PROGRAM KECEMERLANGAN UNIT FIZIK
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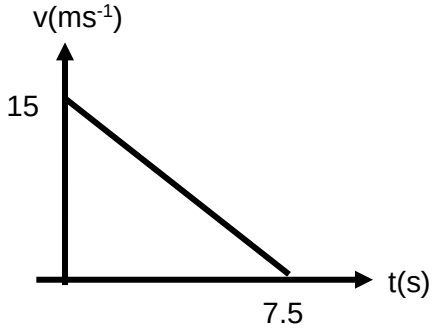
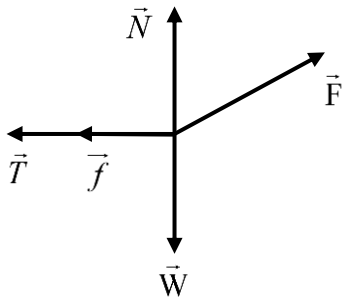
SEM 1 SESI 2022/2023

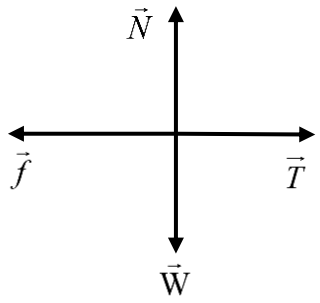
ANSWER SCHEME PRA PSPM 1

NO	ANSWER SCHEME	MARK(S)
1	**LHS** $[v] = LT^{-1}$ **RHS** $[at] = (LT^{-2})(T)$ $[at] = LT^{-1}$ ∴ dimensionally is correct	G1 J1
	TOTAL	**2**

NO	ANSWER SCHEME	MARK(S)
2 a(i)	 $a = \frac{v}{t}$ $2 = \frac{15}{t}$ $t = 7.5\ s$ Correct value and label for 15 ms^{-1} and 7.5 s – D1 Shape – D1	D2

a (ii)	**s = area under v-t graph** $s = \frac{1}{2}(15)(7.5)$ $s = 56.25\,\text{m}$	K1 G1 JU1
b(i)	at maximum height, $v_y = 0$ $u_x = 30\cos(60^\circ) = 15\,\text{ms}^{-1}$ $u_y = 30\sin(60^\circ) = 25.98\,\text{ms}^{-1}$ $v_y^2 = u_y^2 - 2gs_y$ $0 = (25.98)^2 - 2(9.81)s_y$ $s_y = H = 34.40\,\text{m}$	K1 GJU1
b(ii)	At point B, $s_y = 0$ $s_y = u_y t - \frac{1}{2}gt^2$ $0 = (25.98)t - (4.905)t^2$ $t = 5.30\,\text{s}$ $s_x = u_x t$ $s_x = 15(5.30)$ $s_x = 79.5\,\text{m}$	K1 G1 GJU1
	TOTAL	**10**

NO	ANSWER SCHEME	MARK(S)
3 a	$\sum P_{xi} = \sum P_{xf}$ **AND** $\sum P_{yi} = \sum P_{yf}$ **x-comp** $\sum P_{xi} = \sum P_{xf}$ $m_A u_{Ax} + m_B u_{Bx} = m_A v_{Ax} + m_B u_{Bx}$ $(m)(40) + (m)(0) = (m)(v_A \cos 60^\circ) + (m)(v_B \cos 20^\circ)$ $40 = 0.5\ v_A + 0.94\ v_B$ .....(1) **y-comp** $\sum P_{yi} = \sum P_{yf}$ $m_A u_{Ay} + m_B u_{By} = m_A v_{Ay} + m_B u_{By}$ $(m)(0) + (m)(0) = (m)(v_A \sin 60^\circ) + (m)(-v_B \sin 20^\circ)$ $0 = 0.866\ v_A - 0.342\ v_B$ $v_B = 2.532 v_A$ ..... (2) **(2) into (1)** $40 = 0.5\ v_A + 0.94\ (\ 2.532\ v_A\ )$ $40 = 2.88\ v_A$ $v_A = 13.89\ \text{m s}^{-1}$ **Substitute** $v_A = 13.89\ \text{m s}^{-1}$ **in (2)** $v_B = 2.532\ (13.89)$ $v_B = 35.17\ \text{m s}^{-1}$	K1 G1 G1 GJU1 GJU1
3 b (i)	**BOX A**  	D1 **(All forces with arrow and label are correct)**

	BOX B  	D1 **(All forces with arrow and label are correct)**
b (ii)	$\sum F_x = m_A a$ **but a = 0 because v constant** $\sum F_x = 0$ $\sum F_y = 0$ $N_A + F \sin\theta - W = 0$ $N_A + (70)\sin(25) - (30)(9.81) = 0$ $N_A = 264.72$ N $\sum F_x = 0$ $F\cos\theta - T_A - f_A = 0$ $F\cos\theta - \mu N_A = T_A$ $(70)\cos(25) - (0.05)(264.72) = T_A$ $T_A = 50.21$ N	K1 G1 GJU1
b (iii)	$\sum F_x = 0$ $T_A - f_B = 0$ $f_B = T_A$ $f_B = 50.21$ N $f_B = \mu N_B$ $(50.21) = (0.05) N_B$ $N_B = 1004.2$ N $\sum F_y = 0$	G1 G1

