Question	Answer	Marks
1	Use of conservation of momentum	**M1**
	$m \times 2 + 0 = m \times (-0.5) + 0.2 \times 1$	**A1**
	$m = 0.08$	**A1**
		3

Question	Answer	Marks
2(a)	$F - 900 = 4000 \times 0.5$ (**M1** for use of Newton's second law, 3 terms)	**M1**
	$F = 2900$ N	**A1**
2(b)	900×25 (**M1** for use of $P = Fv$ with F = resistance only)	**M1**
	22 500 W or 22.5 kW	**A1**

Question	Answer	Marks
3	Attempt to resolve, either direction with correct number of terms	M1
	$F\cos\alpha = 40\sin30 + 20\sin60 - 50\sin45$ (= 1.965...)	A1
	$F\sin\alpha = 50\cos45 + 20\cos60 - 40\cos30$ (= 10.714...)	A1
	Method for either F or α	M1
	$F = \sqrt{\left((1.965...)^2 + (10.714...)^2\right)} = 10.9 (10.893)$	A1
	$\alpha = \tan^{-1}(10.714... / 1.965...) = 79.6$ (79.606...)	A1
		6

Question	Answer	Marks
4(a)	Trapezium shape with gradient of right-hand side approximately 2 times left side	B1
		1
4(b)	Constant velocity = 500/25 = 20 ms^{-1}	B1
	$20^2 = 0 + 2a \times 50$	M1
	$a = 4$	A1
		3
4(c)	Time to accelerate = 20/4 = 5 s	B1
	Deceleration time = 2.5 s	B1
	So total time = 5 + 25 + 2.5 = 32.5 s	B1
		3

Question	Answer	Marks
5(a)	Decrease in KE $= \frac{1}{2} \times 4 \times (12^2 - 8^2)$	**M1**
	160 J	**A1**
		2
5(b)	PE gained $= 4g \times 10\sin 30$ $(= 200)$	**B1**
	Total work done $= 200 - 160$	**M1**
	Total work done $= 40$ J	**A1 FT**
		3
5(c)	$-4g\sin 30 = 4a$	**M1**
	$a = -5$	**A1**
	$-10 = 8t - \frac{1}{2} \times 5t^2$	**M1**
	$t = 4.16$ s	**A1**
		4

Question	Answer	Marks
6(a)	$a = 4 - t$ (**M1** for differentiation)	**M1**
	When $a = 0$, $t = 4$	**A1**
	At $t = 4$, $v = 12.5$	**A1**
		3
6(b)	Velocity = 0 when $4.5 + 4t - 0.5t^2 = 0$	**M1**
	$t = 9$ (reject $t = -1$)	**A1**
	$\int (4.5 + 4t - 0.5t^2)dt$	**M1**
	$4.5t + 2t^2 - \frac{1}{6}t^3$ [+ c]	**A1**
	Apply limits (0 and 9)	**M1**
	Distance = 81 m	**A1**
		6

Question	Answer	Marks
7(a)	$T - 2mg = 0$	**B1**
	$3mg \sin\theta - T = 0$ (**M1** for resolving forces parallel to the plane and solving for θ)	**M1**
	$\theta = 41.8$ (41.810...)	**A1**
		3
7(b)	$R = 3mg\cos 30$	**B1**
	Use of $F = \mu R$	**M1**
	$2mg - T = 0.1 \times 2m$ OR $T - 3mg \sin 30 - \mu \times 3mg \cos 30 = 0.1 \times 3m$	**M1**
	$2mg - 0.2m - 3mg \sin 30 - \mu \times 3mg \cos 30 = 0.1 \times 3m$	**M1**
	$\mu = \frac{\sqrt{3}}{10}$	**A1**
		5
7(c)	$v^2 = 0 + 2 \times 0.1 \times 0.8$ $(v = 0.4)$	**M1**
	$-3mg \sin 30 - \mu \times 3mg \cos 30 = 3ma$ $(a = -6.5)$	**M1**
	$0 = -0.4 - 6.5t$	**M1**
	$t = 0.4/6.5 = 0.0615$ s	**A1**
		4