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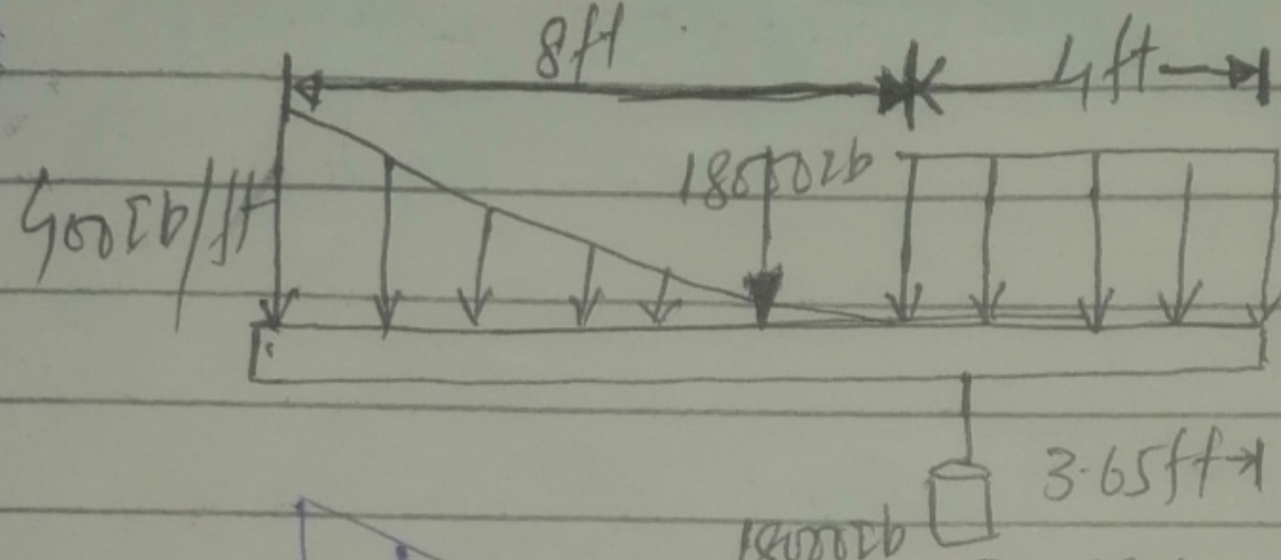
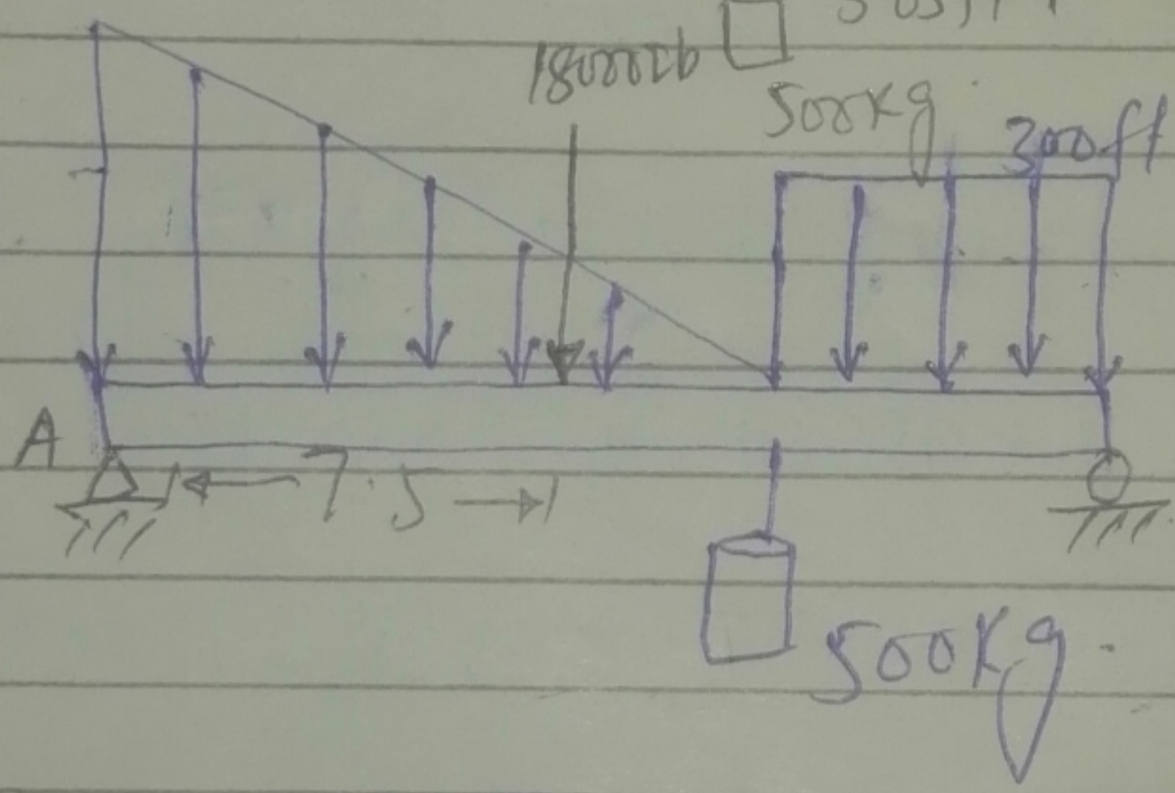
Section: B paper: engineering mechanics

