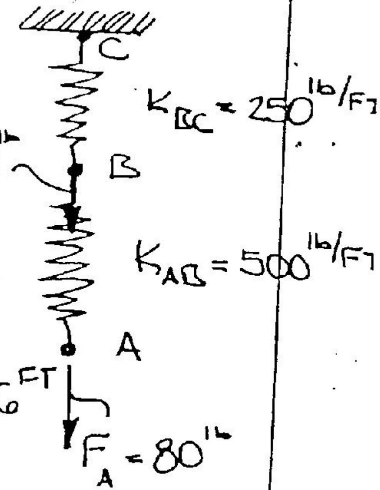
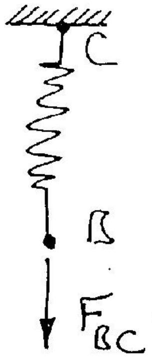
PROBLEM 3-12



ELONGATION OF SPRING BC (Δ_{BC}):



$$F_{BC} = K_{BC}\,\Delta_{BC}$$

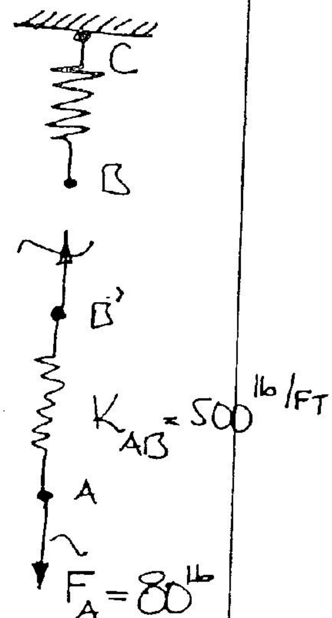
$$\Delta_{BC} = \frac{F_{BC}}{K_{BC}} = \frac{140^{lb}}{250^{lb/FT}} = 0.56^{FT}$$

$$F_{BC} = F_B + F_A = 60^{lb} + 80^{lb} = 140^{lb}$$

ELONGATION OF SPRING AB (Δ_{AB}):

$$F_{AB} = F_A = 80^{lb}$$

$$\Delta_{AB} = \frac{F_{AB}}{K_{AB}} = \frac{80^{lb}}{500^{lb/FT}} = 0.16^{FT}$$

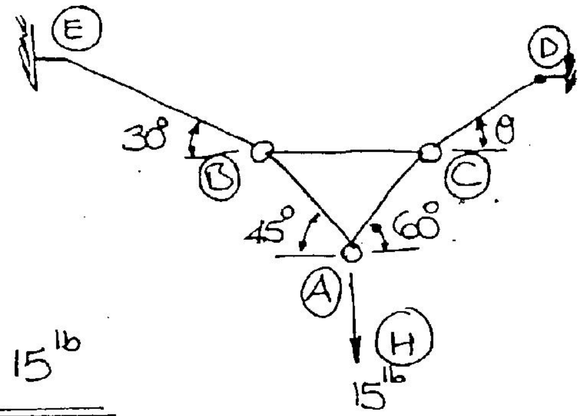


VERTICAL DISPLACEMENT AT A: (Δ_A)

$$\Delta_A = \Delta_{AB} + \Delta_{BC} = 0.16^{FT} + 0.56^{FT}$$

$$\underline{\Delta_A = 0.72^{FT} \text{ OR } 8.64^{IN}}$$

PROBLEM 3-20



EQUILIBRIUM AT A $\quad T_{AH} = 15^{lb}$

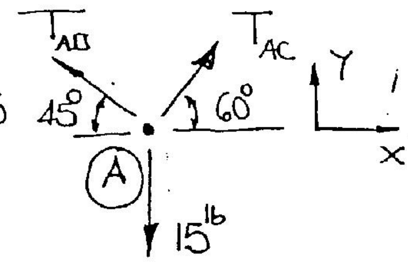
$\Sigma F_x = 0 \longrightarrow T_{AC}(\cos 60) = T_{AB}(\cos 45)$

$\Sigma F_y = 0 \longrightarrow T_{AC}(\sin 60) + T_{AB}(\sin 45) = 15$

$\longrightarrow T_{AC}\left[(\sin 60) + (\cos 60)\right] = 15$

$T_{AC} = 10.98^{lb}$ TENS

$T_{AB} = 7.77^{lb}$ TENS



FBD AT (A)

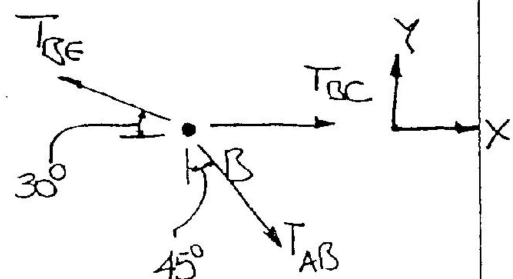
EQUILIBRIUM OF B :

