1	(i)	DF = $P \div 18$	B1		
		$[P \div 18 - 800 = 1400 \times 0.5]$	M1		For using DF – $R = ma$
		$P = 27000$	A1	3	
	(ii)	$[1080 - 800 = 1400a]$	M1		For using DF = $P \div 25$ **and** DF – $R = ma$
		Acceleration is $0.2\,\text{ms}^{-2}$	A1	2	
2			M1		For applying Newton's 2nd law to P or to Q
		$0.65 \times 10 \times (63/65) - T = 0.65a$ **or** $T - 0.65 \times 10 \times (16/65) = 0.65a$	A1		
		$T - 0.65 \times 10 \times (16/65) = 0.65a$ **or** $0.65 \times 10 \times (63/65) - T = 0.65a$ **or** $0.65 \times 10 \times (63 - 16)/65 = 2 \times 0.65a$	B1		
		$[T - 1.6 = 6.3 - T]$ **or** $[T = 6.3 - 0.65 \times (47/13)]$ **or** $[T = 1.6 + 0.65 \times (47/13)]$	M1		For eliminating a
		Tension is 3.95 N	A1	5	
3	(i)	$[W\cos\alpha + 7 \times 0.6 = 8]$	M1		For resolving forces acting at O vertically
		$W\cos\alpha = 3.8$ (cwo)	A1		AG
		$W\sin\alpha = 5.6$	B1	3	
	(ii)		M1		For using $W^2 = (W\sin\alpha)^2 + (W\cos\alpha)^2$ **or** $\tan\alpha = (W\sin\alpha \div W\cos\alpha)$
		$W = 6.77$ or $\alpha = 55.8$	A1		
		$\alpha = 55.8$ or $W = 6.77$	B1	3	
4	(i)	$v(8) = 0.25 \times 8 = 2$	B1		
		$2 = -6.4 + 19.2 - k \rightarrow k = 10.8$	B1ft	2	ft $(12.8 - v)$
	(ii)	$[dv/dt = -0.2t + 2.4$ (= 0 when $t = 12$) $v_{max} = -0.1 \times 144 + 2.4 \times 12 - 10.8]$	M1		For finding t when $dv/dt = 0$ and substituting into $v(t)$
		Maximum speed is $3.6\,\text{ms}^{-1}$	A1ft	2	ft (14.4 – incorrect k)

(iii)	Displacement $s_1 = ½\ 0.25 \times 8^2$ (= 8)	B1		
	[Displacement $s_2 = [-0.1t^3/3 + 1.2t^2 - 10.8t]_8^{18}$ (=26.7)]	M1		For using displacement $s_2 = \int_8^{18}(-0.1t^2 + 2.4t - 10.8)dt$
	Displacement is 34.7 m	A1	3	
5	$[P - 8g\sin5^\circ - F = 8a]$	M1		For using Newton's 2nd law (either case)
	$7X - 8g\sin5^\circ - F = 8 \times 0.15$ **and** $8X - 8g\sin5^\circ - F = 8 \times 1.15$	A1		
	$X = 8$	A1		
		M1		For obtaining a numerical expression for F
	$F = 56 - 8g\sin5^\circ - 8 \times 0.15$ **or** $F = 64 - 8g\sin5^\circ - 8 \times 1.15$ **or** $F = 56 \times 1.15 - 64 \times 0.15 - 8g\sin5^\circ$ **or** $F = 47.8(275...)$	A1√		ft X either from error for one term in X/F equation or from error in solution of correct X/F equations
	$R = 8g\cos5^\circ$ (= 79.695...)	B1		
	$[\mu = 47.8 \div 79.7]$	M1		For using $\mu = \frac{F}{R}$
	Coefficient is 0.600 (accept 0.6)	A1	8	
6 (i)		M1		For using the gradient property for acceleration
	Acceleration is 4 ms^{-2}	A1		
		M1		For applying Newton's 2nd law to both particles or using the formula $(M + m)a = (M - m)g$ and for using $m + M = 1$
	For $T - mg = 4m$ **and** $(1 - m)g - T = 4(1 - m)$ **or** $4 = (1 - m - m)g$	A1		
	P has mass 0.3 kg and Q has mass 0.7 kg	A1	5	

(ii)	For using the area property of the graph or $h = ½ at^2$ to obtain $h = 2$	B1	1	
(iii)	Distance travelled upwards by $P = ½\, 1.4 \times 4$	B1		
	Height is 4.8 m	B1	2	
7 (i)	$4^2 = 0^2 + 2a \times 12.5 \rightarrow a = 0.64$	B1		
	$[35 \times 0.96 - 3g \times 0.6 - F = 3 \times 0.64]$	M1		For using Newton's 2nd law to find F
	$F = 13.68$	A1		
	WD against $F = 13.68 \times 12.5 = 171$ J	B1	4	
(ii)	$R_{\text{from O to A}} = 3g \times 0.8 - 35 \times 0.28$	B1		
	$[\mu = 13.68 \div 14.2\ (= 0.96338)]$	M1		For using $\mu = F \div R$
	Coefficient is 0.963 (accept 0.96)	A1	3	
(iii)	$[-3g \times 0.6 - 0.96338 \times (3g \times 0.8) = 3a]$	M1		For applying Newton's 2nd law to the block to find a
	Acceleration is $-13.7\ \text{ms}^{-2}$	A1		
	$[0 = 16 + 2(-13.7)s]$	M1		For using $v^2 = u^2 + 2as$ to find s
	Distance travelled is 0.584 m	A1	4	
Alternative for part (i)				
(i)	Gain in KE $= ½\, 3 \times 4^2\ (= 24\text{ J})$	B1		
	Gain in PE $= 3g \times 12.5 \times 0.6\ (= 225\text{ J})$	B1		
	$[\text{WD} = 35 \times 12.5 \times 0.96 - ½\, 3 \times 4^2 - 3g \times 12.5 \times 0.6]$	M1		For using WD against F = WD by applied force – KE gain – PE gain
	WD against F is 171 J	A1	4	
Alternative for part (iii)				
	WD against $F = 0.96(338..) \times 3g \times 0.8s$	B1		
		M1		For using KE loss = PE gain + WD against friction
	$½\, 3 \times 4^2 = 3gs(0.6) + 0.96(338..) \times 3g \times 0.8s$	A1		
	Distance travelled is 0.584 m	A1	4	