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 Section : A  
 Paper : Engineering mechanics  
 Dept : civil engineering

Question#1

Answer

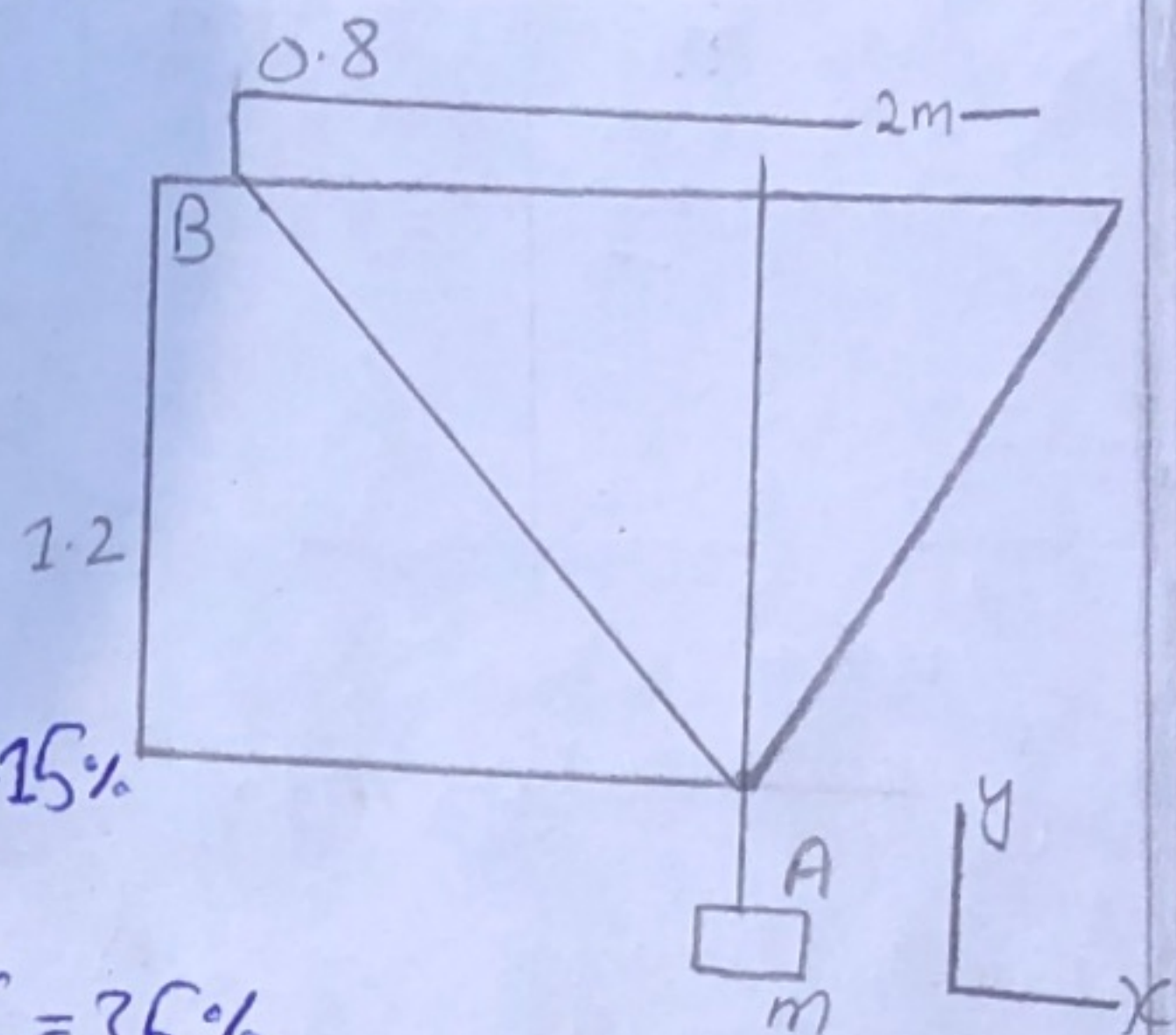
Part A

Given Data

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

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

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



Required

$$AB = ?$$

$$BC = ?$$

Solution

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

$$b = 56.3$$

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

$$B = 31.6$$

As we know that

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



$$T_{AB} \Delta_{AB} = 0.15 \times (181.48)(9.81) [-0.356 - 3i + \sin 563i]$$

$$= 267.417 \{0.55i + 0.83i\}$$

$$T_{AB} = -146.87i + 22i \text{ N}$$

Part B

of the water Tank .....