Dept: Civil Engineering.

Q3 Calculate the Reaction Supports.



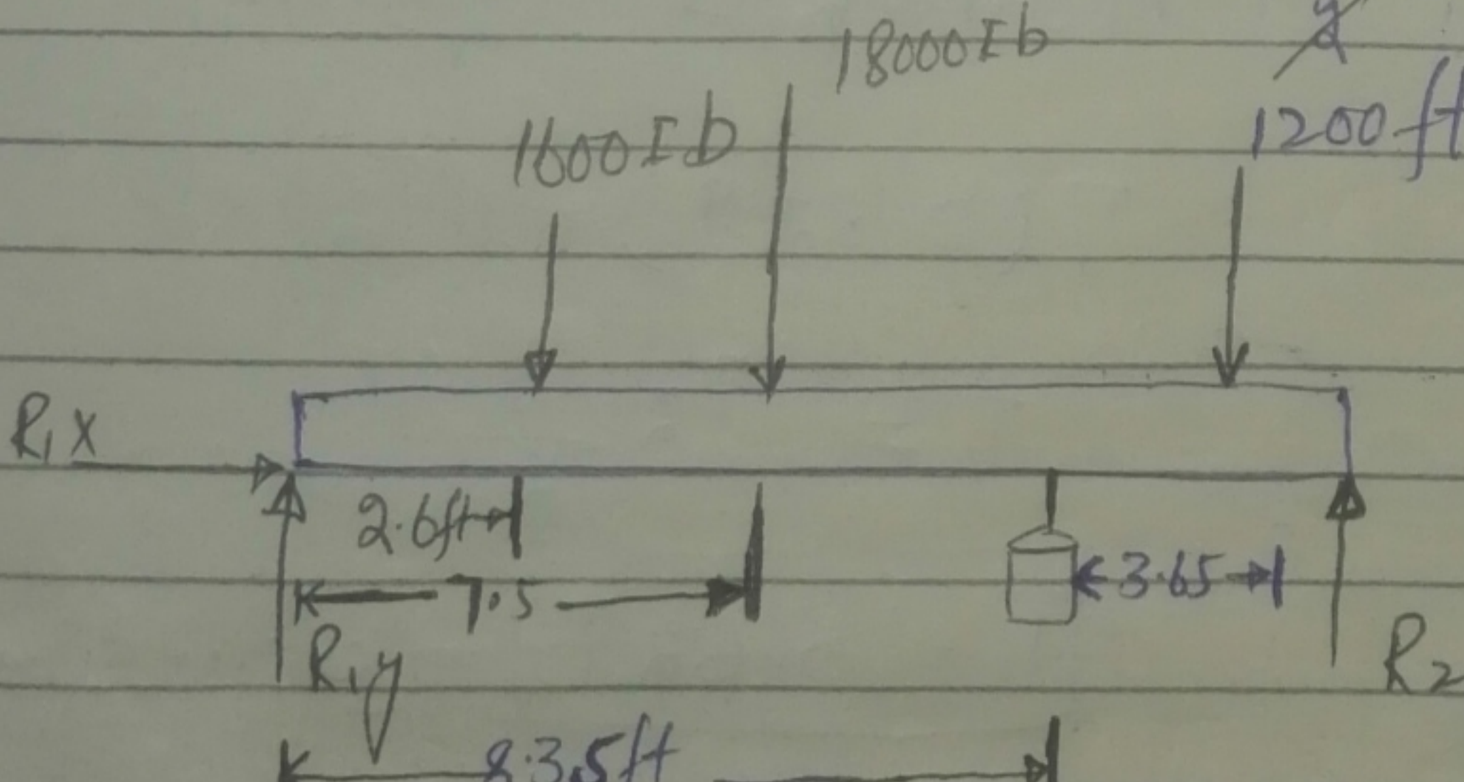
Sol



Resultant of UDL = 300Ib/ft x 4ft = 1200Ib

Resultant of UVL = 400Ib/ft x 8ft = 1600Ib

2



$\sum F_x = 0$ —(i)