$\Sigma F_y = 0 \longrightarrow T_{BE}(\sin 30) = T_{AB}(\cos 45)$

$T_{BE} = 7.77^{lb} \cdot \dfrac{(\cos 45)}{(\sin 30)}$

$T_{BE} = 10.99^{lb}$ TENS

$\Sigma F_x = 0 \longrightarrow T_{CB} = T_{BE}\cos 30 - T_{AB}\cos 45 = 4.02^{lb} = T_{CB}$



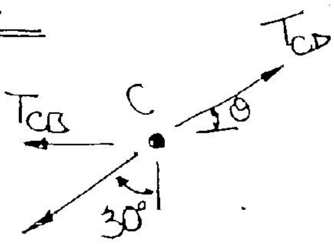
EQUILIBRIUM AT C

$\Sigma F_y = 0 \longrightarrow T_{CD}(\sin\theta) = T_{CA}(\cos 30)$

$\Sigma F_x = 0 \longrightarrow T_{CB} = T_{CD}(\cos\theta) - T_{CA}\sin 30 \quad T_{CA}$

$\longrightarrow \tan\theta = \dfrac{T_{CA}}{T_{CB} + T_{CA}\sin 30}(\cos 30) = \dfrac{10.98(\cos 30)}{9.52 + 10.98\sin 30}$

$\theta = 45^{\circ} \qquad T_{CD} = \dfrac{9.52}{\ldots} = 13.46^{lb} = T_{CD}$ TENS



PROBLEM 3-21

REFER TO PROBLEM 3-20 T_{AH}

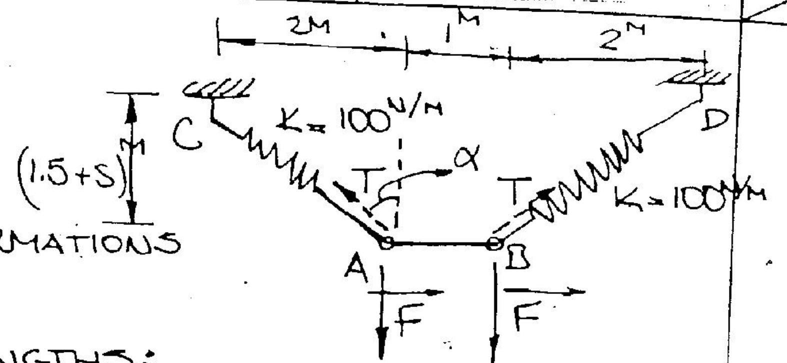
LARGEST CORD FORCE = 15 lb FOR 15 lb WEIGHT

THIS MAXIMUM TENSION FORCE IN CORD AH WILL CONTROL MAXIMUM WEIGHT.

MAXIMUM WEIGHT = $\frac{200}{15} \times 15^{lb}$ = 200 lb = MAX WEIGHT

$\theta = 45^\circ$ SIMILAR TO 3-20

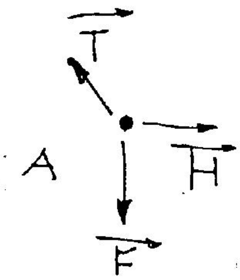
PROBLEM 3-36



$S = 0.5^{M}$ → LARGE DEFORMATIONS

UNSTRETCHED SPRING LENGTHS:

$$L_0 = \sqrt{2^2 + 1.5^2} = 2.5^{M}$$



FBD AT A

ELONGATION OF SPRINGS AC & BD:

$$\text{NEW LENGTH} = \sqrt{(1.5+0.5)^2 + 2^2} = 2.83^{M}$$

$$\text{ELONGATION} = (2.83 - 2.5)^{M} = 0.33^{M}$$

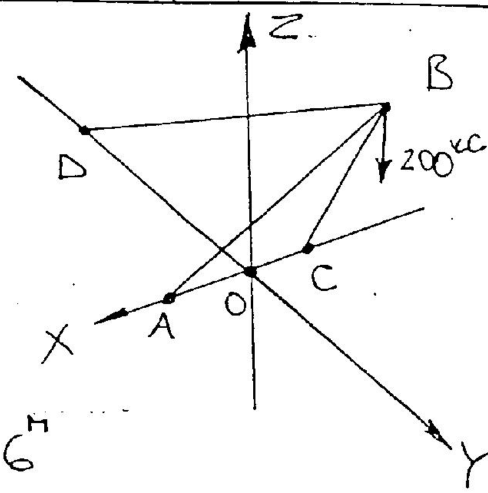
$$\text{TENSION IN SPRING} = T = \overset{100\,N/M}{K} * 0.33 = 33^{N}$$

EQUILIBRIUM AT A:

$$F = T(\cos\alpha) = 33^{N} * \frac{2}{2.83} = 23.3^{N}$$

$$\text{MASS} = \frac{23.3^{N}}{g} = \frac{23.3}{9.81} = \underline{\underline{2.38^{KG} \text{ - MASS}}}$$

PROBLEM 3 - 48



$A(2,0,0)^M$ $\quad \overrightarrow{AB}(-2,4,4)^M$

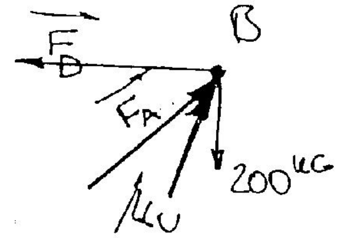
$B(0,4,4)^M$ $\quad \overrightarrow{CB}(2,4,4)^M$