Total will be

$$w = (400 + 400 \times \frac{15}{100}) + 6569 + 6569 \times \frac{35}{100}$$

$$= 400 + 60 + 65 + 2299$$

$$= 9328.15 \text{ lb}$$

$$\sum F_x = 0$$

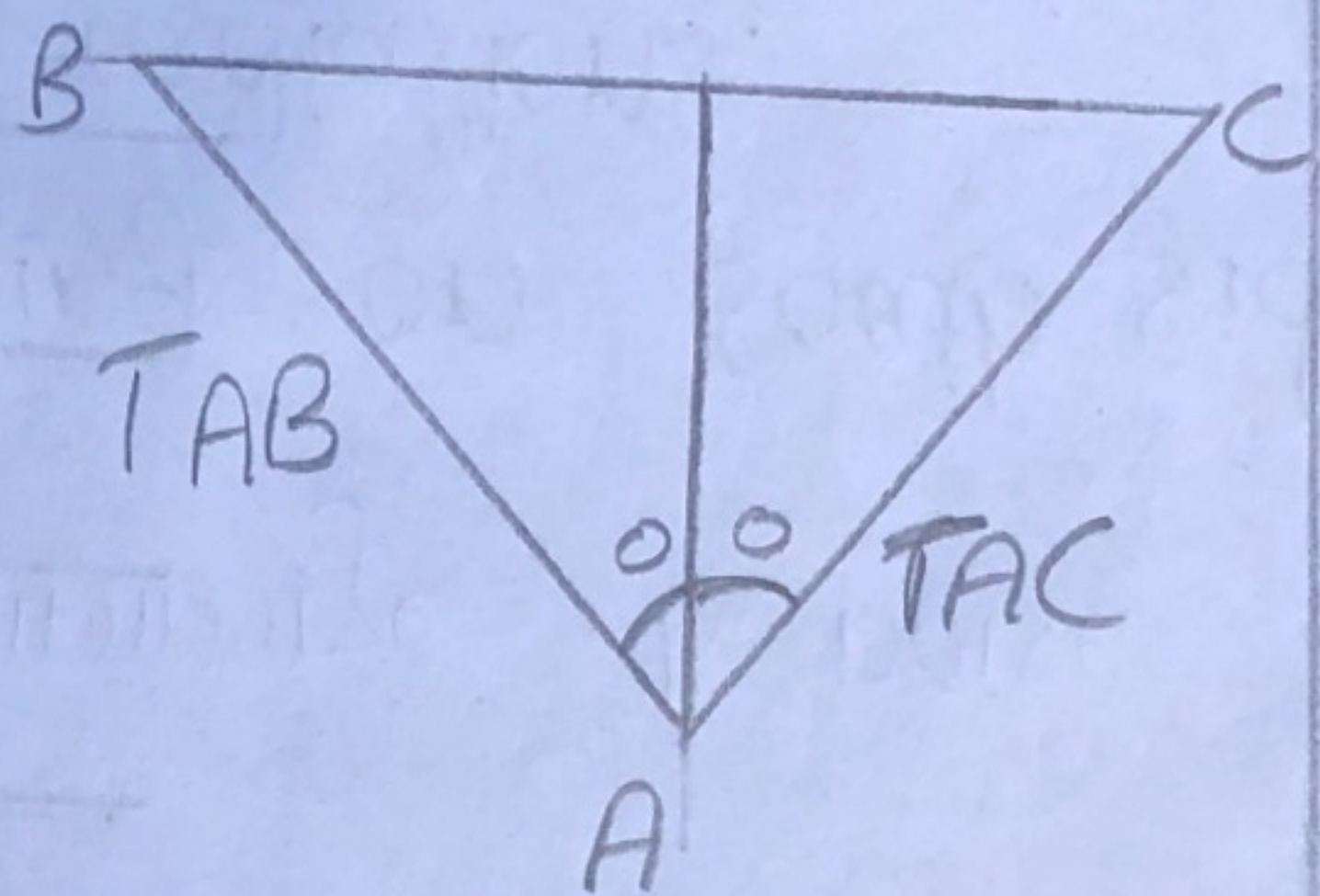
