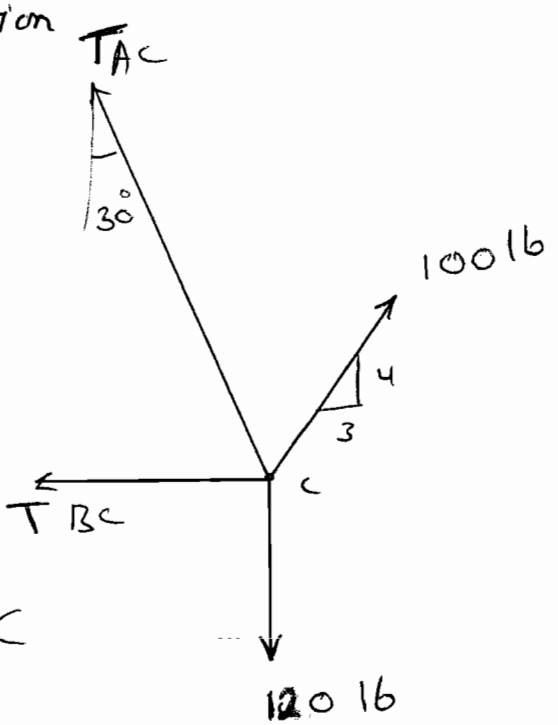
CE 201 - 455 (071)

H.W#3 Key Solution

Problem 1 :-



Given:

fig pro(1) & $P_1 = 100$ lb

Required:-

Tension in cables AC and BC

Solution:-

$\pm \rightarrow \Sigma F_x = 0$

$$-T_{BC} - T_{AC}\cos 60 + 100\,(3/5) = 0$$

$$-T_{BC} - T_{AC}\cos 60 + 60 = 0 \quad \text{——— (1)}$$

$+\uparrow \Sigma F_y = 0$

$$T_{AC}\sin 60 + 100\,(4/5) - 120 = 0 \quad \text{——— (2)}$$

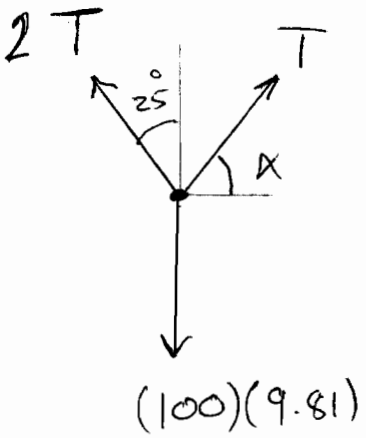
By solving equation (2)

$$\boxed{T_{AC} = 46.18 \text{ lb}}$$

$\therefore$ for equation (1) $\quad -T_{BC} - 46.18\cos 60 + 60 = 0$

$$\therefore \boxed{T_{BC} = 36.9 \text{ lb}}$$

Problem (2):-



Given:-

fig P2

Required:-

Magnitude and direction of T

Solution:-

$\xrightarrow{+} \Sigma F_x = 0$

$$T\cos\alpha - 2T\sin 25 = 0 \quad \text{—— ①}$$

$\uparrow^{+} \Sigma F_y = 0$

$$T\sin\alpha + 2T\cos 25 - (100)(9.81) = 0$$

$$T\sin\alpha + 2T\cos 25 - 981 = 0 \quad \text{—— ②}$$

∴ From eq ①

$$T\cos\alpha = 2T\sin 25$$

$$\cos\alpha = 2\sin 25$$

$$\alpha = \cos^{-1}(2\sin 25) \Longrightarrow \alpha = 32^\circ 30'$$

using eq (2)

