9(a)Moments about A (or any other complete method)M13 $T2a \sin \partial = Mga + 3Mgx$ A11 $T = \frac{Mg(a + 3x)}{2a \cdot \frac{3}{3}} = \frac{5Mg(3x + a)}{6a}$ GIVEN ANSWERA1*2(a)(a)(a)(b) $\frac{5Mg(3x + a)}{6a} \cos \partial = 2Mg$ OR $2Mg \cdot 2a \tan \alpha = Mga + 3Mgx$ M13(c) $\frac{5Mg(3x + a)}{6a} \cos \partial = 2Mg$ OR $2Mg \cdot 2a \tan \alpha = Mga + 3Mgx$ M13(c) $\frac{5Mg(3x + a)}{6a} \cos \partial = 2Mg$ OR $2Mg \cdot 2a \tan \alpha = Mga + 3Mgx$ M13(c) $\frac{7}{6a} \cos \partial = 2Mg$ OR $2Mg \cdot 2a \tan \alpha = Mga + 3Mgx$ M13(c) $\frac{7}{6a} \cos \partial = 2Mg$ OR $2Mg \cdot 2a \tan \alpha = Mga + 3Mg(2a - \frac{2a}{3})$ A1ft1(c) $\frac{7}{9} = 3Mg + Mg - \frac{5Mg(3 \cdot \frac{2g}{3} + a)}{6a} \sin \partial = 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ A1ft1(c) $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha$ A1ft1(c) $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha$ A1ft1(c) $Y = 3Mg + Mg - \left(\frac{2Mg}{2Mg}\right)\sin \alpha$ A11(c) $Y = \frac{5Mg}{2}$ A11(c) $x = \frac{5Mg}{2}$ A12(d) $\frac{5Mg(3x + a)}{6a} \le 5Mg$ and solve for xA12 $x \le \frac{5a}{3}$ A12	Question	Scheme	Marks	AOs
$\frac{T2a\sin\beta = Mga + 3Mgx}{T = \frac{Mg(a + 3x)}{2a \cdot \frac{3}{5}} = \frac{5Mg(3x + a)}{6a} * \text{ GIVEN ANSWER} \qquad A1 \qquad 1.$ $T = \frac{Mg(a + 3x)}{2a \cdot \frac{3}{5}} = \frac{5Mg(3x + a)}{6a} * \text{ GIVEN ANSWER} \qquad A1^* \qquad 2.$ (3) (b) $\frac{5Mg(3x + a)}{6a}\cos\beta = 2Mg \text{OR} 2Mg, 2a\tan\alpha = Mga + 3Mgx \qquad M1 \qquad 3.$ $x = \frac{2a}{3} \qquad A1 \qquad 2.$ (c) (c) $\frac{\text{Resolve vertically} \text{OR} \text{Moments about } B \qquad M1 \qquad 3.$ $Y = 3Mg + Mg - \frac{5Mg(3, \frac{2}{3} + a)}{6a}\sin\beta 2aY = Mga + 3Mg(2a - \frac{2a}{3}) \qquad A1\text{ ft} \qquad 1.$ Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos\alpha}\right)\sin\alpha \qquad A1\text{ ft} \qquad 1.$ $\frac{Y = 5Mg}{2} \qquad A1 \qquad 1.$ N.B. May use $R\sin\beta$ for Y and/or $R\cos\beta$ for X throughout $\frac{1}{\tan\beta = \frac{Y}{X}} \text{or } \frac{R\sin\beta}{R\cos\beta} = \frac{5Mg}{2Mg} \qquad A1 \qquad 2.$ (c) (d) $\frac{5Mg(3x + a)}{6a} \le 5Mg \text{ and solve for } x \qquad M1 \qquad 2.$	9(a)	Moments about A (or any other complete method)	M1	3.3
$T = \frac{Mg(a + 3x)}{2a^{2} \frac{3}{5}} = \frac{5Mg(3x + a)}{6a} * \text{ GIVEN ANSWER} \qquad A1* 2$ (3) (b) $\frac{5Mg(3x + a)}{6a} \cos \beta = 2Mg \text{OR} 2Mg.2a \tan \alpha = Mga + 3Mgx \qquad M1 3$ $x = \frac{2a}{3} \qquad A1 2$ (2) (c) Resolve vertically $\text{OR} \text{Moments about } B M1 3$ $Y = 3Mg + Mg - \frac{5Mg(3.2\frac{a}{3} + a)}{6a} \sin \beta 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ A1ft 1. Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha$ $Y = \frac{5Mg}{2} \qquad A1 1$ 1. N.B. May use $R\sin \beta$ for Y and/or $R\cos \beta$ for X throughout $\tan \beta = \frac{Y}{X} \text{or } \frac{R\sin \beta}{R\cos \beta} = \frac{5Mg}{2Mg} \qquad A1 2$ (5) (d) $\frac{5Mg(3x + a)}{6a} \leq 5Mg \text{and solve for } X \qquad M1 2$		$T2a\sin a = Mga + 3Mgx$	A1	1.1b
