14. Consider the ring B

Resolving vertically and horizontally

$R\sin\theta + T\cos\theta = mg$ and $T\sin\theta - R\cos\theta = m\omega^2 l\sin\theta$

eliminating R we have

$T\cos^2\theta + T\sin^2\theta = mg\cos\theta + m\omega^2 l\sin^2\theta$

i.e. $T = \frac{4}{5}mg + \frac{9}{25}ml.\frac{5g}{2a}$ since $\theta = \sin^{-1}\frac{3}{5}$ and $\omega = \sqrt{\frac{5g}{2a}}$

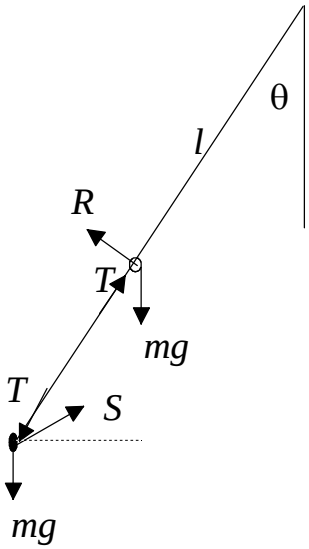
so $T = \frac{4}{5}mg + \frac{9}{10}\frac{lmg}{a}$

compression of spring is $a - (2a - l) = l - a$

so $T = \frac{kmg(l-a)}{a}$

hence, $\frac{4}{5}mg + \frac{9}{10}\frac{lmg}{a} = \frac{kmg(l-a)}{a}$

$\Rightarrow 8a + 9l = 10kl - 10ka \Rightarrow l = \frac{10ka+8a}{10k-9} = \frac{(10k+8)a}{10k-9}$ as required



Now consider the particle A and let the reaction of the rod have horizontal and vertical components R_X and R_Y

so that $13R_X = 21R_Y$

Then $R_Y - T\cos\theta = mg$ and $R_X - T\sin\theta = 2am\omega^2\sin\theta$

i.e. $\frac{13}{21}R_X - T\cos\theta = mg$ and $R_X - T\sin\theta = 5mg\sin\theta$

eliminating R_X gives $\frac{13}{21}(5mg\sin\theta + T\sin\theta) - T\cos\theta = mg \Rightarrow \frac{13}{21}\left(3mg + \frac{3}{5}T\right) - \frac{4}{5}T = mg$

$\Rightarrow 39mg - 9T = 21mg \Rightarrow T = -\frac{18mg}{9} = 2mg$ and $T = \frac{kmg\left(\frac{(10k+8)a}{10k-9} - a\right)}{a} = \frac{17kmg}{10k-9}$

hence, $20kmg - 18mg = 17kmg \Rightarrow k = \frac{18}{3} = 6$

from resolutions for B we have $\frac{3}{5}R + \frac{8}{5}mg = mg \Rightarrow R = -mg$

i.e. reaction between rosd and ring B is mg in opposite direction to that shown.