$$T \sin 32.3 + 2T \cos 25 - 981 = 0$$

$$T (\sin 32.3 + 2\cos 25) = 981$$

$$T = \frac{981}{\sin 32.3 + 2\cos 25} = 417.9 \text{ N}$$

$$\therefore \boxed{T = 418 \text{ N}}$$

Problem (3):-

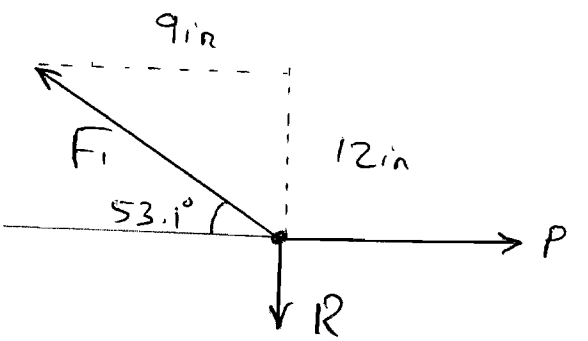
Given:

fig P_3, $c_1 = 9$ in, $c_2 = 12$ in, $K = 10$ lb/in

Required:

Magnitude of P

Solution:-



a- $F_1 = K S_1$

$S_1 = L_1 - L_0$

$L_0 = 12$ in, $L_1 = \sqrt{9^2 + 12^2} = 15$ in Note $\underline{R}$!

$\therefore S_1 = 15 - 12 = 3$ in

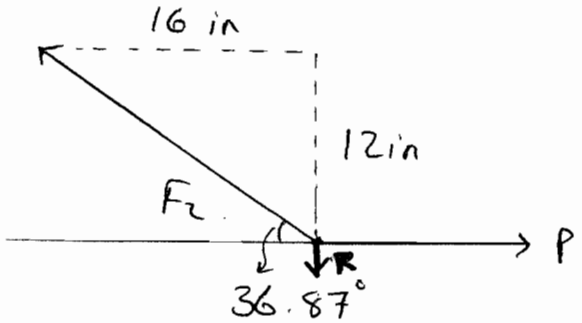
$\therefore F_1 = (10)(3) = 30$ lb

$\xrightarrow{+} \Sigma F_x = 0$

$-F_1 \cos 53.1 + P = 0$

$P = (30) \cos 53.1$

$$\boxed{P = 18.01 \text{ lb}}$$



b- $F_2 = K S_2$

$S_2 = L_2 - L_0$

$L_0 = 12in$, $L_2 = \sqrt{16^2 + 12^2} = 20in$

$\therefore S_2 = 20 - 12 = 8 in$

$\therefore F_2 = (10)(8) = 80$ 16

$\xrightarrow{+} \Sigma F_x = 0$

$- F_2 \cos 36.87 + P = 0$

$P = (80) \cos 36.87 = 63.99$ 16

$\boxed{P = 63.99 16}$

Problem 4:-

Given:

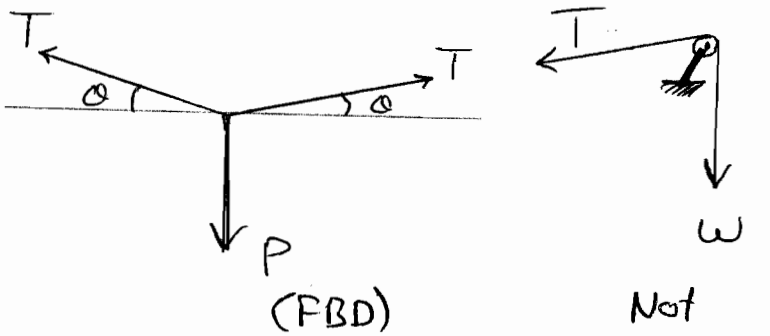
fig P4, $W = 80\,lb$, $P = 10\,lb$, $d = 20\,in$

Required:-

a- Defining W using P, d, h

b- calculating h.