$(b) \qquad \frac{5Mg(3x+a)}{6a}\cos \beta = 2Mg OR 2Mg.2a\tan \alpha = Mga + 3Mgx \qquad M1 \qquad 3.$ $(c) \qquad \frac{8esolve vertically OR Moments about B \qquad M1 \qquad 3.$ $(c) \qquad \frac{8esolve vertically OR Moments about B \qquad M1 \qquad 3.}{Y = 3Mg + Mg - \frac{5Mg(3.2a+a)}{6a}\sin \beta 2aY = Mga + 3Mg(2a - \frac{2a}{3})} \qquad A1ft \qquad 1.$ $(c) \qquad \frac{8esolve vertically OR Moments about B \qquad M1 \qquad 3.}{Y = 3Mg + Mg - \frac{5Mg(3.2a+a)}{6a}\sin \beta 2aY = Mga + 3Mg(2a - \frac{2a}{3})} \qquad A1ft \qquad 1.$ $(c) \qquad \frac{Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha}{Y = \frac{5Mg}{2}} \qquad A1ft \qquad 1.$ $(c) \qquad \frac{Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha}{x Y = \frac{5Mg}{2}} \qquad A1 \qquad 1.$ $(c) \qquad \frac{1}{2} = \frac{5}{4} \qquad A1 \qquad 2.$ $(c) \qquad (c) \qquad (c) \qquad (c) \qquad A1ft \qquad A1 \qquad 2.$ $(c) \qquad (c) \qquad (c) \qquad A1ft \qquad A1 \qquad 2.$ $(c) \qquad (c) \qquad (c) \qquad (c) \qquad A1ft \qquad A1 \qquad 2.$ $(c) \qquad (c) \qquad (c) \qquad (c) \qquad A1ft \qquad A1 \qquad 2.$ $(c) \qquad (c) \qquad (c) \qquad (c) \qquad (c) \qquad A1ft \qquad A1 \qquad 2.$ $(c) \qquad (c) \qquad$		$T = \frac{Mg(a+3x)}{2a \cdot \frac{3}{5}} = \frac{5Mg(3x+a)}{6a} * $ GIVEN ANSWER	A1*	2.1
(b) $\frac{\frac{5Mg(3x+a)}{6a}\cos \beta = 2Mg OR 2Mg.2a\tan \alpha = Mga + 3Mgx}{x = \frac{2a}{3}} \qquad M1 \qquad 3.$ $x = \frac{2a}{3} \qquad A1 \qquad 2$ (c) Resolve vertically OR Moments about B M1 3. $Y = 3Mg + Mg - \frac{5Mg(3.\frac{2a}{3} + a)}{6a}\sin \beta 2aY = Mga + 3Mg(2a - \frac{2a}{3})} \qquad A1ft \qquad 1.$ Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha$ A1ft 1. $Y = \frac{5Mg}{2} \qquad A1 \qquad 1.$ N.B. May use $R\sin \beta$ for Y and/or $R\cos \beta$ for X throughout A1 1. $Ian \beta = \frac{Y}{X} or \frac{R\sin \beta}{R\cos \beta} = \frac{5Mg}{2Mg} \qquad A1 \qquad 2$ (d) $\frac{5Mg(3x+a)}{6a} \le 5Mg and solve for x} \qquad M1 \qquad 2$			(3)	
$x = \frac{2a}{3}$ A1 2 (c) $x = \frac{2a}{3}$ (c) $x = \frac{3}{3}$ (c) $x = \frac{3Mg}{3}$ (c) $x = 3Mg + Mg - \frac{5Mg(3 \cdot \frac{2a}{3} + a)}{6a} \sin \beta - 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ A1ft 1. Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right) \sin \alpha$ A1ft 1. NB. May use $R\sin \beta$ for Y and/or $R\cos \beta$ for X throughout A1 1. $x = \frac{5}{4}$ A1 1. (d) $\frac{5Mg(3x + a)}{6a} \le 5Mg$ and solve for x A1 2. $x \le \frac{5a}{3}$ A1 2.	(b)	$\frac{5Mg(3x+a)}{6a}\cos \partial = 2Mg \qquad \text{OR} \qquad 2Mg.2a\tan \alpha = Mga + 3Mgx$	M1	3.1b
(c) Resolve vertically OR Moments about B M1 3. $Y = 3Mg + Mg - \frac{5Mg(3.\frac{2g}{3} + a)}{6a} \sin \beta 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right) \sin \alpha$ Alft 1. Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right) \sin \alpha$ Alft 1. N.B. May use $R\sin \beta$ for Y and/or $R\cos \beta$ for X throughout Al 1. $Ian \beta = \frac{Y}{X} \text{ or } \frac{R\sin \beta}{R\cos \beta} = \frac{\frac{5Mg}{2}}{2Mg}$ Al 1. (d) $\frac{5Mg(3x + a)}{6a} \le 5Mg$ and solve for x $Ian \beta = \frac{5a}{3}$ Al 1. Al 2. (e) Al 2. (f) Al 2. (f) Al 2. (f) Al 2. (g) Al 2. (h) Al 2.		$x = \frac{2a}{3}$	A1	2.2a
