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The Vancouver aquarium wants to create a new exhibit and hires you as the presiding engineer. They want to hang a giant octagonal tank from the ceiling. Assuming that the ceiling is strong enough to hold the tank up by one hook, and that there are chains attaching the tank to the hook at each corner of the W kg fish tank, what is the force in each chain? If the tank is X meters from one side to the opposite side and hanging Y meters below the hook, what are the Cartesian vector forms of the force in each chain? All sides of the octagon are the same length.

ANSWER:

We can find the force in each chain by,

$$8F_y = W \cdot 9.81\frac{m}{s^2} \rightarrow F_y = \frac{W \cdot 9.81\frac{m}{s^2}}{8}$$

$$F = F_y \cdot \frac{\sqrt{\left(\frac{X}{2}\right)^2 + Y^2}}{Y}$$

To determine the Cartesian vectors, we start by finding the length of one side of the octagon.

$$X = l + 2 \cdot l\sin(45°) \rightarrow l = \frac{X}{1 + 2\sin(45°)}$$

One of the points is located at $\boldsymbol{P_1} = \frac{X}{2}\hat{\boldsymbol{\imath}} + \frac{l}{2}\hat{\boldsymbol{\jmath}} - Y\hat{\boldsymbol{k}}$ from the hook. The length of this vector is,

$$P = \sqrt{\left(\frac{X}{2}\right)^2 + \left(\frac{l}{2}\right)^2 + Y^2}$$

Now, we find the force components.

$$P_{1,x} = \frac{X}{2} \cdot \frac{F}{P}$$

$$P_{1,y} = \frac{l}{2} \cdot \frac{F}{P}$$

$$P_{1,z} = -Y \cdot \frac{F}{P}$$

Clockwise from this point, the force components are,

n=	**2**	**3**	**4**	**5**	**6**	**7**	**8**
$\mathbf{P_{n,x}}$	$=P_{1,y}$	$=-P_{1,y}$	$=-P_{1,x}$	$=-P_{1,x}$	$=-P_{1,y}$	$=P_{1,y}$	$=P_{1,x}$
$\mathbf{P_{n,y}}$	$=P_{1,x}$	$=P_{1,x}$	$=P_{1,y}$	$=-P_{1,y}$	$=-P_{1,x}$	$=-P_{1,x}$	$=-P_{1,y}$
$\mathbf{P_{n,z}}$	$=P_{1,z}$	$=P_{1,z}$	$=P_{1,z}$	$=P_{1,z}$	$=P_{1,z}$	$=P_{1,z}$	$=P_{1,z}$