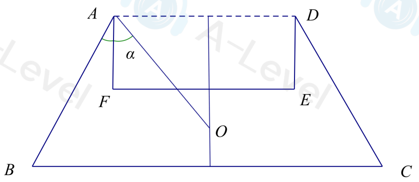
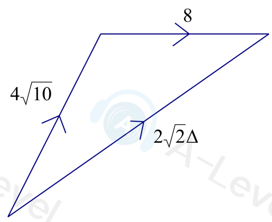
Q	Scheme	Marks	Notes
5a	<table><tr><td></td><td>Mass ratio</td><td>From BC</td></tr><tr><td>Large Δ</td><td>60 (4)</td><td>$4a$</td></tr><tr><td>Small Δ</td><td>15 (1)</td><td>$8a$</td></tr><tr><td>rectangle</td><td>15 (1)</td><td>$4.5a$</td></tr><tr><td>T</td><td>30 (2)</td><td>$\bar{y}$</td></tr></table>	B1 B1	Mass ratios correct Vertical distances correct
	Moments about BC	M1	Or a parallel axis. Signs correct for their split.
	$2\bar{y} = 16a - 8a - 4.5a = \frac{7}{2}a$	A1	Correct unsimplified equation
	$\bar{y} = \frac{7}{4}a$	A1	**Given Answer** Need to see a linear equation in $\bar{y}$
		(5)	
5b			
	$\bar{x} = 5a$ from B	B1	Or equivalent. Seen or implied Might be seen in (a) but needs to be used here.
	$\alpha = \tan^{-1}\left(\frac{\frac{5}{2}a}{6a - \bar{y}}\right)$	M1	Trig ratio of a relevant angle in a triangle involving the c of m
	$\theta = \alpha + \tan^{-1}\frac{5}{12}$	M1	Correct method to find the required angle e.g $\theta = 180° - \tan^{-1}\frac{6}{2.5} - \tan^{-1}\frac{6a - \bar{y}}{2.5a}$
	$= \tan^{-1}\frac{10}{17} + \tan^{-1}\frac{5}{12}$	A1	Correct unsimplified expression for θ seen
			$\tan^{-1}\frac{10}{17} = 30.46..., \tan^{-1}\frac{17}{10} = 59.5..,$ $\tan^{-1}\frac{5}{12} = 22.6.., \tan^{-1}\frac{12}{5} = 67.38...$
	$\theta = 53$	A1	Q asks for a whole number
		(5)	
			See over for alternatives

5balt 1	$\bar{x} = 5a$ from B	B1	Or equivalent. Seen or implied Might be seen in (a) but needs to be used here.
	Correct method to find all 3 sides of a triangle containing θ (or two sides of a right angled triangle containing θ)	M1	e.g.: $BO^2 = (5a)^2 + \left(\frac{7a}{4}\right)^2 = \frac{449}{16}a^2, AB^2 = \frac{169}{4}a^2$ $AO^2 = \left(\frac{5a}{2}\right)^2 + \left(6a - \frac{7a}{4}\right)^2 = \frac{389}{16}a^2$
	Correct method to find the required angle	M1	e.g. $\cos\theta = \frac{AB^2 + AO^2 - OB^2}{2AB.AO}$
	Correct unsimplified expression in θ	A1	$(\cos\theta = 0.60062)$
	$\theta = 53$	A1	Q asks for a whole number
		(5)	
5balt 2	$\bar{x} = 5a$ from B	B1	Or equivalent. Seen or implied Might be seen in (a) but needs to be used here.
	If O is c of m, $\overrightarrow{AB} = \begin{pmatrix} -2.5a \\ -6a \end{pmatrix}, \quad \overrightarrow{AO} = \begin{pmatrix} 2.5a \\ -4.25a \end{pmatrix}$	M1	Expressions for $\overrightarrow{AB}$ and $\overrightarrow{AO}$
	Use of scalar product to find $\cos\theta$	M1	
	$\cos\theta = \frac{\overrightarrow{AB}.\overrightarrow{AO}}{\lvert\overrightarrow{AB}\rvert.\lvert\overrightarrow{AO}\rvert} = \left(\frac{-6.25 + 25.5}{\frac{13}{2} \times \frac{\sqrt{389}}{4}}\right)$	A1	Correct unsimplified expression for $\cos\theta$
	$\theta = 53$	A1	Q asks for a whole number
		(5)	
5balt 3	$\bar{x} = 5a$ from B	B1	Or equivalent. Seen or implied Might be seen in (a) but needs to be used here.
	If O is c of m, find coordinates of point of intersection between the line AO and the perpendicular line through B	M1	Relative to B: $A(2.5a, 6a), O(5a, 1.75a)$ $\Rightarrow AO: y = -1.7x + 10.25a$ If perpendicular through B intersects AO at L, $\Rightarrow BL: y = \frac{10}{17}x \quad \Rightarrow L\left(\frac{3485}{778}, \frac{1025}{389}\right)$
	Correct method to find the required angle	M1	e.g. $\sin\theta = \frac{BL}{BA}$
	Correct unsimplified expression in θ	A1	$= \frac{\sqrt{\left(\frac{3485}{778}\right)^2 + \left(\frac{1025}{389}\right)^2}}{6.5}$
	$\theta = 53$	A1	Q asks for a whole number
		(5)	
			See over for alterrnative