(c) Resolve vertically OR Moments about B M1 3. $Y = 3Mg + Mg - \frac{5Mg(3.\frac{2a}{3} + a)}{6a} \sin \beta 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ A1ft 1. Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right) \sin \alpha$ $Y = \frac{5Mg}{2}$ N.B. May use $R\sin \beta$ for Y and/or $R\cos \beta$ for X throughout $Ian \beta = \frac{Y}{X} \text{ or } \frac{R\sin \beta}{R\cos \beta} = \frac{\frac{5Mg}{2}}{2Mg}$ M1 3. (d) $\frac{5Mg(3x + a)}{6a} \le 5Mg \text{ and solve for } x$ $Ian \beta = \frac{5Mg}{3}$ A1 2.			(2)	
$Y = 3Mg + Mg - \frac{5Mg(3.\frac{2a}{3} + a)}{6a} \sin a 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ A1ft $Or: Y = 3Mg + Mg - \left(\frac{2Mg}{\cos a}\right) \sin a$ $Y = \frac{5Mg}{2}$ A1 $I.$ N.B. May use $R\sin \beta$ for Y and/or $R\cos \beta$ for X throughout $Ian \beta = \frac{Y}{X} \text{ or } \frac{R\sin \beta}{R\cos \beta} = \frac{\frac{5Mg}{2}}{2Mg}$ $Ian \beta = \frac{5}{4}$ A1 $Ian \beta = \frac{5Mg}{2} + \frac{5Mg}{2Mg}$ $Ian \beta = \frac{5Mg}{4} + \frac$	(c)	Resolve vertically OR Moments about B	M1	3.1b
$Y = \frac{5Mg}{2}$ N.B. May use $R\sin\beta$ for Y and/or $R\cos\beta$ for X throughout $Ian \beta = \frac{Y}{X} \text{ or } \frac{R\sin\beta}{R\cos\beta} = \frac{\frac{5Mg}{2}}{2Mg}$ $Ian \beta = \frac{5}{4}$ $Ian \beta =$		$Y = 3Mg + Mg - \frac{5Mg(3.\frac{2a}{3} + a)}{6a}\sin \beta \qquad 2aY = Mga + 3Mg(2a - \frac{2a}{3})$ Or: $Y = 3Mg + Mg - \left(\frac{2Mg}{\cos \alpha}\right)\sin \alpha$	Alft	1.1b
$\ln \beta = \frac{Y}{X} \text{ or } \frac{R \sin \beta}{R \cos \beta} = \frac{5Mg}{2Mg}$ $= \frac{5}{4}$ $(d) \qquad \frac{5Mg(3x+a)}{6a} \le 5Mg \text{ and solve for } x$ $x \le \frac{5a}{3}$ $M1 \qquad 3$ $M1 \qquad 2$ $M1 \qquad 2$ $M1 \qquad 2$		$Y = \frac{5Mg}{2}$ N.B. May use $R\sin\beta$ for Y and/or $R\cos\beta$ for X throughout	A1	1.1b
$=\frac{5}{4}$ A1 2 (d) $\frac{5Mg(3x+a)}{6a} \le 5Mg$ and solve for x M1 2 $x \le \frac{5a}{3}$ A1 2		$\tan \beta = \frac{Y}{X}$ or $\frac{R \sin \beta}{R \cos \beta} = \frac{\frac{5Mg}{2}}{\frac{2}{2Mg}}$	M1	3.4
(d) $\frac{5Mg(3x+a)}{6a} \le 5Mg$ and solve for x(5) $x \le \frac{5a}{3}$ M12		$=\frac{5}{4}$	A1	2.2a
(d) $\frac{5Mg(3x+a)}{6a} \le 5Mg \text{ and solve for } x$ $x \le \frac{5a}{3}$ $A1$ 2			(5)	
$x \le \frac{5a}{3} \tag{A1} 2$	(d)	$\frac{5Mg(3x+a)}{6a} \le 5Mg \text{and solve for } x$	M1	2.4
		$x \le \frac{5a}{3}$	A1	2.4
For rope not to break, block can't be more than $\frac{5a}{3}$ from A oe		For rope not to break, block can't be more than $\frac{5a}{3}$ from A oe		
Or just: $x \le \frac{5a}{3}$, if no incorrect statement seen. B1 A1 2		Or just: $x \le \frac{5a}{3}$, if no incorrect statement seen.	B1 A1	2.4
N.B. If the correct inequality is not found, their comment must mention 'distance from <i>A</i> '.		N.B. If the correct inequality is not found, their comment must mention 'distance from <i>A</i> '.		
(3)			(3)	