Solution:-



a- $\overset{+}{\uparrow}\Sigma F_y = 0$

$$T\sin\theta + T\sin\theta - P = 0$$

$$P = 2T\sin\theta.$$

where $\sin\theta = \dfrac{h}{\sqrt{h^2+d^2}}$

$$\therefore P = \frac{2Th}{\sqrt{h^2+d^2}}$$

It is clear and obvious that $T = W$

$$\therefore \quad P = \frac{2Wh}{\sqrt{h^2+d^2}}$$

$$\boxed{W = \frac{P\sqrt{h^2+d^2}}{2h}}$$

b- using the equation found on part a

$$W = \frac{P\sqrt{h^2+d^2}}{2h}$$

$$80 = \frac{10\sqrt{h^2+20^2}}{2h}$$

$$16h = \sqrt{h^2+20^2}$$

$$256h^2 - h^2 = 400$$

$$h^2 = 1.5686 \Longrightarrow \boxed{h = 1.252 \text{ in}}$$

Problem 5 :-

Given:

Fig P5, P = 700 lb, Q = 300 lb

Required:

Magnitude of tension in all cables

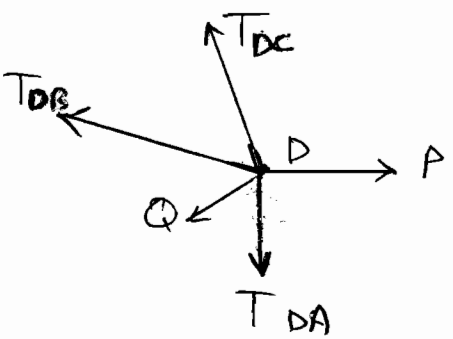
Solution:-

A (6, 0, 0)

B (0, 5, 2)

C (0, 5, -6)

D (6, 2, 0)



$$\vec{T}_{DB} = T_{DB} \frac{-6\vec{i} + 3\vec{j} + 2\vec{k}}{\sqrt{6^2 + 3^2 + 2^2}}$$

$$\vec{T}_{DB} = T_{DB} (-6/7\vec{i} + 3/7\vec{j} + 2/7\vec{k})$$

$$\vec{T}_{DC} = T_{DC} \frac{-6\vec{i} + 3\vec{j} - 6\vec{k}}{\sqrt{6^2 + 3^2 + 6^2}}$$

$$\vec{T}_{DC} = T_{DC} (-2/3\vec{i} + 1/3\vec{j} - 2/3\vec{k})$$

$$\vec{T}_{DA} = T_{DA} \frac{0\vec{i} - 2\vec{j} + 0\vec{k}}{\sqrt{2^2}}$$

$$\vec{T}_{DA} = -(1\vec{j})T_{DA}$$

$$\vec{Q} = 300\,\vec{k}$$

$$\vec{P} = 700\,\vec{i}$$

$\overset{+}{\rightarrow} \Sigma F_x = 0$

$$(-6/7)T_{DB} - 2/3\,T_{DC} + 700 = 0 \quad \text{—— (1)}$$

$\overset{+}{\uparrow} \Sigma F_y = 0$

$$3/7\,T_{DB} + 1/3\,T_{DC} - T_{DA} = 0 \quad \text{—— (2)}$$

$\overset{+}{\swarrow} \Sigma F_z = 0$

$$2/7\,T_{DB} - 2/3\,T_{DC} + 300 = 0 \quad \text{—— (3)}$$

$$-6/7\,T_{DB} - 2/3\,T_{DC} + 700 = 0 \quad \text{—— (1)}$$

$$6/7\,T_{DB} - 6/3\,T_{DC} + 900 = 0 \quad \text{—— (3)} \times 3$$

$$-8/3\,T_{DC} + 1600 = 0$$

$$\therefore \quad \boxed{T_{DC} = 600 \text{ lb}}$$

$$-6/7\, T_{DB} - 2/3\,(600) + 1700 = 0 \quad \text{—(1)}$$

$$\boxed{T_{DB} = 350 \text{ lb}}$$

$$+3/7\,(350) + (1/3)(600) - T_{DA} = 0 \quad \text{—(2)}$$

$$\boxed{T_{DA} = 350 \text{ lb}}$$