	$N_B - W = 0$ $N_B = mg$ $(1004.2) = m(9.81)$ $m = 102.37$ kg	GJU1
	TOTAL	**13**

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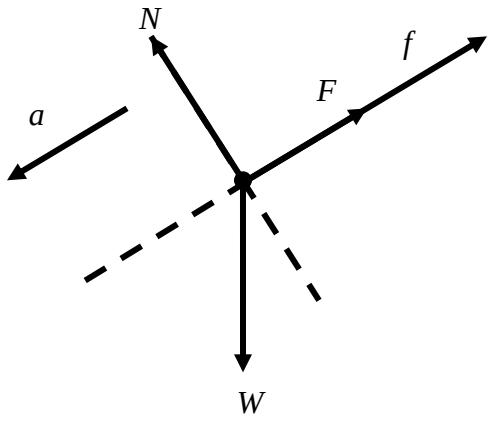
4 a	 $\sum F_y = 0$ $N - mg\cos\theta = 0$ $N = mg\cos\theta$ $= (450)(9.81)\cos 27°$ $= 3.93\times10^3$ N $f = \mu N$ $W_f = fs\cos\theta$ $= \mu Ns\cos\theta$ $= (0.4)(3.93\times10^3)(3.8)\cos180°$ $= -5.97\times10^3$ J	K1 J1 G1 JU1

4 b	$\sum E_i = \sum E_f$ $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$ $\frac{1}{2}(850)\left(6\times10^{-2}\right)^2 = \frac{1}{2}(1.5)v^2$ $v = 1.43 \text{ m s}^{-1}$	K1 GJU1
4 c	$v = 12\frac{\text{km}}{\text{h}} \times \frac{1 \text{ h}}{(60\times60) \text{ s}} \times \frac{1\times10^3 \text{m}}{1 \text{ km}}$ $= \frac{12\times10^3}{60\times60} = 3.33 \text{ m s}^{-1}$ $P = Fv\cos\theta$ $F = \frac{P}{v\cos\theta} = \frac{7500}{(3.33)\cos0°} = 2.25\times10^3 \text{ N}$	G1 GJU1
	TOTAL	**8**

NO	**ANSWER SCHEME**	**MARK(S)**
5 (i)	$\sum F_y = 0$ $N - mg = 0$ $N = mg$ $\sum F_x = F_c$ $f = F_c$ $F_c = \mu N$ $= \mu mg$ $= (0.72)(1500)(9.81)$ $= 1.06\times10^4 \text{ N}$	K1 G1 JU1

(ii)	$\sum F_x = F_c = \frac{mv^2}{r}$ $F_c = \frac{mv^2}{r}$ $v = \sqrt{\frac{F_c r}{m}}$ $= \sqrt{\frac{(1.06\times10^{-4})(70)}{1500}}$ $= 22.24 \text{ m s}^{-1}$	G1 JU1
	TOTAL	**5**

NO	**ANSWER SCHEME**	**MARK(S)**
6 a(i)	$T = \frac{2\pi}{\omega}$ $= \frac{2\pi}{4.38}$ $= 1.43 \text{s}$	G1 JU1
a(ii)	$\omega = \sqrt{\frac{k}{m}}$ $4.38 = \sqrt{\frac{k}{1.50}}$ $k = 28.78 \text{ N m}^{-1}$	G1 JU1
a(iii)	$v_{\max} = \omega A$ $= 4.38(0.056)$ $= 0.245 \text{ m s}^{-1}$	G1 JU1
a (iv)	At $t = 1.00\,s$, $y = 0.056\sin(4.38(1))$ $= -5.29\times10^{-2} \text{ m}$	G1 JU1