$$T_{AB} = 1.54 T_{AC}$$

$$\sum F_y = 0$$

$$(1.8) T_{AC} = 9328$$

$$T_{AB} = 1.54 \times 5182$$

$$T_{AB} = 7980.6 \text{ lb}$$





Question #2

Given Data

Effect  $B_{old} = 600$

Required

$T = ?$

$Q = ?$

Solution

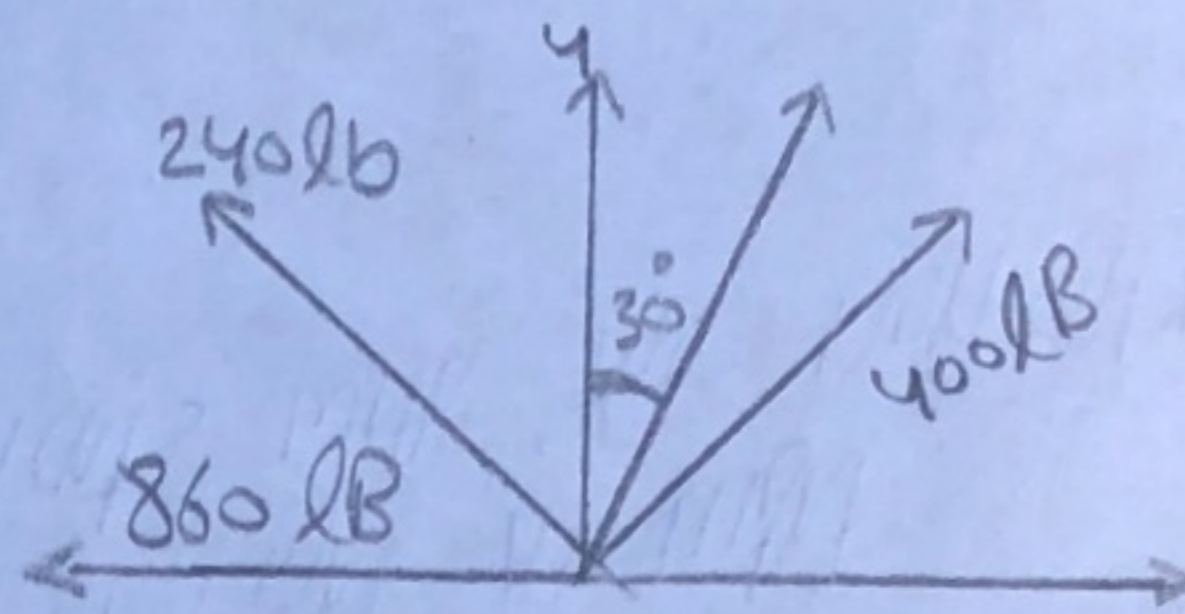
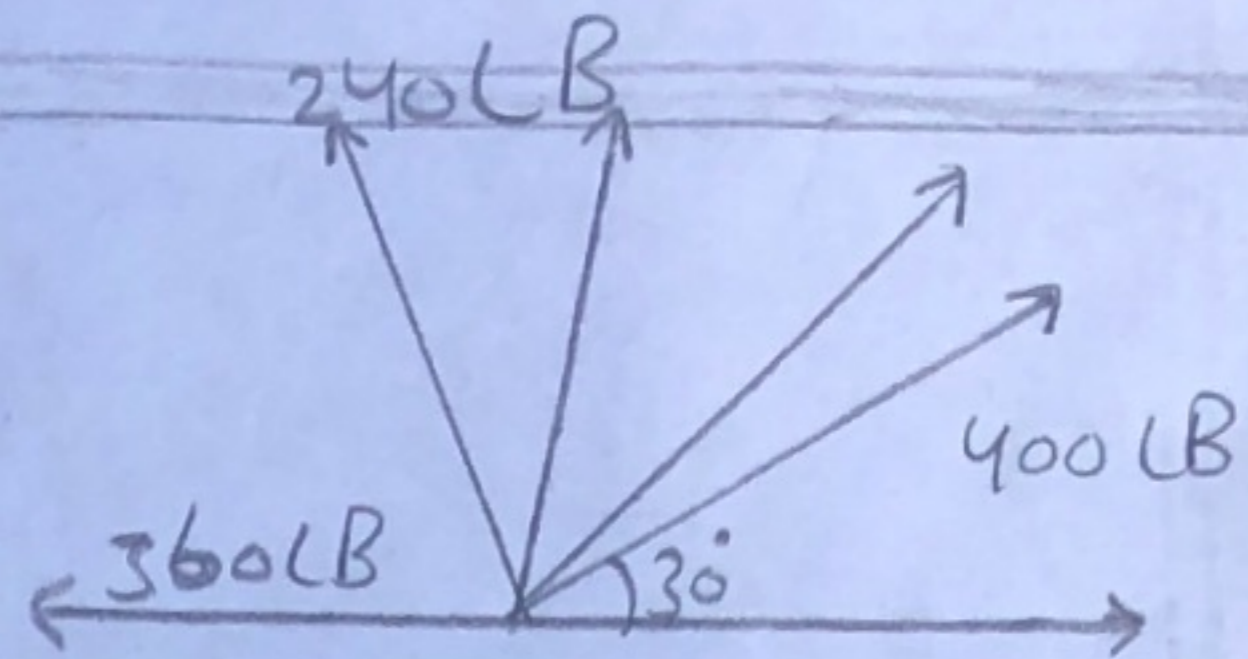
$$\{f_x = 0 = -360 - 240 \sin Q + T \sin Q \cos 30 + 400 \cos 30 = 0$$

