

1(a)	$D - 350 = 900 \times 0.25$
	$D = 575 \text{ N}$
1(b)	$P = 575 \times 15$
	$P = 8625 \text{ W or } 8.625 \text{ kW}$
2(a)	$3 \times 4 = 3 \times (-1) + 5 \times v$
	or $3 \times 4 = 3 \times 1 + 5v$
	$v = 3 \text{ m s}^{-1}$
	$v = 1.8 \text{ m s}^{-1}$
2(b)	$\text{KE} = \frac{1}{2} \times 3 \times 4^2 (= 24) \text{ or } \text{KE} = \frac{1}{2} \times 3 \times 1^2 + \frac{1}{2} \times 5 \times 1.8^2 (= 9.6)$
	or $\text{KE} = \frac{1}{2} \times 3 \times 1^2 + \frac{1}{2} \times 5 \times 3^2 (= 24)$
	$\lambda = 14.4 \text{ ONLY}$

3	For attempt to resolve in any direction to form an equation or expression
	Vertically: $(Y =) \pm(45 + 28\sin 35 - 72\sin 50 - 35\sin 60)$
	Horizontally: $(X =) \pm(28\cos 35 + 72\cos 50 - 35\cos 60)$
	$R = \sqrt{(\text{their } 24.4059\dots)^2 + (\text{their } 51.7169\dots)^2}$
	$\theta = \tan^{-1}\left(\frac{\text{their } 24.4059\dots}{\text{their } 51.7169\dots}\right) [= \tan^{-1} 0.4719\dots]$ OR $\alpha = \tan^{-1}\left(\frac{\text{their } 51.7169\dots}{\text{their } 24.4059\dots}\right) [= \tan^{-1} 2.1190\dots]$
3	$R = 57.2 \text{ N}$ Direction is 25.3° below the positive x -direction or bearing 115°

4	PE lost by A : $\pm mg \times 0.75$
	PE gained by B : $\pm 3g \times 0.75 \times 0.6 [= \pm 13.5]$
	KE gained by A and B : $\pm \left(\frac{1}{2} \times 3 \times 2^2 + \frac{1}{2} \times m \times 2^2 \right) [= \pm (6 + 2m)]$
	Work done against resistance = $\pm \frac{10}{3} \times 0.75 [= \pm 2.5]$
	$\frac{1}{2} \times 3 \times 2^2 + \frac{1}{2} \times m \times 2^2 = 0.75mg - 13.5 - 2.5$
	$m = 4$
	Special case for use of N2L max 3 marks
	$2^2 = 0^2 + 2 \times a \times 0.75 \Rightarrow a = \frac{8}{3}$
	$mg - T = ma$ and $T - 3g \times 0.6 - \frac{10}{3} = 3a$ OR $mg - 3g \times 0.6 - \frac{10}{3} = (m + 3)a$
	$m = 4$

7(a)	$v = \frac{1}{3}(2t^2 - 11t + 12) \Rightarrow \frac{dv}{dt} = \frac{1}{3}(4t - 11)$
	$\frac{1}{3}(4 \times 2 - 11) = -1 \text{ m s}^{-2}$
7(b)	Attempt to integrate
	$s = \frac{1}{3} \left(\frac{2t^3}{3} - \frac{11t^2}{2} + 12t \right) (+c)$
	[P changes direction when] $t = 1.5$
	Attempt to evaluate their $\frac{1}{3} \left(\frac{2t^3}{3} - \frac{11t^2}{2} + 12t \right)$ for $t = 0$ to $t = 1.5$ and $t = 1.5$ to $t = 3$
	Total distance is $[2.625 + -1.125 =] 3.75 \text{ m}$

7(c)

Attempt to evaluate their s for $t = 0$ to $t = 4$

$$\int_0^4 v \, dt = \frac{8}{9} > 0 \text{ so, no } P \text{ does not return to } O$$

7(a)	For attempt to resolve in any direction to form an expression or equation
	$[X =] \pm (30 \cos 30 + 15 \cos 45 - 20 \cos 20)$ OR $[S \cos \alpha =] \pm (30 \cos 30 + 15 \cos 45 - 20 \cos 20)$
	$[Y =] \pm (25 + 15 \sin 45 - 20 \sin 20 - 30 \sin 30)$ OR $[S \sin \alpha =] \pm (25 + 15 \sin 45 - 20 \sin 20 - 30 \sin 30)$
	$S = \sqrt{(their 17.7935...)^2 + (their 13.7661...)^2}$ OR $S = \frac{their 17.7935...}{\cos(their 37.7278...)}$ OR $S = \frac{their 13.7661...}{\sin(their 37.7278...)}$
	$\alpha = \tan^{-1} \left(\frac{their 13.7661...}{their 17.7935...} \right)$ OR $\alpha = \cos^{-1} \left(\frac{their 17.7935...}{their 22.4970...} \right)$ OR $\alpha = \sin^{-1} \left(\frac{their 13.7661...}{their 22.4970...} \right)$
	$[S =] 22.5$ $[\alpha =] 37.7$

7(b)

$$(their\ 17.7935...) - F = 0.6a$$

$$\text{OR } 30\cos 30 + 15\cos 45 - 20\cos 20 - F = 0.6a$$

$$\text{OR } (their\ S)\cos(third\ \alpha) - F = 0.6a \quad [17.8025 - F = 0.6a]$$

$$2 = 0 + \frac{1}{2}a \times 3^2 \quad \left[a = \frac{4}{9} \right]$$

$$R = their(13.7661...) + 0.6g \quad [= 19.7661...]$$

$$\text{OR } R = 25 + 15\sin 45 - 20\sin 20 - 30\sin 30 + 0.6g$$

$$\text{OR } R = (their\ S)\sin(third\ \alpha) + 0.6g \quad [R = 13.759 + 0.6g]$$

$$(their\ 17.7935)...\ - \mu \times 19.7661 = 0.6 \times \left(their\ \frac{4}{9} \right)$$

$$\mu = 0.887$$

7(b)

Alternative scheme for using energy

$$\frac{1}{2} \times 0.6 \times v^2 = (\text{their } 17.7935) \times 2 - F \times 2$$

$$\text{OR } \frac{1}{2} \times 0.6 \times v^2 = (30 \cos 30 + 15 \cos 45 - 20 \cos 20) \times 2 - F \times 2$$

$$\text{OR } \frac{1}{2} \times 0.6 \times v^2 = (\text{their } S) \cos(\text{their } \alpha) \times 2 - F \times 2$$

$$2 = \frac{1}{2}(0 + v) \times 3 \quad \left[v = \frac{4}{3} \right]$$

$$R = \text{their } (13.7661...) + 0.6g \quad [= 19.7661...]$$

$$\text{OR } R = 25 + 15 \sin 45 - 20 \sin 20 - 30 \sin 30 + 0.6g$$

$$\text{OR } R = (\text{their } S) \sin(\text{their } \alpha) + 0.6g \quad [R = 13.759 + 0.6g]$$

$$\frac{1}{2} \times 0.6 \times \left(\text{their } \frac{4}{3} \right)^2 = (\text{their } 17.7935) \times 2 - 19.7661 \times \mu \times 2$$

$$\mu = 0.887$$