$C(-2,0,0)^M$ $\quad \overrightarrow{BD}(0,-9.6,-4)$

$D(0,-5.6,0)^M$ $\quad AB = BC = \sqrt{4^2+2^2+4^2} = 6^M$

$BD = \sqrt{9.6^2+4^2} = 10.4^M$

UNIT VECTORS:



$$\overrightarrow{U_{AB}} = \frac{\overrightarrow{AB}}{AB} = -\frac{1}{3}\overrightarrow{I} + \frac{2}{3}\overrightarrow{J} + \frac{2}{3}\overrightarrow{K}$$

$$\overrightarrow{U_{CB}} = \frac{\overrightarrow{CB}}{CB} = \frac{1}{3}\overrightarrow{I} + \frac{2}{3}\overrightarrow{J} + \frac{2}{3}\overrightarrow{K}$$

FBD AT B

$$\overrightarrow{U_{BD}} = \frac{\overrightarrow{BD}}{BD} = (-0.923)\overrightarrow{J} + (-0.385)\overrightarrow{K}$$

FORCE VECTORS:

$$\overrightarrow{F_A} = F_A \overrightarrow{U_{AB}} = -\frac{F_A}{3}\overrightarrow{I} + \frac{2}{3}F_A\overrightarrow{J} + \frac{2}{3}F_A\overrightarrow{K}$$

$$\overrightarrow{F_C} = F_C \overrightarrow{U_{CB}} = \frac{1}{3}F_C\overrightarrow{I} + \frac{2}{3}F_C\overrightarrow{J} + \frac{2}{3}F_C\overrightarrow{K}$$

$$\overrightarrow{F_D} = F_D \overrightarrow{U_{BD}} = 0\overrightarrow{I} - 0.923\overrightarrow{J} - 0.385\overrightarrow{K}$$

EQUILIBRIUM:

$$\overrightarrow{F_A} + \overrightarrow{F_C} + \overrightarrow{F_D} - 200\overrightarrow{K} = \overrightarrow{0}$$

① $\left(-\frac{1}{3}F_A + \frac{1}{3}F_C\right)\overrightarrow{I}$
\+
② $\left(\frac{2}{3}F_A + \frac{2}{3}F_C - 0.923F_D\right)\overrightarrow{J}$
\+
③ $\left(\frac{2}{3}F_A + \frac{2}{3}F_C - 0.385F_D - 200\right)\overrightarrow{K} = 0$

② & ③ → ④ $F_D = 371.75^{KG}$ TENSION

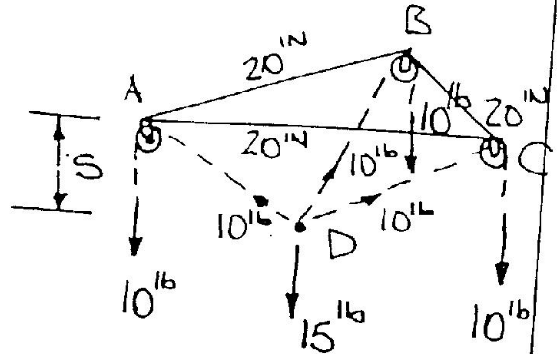
① → ⑤ $F_A = F_C$

④ & ⑤ → $F_A = F_C = 257.34^K$ COMP

6/6

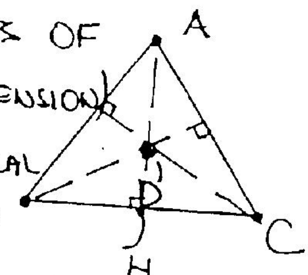
PROBLEM 3_64

$$AD' = \frac{2}{3}(AH) = \frac{2}{3}\left(\frac{AB}{2}\sqrt{3}\right) = \frac{20\sqrt{3}}{3}\ \text{IN}$$



EQUILIBRIUM IN THE VERTICAL DIRECTION AT POINT D:

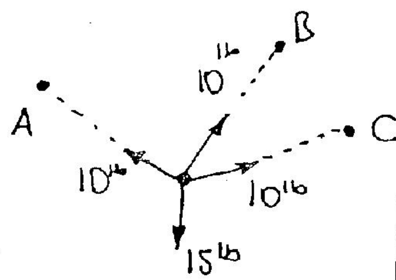
$$15^{lb} = 3\cdot(10)^{lb}\cdot\frac{S \ (DD')}{\sqrt{S^2+\left(\frac{20\sqrt{3}}{3}\right)^2}\ (AD')}$$ = COMPONENTS OF 10 lb LOADS (TENSION) ALONG VERTICAL



TOP VIEW

$$S^2 + \frac{400}{3} = 4S^2$$

$$S^2 = \frac{400}{9} \quad > \quad S = \frac{20}{3}\ \text{IN} \approx 6.67\ \text{IN}$$



FREE BODY DIAGRAM AT D