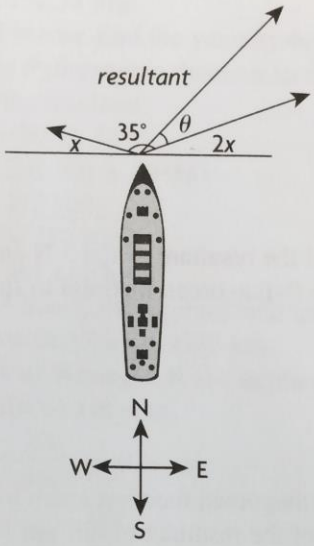
Thus the tension in the 24 cm string is 39.2 N and the tension in the 32 cm string is 29.4 N.

18.



(Port means left and starboard means right.) We are looking for the resultant of these two force vectors that are 35° apart. We don't know the exact value of the force, so we will call it x. So the small tug is pulling with a force of x and the large tug is pulling with a force of $2x$. To find the magnitude of the resultant, r, in terms of x, we use the cosine law.

$$\begin{aligned} r^2 &= x^2 + (2x)^2 - 2(x)(2x)\cos 145° \\ &= x^2 + 4x^2 - 4x^2 \cos 145° \\ &\doteq 5x^2 - 4x^2(-0.8192) \\ &\doteq 5x^2 + 3.2768x^2 \\ &\doteq 8.2768x^2 \\ r &\doteq \sqrt{8.2768x^2} \\ &\doteq 2.8769x \end{aligned}$$

Now we use the cosine law again to find the angle, θ, made by the resultant.

$$\begin{aligned} x^2 &= r^2 + (2x)^2 - 2(2.8769x)(2x)\cos\theta \\ x^2 &= 8.2768x^2 + 4x^2 - 11.5076x^2 \cos\theta \\ x^2 &= 12.2768x^2 - 11.5076x^2 \cos\theta \\ -11.2768x^2 &= -11.5076x^2 \cos\theta \\ \cos\theta &= \frac{11.2768}{11.5076} \\ \theta &= \cos^{-1}\left(\frac{11.2768}{11.5076}\right) \\ &\doteq 11.5° \end{aligned}$$

from the large tug toward the small tug, for a net of 8.5° to the starboard side.