M□T□W□T□F□S H/W□-C/W□ Date:...../...../20.....

NAME = WAQAR AHMAD

ID = 16117

Section = A

Department = BE(civil)

Semister = 2nd

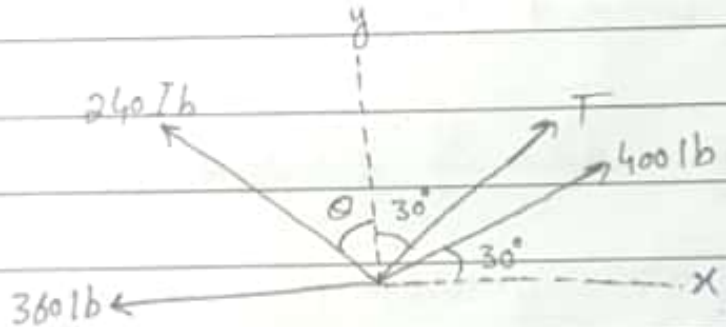
Paper = Engineering Mechanics

Submitted to = Engr. M Majid Naeem

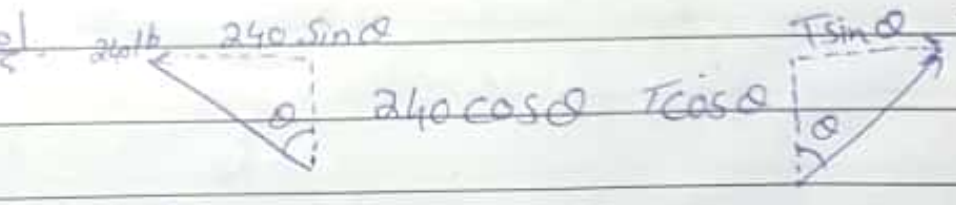
Date = 26-4-2020

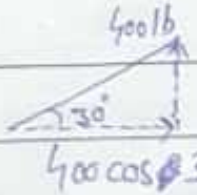
MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

Q(2) Four forces are exerted on the eyebolt as shown below of the net effect on the bolt is a direct pull of 600 pounds in the y-direction. determine the value of T and



Ans Sol.





$$\Sigma F_x = 0$$

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

$$-240\sin\theta + 0.5T - 360 + 346.4 = 0$$

$$0.5T - 240\sin\theta - 13.59 = 0 \quad -(1)$$

MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

$\Sigma f_y = 0$

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

$0.866T + 240\cos\theta + 200 = 600$

$0.866T + 240\cos\theta = 600 - 200$

$0.866T + 240\cos\theta = 400$ — (2)

$\sin^2\theta + \cos^2\theta = 1$ — (3)

Finding value of $\sin\theta$ and $\cos\theta$

Taking equation (1)

$0.5T - 240\sin\theta - 13.59 = 0$

$240\sin\theta = 0.5T - 13.59$

$\sin\theta = \frac{0.5T - 13.59}{240}$ → eq (4)

Taking eq (2)

$0.866T + 240\cos\theta = 400$

$240\cos\theta = 400 - 0.866T$

$\cos\theta = \frac{400 - 0.866T}{240}$ — (5)

Put eq (4) and eq (5) in eq (3) we get

MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

$$\left(\frac{0.5T-13.59}{240}\right)^2+\left(\frac{400-0.866T}{240}\right)^2=1$$

$$(0.5T-13.59)^2+(400-0.866T)^2=(240)^2$$

$$= 0.25T^2-13.59T+184.688+0.751^2-692.8T$$
$$+160000=57600$$

$$= 0.25T^2+0.75T^2-13.59T-692.8T+184.688+$$
$$+160000-57600=0$$

$$T^2-706.39T+102584.688=0$$

Using quadratic formula we get

$$T_1 = 502.0659\,lb$$

$$T_2 = 204.325\,lb$$

Since $\sin^2\theta = \sin^2(-\theta)$ and $\cos^2\theta = \cos^2(-\theta)$.

for $T = 502.065\,lb$

use eq − (4)

$$\sin\theta = \left(\frac{0.5\times502.065-13.59}{240}\right)$$

(4)

MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

$$\theta = \sin^{-1}\left(\frac{0.5 \times 502.065 - 13.59}{240}\right)$$

$$\theta = 81.63^\circ$$

Use eqn - (5)

$$\cos\theta = 400 - \frac{(0.866 \times 502.065)}{240}$$

$$\theta = \cos^{-1}\left(400 - \frac{(0.866 \times 502.065)}{240}\right)$$

$$\theta = 98.33^\circ$$

$81.63^\circ \neq 98.33^\circ$ (Solution).

For $T = 204.325$ lb

using eqn (4)

$$\sin\theta = \frac{(0.5 \times 204.325) - 13.59}{240}$$

$$\theta = 21.66^\circ$$

using eqn - (5)

$$\cos\theta = \frac{400 - 0.866(204.325)}{240}$$

$$\theta = \cos^{-1}\left(\frac{400 - 0.866(204.325)}{240}\right)$$

portant

MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

$\theta = 21.7°$

Since $21.7° = 21.7°$

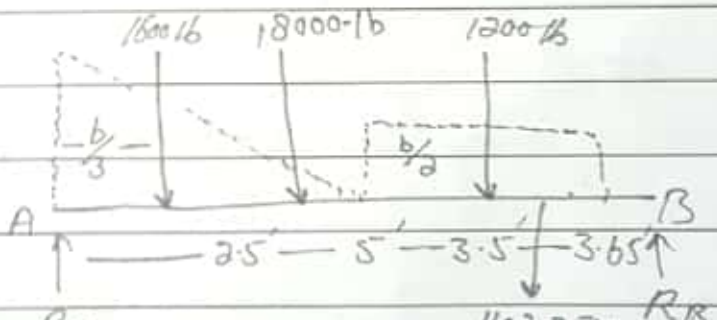
Solution is valid

Therefore $T = 204.325$ lb

$\theta = 21.7°$

Q(3) Calculate the reaction at supports.

