

Question	Scheme	Marks	AOs
	<b>N.B.</b> Use the mass in the <i>ma</i> term to determine which part of the system the equation refers to.		
<b>4(a)</b>	Equation of motion:	M1	3.3
	$1740 - 400 - R = (600 + 800) \times 0.6$	A1	1.1b
	Or $\begin{cases} 1740 - T - 400 = 800 \times 0.6 \\ T - R = 600 \times 0.6 \end{cases}$ with <i>T</i> eliminated or found (860) from the first equation, and then used in the second to find <i>R</i> .		
	$R = 1740 - 840 - 400 = 500$ *	A1*	2.2a
		(3)	
<b>(b)</b>	Equation of motion for car or trailer	M1	3.4
	$1740 - T - 400 = 800 \times 0.6$ or $T - 500 = 600 \times 0.6$	A1	1.1b
	$T = 860$	A1	1.1b
		(3)	
<b>(c)</b>	Use of $500 = \pm 600a$ to obtain *	B1*	1.1b
	<b>N.B.</b> Need to see explicitly deceleration $= \frac{5}{6}$		
		(1)	
<b>(d)</b>	Complete method to find distance with $a = \pm \frac{5}{6}$	M1	3.4
	$0 = 12.5^2 - 2 \times \frac{5}{6} \times d$	A1	1.1b
	<b>OR e.g.</b> $t = \frac{12.5}{\frac{5}{6}} = 15$ then $d = \frac{1}{2} \times \frac{5}{6} \times 15^2$ or $d = \frac{1}{2} \times (0 + 12.5) \times 15$		
	or $d = 12.5 \times 15 + \frac{1}{2} \times (-\frac{5}{6}) \times 15^2$		
	93.75 oe	A1	1.1b
		(3)	
<b>(e)</b>	<b>N.B.</b> If <b>more than two</b> answers given, subtract 1 from any marks earned for each incorrect extra answer which are in group 7 below but do <b>not</b> penalise answers which are in group 8 and then, on ePEN, award as appropriate either: B1B1, B1B0 or B0B0 but NOT B0B1.	B1	3.5b
		B1	3.5b
		(2)	
(12 marks)			
<b>Notes:</b>			
<b>(a)</b>	<b>N.B.</b> Mark (a) and (b) together if no labelling.		

<b>M1</b>	Use one or two equations of motion to form an equation in $R$ only but allow a different letter, with $a = 0.6$ substituted. For each equation used, need all terms and dimensionally correct but condone sign errors.
<b>A1</b>	Correct unsimplified equation in $R$ or their $R$
<b>A1*</b>	Obtain given answer from correct working but condone missing brackets around 600+800 if they are implied by subsequent working. <b>N.B.</b> Need to see $R = 500$ <b>N.B.</b> Allow verification with $R = 500$ used to show that $a = 0.6$ , but must state that $R = 500$ at the end to earn this mark.
<b>(b)</b>	<b>N.B.</b> The working for this part may appear in (a).
<b>M1</b>	Use the equation of motion for the car or trailer to form an equation in $T$ need all terms and dimensionally correct but condone sign errors, with $a = 0.6$ substituted.
<b>A1</b>	Correct unsimplified equation in $T$ only
<b>A1</b>	Correct only
<b>(c)</b>	
<b>B1*</b>	Correct justification of given answer
<b>(d)</b>	
<b>M1</b>	Use a complete <i>suvat</i> method to find an equation in $d$ only <b>N.B.</b> Allow the use of another letter other than $d$ , e.g. $s$ , for this mark.
<b>A1</b>	Correct unsimplified equation in $d$ or $s$ <b>N.B.</b> if they use $s$ , allow $0 = 12.5^2 \pm 2 \times \frac{5}{6} \times s$
<b>A1</b>	94 or better <b>N.B.</b> if they use $s$ in their equation, they must then state $d =$ or have said that $s = d$ to earn this mark.
<b>(e)</b>	<b>N.B. On Epen, these are the only possible marks: B1B1, B1B0 or B0B0</b>
<b>B1</b> <b>B1</b>	Any two <b>different</b> appropriate reasons. Do not accept more than <b>one</b> from each of the 6 groups below. Award B1 for any <b>one</b> reason which is in any of the 6 groups.  <b>Correct answers (not verbatim but equivalent to)</b> <b>1.</b> Resistance to motion of the trailer will be different (when not in the slipstream of the car). or there will be more air or wind resistance. Resistance to motion of the trailer will not be constant/ be exactly 500 N. Wind or air resistance would not be constant. The deceleration won't be constant/ be exactly $5/6 \text{ m s}^{-2}$ .  <b>2.</b> The model takes no account of forces acting side to side. The trailer may not continue to move in a straight line.

**3.**

The trailer could be affected by any unevenness of the road e.g. potholes, bumps etc  
Does not take account of the type of ground.

**4.**

Not considered the mass of the towbar.

**5.**

Trailer emergency brake may engage.

**6.**

After the towbar breaks the trailer will tip and drag on the road.

The trailer will be unstable.

**Incorrect answers which incur a penalty (not verbatim but equivalent to).**

**7.**

Any answer which mentions the car.

The acceleration wouldn't be equal.

Not considered the length of the trailer.

Road might not be straight and/or horizontal.

Mass of the trailer.

Does not take friction (between the tyres and the ground) into account.

Does not take air resistance into account.

Does not take wind resistance into account.

**Incorrect answers which do NOT incur a penalty (not verbatim but equivalent to).**

**8.**

Obstacles in the road or cars which the trailer could hit.

Does not take account of weather conditions e.g. wind, rain, snow etc

The dimensions/shape of the trailer would slow it down.

It won't be travelling at a constant speed oe.