P.t.O

$\Sigma Fy = 0$

$$R_1y + R_2y - 1600 - 18000 - 500 - 1200 = 0 \quad \text{— (ii)}$$

$\Sigma M = 0$

$$(R_2y \times 12ft) - (1600 \times 2.6) - (1800 \times 7.5) - (500 \times 8.3) - (1200 \times 10) = 0$$

$$12\,R_2y - 4160 - 135000 - 4150 - 12000 = 0$$

$$12\,R_2y - 155310 = 0$$

$$12\,R_2y = 155310$$

$$R_2y = \frac{155310}{12}$$

$$\boxed{R_2y = 12942.5\ Ib}$$

put the value of R_2y in eq (ii) we get

$$R_1y + (12942.5) - 1600 - 18000 - 500 - 1200 = 0$$

$$R_1y + 12942.5 - 21300 = 0$$

$$R_1y - 8357.5 = 0$$

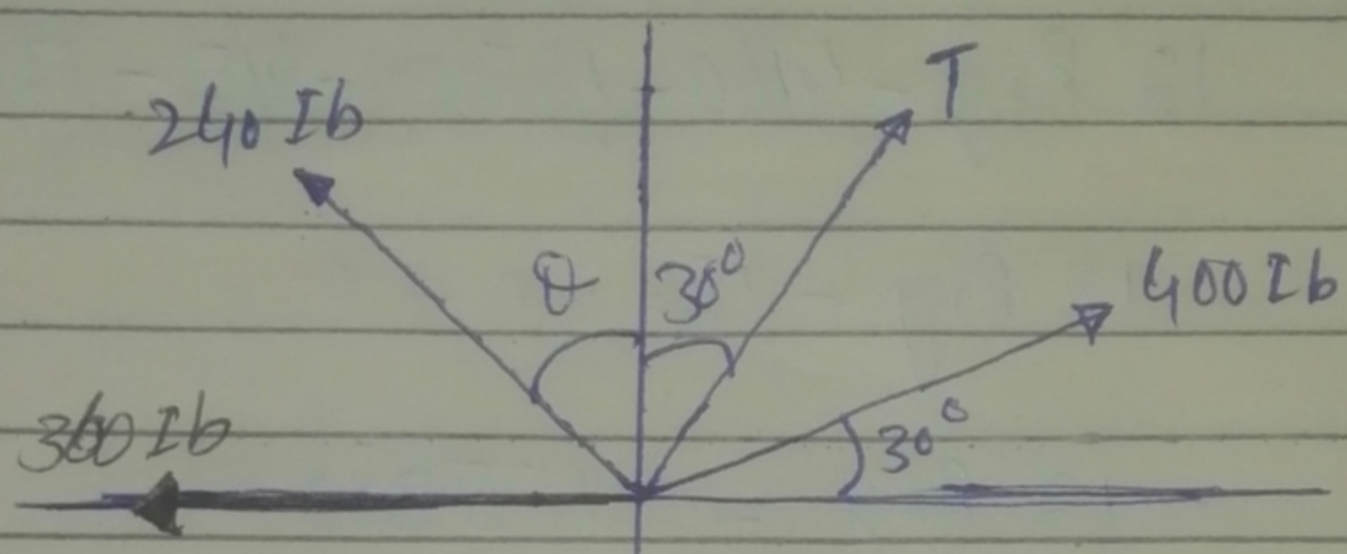
$$\boxed{R_1y = 8357.5\ Ib}$$

$\boxed{R_1x = 0}$ $\boxed{R_1y = 8357.5\ Ib}$ $\boxed{R_2y = 12942.5\ Ib}$

Ans

QNo2

Four forces are exerted on the eyebolt as show below. If the net effect on the bolt is directed pull of 600 pounds in the y- direction, determine the value of