Notes:

(a)

M1: Using M(A), with usual rules, or any other complete method to obtain an equation in a, M, x and T only.

A1: Correct equation

A1*: Correct PRINTED ANSWER, correctly obtained, need to see $\sin \alpha = \frac{3}{5}$ used.

(b)

M1: Using an appropriate strategy to find *x*. e.g. Resolve horizontally with usual rules applying OR Moments about *C*. Must use the <u>given</u> expression for *T*.

A1: Accept 0.67*a* or better

(c)

M1: Using a complete method to find $Y(\operatorname{or} R \sin \beta)$ e.g. resolve vertically or Moments about *B*, with usual rules

A1 ft: Correct equation with their x substituted in T expression or using $T = \frac{2Mg}{\cos \alpha}$

A1: $Y(\text{ or } R\sin\beta) = \frac{5Mg}{2} \text{ or } 2.5Mg \text{ or } 2.50Mg$

M1: For finding an equation in tan β only using $\tan \beta = \frac{Y}{X}$ or $\tan \beta = \frac{X}{Y}$

This is independent but must have found a Y.

A1: Accept $\frac{-5}{4}$ if it follows from their working.

M1: Allow T = 5Mg or T < 5Mg and solves for x, showing all necessary steps (M0 for T > 5Mg)

A1: Allow $x = \frac{5a}{3}$ or $x < \frac{5a}{3}$. Accept 1.7*a* or better.

B1: Treat as A1. For any appropriate equivalent fully correct comment or statement. E.g. maximum value of x is $\frac{5a}{3}$