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Section: A

Paper: Engineering Mechanics.

Dept: Civil Engineering.

Q1 Question 1

Answer Part A

Given DATA

$$m = 400 \text{ lbs}$$

increase of volume $\Rightarrow \Delta AB = 15\%$
 increase of volume $\Rightarrow \Delta AC = 35\%$

Required

$$AB = ?$$

$$BC = ?$$

Solution

$$\theta = \tan^{-1} \left(\frac{1.2}{0.8} \right)$$

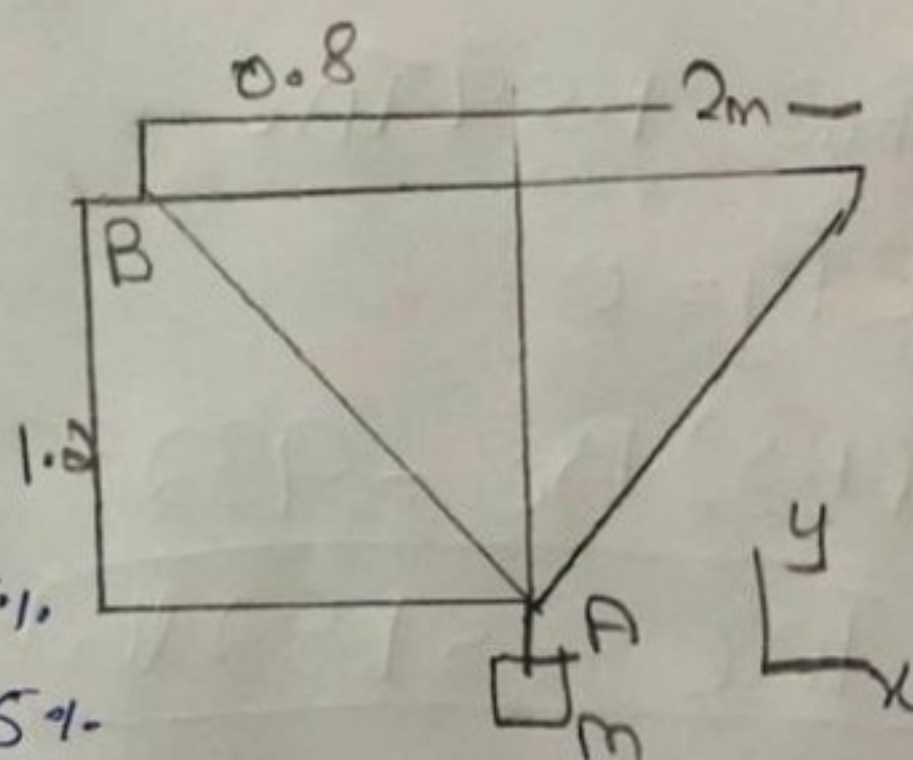
$$\theta = 56.3$$

$$\beta = \tan^{-1} \left(\frac{1.2}{2} \right)$$

$$\beta = 31.6$$

we know that

$$m = 400 \text{ lbs} \Rightarrow 400/2.204 = 181.48 \text{ kg}$$



$$\begin{aligned} \overline{T}_{AB} \Delta_{AB} &= 0.15 \times (181.48) (9.81) \left[-\left(\frac{6356-31+30n}{563i} \right) \right] \\ &= 267.047 \left\{ -0.55i + 0.83j \right\} \\ \overline{T}_{AB} &= -146.87i + 221j \text{ (N)} \end{aligned}$$

Part B If the water tank total will be

$$W = \left(400 + 400 \times \frac{15}{100} \right) + 6569 + 6569 \times \frac{35}{100}$$

$$\begin{aligned} &= 400 + 60 + 65 + 2299 \\ &= 9328.15 \text{ lb.} \end{aligned}$$

