Question	Answer	Marks
1	Resultant = $100 - 2 \times 50\cos\alpha$	**M1**
	20 N	**A1**
	Direction is to the left (or equivalent)	**B1**
		3

Question	Answer	Marks
2(a)	$[T - 100 = 400 \times 1.5]$	**M1**
	$T = 700$ N	**A1**
		2
2(b)	$F - 250 - 100 = 2200 \times 1.5$ ($F = 3650$ N) (**M1** for using Newton's second law for the system or for the car using the result from **2(a)**)	**M1**
	For use of power $= Fv$	**M1**
	73 000 W or 73 kW	**A1**
		3

Question	Answer	Marks
3(a)	$0 = 5^2 - 2gs$	**M1**
	$s = 1.25$	**A1**
	[Height above ground =] 4.05 m	**A1**
		3
3(b)	Use of $s = ut + ½ at^2$	**M1**
	$0.8 = 5t - 5t^2$	**A1**
	$t = 0.2$ or 0.8	**M1**
	Length of time = 0.6 s	**A1**
		4

Question	Answer	Marks
4(a)	Resolving forces in either direction	**M1**
	$R = T\sin 30 + 0.1g,\ F = T\cos 30$	**A1**
	$T\cos 30 = 0.8\ (T\sin 30 + 0.1g)$	**M1**
	$T = 1.72\ (1.7166...)$	**A1**
		4
4(b)	$R = 3\sin 30 + 0.1g$	**B1**
	$3\cos 30 - 0.8(3\sin 30 + 0.1g) = 0.1a$	**M1**
	$a = 5.98\ \text{ms}^{-2}\ (5.9807...)$	**A1**
		3

Question	Answer	Marks
5(a)	Attempt at finding PE lost	**M1**
	PE lost = $35g\,(4\cos 22.5 - 4\cos 45)$	**A1**
	$\frac{1}{2}\times 35v^2 = 35g\,(4\cos 22.5 - 4\cos 45)$	**M1**
	Speed = $4.16\ \text{ms}^{-1}$ (4.1643...)	**A1**
		4
5(b)	Use of the work-energy equation in the form: PE lost = KE gain + WD against resistance	**M1**
	$\frac{1}{2}\times 35\times 4^2 = 35g\,(4 - 4\cos 45) - X$	**A1**
	$X = 130$ (130.05...)	**A1**
		3

Question	Answer	Marks
6(a)	$\int k\left(t^2 - 10t + 21\right)\mathrm{d}t$	**M1**
	$s = k\left(\frac{1}{3}t^3 + 5t^2 + 21t\right) + \mathrm{C}$	**A1**
	$2.85 = k\left(\frac{1}{3}\times 3^3 - 5\times 3^2 + 21\times 3\right) + \mathrm{C}$ or $2.4 = k\left(\frac{1}{3}\times 6^3 - 5\times 6^2 + 21\times 6\right) + \mathrm{C}$	**M1**
	$2.85 = 27k + \mathrm{C}$, $2.4 = 18k + \mathrm{C}$ (**A1** for both)	**A1**
	Solving for k	**M1**
	$k = 0.05$	**A1**
	$s = 0.05\left(\frac{1}{3}t^3 - 5t^2 + 21t\right) + 1.5$	**A1**
		7
6(b)	Differentiating v or completing the square for v	**M1**
	$a = 0.05(2t - 10)$	**A1**
	Min value of v is at $t = 5$.	**M1**
	Displacement at $t = 5$ is 2.58 m (2.5833...)	**A1**
		4

Question	Answer	Marks
7(a)	$0.3g\sin 30 = 0.3a$ $(a = 5)$ (**M1** for applying Newton's second law parallel to the plane)	**M1**
	$v^2 = 0 + 2 \times 2.5 \times a$	**M1**
	$v = 5$	**A1**
	$0.3 \times 5 + 0 = 0.3 \times 2 + 0.2\,w$	**M1**
	Velocity of $Q = 4.5$ ms^{-1}	**A1**
		5

Question	Answer	Marks
7(b)	$0.3 \times z + 0 = 0.5 \times 1.2$	**M1**
	Velocity of P before collision $z = 2$	**A1**
	Friction force on P after reaches horizontal plane $F = \mu \times 0.3\,g$	**B1**
	$\mu \times 0.3g \times 1.5 = \frac{1}{2} \times 0.3 \times 5^2 - \frac{1}{2} \times 0.3 \times 2^2$	**M1**
	Coefficient $\mu = 0.7$	**A1**
	Alternative method for question 7(b)	
	$0.3 \times z + 0 = 0.5 \times 1.2$	**M1**
	Velocity of P before collision $z = 2$	**A1**
	Friction force on P after reaches horizontal plane $F = \mu \times 0.3\,g$	**B1**
	$a = (5^2 - 2^2) / (2 \times 1.5) = 7$, $F = 0.3 \times 7$	**M1**
	Coefficient $\mu = 0.7$	**A1**
		5