$$\{f_y = 0 = 240 \cos Q + T \cos 30 + 400 \sin 30 = 600$$

Numerical solution of equation (1) in (2)

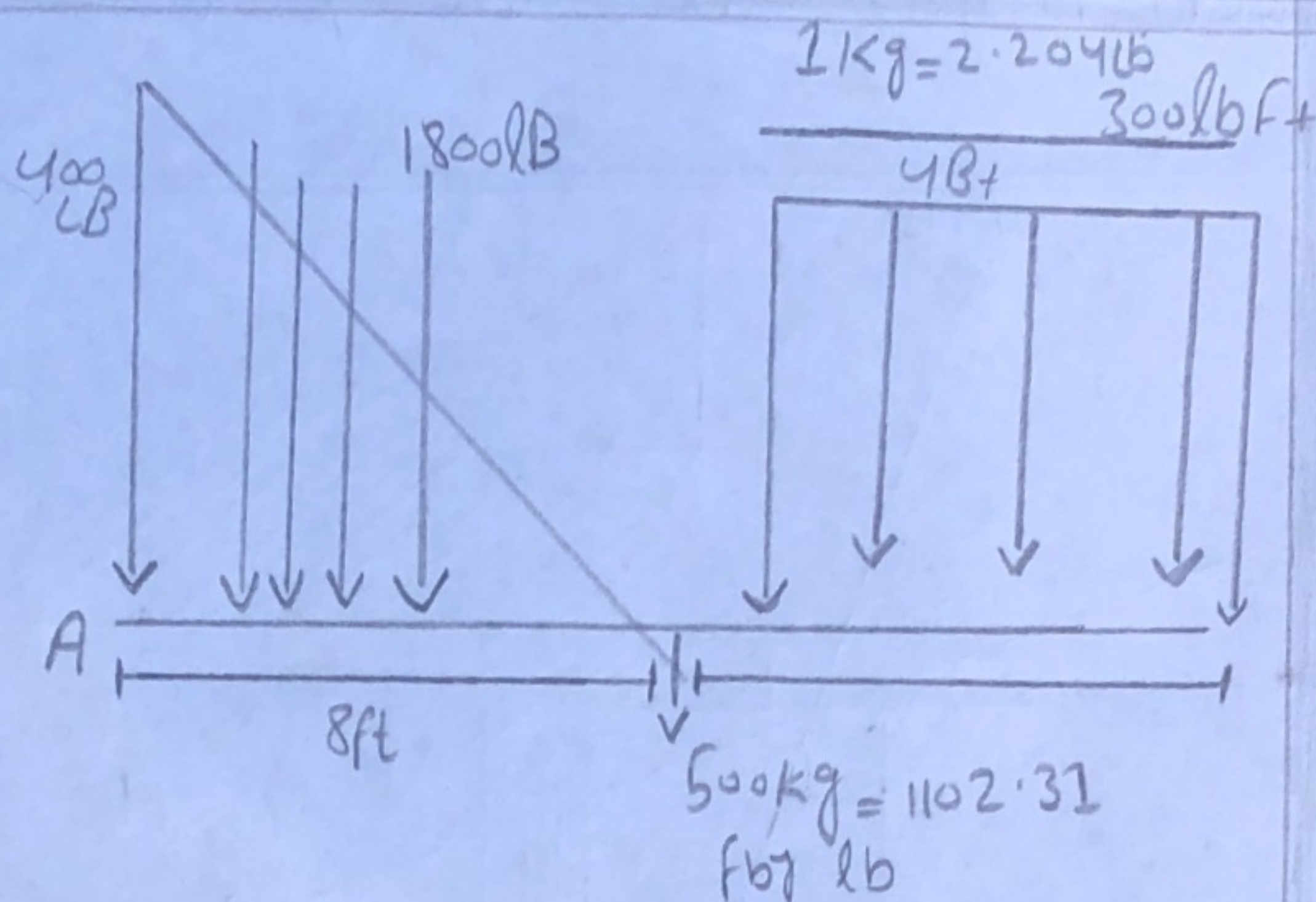
$$\boxed{Q = 21.7 \quad T = 204 \text{ lb}} \text{ ANS}$$

Note: we could eliminate  $T$  between equation 1 & 2 the resulting equation is transcendental.





## Question 3

Sol

finding reaction

 $\uparrow + \downarrow -$  $\frac{1}{2} (h \times h)$  $(b \times h)$ 

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

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

$$F_{Ay} = 21902.31 - F_{By} \quad \text{--- (i)} \quad \left[ \frac{1}{2} (400 \times 8) \right] \text{ lb}$$

$$\sum M_A = 0 \quad \curvearrowright \oplus \quad \curvearrowleft \ominus$$

$$\left[ \frac{1}{2} (400 \times 8) \right] \times \left[ \frac{1}{3} (8) \right] + \left[ (18000) (7.5) \right] + (1102.31) \times (8.35) + \frac{(300 \times 4)}{2 \text{ ft}} (10) - (F_{By} \times 12) = 0$$

$$\frac{300 \times 4}{2 \text{ ft}}$$

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

$$\frac{12 F}{12 F} F_{By} = \frac{160470.9}{12}$$

$$\Rightarrow F_{By} = 13375.6 \text{ lb}$$

$$\text{eq (i)} \quad F_{Ay} = 21902.31 - 13375.6 \quad \text{Put in eq (i)}$$

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