5balt 4	$\overline{x} = 5a$ from B	B1	Or equivalent. Seen or implied Might be seen in (a) but needs to be used here.
	If O is c of m, find coordinates of point of intersection between the line AB and the perpendicular line through O	M1	$AB: y = \frac{12}{5}x$ If perpendicular through O intersects AB at H, $OH: y = -\frac{5}{12}x + \frac{23}{6}$, $H\left(\frac{230}{169}, \frac{552}{169}\right)$
	Correct method to find the required angle	M1	e.g. $\sin\theta = \frac{OH}{OA}$
	Correct unsimplified expression in θ	A1	$= \dfrac{\frac{205}{52}}{\sqrt{\frac{389}{16}}}$
	$\theta = 53$	A1	Q asks for a whole number
		[10]	

QUESTION NUMBER	SCHEME	MARKS
3	Accept column vectors throughout this question	
3(a)	Complete method to find greatest height (h) e.g. $0 = 14^2 + 2(-g)h$	M1
	$h = 10$	A1
		(2)
3(b)	Vertical component $v = 14 - g(2.4)$	M1
	Use Pythagoras to find Speed = $\sqrt{8^2 + (14 - 2.4g)^2}$	M1
	12.4 or 12 (ms^{-1})	A1
		(3)
3(c)	Relevant equation in t formed using vertical motion. e.g. $3 = 14t + \frac{1}{2}(-g)t^2$	M1 A1
	Use Horizontal motion to find the required distance $8t$	M1
	8x 2.6..	A1
	21 or 21.0 (m)	A1
		(5)
	ALT method forming trajectory equation	
	Relevant equation in t and y formed using vertical motion. $y = 14t - \frac{1}{2}gt^2$	M1
	Form relevant horizontal equation in x and t $x = 8t$	M1
	Eliminate t to form correct equation in x and y $y = 14 \times \frac{x}{8} - \frac{1}{2}g\left(\frac{x}{8}\right)^2$	A1
	Substitute y=3 into correct equation and solve for x	A1
	21 or 21.0 (m)	A1
		(5)
	ALT method using Energy	
	Vertically: $\frac{1}{2}(m)(14^2 - v^2) = 3(m)g$	M1
	Form vertical suvat equation in their v and t $v = 14 - gt$	M1
	$\sqrt{\frac{686}{5}} = 14 - gt$	A1