Sol:



Free body diagram

$\Sigma M_D = \circlearrowleft G \cdot i)$

$-(1600 \times 2.667) - (1800 \times 7.5) - (1102.25 \times 8.35) - (1200 \times 10) + R_B \times 12 = 0$

$R_B \times 12 = 4272 + 13500 + 9203.78 + 1200$

$R_B \times \frac{12}{12} = \frac{38975.78}{12}$

$R_B = 2347.75625$

MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

$\Sigma F_y = 0$ ↑+↓-

$R_A - 1600 - 1800 - 1102.5 - 1200 + R_B = 0$

$R_A = 1600 + 1800 + 1102.5 + 1200 - R_B$

$= 5702.5 - R_B$

$= 57\,02.5 - 2347.75625$

$R_A = 3354.74375$ lb

REACTION:

AT A =

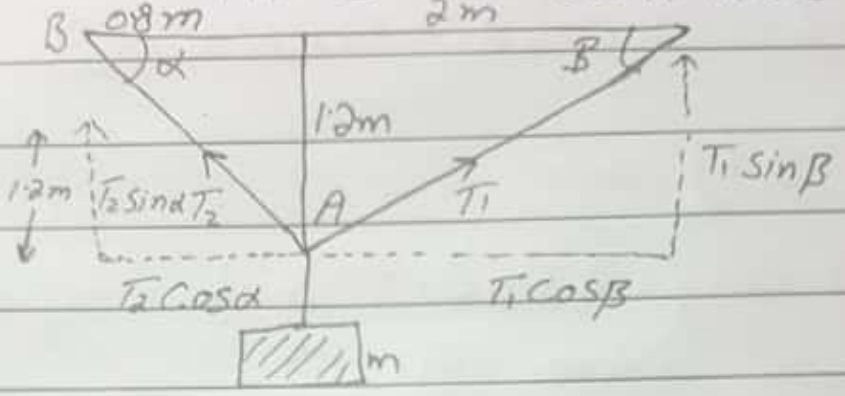
$R_A = \boxed{2454.25\ lb}$

AT B =

$R_B = \boxed{3248\ lb}$

MOTOWOTOFOS H/WO-C/WO Date:...../...../20.....

(1) a) Reactions: AT A = R_A = 3354.75825
AT B = R_B = 2347.75825



Part (a)

Solution:

m = mass of tank + mass of water

mass of tank = 400 pounds

1 kg = 2.21 pounds

mass of tank = 400/2.21 = 181 kg

mass of water = ?

Volume = 3000 liters

$1 m^3$ = 1000 liters

~~1 m³~~

volume of water = 3000/1000 = $3 m^3$

density of water = 1000 $kg m^{-3}$

mass = 3 x 1000 => 3000kg

Total mass (m) = 181 + 3000

= 3181 kg

weight = 3181 x 9.81

F = 31205 N

MOTOWOTOFOS H/WO-C/WO Date:...../...../20...

$\Sigma F_x = 0$

$\Sigma F_x = T_1 \cos\beta = T_2 \cos\alpha$ — (1)

$\Sigma F_y = 0$

$\Sigma F_y = T_1 \sin\beta + T_2 \sin\alpha = mg$ — (2)

from eq (1)

$T_1 \cos\beta = T_2 \cos\alpha$

$T_2 = \frac{T_1 \cos\beta}{\cos\alpha}$

Putting values in eq (2)

$T_1 \sin\beta + \frac{T_1 \cos\beta (\sin\alpha)}{\cos\alpha} - mg$

$T_1 \left[\sin\beta + \frac{\sin\alpha \cos\beta}{\cos\alpha}\right] = mg$

$T_1 = \frac{mg}{\sin\beta + \frac{\sin\alpha \cos\beta}{\cos\alpha}}$

$\alpha = \tan^{-1}\left[\frac{1.2}{1.8}\right]$

$\alpha = 56.30°$

$\beta = \tan^{-1}\left[\frac{1.2}{2}\right]$

$\beta = 31°$

portant

$T_1 = 17333.16N$

$T_2 = \frac{T_1 \cos\beta}{\cos\alpha}$

$T_2 = \frac{17.333.16 \times \cos(31)}{\cos(56.3)}$

$T_2 = 26777.63N$

$AB\% = \frac{26777.63}{31205} \times 100$

$AB = 85.81\%$

Part b:-

Tank mass increase 15%.

new mass = 181 x 1.15

= 208.15kg

Volume of water increase 35%.

new volume = 3 x 1.35

= 4.05 m^3

mass of water = 4050

Total mass = 4258.15kg

F = 41772.45N

T_1 will be 23203N

T_2 = 35846N

AB% will be same

AB% = 85.81%