ANSWER SCHEME SET A

$\begin{array}{cccccccccccccccccccccccccccccccccccc$	NO	ANSWER	MARKS
$ F_{\text{net}} = \sqrt{F_{\text{x}}^2 + F_{\text{y}}^2}$ $= \sqrt{(-20)^2 + (25)^2} \qquad (*\text{must have negative sign}) \qquad \text{G1}$ $= 32.02 \text{ N}$ $TOTAL \qquad 2 \text{ MARKS}$ $2.(a)(i) \qquad t_{Total} = ?$ $t = \frac{v - u}{a}$ $t = \frac{24.0 - 0}{1.50}$ $t = 16.0 \text{ s}$ $s = ut + \frac{1}{2}at^2$ $180 = 24.0t + 0$ $t = 7.5 \text{ s}$ $t_{Total} = 16.0 + 7.5 + 6.5 = 30.0 \text{ s}$ $JU1$ $2.(a)(ii) \qquad v_{ave} = ?$ $s = ut + \frac{1}{2}at^2$ $s = 0 + \frac{1}{2}(1.50)(16)^2$ G1	1	$F_{x} = -F_{1} = -20 \text{ N}$	
		$F_y = F_2 = 25 \text{ N}$	
		$ F_{\text{net}} = \sqrt{F_{\text{x}}^2 + F_{\text{y}}^2}$	
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2.(a)(i) $t_{Total} = ?$ $t = \frac{v - u}{a}$ $t = \frac{24.0 - 0}{1.50}$ $t = 16.0 \text{ s}$ $s = ut + \frac{1}{2}at^{2}$ $180 = 24.0t + 0$ $t = 7.5 \text{ s}$ $t_{Total} = 16.0 + 7.5 + 6.5 = 30.0 \text{ s}$ $JU1$ 2.(a)(ii) $v_{ave} = ?$ $s = ut + \frac{1}{2}at^{2}$ $s = 0 + \frac{1}{2}(1.50)(16)^{2}$ G1			
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$s = ut + \frac{1}{2}at^{2}$ $180 = 24.0t + 0$ $t = 7.5 \text{ s}$ $t_{Total} = 16.0 + 7.5 + 6.5 = 30.0 \text{ s}$ $JU1$ $2.(a)(ii)$ $v_{ave} = ?$ $s = ut + \frac{1}{2}at^{2}$ $s = 0 + \frac{1}{2}(1.50)(16)^{2}$ G1		$t = \frac{1.50}{}$	GI
$180 = 24.0t + 0$ $t = 7.5 \text{ s}$ $f_{Total} = 16.0 + 7.5 + 6.5 = 30.0 \text{ s}$ $2.(a)(ii)$ $v_{ave} = ?$ $s = ut + \frac{1}{2}at^{2}$ $s = 0 + \frac{1}{2}(1.50)(16)^{2}$ G1		t = 16.0 s	
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2.(a)(ii) $v_{ave} = ?$ $s = ut + \frac{1}{2}at^{2}$ $s = 0 + \frac{1}{2}(1.50)(16)^{2}$ G1		t_{-} = 16.0 + 7.5 + 6.5 = 30.0 s	П 11
$s = ut + \frac{1}{2}at^{2}$ $s = 0 + \frac{1}{2}(1.50)(16)^{2}$ G1		Total = 10.0 1 7.5 1 6.5 = 30.0 3	JUI
$s = ut + \frac{1}{2}at^{2}$ $s = 0 + \frac{1}{2}(1.50)(16)^{2}$ G1	2 (a)(ii)	12 — ?	
$s = 0 + \frac{1}{2}(1.50)(16)^2$ G1	2.(a)(11)		
		$s = ut + \frac{1}{2}at^2$	
			G1
s = 192 m		L	G1
		s = 192 m	
$v_{ave} = \frac{S_f - S_i}{t_f - t_i}$		$v_{ave} = \frac{S_f - S_i}{t_f - t_i}$	
$v_{ave} = \frac{(192 + 180) - 0}{23.5 - 0}$		(192 + 180) - 0	
$v_{ave} = 15.83 \text{ m s}^{-1}$ GJU1		$v_{ave} = 15.83 \text{ m s}^{-1}$	GJU1

2.(b)(i)	u = ?	
	$S_x = 17.5 m$	
	$u_x = u \cos 35^\circ$ & $u_y = u \sin 35^\circ$	
	$u_x = 0.819u u_y = 0.574u$	
	$S_x = u_x t$	
	17.5 = (0.819u)t	G1
	$S_y = u_y t - \frac{1}{2}gt^2$	
	$0 = (0.574u)t - \frac{1}{2}(9.81)t^2$	G1
	t = 0.117u	
	17.5 = (0.819u)(0.117u)	G JU1
	$u = 13.5 \text{ m s}^{-1}$	0301
2.(b)(ii)	$S_{y} = ?$	K 1
	$At H_{max}, v_y = 0$	$(v_y = 0)$
	$v_y^2 = u_y^2 - 2gS_y$	
	$0 = (0.574 \times 13.5)^2 - 2(9.81)S_y$	CHII
	$\therefore S_y = 3.06 m$	GJU1
	TOTAL	10 MARKS
3.(a)		***
	$F\Delta t = \Delta p$	K1
	8.5(30) = 4.5(25) - 4.5u	
	$u = -31.67 ms^{-1}$	CHII
	$\therefore magnitude \ of \ u = 31.67ms^{-1}$	GJU1
3.(b)	x-comp:	
	$m_1 u_{1x} = (m_1 + m_2) v_x$	
	$m(7.5) = 2m(v_x)$	K1
	$v_x = 3.75 m s^{-1}$	