	8x2.6…	A1
	21 or 21.0 (m)	A1
		(5)
		(10)
	Notes for question	
3(a)		
M1	Complete method to find greatest height. Condone sign errors.	
A1	cao	
3(b)		
M1	Complete method to find the vertical component at t=2.4 Condone sign errors.	
M1	Use of Pythagoras with both components to find speed	
A1	Correct answer, 2/3sf	
3(c)		
M1	Relevant equation formed using vertical motion. Condone sign errors.	
A1	Correct unsimplified equation(s). (Note $t = 2.62$ (3sf) but does not need to be seen for this mark)	
M1	Use horizontal motion to find the required distance	
A1	Uses 'larger' t=2.6...to calculate distance AB	
A1	Correct answer with 2 or 3sf. Accept 21, 21.0.	
	Alt method Trajectory **Enter marks in correct M and A spaces**	
M1	Relevant equation formed in t and y using vertical motion.	
M1	Form relevant horizontal equation in x and t	
A1	Eliminate t to form correct equation in x and y	
A1	Substitute t=3 into correct equation and solve for x	
A1	Correct answer with 2 or 3sf. Accept 21, 21.0.	
	Alt method Energy	
M1	Form (vertical) energy equation,m's may have been cancelled and 8^2 may have been added to both velocity parts	
M1	Form vertical suvat equation in their v and t	
A1	Substitute correct value for v ($\sqrt{\frac{686}{5}}$=11.71..) and solve for t	
A1	Uses t=2.62...to calculate distance AB	
A1	Correct answer with 2 or 3sf. Accept 21, 21.0.	

5a	Impulse-momentum equation.	M1	Dimensionally correct. Subtraction seen or implied. Condone subtraction in wrong order.
	$(\pm\mathbf{I}=)$ $2(\lambda\mathbf{i}+\lambda\mathbf{j})-2(4\mathbf{i})\left(=(2\lambda-8)\mathbf{i}+2\lambda\mathbf{j}\right)$	A1	Or equivalent Ignore $4\sqrt{10}$ if seen here
	$\left(\lvert\mathbf{I}\rvert^2=\right)160=(2\lambda-8)^2+(2\lambda)^2$	DM1	Use of Pythagoras to obtain an equation in λ Dependent on the previous M1
	$\left(\Rightarrow 0=\lambda^2-4\lambda-12\right)$	A1	Or any correct unsimplified equation in λ
	$\Rightarrow(\lambda=)6$	A1	Correct only.
	SC Allow 5/5 in (a) if working with **-I.** They will lose marks later.		
		[5]	
5a alt	Form vector triangle for impulse or for momentum.	M1	Dimensionally correct. Must be subtracting. Condone subtraction in wrong order.
	Correct triangle	A1	e.g. 
	$160=64+8\lambda^2-32\sqrt{2}\lambda\times\frac{1}{\sqrt{2}}$	DM1	Use of Cosine Rule to obtain an equation in λ Dependent on the previous M1
	$\Rightarrow 0=8\lambda^2-32\lambda-96$	A1	Or equivalent equation in λ
	$\Rightarrow(\lambda=)6$	A1	Correct only
		[5]	
5b	$\mathbf{I}=4\mathbf{i}+12\mathbf{j}$	B1ft	Follow their λ $\left(\mathbf{I}=(2\lambda-8)\mathbf{i}+2\lambda\mathbf{j}\right)$ B0 for a column vector. B0 if still in terms of lambda. Ignore second solution for negative lambda if seen
		[1]	
5c	$\tan\theta°=\frac{12}{4}$ or $\cos\theta°=\frac{16}{4\times4\sqrt{10}}$	M1	Correct use of trig or scalar product for the required angle with *their* **I** provided both components are non-zero Do not allow for the reciprocal
	$\theta=72$	A1	72 or better (71.56505…) from correct work only Ignore second solution for negative lambda if seen
		[2]	

Question Number	Scheme	Marks
2a	Equation of motion: $F + 1000g\sin\theta + 250g\sin\theta - 300 - 100 = 1250a$	M1A2
	$F + 612.5 - 400 = 1250a = 250$	
	$F = 37.5$ (N)	M1
	Power $= Fv = 37.5 \times 25 = 940$ W to 2 s.f. (938 W)	M1A1
		(6)
2b	Motion of trailer: $T - 100 + 250g\sin\theta = 250a$	M1A2
	$T = 27.5$ (N) or 28 (N)	A1
		(4)
Alt 2b	Motion of car: $F + 1000g\sin\theta - T - 300 = 1000a$	M1A2 ft
	$T = 27.5$ (N) or 28 (N)	A1
		(4)
		[10]

