Question	Answer	Marks	Guidance
7(a)	$0=\frac{9}{4}+\frac{b}{(5+1)^2}-c\times5^2$	B1	Use of $v(5)=0$ to form equation in b and c
	$a=-2\frac{b}{(t+1)^3}-2ct$	M1	For use of $a=\frac{dv}{dt}$ and $a(5)=-\frac{13}{12}$
	$-\frac{13}{12}=-2\frac{b}{(5+1)^3}-2c\times5$	A1	
	$\frac{b}{36}-25c=-\frac{9}{4}$ and $-\frac{b}{108}-10c=-\frac{13}{12}$ leading to $b=\ldots$ or $c=\ldots$	M1	Attempts to solve simultaneous equations
	$b=9$ and $c=0.1$	A1	$b=9$ (AG)
		5	

Question	Answer	Marks	Guidance
7(b)	$\int\left(\frac{9}{4}+\frac{9}{(t+1)^2}-0.1t^2\right)\mathrm{d}t = \ldots$	M1	For use of $s=\int v\,dt$
	$=\frac{9}{4}t-\frac{9}{(t+1)}-\frac{1}{30}t^3\,[+K]$	A1 FT	FT *their* value of c from **(a)**
	$\left[\frac{9}{4}t-\frac{9}{(t+1)}-\frac{1}{30}t^3\right]_5^{10}=\left[\left(\frac{9}{4}\times10-\frac{9}{(10+1)}-\frac{1}{30}\times10^3\right)-\left(\frac{9}{4}\times5-\frac{9}{(5+1)}-\frac{1}{30}\times5^3\right)\right]$	M1	For evaluation from 0 to 5 **or** from 5 to 10
	$=$ $\left[\left(\frac{9}{4}\times5-\frac{9}{(5+1)}-\frac{1}{30}\times5^3\right)-(-9)\right]-\left[\left(\frac{9}{4}\times10-\frac{9}{(10+1)}-\frac{1}{30}\times10^3\right)-\left(\frac{9}{4}\times5-\frac{9}{(5+1)}-\frac{1}{30}\times5^3\right)\right]$ $=5.583+9+11.651+5.583$ or $\frac{175}{12}+\frac{2275}{132}$	M1	For evaluation from 0 to 5 **and** from 5 to 10 to find distance travelled
	$=31.8$ m	A1	or $\frac{350}{11}$
		5	

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	Guidance
4(a)	$52 = u(2) + 0.5a(2)^2 - \left(u(1) + 0.5a(1)^2\right)$ or $64 = u(4) + 0.5a(4)^2 - (u(3) + 0.5a(3)^2$	M1	Use of $s = ut + ½ at^2$ or equivalent to form equation for 2nd or 4th second .
		M1	Second equation in u and a.
	$52 = u + 1.5a$ and $64 = u + 3.5a$	A1	Two correct equations in u and a.
	$12 = 2a$ leading to $a = 6$	M1	Solves simultaneous equations to find either u or a.
	Initial speed $= 43$ ms^{-1} and acceleration $= 6$ ms^{-2}	A1	
		5	
4(b)	$s = 43 \times 10 + 0.5 \times 6 \times 10^2$	M1	Use of $s = ut + ½ at^2$ or equivalent.
	Distance $= 730$m	A1 FT	FT $10u + 50a$ with u and a from part (a).
		2	

Question	Answer	Marks	Guidance
4(a)	**Alternative Method for Question 4(a): Using the given value of $P = 200$ kW**		
	For use of $P = Fv$	B1	e.g. $200\,000 = 20F$ or $200\,000 = 25F$ OE. e.g. $F = \frac{200000}{20}[=10000]$ or $F = \frac{200000}{25}[=8000]$.
	Attempt to use Newton's second law in at least one case	M1	Must have 3 terms. Allow sign errors. Allow with F. Allow 200 in place of 200 000.
	$\frac{200000}{20} - 6000 = 15000a$ and $\frac{200000}{25} - 6000 = 15000\left(\frac{1}{2}a\right)$	A1	For both. Allow $2a$' and a' here.
	For solving for a in both cases.	M1	
	For showing that both equations lead to $a = \frac{4}{15}$ [m s^{-2}]	A1	awrt 0.267.
		5	
4(b)	For attempt at resolving up hill $\frac{200000}{v} - 6000 - 15000g\sin 1 = 0$	M1	Or $\frac{200000}{v} - 6000 - 2618 = 0$. May see $\frac{200000}{8618}$. Must have correct number of terms. Allow sin/cos mix. Allow sign errors. Allow g missing, but not a different acceleration. Do not allow F.
	Steady speed = 23.2 [m s^{-1}]	A1	
		2	

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