$m(7.5) = 2m(v_y)$	Κ 1
$m(7.5) = 2m(v_y)$	
$v_y = 3.75 m s^{-1}$	
$tan\theta = \frac{v_y}{v_x}$	
$tan\theta = \frac{3.75}{3.75}$	
$\theta = 45^{\circ}$ (above +y axis)	
J	U1
$v = \sqrt{3.75^2 + 3.75^2}$	
	T T 1
J = 5.50 ms	U1
3.(c)(i)	
N X	
T	
	D2
↓ W	
T	
	D 1
W	
3.(c)(ii)	
Block A	
$\sum F_{x} = ma$	
$T - Wsin\theta = ma$	ζ 1
$T - 35(9.81)\sin 30^o = 35a$	X 1

	Block B	
	$\sum F_y = ma$ $W - T = 22a$ $T = 22(9.81) - 22a$	K1
	$22(9.81) - 22a - 35(9.81)\sin 30^o = 35a$	
	$a = 0.774 ms^{-2}$	****
2 (a)(iii)		JU1
3.(c)(iii)	T = 22(9.81) - 22(0.774) $T = 198.72N$	GJU1
	TOTAL	13 MARKS
4 (a)(i)	T a	
	mg	K1
	$T = mg + ma = (150)(9.81) + (150)(0.5) = 1546.50 N$ $W_T = T(s)\cos 0 = (1546.5)(3)\cos 0 = 4.64 \times 10^3 J$	GJU1
4 (a)(ii)	$W_W = mg(s)\cos 180^\circ$	G1
	$W_W = (150)(9.81)(3)\cos 180^{\circ}$ $W_W = -4.41 \times 10^3 J$	JU1
4 (a)(iii)	$W_{Total} = W_T + W_W$	K1
	$W_{Total} = (4.64 \times 10^3) + (-4.41 \times 10^3)$ $W_{Total} = 0.23 \times 10^3 J$	GJU1
4 (b)	$12 \text{ km/h} \times (1000 \text{ m})/\text{km} \times (1 \text{ h})/(3600 \text{ s}) = 3.333 \text{ m/s}.$	
	$F = \frac{P}{v} = \frac{7500}{3.33} = 2250 \text{ N}$	G1
	$F = \frac{1}{v} = \frac{1}{3.33} = 2250 N$	JU1
	TOTAL	13 MARKS
5(i)	$\omega = \frac{2\pi}{T} = \frac{2\pi}{1.7} = 3.7 \ rads^{-1}$	G1
	$a = r\omega^2 = (0.6)(3.7)^2 = 8.21ms^{-2}$	JU1

5(ii)	$\omega = \frac{1 \text{ rev}}{2 \text{ mins}} \times \frac{2\pi \text{ rad}}{1 \text{ rev}} \times \frac{1 \text{ min}}{60 \text{ sec}} = 0.0524 \text{ rads}^{-1}$	G1
	$F_c = mr\omega^2$	
	$= (0.9)(0.6)(0.0524)^2$	G1
	$= 1.5 \times 10^{-3} \text{ N}$	JU1
	TOTAL	5 MARKS
6.(a)(i)	Given; A = 25 cm $a_{max} = 12.5 \text{ m s}^{-2}$	
	$a_{max} = A\omega^2$ $12.5 = (0.25)\omega^2$ $\omega = 7.07 \text{ rads}^{-1}$	G1
	$\omega = \frac{2\pi}{T}$ $T = \frac{2\pi}{7.07} = 0.89 \text{ s}$	JU1
6.(a)(ii)	Given; $y = 15 \text{ cm}$	
	$v = \omega \sqrt{A^2 - y^2}$ = 7.07\sqrt{0.25^2 - 0.15^2} = 1.41 m s^{-1}	G1 JU1
6.(b)(i)	Given; $v = 8 \text{ ms}^{-1}$ (to the left) A = 20 mm $\lambda = 40 \text{ cm}$	
	$v = f\lambda$ $8 = f(0.4)$ $f = 20 \text{ Hz}$	G1 JU1
6.(b)(ii)	$y = A\sin(\omega t + kx)$ $\omega = 2\pi f$ $= 2\pi (20)$	
	$k = \frac{2\pi}{\lambda}$ $k = \frac{2\pi}{\lambda}$ $= \frac{2\pi}{0.4}$ $= 5\pi m^{-1}$	G1
	$= \frac{1}{0.4}$ $= 5\pi m^{-1}$	G1