Sol

$$\sum F_x = 0$$

$$-360 - 240\sin\theta + T\sin 30^\circ + 400\cos 30^\circ = 0$$

$$-240\sin\theta + (0.5)T + 346.4 = 360$$

$$-240\sin\theta + 0.5T = 360 - 346.4$$

$$-240\sin\theta + 0.5T = 13.6 \quad \text{— (i)}$$

$$\sum F_y = 600$$

$$240\cos\theta + T\cos 30^\circ + 400\sin 30^\circ = 600$$

$$240\cos\theta + (0.866)T + 400(0.5) = 600$$

$$240\cos\theta + 0.86T + 200 = 600$$

$$240\cos\theta + 0.86T = 600 - 200$$

$$240\cos\theta + 0.86T = 400 \quad \text{— (ii)}$$

$$-240\sin\theta + 0.5T = 13.6 \quad \text{— (i)}$$

$$240\cos\theta + 0.866T = 460 \quad \text{— (ii)}$$

from the solution of eq (i) & eq (ii) we get

$$\boxed{\theta = 21.7^\circ}$$

put $\theta = 21.7^\circ$ in eq (i) we get.

$$-240\sin(21.7)^\circ + 0.5T = 13.6$$

$$-88.7 + 0.5T = 13.6$$

$$0.5T = 13.6 + 88.7$$

$$0.5T = 102.3$$

$$T = \frac{102.3}{0.5}$$

$$\boxed{T = 204.6 \text{ lb}}$$

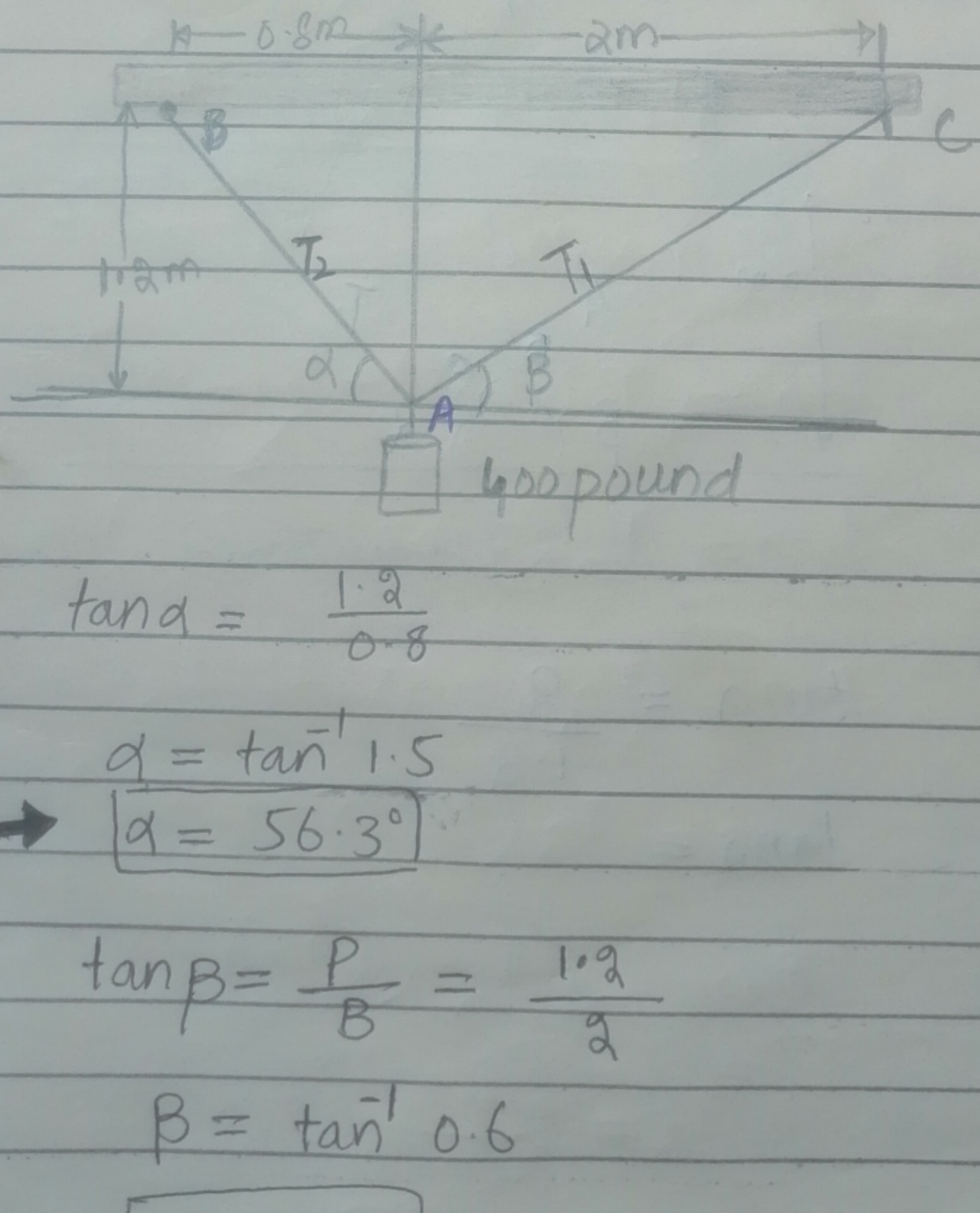
So

$$\boxed{\theta = 21.7^\circ} \qquad \boxed{T = 204.6 \text{ lb}}$$

Ans.

Q.No 1 part-(a)

two high strength flexible steel Cables AB & AC are fastened to the Ceiling of a building through high Carbon steel hooks at point B & C. These Cables are Knotted togather to a 3rd Cables at point A which is holding a thick wall water tank weighting 400 pounds and is full of 3000 liters of water volume. What percentage of the whole weight is being held by Alone?. what amount of tension must be there in both the Cables to maintain the static equilibrium of the system?



Sol

$$\tan\alpha = \frac{1.2}{0.8}$$

$$\alpha = \tan^{-1} 1.5$$

