Question	Scheme	Marks
7(a)	$v = 1^2 - 10\times 1 + 28 = 19$ [m/s]	B1 [1]
(b)	$s = \int (t^2 - 10t + 28)\,\mathrm{d}t = \frac{t^3}{3} - \frac{10t^2}{2} + 28t(+c)$	M1
	$24 = \frac{3^3}{3} - \frac{10\times 3^2}{2} + 28\times 3 + c \Rightarrow c = -24 \Rightarrow \left[s = \frac{t^3}{3} - \frac{10t^2}{2} + 28t - 24\right]$	M1A1
	$t = 5, \quad s = \frac{5^3}{3} - \frac{10\times 5^2}{2} + 28\times 5 - 24 = \frac{98}{3}$ [m]	M1A1 [5]
(c)	$\frac{\mathrm{d}v}{\mathrm{d}t} = 2t - 10$ when $t = 9$, acceleration = 8 [m/s ^{2}]	M1 A1 [2]
(d)	(i) $v = (t-5)^2 + 3$	M1
	Irrespective of the value of t $v \geqslant 3$ so the particle never comes to rest.	A1
	ALT $b^2 - 4ac < 0 \Rightarrow (-10)^2 - 4\times 1\times 28 = -12$ No real solutions so the particle never comes to rest.	[M1 A1]
	(ii) Least value of v is 3 [m/s]	B1
		[3]
	Total 11 marks	

Question	Notes	Marks
7(a)	$v = t^2 - 10t + 28$	
	$v = 1^2 - 10\times 1 + 28 = 19$ [m/s]	B1 [1]
(b)	For an attempt to integrate the given expression for v [See general guidance for the definition of an attempt] $s = \int (t^2 - 10t + 28)\,\mathrm{d}t = \frac{t^3}{3} - \frac{10t^2}{2} + 28t(+c)$	M1
	For finding the value of c. They cannot score this mark without $+c$ $24 = \frac{3^3}{3} - \frac{10\times 3^2}{2} + 28\times 3 + c \Rightarrow c = ...$	M1
	For the correct expression for s. This need not be explicitly stated. $s = \frac{t^3}{3} - \frac{10t^2}{2} + 28t - 24$	A1

	Award for the correct value of c seen -24 [m]	
	For using their integrated expression for s to find a value of the displacement when $t = 5$ $s = \frac{5^3}{3} - \frac{10 \times 5^2}{2} + 28 \times 5 - 24 = ...$	M1
	For the correct value of $s = \frac{98}{3}$ [m] Accept $s = 32.7$ [or better]	A1 [5]
(c)	For an attempt to differentiate the given v and substituting $t = 9$ into their differentiated expression. $\frac{dv}{dt} = 2t - 10 \Rightarrow \frac{dv}{dt} = 2 \times 9 - 10 = ...$	M1
	For acceleration = 8 [m/s ^{2}]	A1 [2]
(d)(i)	**Method A** Completes the square to give $v = (t-5)^2 + 3$	M1
	Concludes that at the minimum velocity [3 m/s] $t = 5$ so P never comes to rest	A1
	Method B Finds the value of the discriminant $b^2 - 4ac < 0 \Rightarrow (-10)^2 - 4 \times 1 \times 28 = -12$	M1
	Concludes that as there are no real solutions, **so *P* does not come to rest.**	A1
	Method C Solves the 3TQ to give the following two [non-real] values of t: $5 + \sqrt{3}\mathrm{i}$ and $5 - \sqrt{3}\mathrm{i}$ or $\left(t - \left[5 + \sqrt{3}\mathrm{i}\right]\right)\left(t - \left[5 + \sqrt{3}\mathrm{i}\right]\right) = 0$	M1
	Concludes that as there are no real solutions, **so *P* does not come to rest.**	A1
	Method D Uses their result from (c) $\frac{dv}{dt} = 2t - 10 = 0 \Rightarrow t = 5$	M1
	Concludes that at the minimum velocity [3 m/s] $t = 5$ so P never comes to rest	A1
(ii)	For the correct value of $v = 3$ [m/s}	B1 [3]
		Total 11 marks