Notes on Question 2

Question 2(a)

(Deduct only 1 mark in **whole question** for not giving an answer to either 2 sf or 3 sf, following use of g = 9.8, or for use of g = 9.81) **Deduct the final A mark in whichever part of the question it first occurs.**

N.B. Use the value of the mass (1250, 1000 or 250) that is used in an equation to decide which part of the system the equation is for.

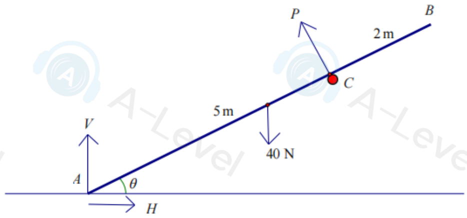
First M1 for $F = ma$ along the plane (up or down) for whole system, with usual rules ; allow even if a nor sin θ substituted, to produce an equation in F only (i.e. no T terms) **N.B.** They could use the equation(s) for the car and trailer to either find or eliminate T to produce this equation.
First A2 for the equation. (-1 each error.) Omission of g is an A error.
N.B. If they group two terms together in the whole system equation, penalise any errors for each part
e.g. + 400 for the resistance would count as 2 errors (+ 100 and +300)
or $1250\sin\theta$ for the combined weight component would count as 2 errors (g omitted twice)
Second M1(independent) for producing a value for F
Third M1 for (their F x 25)
Third A1 for 940 (w) or 938 (w) oe.

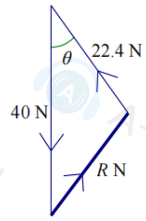
Question 2(b)

N.B. Use the value of the mass (1250, 1000 or 250) that is used in an equation to decide which part of the system the equation is for.

First M1 for $F = ma$ along the plane (up or down) for either car or trailer, with usual rules ; allow even if a nor sin θ (nor F in car equation) substituted
First A2 for the equation. (-1 each error.) (**ft** on their F)
Third A1 for 28 (N) or 27.5(N)

Question Number	Scheme	Marks	Notes
6a	Taking moments about A:	M1	Requires all terms - condone trig confusion and sign errors
	$bF = 3mga\cos\theta + mg\times 2a\cos\theta$	A2	-1 each error
	$bF = 5mga\cos\theta \qquad F = \frac{5mga}{b}\cos\theta$	A1 (4)	***Given answer***
6b	Component of **R** parallel to AB: $\left(R\cos(\phi-\theta)\right)$	M1	Requires all terms - condone trig confusion
	$= 3mg\sin\theta + mg\sin\theta = 4mg\sin\theta$	A1	Correct unsimplified
	Component of **R** perpendicular to AB:	M1	Requires all terms - condone consistent trig confusion and sign errors
	$\left(R\sin(\phi-\theta)\right) + F = 4mg\cos\theta$	A1	Correct unsimplified
	Alternatives for M1A1: $M(B)$		$2aR\sin(\phi-\theta) + 3mga\cos\theta = F(2a-b)$
	$M(C)$		$bR\sin(\phi-\theta) + (2a-b)mg\cos\theta$ $= 3mg(b-a)\cos\theta$
	$\left(R\sin(\phi-\theta)\right) = 4mg\cos\theta - \frac{5mga}{b}\cos\theta$	A1	Correct with F substituted.
	ISW for incorrect work after correct components seen	(5)	
6c	Use of $R\sin(\phi-\theta) > 0$	M1	
	Solve for b in terms of a: $4 > \frac{5a}{b}, \quad (2a \geq) b > \frac{5}{4}a$	A1	$2a$ not required CSO
		(2)	
		[11]	
SC	Misread of directions in (b)		NB This MR can score full marks
6(b)	$X = F\sin\theta = \frac{5mga}{b}\cos\theta\sin\theta$	M1	Allow with F. Requires all terms - condone trig confusion
		A1	F substituted.
	$Y = 4mg - F\cos\theta = 4mg - \frac{5mga}{b}\cos^2\theta$	M1	Allow with F. Requires all terms - condone trig confusion and sign errors.
		A1	Correct unsimplified
		A1	Correct substituted
6(c)	For $\varphi > \theta$, $\tan\phi > \tan\theta$		
	$\tan\varphi = \frac{Y}{X} = \frac{4 - \frac{5a}{b}\cos^2\theta}{\frac{5a}{b}\cos\theta\sin\theta} > \tan\theta$	M1	
	$4 - \frac{5a}{b}\cos^2\theta > \frac{5a}{b}\sin^2\theta$		
	$4 > \frac{5a}{b}\left(\cos^2\theta + \sin^2\theta\right) \quad \Rightarrow b > \frac{5}{4}a$	A1	CSO

