Question	Answer	Marks
1(a)	Trapezium, deceleration steeper than acceleration	**B1**
	Time from 0 to 200	**B1**
		2
1(b)	$0.5(170+200)v = 2775$	**M1**
	$v = 15$	**A1**
		2
1(c)	$a = 15 \div 20$	**M1**
	$a = 0.75$	**A1**
		2

Question	Answer	Marks
2	Resolving forces in either direction	**M1**
	$20\cos\theta = 4P\cos 30$	**A1**
	$4P + 2P\sin 30 = 20\sin\theta$	**A1**
	$\cos\theta = \frac{\sqrt{3}}{10}P$ $\sin\theta = \frac{P}{4}$ $\frac{3}{100}P^2 + \frac{1}{16}P^2 = 1$	**M1**
	$P = 3.29$	**A1**
	$\theta = 55.3$	**A1**
		6

Question	Answer	Marks
3	$T\sin 60 + R = 25\cos 20$	**B1**
	Attempt at resolving in any direction	**M1**
	$T\cos 60 = F + 25\sin 20$	**A1**
	$T\cos 60 + F = 25\sin 20$	**A1**
	Use of $F = \mu R$	**M1**
	$T\cos 60 = 25\sin 20 \pm 0.3(25\cos 20 - T\sin 60)$ $T = \dfrac{25\sin 20 \pm 0.3\times 25\cos 20}{\cos 60 \pm 0.3\sin 60}$	**M1**
	$T = 6.26$	**A1**
	$T = 20.5$	**A1**
		8

Question	Answer	Marks
4(a)	$4\times10\,[+0]=4\times0.5v+2v$	**M1**
	$v_A=5$ and $v_B=10$	**A1**
		2
4(b)	Conservation of momentum *B, C* $2\times10\,[+0]=2\times v+3v$	**M1**
	$v=4$	**A1**
	$v_A>v_B$, hence another collision	**A1**
		3
4(c)	Conservation of momentum *A, B*	**M1**
	$4\times their5+2\times their4=4v+2v \qquad v=\frac{14}{3}\ (\text{m s}^{-1})$	**A1**
	KE initial $=\frac{1}{2}\times4\times10^2$	**M1**
	KE final $=\frac{1}{2}\times6\times their(\frac{14}{3})^2+\frac{1}{2}\times1\times their12^2$	**A1**
	Loss of KE $=200-\frac{412}{3}=\frac{188}{3}$	**A1**
		5

Question	Answer	Marks
5(a)(i)	$DF = 750$	**B1**
	Power $= their(750) \times 32$ $= 24\text{kW}$	**B1 FT**
		2
5(a)(ii)	$16000 = DF \times 32$ $DF = 500$	**M1**
	$500 - 750 = 1250 \times a$	**M1**
	$a = [-]0.2$	**A1**
		3
5(b)	$DF = 1000 + 8v + 1250 \times 10 \times 0.096$	**M1**
	$2200 + 8v$	**A1**
	$60000 = (2200 + 8v)v$	**M1**
	$8v^2 + 2200v - 60000 = 0$	**A1**
	$v = 25$	**A1**
		5

Question	Answer	Marks
6(a)	Correct for $0 \leq t \leq 5$	**B1**
	Correct for $5 \leq t \leq 7$	**B1**
	Correct for $7 \leq t \leq 13.5$	**B1**
		3
6(b)	$a = -2t$ by differentiating	**M1**
	$a = -12$	**A1**
		2
6(c)	$s = \int_0^5 (2t+1)\,\mathrm{d}t + \int_5^6 (36-t^2)\,\mathrm{d}t + \left\lvert \int_6^7 (36-t^2)\,\mathrm{d}t + \int_7^{13.5} (2t-27)\,\mathrm{d}t \right\rvert$	**M1**
	$s = \int_0^5 (2t+1)\,\mathrm{d}t + \int_5^6 (36-t^2)\,\mathrm{d}t + \left\lvert \int_6^7 (36-t^2)\,\mathrm{d}t + \int_7^{13.5} (2t-27)\,\mathrm{d}t \right\rvert$	**A1**
	$s = [t^2 + t] + [36t - \frac{t^3}{3}] + t^2 - 27t$	**M1**
	All correct	**A1**
	$s = 84.25$	**A1**
		5