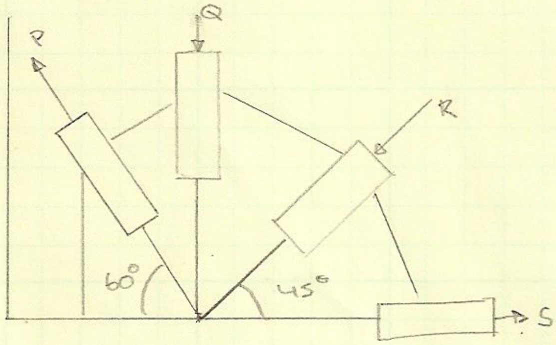
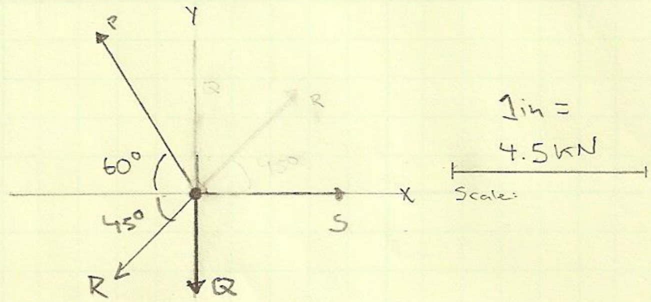
Problem #1 on pdf



P = 4.45 kN
Q = 2.26 kN

Find: The mag. & dir. of $\vec{R}$ and $\vec{S}$ to allow equilibrium

Solution:



$\vec{P} = -\cos(60)\cdot P\,\vec{i} + \sin(60)\cdot P\,\vec{j}$

$\vec{Q} = \qquad -Q\,\vec{j}$

$\vec{R} = -\cos(45)\cdot R\,\vec{i} - \cancel{\cos}\ \sin(45)\cdot R\,\vec{j}$

$\vec{S} = \quad S\,\vec{i}$

$\vec{P} + \vec{Q} + \vec{R} + \vec{S} = 0$

(i) $\sum F_x = 0 = -\cos(60)\cdot P - \cos(45)R + S$

(ii) $\sum F_y = 0 = \sin(60)P - Q - \cancel{\cos}\ \sin(45)\cdot R$

From (ii): $\dfrac{\sin(60)\cdot(4.45) - 2.26}{\sin(45)} = R$

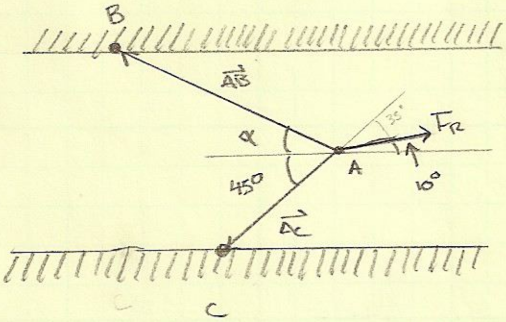
$\boxed{R = 2.25\text{ kN}}$ $\qquad \vec{R} = -\cos(45)\cdot R\vec{i} - \sin(45)R\vec{j}$

From (i): $S = \cos(60)\cdot(4.45) + \cos(45)\cdot(2.25)$

$\boxed{S = 3.82\text{ kN}}$

$\boxed{R = -1.59\vec{i} - 1.59\vec{j}\ [\text{kN}] \qquad S = 3.82\vec{j}\ [\text{kN}]}$

Problem #2 on pdf

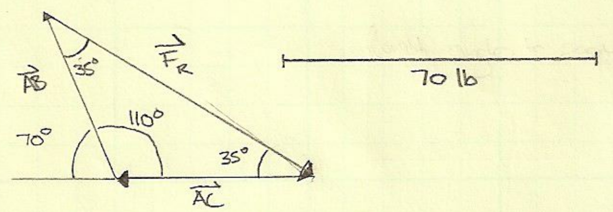


$\alpha = 25°$

$F_R = 70 lb$

Find: Find tension AB & AC

Solution:

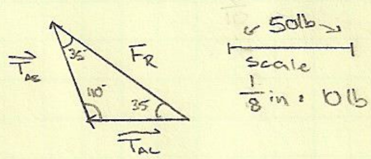


Use law of sines:

$$\frac{\sin(110)}{F_R} = \frac{\sin 35}{T_{AB}} = \frac{\sin 35}{T_{AC}}$$

$$T_{AC} = \frac{F_R \sin(35)}{\sin(110)} = 42.7 \text{ lb}$$

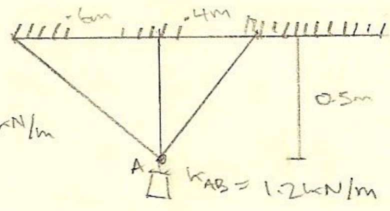
$$T_{AB} = \frac{F_R \sin(35)}{\sin(110)} = 42.7 \text{ lb}$$



$T_{AC} = 42.7$ lb

$T_{AB} = 42.7$ lb

problem: 3.27 in book

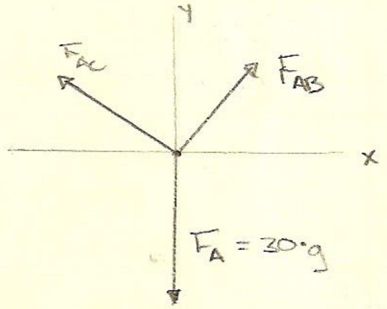


30kg block

Find: The unstretched length of each spring after each spring is removed

Solution:

$F = ks$ for springs



$AC = \sqrt{.6^2 + .5^2} = 0.78m$

$AB = \sqrt{.4^2 + .5^2} = 0.64m$

Find the force in each spring

$F_{AC} + F_{AB} = F_A$

(i) $\sum f_x = 0: \; -\frac{0.6}{AC} \cdot F_{AC} + \frac{0.4}{AB} \cdot F_{AB} = 0$

(ii) $\sum f_y = 0: \; \frac{0.5}{AC} \cdot F_{AC} + \frac{0.5}{AB} F_{AB} = 30g$

$$\underbrace{\begin{bmatrix} \frac{-0.6}{0.78} & \frac{0.4}{0.64} \\ \frac{0.5}{0.78} & \frac{0.5}{0.64} \end{bmatrix}}_{A} \underbrace{\begin{bmatrix} 0 \\ 30 \cdot 9.81 \end{bmatrix}}_{B}$$

$Ax = B$

$x = B \cdot A^{-1} = \begin{bmatrix} F_{AC} \\ F_{AB} \end{bmatrix}$

calc result: $x = \begin{bmatrix} -918.2 \\ 1130.1 \end{bmatrix}$

$F_{AC} = -918.2$

$F_{AB} = 1130.1$

Use spring formula:

$F_{AC} = k_{AC} \cdot S_{ac}$

$S_{ac} = \frac{F_{AC}}{k_{AC}} = -0.612$

$F_{AB} = K_{ab} \cdot S_{ab}$

$S_{ab} = \frac{F_{AB}}{K_{AB}} = 0.941$

Problem 3.27 cont.

Determine final length:

$AC_{final} = AC - S_{ac}$

$= 0.78 - (-.612)$

$\boxed{AC_{final} = 1.39\ m}$

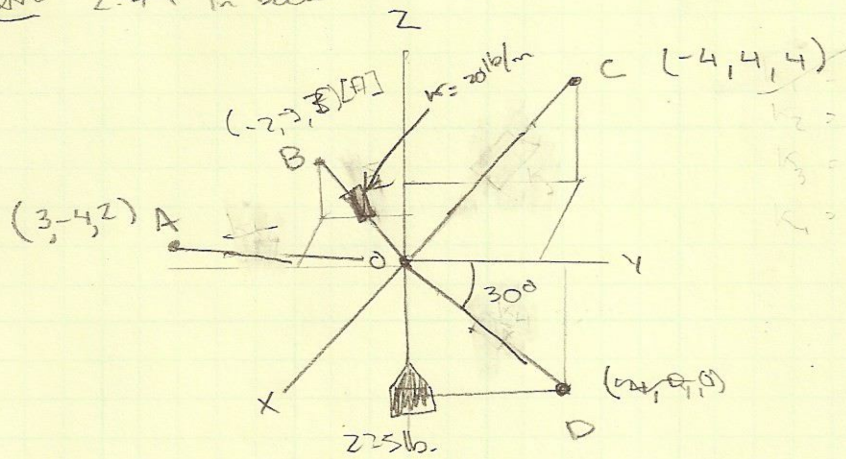
$AB_{final} = AB - S_{ab}$

$= 0.64 - .94$

$\boxed{AB_{final} = -0.3\ m}$

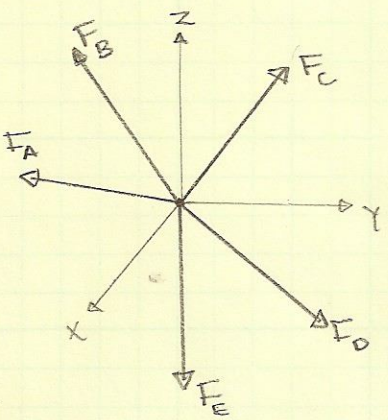
* obviously incorrect!

Problem 2.74 in book



$\Delta OB = 2 in.$

Find: Tension in ropes to hold 225lb weight in equilibrium



$OA = \sqrt{3^2+4^2+2^2} = \sqrt{29}$

$\overline{OB} = \sqrt{2^2+3^2+3^2} = \sqrt{22}$

$OC = \sqrt{4^2+4^2+4^2} = 4\sqrt{3}$

Group component-wise vectors

$$\Sigma F_x = 0: \frac{3}{OA}\cdot F_A - \left(20\cdot\frac{1}{6}\right)\frac{2}{OB} - \frac{4}{OC}F_c + \cos(60)\cdot F_D = 0$$

$$\Sigma F_y = 0: \frac{-4}{OA}F_A - \frac{3}{OB}\left(\frac{20}{6}\right) + \frac{4}{OC}F_c + \cos(30)F_D = 0$$

$$\Sigma F_z = 0: \frac{2}{OA}F_A + \frac{3}{OB}\left(\frac{20}{6}\right) + \frac{4}{OC}F_c + 0 - 225\cdot g = 0$$

Matrix form:

$$\begin{bmatrix} \frac{3}{OA} & \frac{-4}{OC} & \cos(60) \\ \frac{-4}{OA} & \frac{4}{OC} & \cos(30) \\ \frac{2}{OA} & \frac{4}{OC} & 0 \end{bmatrix} X = \begin{bmatrix} \frac{20}{6}\cdot\frac{2}{OB} \\ +\frac{20}{6}\cdot\frac{3}{OB} \\ \frac{20}{6}\cdot\frac{3}{OB} + 225\cdot g \end{bmatrix}$$

$$\begin{bmatrix} \frac{3}{\sqrt{29}} & \frac{-4}{4\sqrt{3}} & \cos 60 \\ \frac{-4}{\sqrt{29}} & \frac{1}{\sqrt{3}} & \cos 30 \\ \frac{2}{\sqrt{29}} & \frac{1}{\sqrt{3}} & 0 \end{bmatrix} X = \begin{bmatrix} \frac{10\sqrt{22}}{33} \\ \frac{3\sqrt{22}}{11} \\ 2209 \end{bmatrix}$$

Calc. result:

$$X = \begin{bmatrix} 1104 \\ 1913 \\ 1.7 \end{bmatrix} = \begin{bmatrix} F_A \\ F_C \\ F_D \end{bmatrix}$$

$$\boxed{\begin{aligned} F_A &= 1104\,\text{lb} \\ F_B &= 1913\,\text{lb} \\ F_D &= 1.7\,\text{lb} \end{aligned}}$$