6a			
	Moments about A:	M1	Dimensionally correct. Condone sine / cosine confusion
	$5P = 40\times\frac{7}{2}\cos\theta$	A1	Correct unsimplified equation
	$P = 22.4$ *	A1*	Obtain **given answer** from correct working. Need to see evidence of $\cos\theta = \frac{4}{5}$
		[3]	
6b	Two equations required. M1A1 for the first equation seen, M1A1 for the second equation. If more than 2 equations mark the two equations used to obtain the resultant, or the best 2 if they do not go on to find the resultant.		
	First equation	M1	e.g. Resolve horizontally Condone sine / cosine confusion
	$H = P\sin\theta\ (=13.44)$	A1	Correct unsimplified equation
	Second equation	M1	e.g. Resolve vertically Condone sine / cosine confusion
	$V + P\cos\theta = 40\ (V = 22.08)$	A1	Correct unsimplified equation
	$\|R\| = \sqrt{H^2 + V^2}$	DM1	solve for $\|R\|$ Dependent on the 2 preceding Ms
	$\|R\| = 26\ (\text{N})$	A1	Or better (25.84879…..) Accept $\frac{24\sqrt{29}}{5}$
		[6]	
	Two alternatives on following page		

6balt	First equation	M1	e.g. Resolve parallel Condone sine / cosine confusion
	$X = 40\sin\theta (= 24)$	A1	Correct unsimplified equation
	Second equation	M1	e.g. Resolve perpendicular Condone sine / cosine confusion
	$Y + P = 40\cos\theta\ (Y = 9.6)$	A1	Correct unsimplified equation
	$\lvert R\rvert = \sqrt{X^2 + Y^2}$	DM1	solve for $\lvert R\rvert$ Dependent on the 2 preceding Ms
	$\lvert R\rvert = 26\ (\text{N})$	A1	Or better (25.84879…..) Accept $\frac{24\sqrt{29}}{5}$
		[6]	
	Alternative equations: $\text{M}(C)\quad 40\times1.5\cos\theta + H\times5\sin\theta = V\times5\cos\theta$ $\text{M}(B)\quad 2P + 7\cos\theta\times V = 7\sin\theta\times H + 3.5\times40\cos\theta$ $\text{M}(G)\quad 1.5P + 3.5\sin\theta\times H = 3.5\cos\theta\times V$		
6balt		M1 A1	3 force diagram seen or implied Forces and angle in correct positions
	Use Cosine Rule	M1	Correct formula used
	$(\lvert R\rvert)^2 = 40^2 + 22.4^2 - 2\times40\times22.4\cos\theta$	A1	Correct unsimplified equation
	Substitute for trig and solve for $\lvert R\rvert$	DM1	Dependent on the 2 preceding Ms
	$\lvert R\rvert = 26\ (\text{N})$	A1	Or better (25.84879…..) Accept $\frac{24\sqrt{29}}{5}$
		[6]	
		(9)	

