		mark		Sub
1(i)	$2000 = 1000a$ so $a = 2$ so 2 m s^{-2}	B1		
		M1	Use of appropriate *uvast* for t	
	$12.5 = 5 + 2t$ so $t = 3.75$ so 3.75 s	A1	cao	3
(ii)	$2000 - R = 1000 \times 1.4$	M1	N2L. Accept $F = mga$. Accept sign errors. Both forces present. Must use $a = 1.4$	
	$R = 600$ so 600 N (AG)	E1		2
(iii)	$2000 - 600 - S = 1800 \times 0.7$	M1	N2L overall or 2 paired equations. $F = ma$ and use 0.7. Mass must be correct. Allow sign errors and 600 omitted.	
		A1	All correct	
	$S = 140$ so 140 N (AG)	E1	Clearly shown	3
(iv)	$T - 140 = 800 \times 0.7$	M1	N2L on trailer (or car). $F = 800a$ (or $1000a$). Condone missing resistance otherwise all forces present. Condone sign errors.	
		B1	Use of 140 (or 2000 – 600) and 0.7	
	$T = 700$ so 700 N	A1		3
(v)	N2L in direction of motion car and trailer			
	$-600 - 140 - 610 = 1800a$	M1	Use of $F = 1800a$ to find new accn. Condone 2000 included but not T. Allow missing forces.	
		A1	All forces present; no extra ones Allow sign errors.	
	$a = -0.75$	A1	Accept $\pm$. cao.	
	For trailer			
	$T - 140 = -0.75 \times 800$	M1	N2Lwith their a ($\neq 0.7$) on trailer or car. Must have correct mass and forces. Accept sign errors	
	so $T = -460$ so 460	A1	cao. Accept ± 460	
	thrust	F1	Dep on M1. Take tension as +ve unless clear other convention	6
	total	17		

2	**(i)**		$s = ut + \frac{1}{2}at^2$ $7.2 = \frac{1}{2} \times a \times 6^2$ $a = 0.4\,\text{ms}^{-2}$	M1 A1 A1 **[3]**	Substitution required Cao
	(ii)		$F = ma$ $300\cos 30° + 175\cos 15° - R = 1000 \times 0.4$ $R = 28.8\,\text{N}$	M1 M1 A1 A1 **[4]**	Attempt at Newton's second law Attempt at resolving both *S* and *T* (Correct elements present and no extras); follow through for *a* Cao
	(iii)		The resistance perpendicular to the line of motion has been ignored.	**B1** **[1]**	Allo There is also a sideways resistance force

Question			Answer	Marks	Guidance
3	(i)		**Either** $s = \frac{1}{2}(u+v)t$ Take O as the origin.	M1	Use of one relevant equation, including substitution
			$30 = \frac{1}{2} \times (u+9) \times 10$		
			$u = -3$	A1	
			$v = u + at$	M1	Use of a second relevant equation including substitution
			$9 = -3 + 10a$		
			$a = 1.2$	A1	
			or $v = u + at \Rightarrow u + 10a = 9$	M1	Use of one relevant equation, including substitution
			$s = ut + \frac{1}{2}at^2 \Rightarrow u + 5a = 3$	M1	Use of a second relevant equation including substitution
			Solving simultaneously: $a = 1.2$	A1	
			$u = -3$	A1	
			or $s = vt - \frac{1}{2}at^2$	M1	Use of one relevant equation, including substitution
			$\Rightarrow a = 1.2$	A1	
			$v = u + at$	M1	Use of a second relevant equation including substitution
			$\Rightarrow u = -3$	A1	
				[4]	
	(ii)		**Either** $s = ut + \frac{1}{2}at^2$		
			Solving for P: $-5 = -3t + \frac{1}{2} \times 1.2t^2$	M1	Quadratic equation with $s = -5$
			$0.6t^2 - 3t + 5 = 0$		
			Discriminant $= 3^2 - 4 \times 0.6 \times 5 = -3$	M1	Considering the discriminant or equivalent
			No real roots for t ($\Rightarrow$ Particle is never at P)	E1	Cao without wrong working in the whole question.

Question	Answer	Marks	Guidance
	Or Find when $v = 0$	M1	
	$v = u + at$, $v = 0 \Rightarrow t = 2.5$		
	$s = ut + \frac{1}{2}at^2$ and $t = 2.5$	M1	Or use $v^2 = u^2 + 2as$
	$\Rightarrow s = -3.75 > -5$	E1	Cao without wrong working in the whole question. Comparison necessary
	Special cases when their $u > 0$ and their $a > 0$	SC1	"It is always going to the right"
		SC1	Demonstration that it is at –5 for two negative times.
		[3]	

		mark		Sub
4(i)	$14 = 2u + 0.5a \times 4$ $19 = u + 5a$ Solving gives u = 4 and a = 3	M1 A1 A1 M1 F1	U of appropriate *uvast* for either equn Any form y form Attempt at solution of 2 equns in 2 unknowns. At least one value found . Must have complete correct solution to **their** equns. .	5
(ii)	$19^2 = 4^2 + 2 \times 3 \times s$ or $s = 4 \times 5 + 0.5 \times 3 \times 25$ s = 57.5 so 57.5 m	M1 A1	Use of appropriate *uvast* and **their** u, a & t = 5. cao [Accept 50 if t = 7 instead of t = 5 in (i) for 2/2]	2
				7