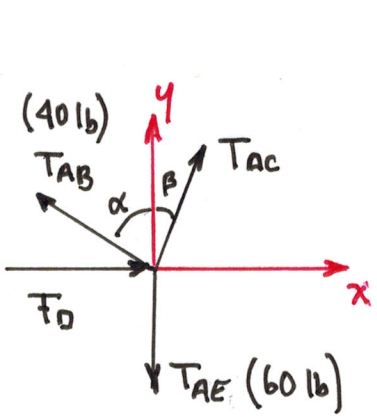
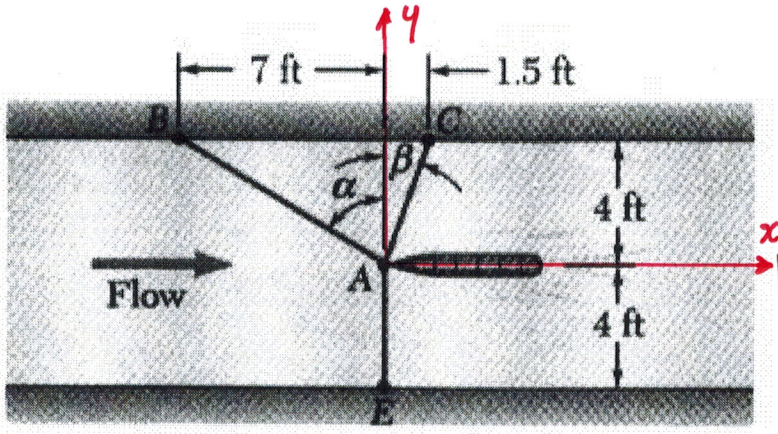
The drag of a prototype sailboat hull is being tested. Three cables are used to align its bow on the channel centerline. For a given speed, the tension in cables *AB* and *AE* are 40 lb and 60 lb, respectively.

Determine the drag force and the tension in cable *AC*





$\alpha = \tan^{-1}\left(\frac{7}{4}\right) = 60.25°$

$\beta = \tan^{-1}\left(\frac{1.5}{4}\right) = 20.56°$

- Resolve forces

$$T_{AB} = 40\{-\sin(60.25)i + \cos(60.25)j\} = \{-34.73i + 19.84j\}\,lb$$

$$T_{AC} = \|T_{AC}\|\{\sin(20.56)i + \cos(20.56)j\} = \{0.3512\|T_{AC}\|i + 0.9363\|T_{AC}\|j\}\,l$$

$$T_{AE} = -60j\ lb$$

$$F_D = \|F_D\|i$$

- Apply equations of equilibrium

$$\Sigma F = \Sigma F_x i + \Sigma F_y j = 0 \quad (-34.73 + 0.3512\|T_{AC}\| + \|F_D\|)i + (19.84 + 0.9363\|T_{AC}\| - 60)j = 0$$

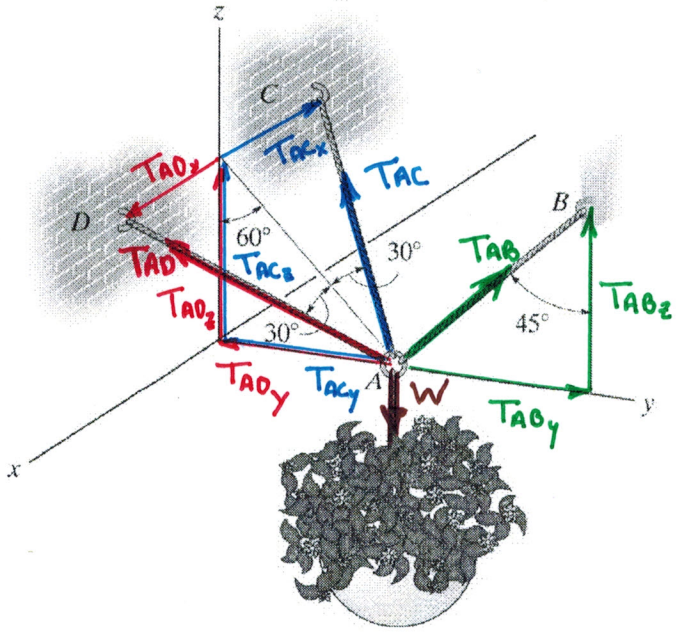
$$\Sigma F_x = 0 \qquad -34.73 + 0.3512\|T_{AC}\| + \|F_D\| = 0$$

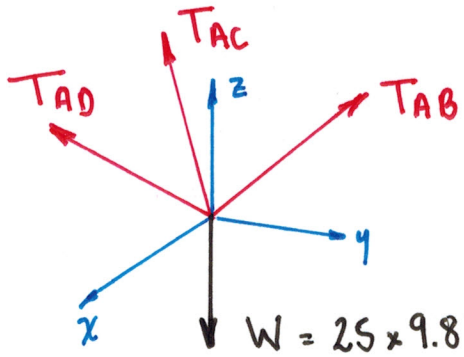
$$\Sigma F_y = 0 \qquad 19.84 + 0.9363\|T_{AC}\| - 60 = 0$$

$$\|T_{AC}\| = \frac{60 - 19.84}{0.9363} = 42.9\ lb$$

$$\|F_D\| = 34.73 - 0.3512(42.9) = 19.66\ lb$$

The 25 kg flowerpot is supported at A by three cords. Determine the tension in each of the cords for equilibrium.





- Resolve each force

$$T_{AD} = \|T_{AD}\| \{ \sin 30^\circ i - \cos 30^\circ \sin 60^\circ j + \cos 30^\circ \cos 60^\circ k \} N$$

$$T_{AC} = \|T_{AC}\| \{ -\sin 30^\circ i - \cos 30^\circ \sin 60^\circ j + \cos 30^\circ \cos 60^\circ k \} N$$

$$T_{AB} = \|T_{AB}\| \{ 0i + \sin 45^\circ j + \cos 45^\circ k \} N$$

- Apply equations of equilibrium

$$\Sigma F_x = 0 \qquad \|T_{AD}\| \sin 30 - \|T_{AC}\| \sin 30 = 0 \qquad \therefore \|T_{AD}\| = \|T_{AC}\| \quad (1)$$

$$\Sigma F_y = 0 \qquad -\|T_{AD}\| \cos 30 \sin 60 - \|T_{AC}\| \cos 30 \sin 60 + \|T_{AB}\| \sin 45^\circ = 0$$

sub eq. (1)

$$-1.5\|T_{AD}\| + \|T_{AB}\| \sin 45^\circ = 0$$

$$\|T_{AD}\| = \frac{\|T_{AB}\|}{1.5} \sin 45^\circ \quad (2)$$

$$\sum F_z = 0 \qquad \|T_{AD}\| \cos 30 \cos 60 + \|T_{AC}\| \cos 30 \cos 60 + \|T_{AB}\| \cos 45 - 245.25 = 0$$

sub eqs. (1) and (2)

$\cos 30 \cos 60 + \cos 30 \cos 60$

$$\|T_{AB}\| \left(\frac{\sin 45\,(0.866)}{1.5} + \cos 45 \right) - 245.25 = 0$$

$$\|T_{AB}\| = \frac{245.25}{1.115} = \underline{220\ N}$$

Back substitute in eqs (1) and (2)

$$\|T_{AD}\| = \frac{220}{1.5} \sin 45 = \underline{104\ N} \qquad \underline{\|T_{AC}\| = 104\ N}$$