Question Number	Scheme	Marks	Notes
3(a)	$N = 4g\cos 40° \; (= 30.028...)$		
	$F = 0.5 \times 4g\cos 40°$	M1	Use of $F = \mu N$ where N is a resolved component of $4g$. Condone sin/cos confusion
	Work done $= 12 \times 0.5 \times 4g\cos 40°$	M1	Their $F \times 12$
	$(= 180.17...) = 180$ J	A1	Max 3 s.f.
		(3)	
(b)	Work done + Final KE = Initial KE + GPE	M1	Must be using W.E. Need all terms. Condone sign errors. Terms must be dimensionally correct. Condone sin/cos confusion
	Their WD $+ \frac{1}{2} \times 4 \times 24^2$ $= \frac{1}{2} \times 4u^2 + 4g \times 12\sin 40°$ follow their WD	A1ft	At most one error Incorrect sign(s) is one error. $(4g \times 12\sin 40 = 302.367.....)$
		A1ft	Correct unsimplified (for their WD)
	$u(= 22.691...) = 23$ or 22.7 m s^{-1}	A1	Max 3 s.f.
		(4)	
		[7]	

Question Number	Scheme	Marks
1a	$v=\int a\,\mathrm{d}t=\int 2t-3\,\mathrm{d}t=t^2-3t(+C)$	M1A1
	$t=0, v=2 \Rightarrow C=2 \quad v=t^2-3t+2$	M1A1
		(4)
1b	$v=0$	M1
	$(t-1)(t-2)=0$	M1
	$t_1=1, \quad t_2=2$	A1
		(3)
1c	$s=\int_1^2 t^2-3t+2\mathrm{d}t=\left[\frac{1}{3}t^3-\frac{3}{2}t^2+2t\right]_1^2$	M1A1
	$=\left(\frac{8}{3}-6+4\right)-\left(\frac{1}{3}-\frac{3}{2}+2\right)$ or $=\frac{1}{3}(8-1)-\frac{3}{2}(4-1)+2(2-1)$	**DM**1
	Distance $=\frac{1}{6}$, 0.17 or better (m) (must be positive)	A1
		(4)
		[11]

Notes for Question 1

Question 1(a)
First M1 for attempt to integrate (one power increasing by 1)

N.B. They may use definite integrals: $\int_2^v \mathrm{d}v=\int_0^t 2t-3\mathrm{d}t$

First A1 for a correct integral, without c
Second M1 for using t=0, v=2 to find a c value or substituting their limits
Second A1 for answer. ('$v=$' not needed)

Question 1(b)
First M1 for setting their v expression equal to zero.
Second M1 for solving for t (must be a quadratic) (This mark can be implied by two correct answers)
A1 for both answers.

Question 1(c)
First M1 for attempt to integrate their v (all powers increasing by 1)
First A1 for a correct integral (**NOT ft**), without c
Second M1, **dependent on first M1**, for substituting their t values and subtracting (either way round)
Second A1 for answer (must be positive) ; accept 0.17 or better.
N.B. If they go on and add or subtract some other distance it's M0.

Question Number	Scheme	Marks
3a	Use of $P = Fv$: $F = \frac{180}{4}$	B1
	Equation of motion: $F - R = 75 \times 0.2$	M1
	Equation in R: $\frac{180}{4} - R = 75 \times 0.2 \ (45 - R = 15)$	**DM**1
	$R = 30$	A1
		(4)
3b	Equation of motion: $D - 75g\sin\theta - R = 0$	M1
	$\frac{180}{v} - 75 \times g \times \frac{1}{21} -$ their $R = 0$	A2 **ft**
	$v = 2.77$ or 2.8	A1
		(4)
		[8]
	Notes for Qu3	
	3(a) B1 for $F = \frac{180}{4}$ seen First M1 for equation of motion with usual rules, F does not need to be substituted Second M1, dependent on first M1, for an equation in R only with usual rules A1 for $R = 30$	
	3(b) M1 for equation of motion with usual rules but none of D, $\sin\theta$ nor R need to be substituted A2 **ft** for a correct equation, in v only, ft on their R A1A0 if one error Third A1 for 2.77 or 2.8 (**Only** answers)	

