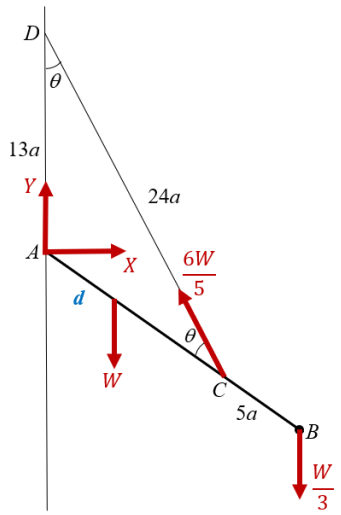
Question Number	Answer	Mark
6		
6(a)	Method to form an equation in d (and a)	M1
	E.g. M(A): $\left(W \times d \sin 2\theta\right) + \left(\frac{W}{3} \times 18a \sin 2\theta\right) = \left(\frac{6W}{5} \times 13a \sin\theta\right)$	A1 A1
	$d = \frac{49}{20}a = 2.45a$	A1
		(4)
6(b)	First relevant equation	M1
	E.g. Horiz: $\pm X = \frac{6W}{5}\sin\theta$	A1
	Second relevant equation	M1
	E.g. Vert: $\pm Y + \frac{6W}{5}\cos\theta = W + \frac{W}{3}$	A1
	Other possible equations: Parallel to the rod: $\pm P + \frac{6W}{5}\cos\theta = W\cos 2\theta + \frac{W}{3}\cos 2\theta$ Perp. to the rod: $\pm Q + \frac{6W}{5}\sin\theta = W\sin 2\theta + \frac{W}{3}\sin 2\theta$ M(B): $\left(\frac{6W}{5} \times 5a \sin\theta\right) + \left(Y \times 18a \sin 2\theta\right) + \left(X \times 18a \cos 2\theta\right) = \left(W \times \frac{311a}{20}\text{si}\right.$ M(C): $\left(\frac{W}{3} \times 5a \sin 2\theta\right) + (Y \times 13a \sin 2\theta) + (X \times 13a \cos 2\theta) = W \times \frac{211a}{20}\text{sin}$ M(D): $13aX = \left(W \times \frac{49a}{20}\sin 2\theta\right) + \left(\frac{1}{3}W \times 18a \sin 2\theta\right)$	

	Pythagoras using X and Y: $\sqrt{\left(\frac{6W\sin\theta}{5}\right)^2+\left(\frac{4W}{3}-\frac{6W\cos\theta}{5}\right)^2}$ $\left(=\sqrt{\left(\frac{6W}{13}\right)^2+\left(\frac{44W}{195}\right)^2}\right)$ Pythagoras using P and Q:	**d**M1
	$\sqrt{\left(W\cos 2\theta+\frac{W}{3}\cos 2\theta-\frac{6W}{5}\cos\theta\right)^2+\left(W\sin 2\theta+\frac{W}{3}\sin 2\theta-\frac{6W}{5}\right.}$ $\left(=\sqrt{\left(\frac{82W}{169}\right)^2+\left(\frac{428W}{2535}\right)^2}\right)$	
	$=0.51W$ or better $(0.51374\ldots)W$ or $W\sqrt{\frac{772}{2925}}$ or any equivalent surd form.	A1
		(6)
		(10)
	Notes for question	
(a)		
M1	Complete method to find an equation in d only. Correct no. of terms **with correct angle and force pairings.** Dimensionally correct. Condone sin/cos confusion. Trig does not need to be replaced here. W's may be cancelled before the equation is formed. The distance d may be a different letter or written as a multiple of a e.g. ka **N.B.** Allow M1A0A0 if they use say α for 2θ Can score max M1A1A0A0 if they have T instead of $\frac{6W}{5}$ and never replace it. Allow the $\frac{6W}{5}\times 13a\sin\theta$ term to be cancelled down immediately to either $\frac{6W}{5}\times 5a$ or $6Wa$	
A1	Unsimplified equation with at most one error. **N.B.** Count each error on each term.	
A1	Correct unsimplified equation.	
A1	Any equivalent **exact** answer.	
(b)		
M1	First relevant equation. Dimensionally correct. Condone sin/cos confusion but must be using the correct angle. **N.B.** Trig does not need to be replaced here nor $T=\frac{6W}{5}$	

A1	Correct unsimplified equation with $T = \frac{6W}{5}$.	
M1	Second relevant equation. Dimensionally correct. Condone sin/cos confusion but must be using the correct angle. **N.B.** Trig does not need to be replaced here nor $T = \frac{6W}{5}$	
A1	Correct unsimplified equation with $T = \frac{6W}{5}$.	
dM1	Solve equations to find X and Y and use Pythagoras with square root to find magnitude of the force at A in terms of W *and* θ *only*, **dependent** on both M marks.	
A1	$(0.51374\ldots)W$	