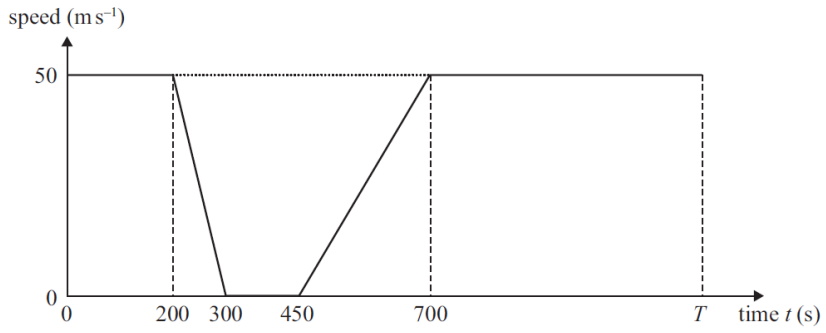
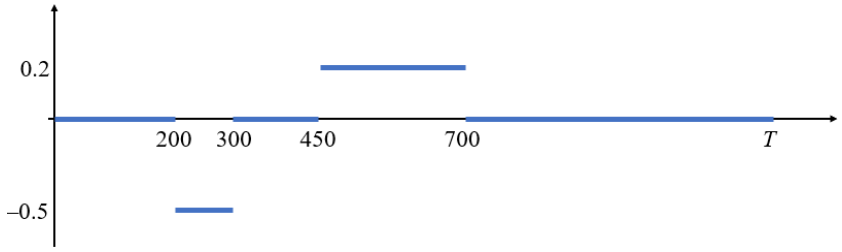
Question Number	Answer	Mark
		
3(a)	Method to find deceleration, $\pm\frac{50}{300-200}$	M1
	(deceleration =) 0.5 ($m\,s^{-2}$)	A1
		(2)
3(b)		B1 2 horiz lines for dec then acc B1ft ALL labels
		(2)
3(c)	Distance, $50\times15\times60$ (= 45000) (m) seen or implied	B1
	Method to find T or an equation in T	M1
	For example, • $45000=(200\times50)+\left(\frac{100\times50}{2}\right)+\left(\frac{250\times50}{2}\right)+(T-700)\times50$ • $45000=50\left(\frac{300+200}{2}\right)+50\left(\frac{(T-700)+(T-450)}{2}\right)$ • $45000=50T-\frac{1}{2}\times50\times(150+500)$	A1
	(T =) 1225	A1
		(4)
3(d)	Method to find the time moving at less than 30ms^{-1} whilst decelerating or accelerating.	M1
	Time whilst decelerating, for example • $\frac{30}{0.5}(=60)$ • $100-\left(\frac{30-50}{-0.5}\right)(=60)$	A1

	• $\frac{3}{5}\times 100\,(=60)$	
	Time whilst accelerating, for example • $\frac{30}{0.2}\,(=150)$ • $\frac{3}{5}\times 250\,(=150)$	A1
	Total = 360 (s)	A1
		(4)
		(12)
	Notes for Question 3	
3(a)		
M1	Correct method to find acceleration or deceleration, ignore signs.	
A1	Correct answer, must be positive.	
3(b)		
B1	Two horizontal lines, one representing a negative acceleration and another representing a positive acceleration. B0 if there are any solid vertical line(s). B0 if any graph sections are slopes.	
B1ft	Correct figs on both axes including *T* (condone *t* unless it is clearly labelling the horizontal axis). Follow through their accelerations which must be numerical. B0 if any graph sections are slopes.	
3(c)		
B1	Correct, seen or implied.	
M1	Method using their "45000" to find *T* or (*T* – 700). May form an equation in *T* only or may find the length of the relevant rectangle. May use areas or *suvat* but must include the correct number of terms, each with the correct structure. Condone a transcription error. Allow use of *t* for $(T-700)$.	
A1	Correct unsimplified equation in their *T* only	
A1	Correct	
3(d)		
M1	Method to find either time moving at less than 30ms^{-1} (whilst decelerating or accelerating). E.g. use of relevant *suvat*, gradient or 0.6 scale factor. Allow with their calculated acceleration or deceleration.	
A1	Correct unsimplified time while decelerating.	
A1	Correct unsimplified time while accelerating.	

A1	Correct, 360 (s), accept 6 minutes.	

4. [*In this question* **i** *and* **j** *are horizontal unit vectors.*]

A particle P of mass m kg lies on a smooth horizontal plane. The particle is acted upon by two forces, $\mathbf{F}_1$ N and $\mathbf{F}_2$ N, where $\mathbf{F}_1 = (3\mathbf{i} + \mathbf{j})$ and $\mathbf{F}_2 = (5\mathbf{i} - 16\mathbf{j})$.

Given that P moves with acceleration $68\,\text{m s}^{-2}$

(a) find the value of m.

(4)

Given that the force $(\mathbf{F}_1 + k\mathbf{F}_2)$ N, where k is a constant, acts in a direction which is perpendicular to the vector $(2\mathbf{i} + \mathbf{j})$

(b) find the exact value of k.

(4)