$$\sum F_x = 0$$

$$\overline{T}_{AB} = 1.54 \overline{T}_{AC}$$

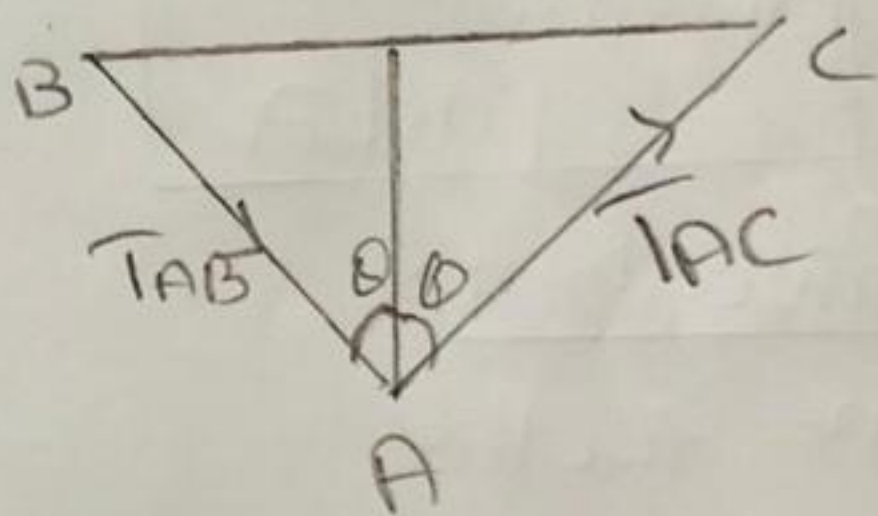
$$\sum F_y = 0$$

$$(1.8) \overline{T}_{AC} = 9328$$

$$\boxed{\overline{T}_{AC} = 5182 \text{ lb}}$$

$$\overline{T}_{AB} = 1.54 \times 5182$$

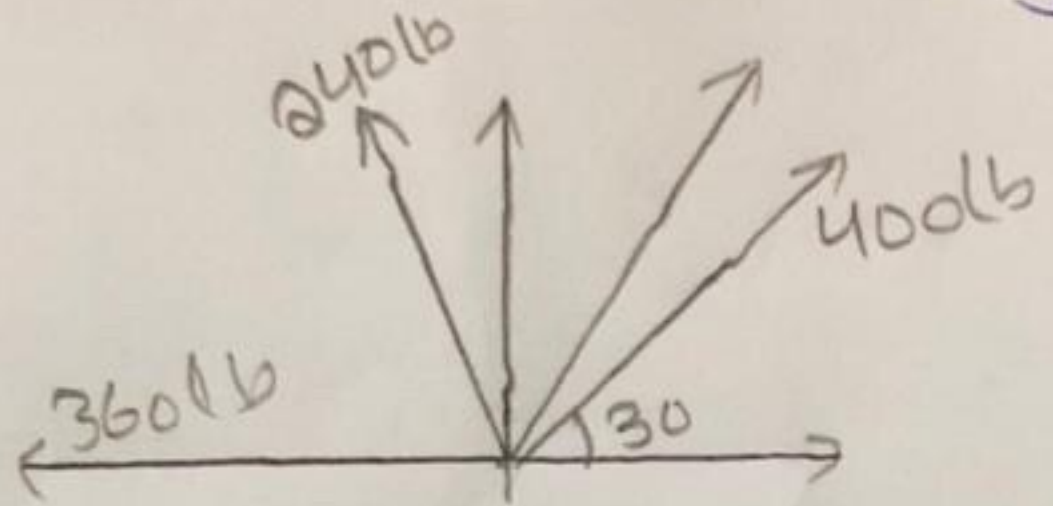
$$\boxed{\overline{T}_{AB} = 7980.6 \text{ lb}}$$



Question 2

Given DATA

Spec of bolt = 600 lb

Required

$T = ?$

$\theta = ?$

Sol:-

$$\sum F_x = 0 = -360 - 240 \sin \theta + T \sin 30 + 400 \cos 30 = 0$$

$$\sum F_y = 0 = 240 \cos \theta + T \cos 30 + 400 \sin 30 = 600$$

Numerical solution of equation (1) and (2)