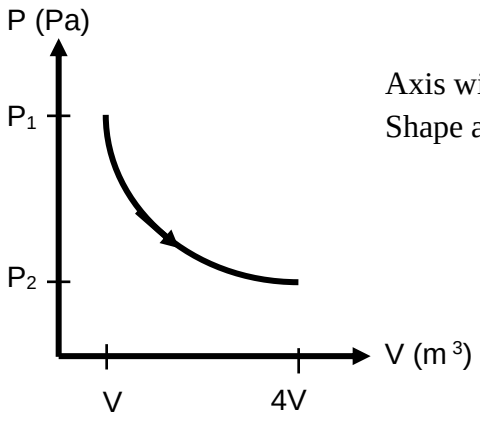
	$v = 0.245\cos\left(4.38t\right)$ $= 0.245\cos\left(4.38\left(1\right)\right)$ $= -7.99\times10^{-2}\ \text{m s}^{-1}$ $a = -1.074\sin\left(4.38t\right)$ $= -1.074\sin\left(4.38\left(1\right)\right)$ $= 1.02\ \text{m s}^{-2}$	G1 JU1 G1 JU1
6 b (i)	$v = f\lambda$ $30 = f\left(1.6\right)$ $f = 18.75\ \text{Hz}$ $\omega = 2\pi f$ $= 2\pi\left(18.75\right)$ $= 37.5\pi\ \text{rad s}^{-1}\ \text{or}\ 117.81\ \text{rad s}^{-1}$ $k = \frac{2\pi}{\lambda}$ $= \frac{2\pi}{1.6}$ $= 1.25\pi\ \text{m}^{-1}\ \text{or}\ 3.93\ \text{m}^{-1}$	GJU1 GJU1 GJU1
b (ii)	$y\left(x,t\right) = 3.5\times10^{-3}\sin\left(37.5\pi t - 1.25\pi x\right)$ where x and y in meters and t in seconds.	J1
b (iii)	The left-hand end is located at $x = 0$. $y\left(t\right) = 3.5\times10^{-3}\sin\left(37.5\pi t\right)$ where x and y in meters and t in seconds.	J1
b (iv)	Particle at $x = 1.40\,m$, $y\left(x,t\right) = 3.5\times10^{-3}\sin\left(37.5\pi t - 1.25\pi\left(1.4\right)\right)$ $y\left(t\right) = 3.5\times10^{-3}\sin\left(37.5\pi t - 1.75\pi\right)$ where x and y in meters and t in seconds.	J1

b (v)	$v_{max} = \omega A$ $= 37.5\pi\left(3.5\times10^{-3}\right)$ $= 0.41\text{m s}^{-1}$	GJU1
b (vi)	At $t = 0.05\,s$ and $x = 1.40\,m$, $y = 3.5\times10^{-3}\sin\left(37.5\pi\left(0.05\right)-1.25\pi\left(1.40\right)\right)$ $y = 1.34\times10^{-3}\text{ m}$ $v_y = 0.412\cos\left(37.5\pi t - 1.25\pi x\right)$ $= 0.412\cos\left(37.5\pi\left(0.05\right)-1.25\pi\left(1.40\right)\right)$ $v_y = 0.381\text{m s}^{-1}$	G1 JU1 G1 JU1
	TOTAL	**23**

NO	ANSWER SCHEME	MARK(S)
7 a(i)	Radius of wire, r = 1.65×10^{-3} m Cross-sectional area of steel wire, $A = \pi r^2$ $A = \pi(1.65\times10^{-3})^2$ $A = 8.55\times10^{-6}\text{ m}$ Young's Modulus, $Y = \dfrac{Fl}{Ae}$ $Y = \dfrac{[(2.5)(9.81)](0.4)}{(8.55\times10^{-6})(0.1\times10^{-3})}$ $Y = 1.15\times10^{10}\text{ Nm}^{-2}$	G1 G1 JU1

a(ii)	Energy, $U = \frac{1}{2}Fe$ $U = \frac{1}{2}(24.53)(0.1\times10^{-3})$ $U = 1.23\times10^{-3}\ \text{J}$	 G1 JU1
7 b	Let T_θ as the temperature between the interface At steady state, $\left(\frac{Q}{t}\right)_{iron} = \left(\frac{Q}{t}\right)_{copper}$ $k_{iron}\,A\left(\frac{\Delta T}{L}\right) = k_{copper}\,A\left(\frac{\Delta T}{L}\right)$ $\frac{40\,A(70-T_\theta)}{0.5} = \frac{360\,A(T_\theta-10)}{1.2}$ $3360-48T_\theta = 180T_\theta - 1800$ $228T_\theta = 5160$ $T_\theta = 22.63^\circ\text{C}$	 K1 G1 JU1
	TOTAL	**8**

NO	**ANSWER SCHEME**	**MARK(S)**
8 a	$f = 3$ $U = \frac{f}{2}NkT$ $1.56\times10^{-20} = \frac{3}{2}(2)(1.38\times10^{-23})(T)$ $T = 376.8\ \text{K}$	K1 J1

	$v_{rms} = \sqrt{\frac{3RT}{M}}$ $v_{rms} = \sqrt{\frac{3(8.31)(376.8)}{(4\times10^{-3})}}$ $v_{rms} = 1532.5\ \text{ms}^{-1}$	G1 JU1
b (i)	 Axis with unit and both label – D1 Shape and arrow – D1	D2
b (ii)	$Q = \Delta U + W$ $Q = 0 + (5.6\times10^{3})$ $Q = 5.6\times10^{3}\ \text{J}$ Heat is absorbed	G1 JU1 J1
b (iii)	$W = nRT\ln\frac{V_2}{V_1}$ $5.6\times10^{3} = (2)(8.31)(T)\ln\frac{4V}{V}$ $T = 243.1\,K$	G1 JU1
	TOTAL	**11**