm{B}}\mathrm{A}\left(\frac{\Delta T_{\mathrm{B}}}{L_{\mathrm{B}}}\right)$ $-(205)\mathrm{A}\left(\frac{T - 150.0}{0.800}\right) = -(109)\mathrm{A}\left(\frac{20.0 - T}{0.500}\right)$ $T = 90.37$ °C	**K1** **G1** **JU1**
7 (b)(ii)	$\frac{\Delta T_{\mathrm{B}}}{L_{\mathrm{B}}} = \left(\frac{20.0 - 90.37}{0.500}\right) = -140.74$ °C m^{-1}	**GJU1**
	TOTAL	**8**

NO.	ANSWER SCHEME	MARK (S)
8 (a)(i)	Original : $PV = \frac{1}{3}Nmv_{\text{rms}}{}^2 \rightarrow PV = \frac{1}{3}Nmv_{\text{ori}}{}^2$ New: $(2P)2V = \frac{1}{3}Nmv_{\text{new}}{}^2 \rightarrow 4PV = \frac{1}{3}Nmv_{\text{new}}{}^2$ $\frac{\text{New}}{\text{Ori}} \rightarrow \frac{4PV}{PV} = \frac{\frac{1}{3}Nmv_{\text{new}}{}^2}{\frac{1}{3}Nmv_{\text{ori}}{}^2} \rightarrow \frac{v_{\text{new}}{}^2}{(1350)^2} = 4$ $v_{\text{new}} = 2700 \text{ m s}^{-1}$	**G1** **G1** **JU1**
8 (a)(ii)	$v_{\text{new}} = \sqrt{\frac{3RT}{M}} \rightarrow 2700 = \sqrt{\frac{3(8.31)T}{0.004}}$ $T = 1169.68 \text{ K}$	**G1** **JU1**
8 (b)(i)	Isothermal : $W_{\text{isothermal}} = nRT_{\text{i}} \ln\left(\frac{V_{\text{f}}}{V_{\text{i}}}\right) \rightarrow W_{\text{isothermal}} =$ $= 0.5(8.31)303 \ln\left(\frac{0.3}{0.5}\right)$ $W_{\text{isothermal}} = -643.11 \text{ J}$ Isobaric : $W_{\text{isobaric}} = P_{\text{f}}(V_{\text{f}} - V_{\text{f}}) \rightarrow W_{\text{isobaric}}$ $= 4.20 \times 10^3(0.5 - 0.3)$ $W_{\text{isobaric}} = 840 \text{ J}$ $W_{\text{total}} = W_{\text{isothermal}} + W_{\text{isobaric}}$ $W_{\text{total}} = -643.11 + 840 \rightarrow W_{\text{total}} = 196.89 \text{ J}$	**G1** **G1** **K1** **GJU1**
8 (b)(ii)	Isobaric : $f = 3$ $\Delta U = U_{\text{f}} - U_{\text{i}} = \frac{1}{2}fnR(T_{\text{f}} - T_{\text{i}})$ $\Delta U = \frac{1}{2}(3)0.5(8.31)(505 - 303) \rightarrow \Delta U = 1258.97 \text{ J}$	**K1** **GJU1**
	TOTAL	**11**