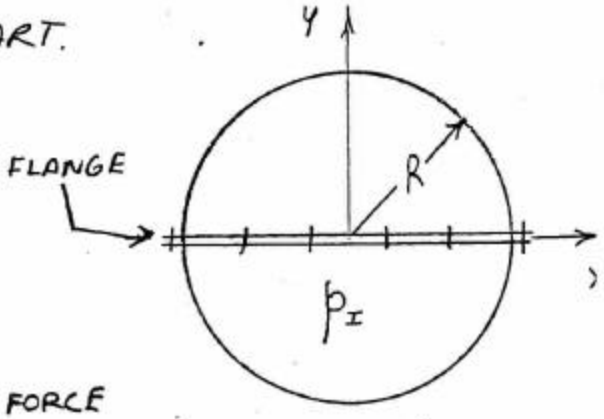
"HARD WAY"

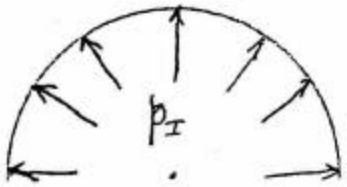
GIVEN: SPHERICAL TANK AS SHOWN BELOW.

FIND: NET FORCE IN Y-DIRECTION TENDING TO PULL TANK APART AT FLANGE.



SOLUTION:

F.B.D.



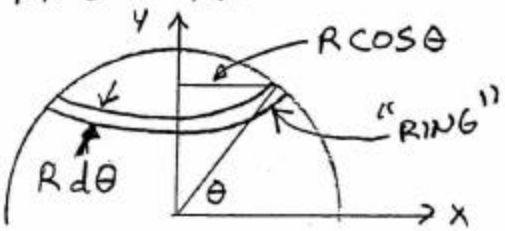
R_y ← REACTION FORCE

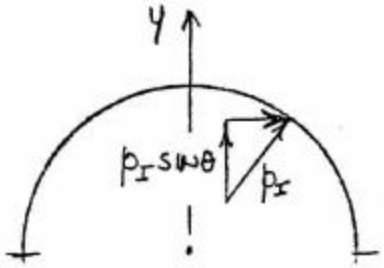
$p_o = 0$

$\Sigma F_y = 0$ $\quad \left(\begin{matrix}\text{PRESSURE}\\ \text{FORCE}\end{matrix}\right)_y - R_y = 0$ ← Y-COMPONENT

$R_y = (\text{PRESSURE FORCE})_y$

INTEGRATE Y-COMPONENT OF p_I OVER HEMISPHERE TO FIND PRESSURE FORCE.





PRESSURE COMPONENT IN Y-DIRECTION — CIRCUMFERENCE OF "RING" — WIDTH OF "RING"

$$R_y = \int_0^{\frac{\pi}{2}} (p_I \sin\theta)\,\underbrace{(2\pi R\cos\theta)}\,(R\,d\theta)$$

$$R_y = 2\pi R^2 p_I \int_0^{\frac{\pi}{2}} \sin\theta\cos\theta\,d\theta$$

TRIG. IDENTITY $\quad \sin\theta\cos\theta = \frac{1}{2}\sin 2\theta$

$$R_y = \pi R^2 p_I \int_0^{\frac{\pi}{2}} \sin 2\theta\,d\theta = \pi R^2 p_I \left[-\tfrac{1}{2}\cos 2\theta\right]_0^{\frac{\pi}{2}}$$

$$R_y = -\frac{\pi R^2 p_I}{2}\left[-1 - 1\right] = \pi R^2 p_I$$

$$\boxed{R_y = \pi R^2 p_I}$$