Question Number	Scheme	Marks
3a	Moments about A: $W \times 2a\cos 30 = T\cos 60 \times 2.5a$	M1A1
	$T = \frac{2W\sqrt{3}/2}{2.5 \text{ x } 1/2} = \frac{4W\sqrt{3}}{5}$ **ANSWER GIVEN**	A1
		(3)
3b	Horizontally: $(H =) \pm T\cos 60$	M1A1
	Vertically: $(V =) \pm (W - T\cos 30)$	M1A1
	$\lvert R\rvert = \frac{W}{5}\sqrt{1+12} = \frac{\sqrt{13}}{5}W$ (0.72W or better)	**DM1**A1
		(6)
	OR: **Components along the rod (X) and perpendicular to the rod (Y)**	
	$\pm X = T\cos 30 - W\cos 60 \quad (=\frac{7W}{10})$	M1A1
	$\pm Y = W\cos 30 - T\cos 60 \quad (=\frac{\sqrt{3}W}{10})$	M1A1
	$\lvert R\rvert = \frac{W}{10}\sqrt{49+3} = \frac{\sqrt{13}}{5}W$ oe	**DM1**A1
		(6)
		[9]

Notes on Question 3

Question 3(a) **N.B.** Extra g's are A errors not M errors.
First M1 is for producing an equation in T and W *only*, usually by taking moments about A (condone consistent missing 'a' s).
First A1 for a correct equation; trig ratios do not need to be evaluated.

Second A1 for **the given answer correctly obtained** (trig ratios do need to be evaluated in surd form but allow cancelling of 2's)

Question 3(b)
First M1, with usual rules, for producing horizontal cpt; could be $X =$ or $R\cos\alpha =$ in terms of T and/or W only. (**N.B**. They may use 2 equations to do this)
First A1 for a correct expression (T does not need to be substituted)
Second M1, with usual rules, for producing vertical cpt; could be $Y =$ or $R\sin\alpha =$ in terms of T and/or W only (**N.B**. They may use 2 equations to do this)
Second A1 for a correct expression (T does not need to be substituted)
Third M1**, dependent on previous two M's**, for solving for R *in terms of W only ,usually squaring and ADDING and square rooting*
Third A1 for $(W\sqrt{13})/5$ or 0.72W or better

Alternative using Triangle of Forces:
First M1 for attempt at cos rule: $R^2 = W^2 + T^2 - 2TW\cos 30^o$
First A1 if correct
Second M1 for substituting for T and cos30° (either surd or decimal)
Second A1 for a correct equation
Third M1, dependent on previous two M's, for solving for R
Third A1 for $(W\sqrt{13})/5$ or 0.72W or better

Question Number	Scheme	Marks	
2(a)	Driving force $= 150 + 500g\sin\theta$	M1	Requires both terms. Condone sign and sin/cos confusion
	$= 150 + 500 \times 9.8 \times \frac{1}{20}(= 395)$ (N)	A2	-1 each error Use of 9.81 is an error
	Rate of work $= 20 \times (395)$	M1	Use of $P = Fv$
	$= 7.9$ kW	A1	or 7900 (W)
		[5]	
	If they use $\theta = 2.87$ this leads to inaccurate answers. Allow all the marks apart from the final A1 in each part, but watch out for those who tell you $\theta = 2.87$ and actually use the correct value and score full marks.		
2(b)	$150d + 500g \times \sin\theta \times d\left(=\left(\text{their } 395\right)d\right) = \frac{1}{2} \times 500 \times 20^2$	M1	**The question specifies work-energy** Energy equation. Requires all 3 terms (of correct form), with no duplication, but condone sign errors and sin/cos confusion.
	$150d + 500g \times \frac{1}{20} \times d\left(=\left(\text{their } 395\right)d\right) = \frac{1}{2} \times 500 \times 20^2$	A2	Correct unsimplified equation in d. -1 each error
			M1A2 available for correct work leading to -ve d
	$d = 250$ (m)	A1	accept 253 (answer must be +ve)
		[4]	