$$\boxed{\theta = 21.7^\circ \quad T = 204 \text{ lb}}$$

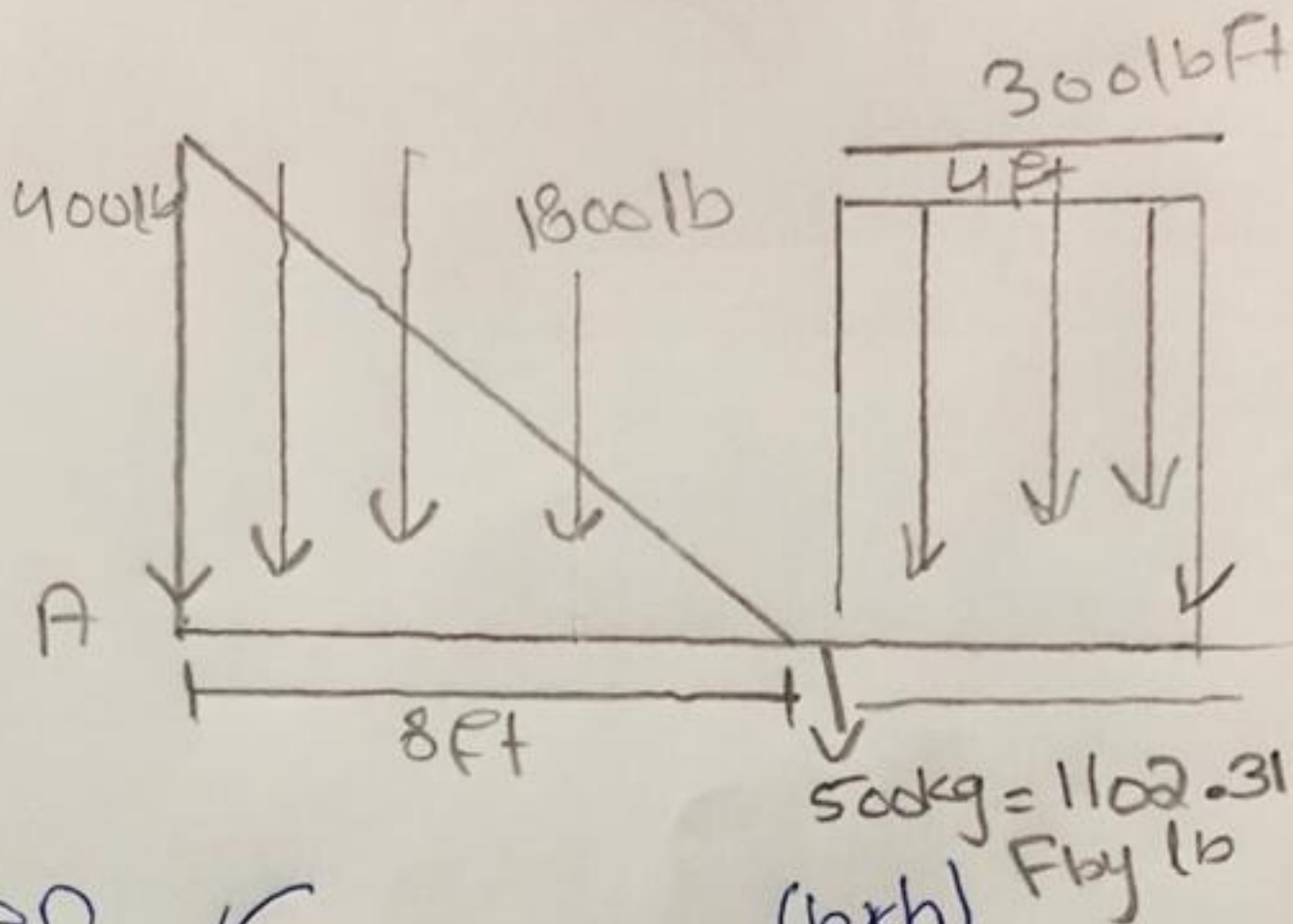
Ans

Note:

we could eliminate T between Equation 1 & 2 the resulting equation Transcendental.

$1 \text{ kg} = 2.204 \text{ lb}$

Question 3



Q3

Solution

Finding reaction

$\uparrow + \downarrow -$

$\sum F_y = 0$

$F_{Ay} - \left\{ \frac{1}{2} (400 \times 8) \right\} - 1800 - (4 \times 300) - 1102.31 + F_{By} = 0$

$F_{Ay} = 18000 + 1102.31 + 1200 + 1600 - F_{By}$

$F_{Ay} = 21902.31 - F_{By}$

$\sum M_A = 0 \quad \curvearrowright + \curvearrowleft$

$\left\{ \frac{1}{2} (400)(8) \right\} \times \left\{ \left(\frac{1}{3} \right) (8) \right\} + \left\{ (18000)(7.5) \right\} + (1102.31)(8) - (300 \times 4)(10) - (F_{By})(12) = 0$

$(8.35) + (300 \times 4)(10) - (F_{By} \times 12) = 0$



$12 F_{By} = 4266.7 + 135000 + 9204.205 + 12000$

$F_{By} = \frac{160470.9}{12} \Rightarrow F_{By} = 13375.6 \text{ lb}$

Put in Eq 1
 $F_{Ay} = 21902.31 - 13375.6$

$F_{Ay} = 8526.71 \text{ lb}$