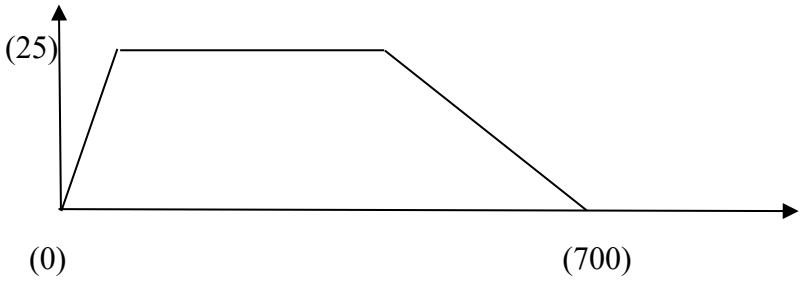
Question	Scheme	Marks	AOs
1(a)	 shape	B1	1.1b
		(1)	
(b)	Using *total* area = 15000 to set up an *equation* in **one unknown** Or they may use *suvat* on one or more sections (but must still be considering *all* sections) Allow an attempt at a clear explicit verification using $t = 40$ e.g. the following would score M1A1A1*: $4\times 40 = 160$ then $700 - 40 - 160 = 500$ $\frac{(700+500)}{2}\times 25 = 15000 = 15$ km Withhold A1* if they don't include = 15 km **N.B.** M0 if a single *suvat* formula is used for the whole journey.	M1	3.4
	$\frac{1}{2}(700+700-t-4t)\times 25 = 15000$ **OR** $\frac{1}{2}\times 25\times t + 25(700-t-4t) + \frac{1}{2}\times 25\times 4t = 15000$	A1	1.1b
	$t = 40$ (s)*	A1*	1.1b
		(3)	
(c)	0.63 or 0.625 or $\frac{5}{8}$ oe (m s^{-2}) isw	B1	1.1b/ (2.2a)
		(1)	
(d)	Complete method to find the speed or velocity at $t = 572$ e.g $\pm\left(25-(32\times\frac{5}{32})\right)$ or $\pm\left(128\times\frac{5}{32}\right)$ oe	M1	3.1b
	20 (m s^{-1})	A1	1.1b
		(2)	
(e)	e.g. (the train) cannot instantaneously change acceleration, (the train) won't move with <u>constant</u> acceleration , (the train) won't move with <u>constant</u> speed Allow negatives of these:	B1	3.5b

	e.g. (The train) moving at constant speed, or just 'constant speed' or 'constant acceleration' (is a limitation of the model) Must be a limitation of the model, so friction or air resistance or size of train is B0. **N.B.** Ignore incorrect **reasons** following a correct answer.		
		(1)	
			(8 marks)

Notes:		
1a	B1	Overall shape of graph, starting at the origin, with deceleration phase *longer* than the acceleration phase if nothing on the t-axis but ignore the relative lengths and allow if t (or 40) and $4t$ (or 160) are clearly and correctly marked. Ignore incorrect figs on the axes. This mark can be earned if the graph appears anywhere in qu 2.
1b	M1	Need *all* sections to be included, with correct structure for each section, with $\frac{1}{2}$'s where appropriate. Allow = 15 or 150 or 1500 etc instead of 15000
	A1	A correct equation **in their t only, seen or implied** (or with $t = 40$ for verification)
	A1*	cso. At least one line of working with brackets removed and t's collected, or equivalent
1c	B1	cao
1d	M1	Any complete method, must have correct figs, but condone sign errors
	A1	cao. Must be positive and exact i.e must not come from rounding.
1e	B1	Any appropriate limitation of the model. B0 if any incorrect extra **answers.**

Question	Scheme	Marks	AOs
2(a)	Because the distances travelled or displacements are equal oe. If they mention the times are the same as well, ignore it.	B1	2.4
		(1)	
2(b)	0.8 or 4/5 ($\mathrm{m\,s^{-2}}$)	B1	1.1b
		(1)	
2(c)	$\frac{1}{2}\times 5\times 4+(4\times 22.5)$ **OR** $\frac{1}{2}(27.5+22.5)\times 4$ **OR** $27.5\times 4-\frac{1}{2}\times 5\times 4$	M1	3.1b
	100 (m)	A1	1.1b
		(2)	
2(d)	Total area under graph = their answer for part (c)	M1	3.1b
	$\frac{1}{2}X\times X+X(27.5-X)=100$	A1**ft**	1.1b
	OR $\frac{1}{2}(27.5+27.5-X)\times X=100$ **OR** $27.5X-\frac{1}{2}X^2=100$	A1**ft**	1.1b
	X = 3.92 to 3sf	A1	1.1b
		(4)	
			(8 marks)

Notes:

2a	B1	Must mention distances being equal specifically.
2b	B1	cao
2c	M1	Clear attempt to find the **total** area under the *P* graph, with the correct structure i.e. (triangle + rectangle) **OR** trapezium **OR** (rectangle – triangle); must see use of ½ where appropriate. **OR** they may use *suvat* to find the distance covered by *P* in one or more of the sections. **N.B**. M0 for use of a single *suvat* formula for the whole motion
	A1	cao
2d	M1	Clear attempt to equate the total area under the *S* graph, with the correct structure, i.e. (triangle + rectangle) **OR** trapezium **OR** (rectangle – triangle), must see use of ½ where appropriate, to their answer for (c) to give a <u>quadratic equation in *X* only</u> **N.B.** they may use *suvat* to find the distance covered by *S* in one or more of the sections. **N.B**. M0 for use of a single *suvat* formula for the whole motion
	A1**ft**	Correct unsimplified quadratic equation in *X* only with at most one error, follow their answer for (c)
	A1**ft**	Correct unsimplified quadratic equation in *X* only, follow their answer for (c)
	A1	cao