	$y = 0.02 \sin(40\pi t + E\pi x)$	GJU1
	$y = 0.02 \sin(40\pi t + 5\pi x)$ Where we divide in material tip second	GJU1
	Where x and y are in meter and t in second.	
6.(b)(iii)	$v = 0.02(40\pi)\cos(40\pi t + 5\pi x)$	K1
	At $t = 0.3$ s and $x = 0.15$ m,	
	$v = 0.02(40\pi)\cos[(40\pi)(0.3) + (5\pi)(0.15)]$	G1
	$= -1.78 \text{ m s}^{-1}$	JU1
6.(c)(i)	Given;	
	$f_3 = 547 \text{ Hz}$	
	$v_s = 343 \text{ m s}^{-1}$	
	7111	
	$f_n = \frac{nv}{2l}$	
		K1
	$547 = \frac{3(343)}{2I}$	(n=3)
	$547 = {2l}$	
	1 004	
	l = 0.94 m	GJU1
6.(c)(ii)	W1 2 3λ 1	K1
0.(0)(11)	When $n = 3$; $\frac{3\lambda}{2} = l$	IXI
	11 343	
	$\frac{3\lambda}{2} = 0.94 \qquad \qquad \text{or} \qquad \lambda = \frac{v}{f} = \frac{343}{547}$	G1

	$\therefore \lambda = 0.63 \text{ m} = 0.63 \text{ m}$ $f_n = \frac{nv}{2l}$ $n = 2;$	JU1
6. (c)(iii)	$f_n = \frac{nv}{2}$	
	n=2;	K1
	,	(n=2)
	$f_2 = \frac{2(343)}{2(0.94)}$	(11 -)
	=364.89 Hz	JU1
6.(d)(i)	Given;	
	$f_s = 1000 \text{ Hz}$ $v = 343 \text{ m s}^{-1}$	
	v - 343 m/s $v_o = 0 \text{ m/s}^{-1}$	
	$v_s = 70 \text{ km h}^{-1} = 19.44 \text{ m s}^{-1}$	
	$f_a = \left(\frac{v \pm v_o}{v \mp v_s}\right) f_s$	
	$v = v_s / v_s$	
	$f_a = \left(\frac{343}{343 - 19.44}\right) 1000$	K1
	$f_a = \left(\frac{3.73}{24.2 + 10.44}\right) 1000$	18.1
	(343 — 17.44)	
	=1060.08 Hz	GJU1

6. d(ii)	$f_a = \left(\frac{343}{343 + 19.44}\right)1000$	K1
	=946.36 Hz	GJU1
	TOTAL	23 MARKS
7 (a)(i)	$\sigma = \frac{F}{A} = \frac{mg}{A} = \frac{(5)(9.81)}{(1.20 \times 10^{-6})}$ $\sigma = 4.09 \times 10^7 N m^{-2}$	GJU1
7(a)(ii)	$\frac{U}{V} = \frac{1}{2}\sigma\varepsilon = \frac{1}{2}\frac{\sigma^2}{Y} = \frac{1}{2}\frac{(4.09 \times 10^7)^2}{(190 \times 10^9)}$ $\frac{U}{V} = 4.40 \times 10^3 J m^{-3}$	G1 JU1
7(b)(i)	$\frac{\Delta T}{L} = \frac{(0 - 60)}{0.1} = -600 ^{\circ}\text{C} m^{-1}$	GJU1
7(b)(ii)		K1
	$(380) \left(\frac{60 - 100}{L}\right)_{cu}^{cu} = 46(-600)$ $L = 0.55 m$	G1 JU1
7(c)	$\Delta A = \beta A_o \Delta T$ $(600 - 550) \times 10^{-4} = 2(2.3 \times 10^{-5})(550 \times 10^{-4})(T - 10)$ $T = 1986.28 ^{\circ}\text{C}$	GJU1
	TOTAL	8 MARKS
8(a)	Using formula $P = \frac{1}{3} \rho v_{rms}^{2}$ $\rho = \frac{3P}{V_{rms}^{2}}$	
	$=\frac{3(1.01\times 10^5)}{(2500)^2}$	G1
	$= 0.048 \text{ kg m}^{-3}$	JU1

8.(b)(i)	$K = \frac{3}{2}kT = \frac{3}{2}(1.38 \times 10^{-23})(310)$ $K = 6.417 \times 10^{-21} J$	G1 JU1
8.(b)(ii)	$U = \frac{f}{2}nRT = \frac{3}{2}(0.2)(8.31)(310)$	G1
	U = 772.83 J	JU1
8.(c)(i)	Isothermal compression	J1
8.(c)(ii)	$W = nRT \ln \frac{V_f}{V_i}$	
	$W = (0.5)(8.31)(200) \ln \frac{0.004}{0.007}$	G1
	= -465.04 J	JU1
8.(c)(iii)	$\Delta U = Q - W$	
	$\Delta U = 0$	K1
	Q = W = -465.04 J	JU1
	TOTAL	11 MARKS