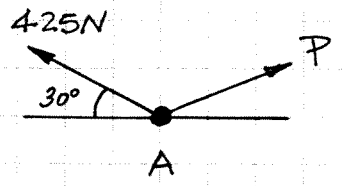
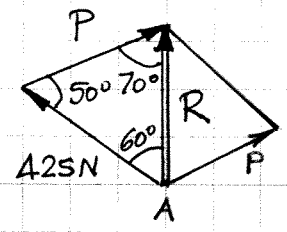
CIV 100F: Solutions to Assignment No. 1

1. **GIVEN:** Resultant $\vec{R}$ of the two forces must be vertical and $\alpha = 120$

FIND: (a) P; (b) R.



OR



LAW OF SINES:

$$\frac{P}{\sin 60^\circ} = \frac{425}{\sin 70^\circ} = \frac{R}{\sin 50^\circ}$$

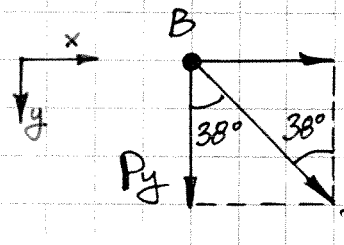
$\therefore$ (a) $P = 425 \dfrac{\sin 60^\circ}{\sin 70^\circ} = \underline{392\text{N}}$

(b) $R = 425 \dfrac{\sin 50^\circ}{\sin 70^\circ} = \underline{346\text{N}}$

---

2. **GIVEN:** (1) Force $\vec{P}$ acting along cable BO; (2) Horizontal component of $\vec{P}$ is 120N.

FIND: (a) P; (b) Vertical component of $\vec{P}$



$P_x = 120\text{N}$

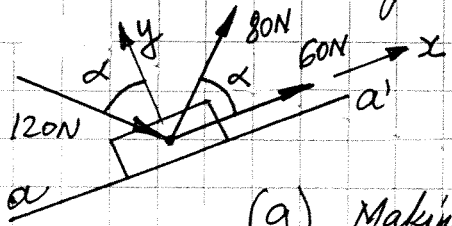
(a) $P = \dfrac{P_x}{\sin 38^\circ} = \dfrac{120\text{N}}{\sin 38^\circ} = \underline{194.9\text{N}}$

(b) $P_y = \dfrac{P_x}{\tan 38^\circ} = \dfrac{120\text{N}}{\tan 38^\circ} = \underline{153.6\text{N}}\downarrow$

---

3. **GIVEN:** Resultant of the forces must be parallel to aa'

FIND: (a) Angle α; (b) R.



(1) $R_x = \Sigma F_x = 60\text{N} + (80\text{N})\cos\alpha + (120\text{N})\sin\alpha$

(2) $R_y = \Sigma F_y = (80\text{N})\sin\alpha - (120\text{N})\cos\alpha$

(a) Making $R_y = 0$: $80\sin\alpha - 120\cos\alpha = 0$

$\tan\alpha = \dfrac{120}{80} = 1.5 \quad \therefore \underline{\alpha = 56.3^\circ}$

(b) Substituting for α in Eqn. (1):

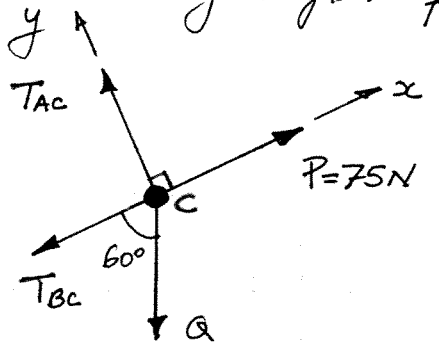
$R_x = 60\text{N} + (80\text{N})\cos(56.3^\circ) + (120\text{N})\sin(56.3^\circ) =$

$= 60 + 44.38 + 99.85$

$\therefore \underline{R = R_x = 204\text{N}}$

4. GIVEN: $T_{AC} \leq 60N$, $T_{BC} \leq 60N$
FIND: Range of values of Q to satisfy the above requirements.

Free Body Diagram of C:



- By inspection note that T_{AC} is perpendicular on P, hence select axes as shown.

- For equilibrium: $\Sigma F_x = 0$
$\Sigma F_y = 0$

OR $-T_{BC} - Q\cos 60° + 75N = 0 \rightarrow T_{BC} = 75 - Q\cos 60°$

$T_{AC} - Q\sin 60° = 0 \rightarrow T_{AC} = Q\sin 60°$

But: $T_{AC} \leq 60N$, hence $Q\sin 60° \leq 60N \rightarrow Q \leq 69.3N$

$T_{BC} \leq 60N \rightarrow 75 - Q\cos 60° \leq 60N \rightarrow Q \geq 30.0N$

∴ Allowable Range: $30.0N \leq Q \leq 69.3N$

---

5. GIVEN: Tension in cable DBE is 385N.
FIND: Components of force exerted by cable on (a) D; (b) E

(a) $\vec{DB} = (480\,mm)\vec{i} + (510\,mm)\vec{j} + (320\,mm)\vec{k}$

$DB = \sqrt{(480)^2 + (-510)^2 + (320)^2} = 770\,mm$

$\vec{F} = F\cdot\vec{\lambda}_{DB} = F\frac{\vec{DB}}{DB} = \frac{385N}{770mm}\left[(480\,mm)\vec{i} - (510\,mm)\vec{j} + (320\,mm)\vec{k}\right]$

∴ $\vec{F} = (240N)\vec{i} - (255N)\vec{j} + (320N)\vec{k}$

OR: $F_x = 240N$, $F_y = -255N$, $F_z = 160.0N$

(b) $\vec{EB} = (270)\vec{i} - (400)\vec{j} + (600)\vec{k}$ and $EB = \sqrt{(270)^2 + (-400)^2 + (600)^2} = 770$ mm

$\vec{F} = F\cdot\vec{\lambda}_{EB} = F\frac{\vec{EB}}{EB} = \frac{385}{770}\left[(270)\vec{i} - (400)\vec{j} + (600)\vec{k}\right]$

∴ $\vec{F} = \left[(135)\vec{i} - (200)\vec{j} + (300)\vec{k}\right]N$

OR: $F_x = 135.0N$ $F_y = -200N$, $F_z = 300N$