$$\rightarrow \boxed{\alpha = 56.3^\circ}$$

$$\tan\beta = \frac{P}{B} = \frac{1.2}{2}$$

$$\beta = \tan^{-1} 0.6$$

$$\rightarrow \boxed{\beta = 31^\circ}$$

P.t.o

$W = 0i - 400j$

$T_2 = -T_2 \sin 31^\circ i + T_2 \cos 31^\circ j$

$T_1 = T_1 \sin 56^\circ i + T_2 \cos 56 j$

$400 = T_2 \cos 31^\circ + T_1 \cos 56^\circ$ — (★)

$0 = -T_2 \sin 31^\circ + T_1 \sin 56^\circ$

$T_2 \sin 31^\circ = T_1 \sin 56^\circ$

$T_2(0.51) = T_1(0.829)$

$T_1 = T_2 \left(\frac{0.51}{0.829}\right)$

$\boxed{T_1 = 0.62 T_2}$ — (★★)

the value of T_1 put in eq (★) we get

$400 = T_2(0.85) + T_1(0.55)$

$400 = T_2(0.85) + (0.62 T_2)(0.55)$

$400 = T_2(0.85) + T_2(0.341)$

$400 = T_2(0.85 + 0.341)$

$400 = T_2(1.19)$

$T_2 = \frac{400}{1.19}$

$\boxed{T_2 = 336 \text{ N}}$

p.t.o

$\boxed{T_2 = 336\ lb}$

like value of T_2 put in eq (**) we get

$T_1 = (0.62)\, T_2$

$T_1 = (0.62)(336)$

$\boxed{T_1 = 208.3\ lb}$

$\%_{AB} = ?$

$$\% AB = \frac{\text{Tension in AB}}{\text{total weight}} \times 100$$

$$= \frac{336}{400} \times 100$$

$$= 0.84 \times 100$$

$\boxed{T_{AB} = 84\ \%}$

Q NO 2 part "b"

Sol

$W_t = W_{tank} + W_{water}$

$= 400 + \frac{mg}{V}$

$= 400 + 8g$.

p.t.o

fixed weight of water

$$m_w = \delta_w V_w$$

$$m_w = 1000 \times 3$$

$$= 3000 \text{ Kg}$$

$$\text{weight}_w = m_w g \qquad g = 32.2$$

$$= 3000 \times 32.2$$

$$W_w = 96600 \text{ lb}$$

$$W_{total} = 400 + 96600$$

$$\boxed{= 97000 \text{ lb}}$$

$$W_{tank} = 1.15 \times 400$$

$$\boxed{W_{tank} = 460 \text{ lb}}$$

$$W_{water} = 1.35 \times 96600$$

$$\boxed{= 130410 \text{ lb}}$$