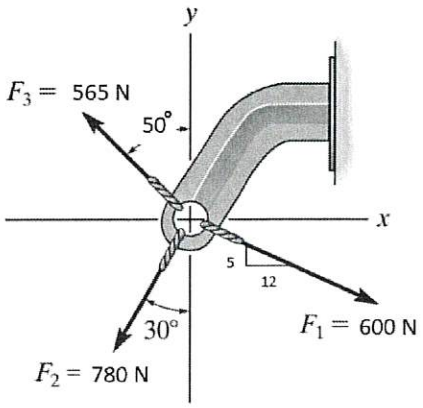
ENSC 2113 Quiz #1 ~~Sample~~ FALL ~~Spring~~ 2023

Name (In English) KEY **Name (In Chinese)** _____

Show all work. Use correct units. Box your final answers.

Problem #1: Calculate the magnitude and direction (from positive x-axis) of the resultant force.

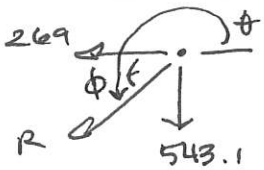


$$R_x = \sum F_x = \frac{12}{13}(600N) - 565N\sin 50° - 780N\sin 30$$
$$= 553.85 - 432.82 - 390$$
$$= -269\,N = 269N \leftarrow$$

$$R_y = \sum F_y \uparrow = -\frac{5}{13}(600N) + 565N(\cos 50) - 780N\cos 30$$
$$= -230.77N + 363.17N - 675.5N$$
$$= -543.1N = 543.1N \downarrow$$

$$R = \sqrt{R_x^2 + R_y^2} = 606N$$

$R = 606$ N @ $\theta = 243.7°$

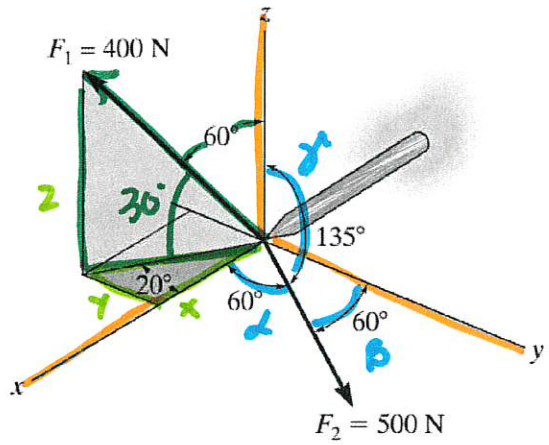


$\theta = 180° + \phi = 180° + \tan^{-1}\frac{543.1N}{269N}$

$\theta = 180° + 63.65°$

$\theta = 243.65°$

Problem #2: Calculate the magnitude of the resultant force and the direction cosine angles (alpha, beta, and gamma).



$$\vec{F}_1 = \{400\cos 30\cos 20\,\vec{i} - 400\cos 30\sin 20\,\vec{j} + 400\sin 30\,\vec{j}\}N$$

$$\vec{F}_1 = \{325.5\vec{i} - 118.5\vec{j} + 200\vec{k}\}N$$

$$\vec{F}_2 = \{500\cos 60\,\vec{i} + 500\cos 60\,\vec{j} + 500\cos 135\,\vec{k}\}N$$

$$\vec{F}_2 = \{250\vec{i} + 250\vec{j} - 353.55\vec{k}\}N$$

$$\vec{R} = \vec{F}_1 + \vec{F}_2 = \{575.5\vec{i} + 131.5\vec{j} - 153.55\vec{k}\}N$$

$|R| = 610$ N

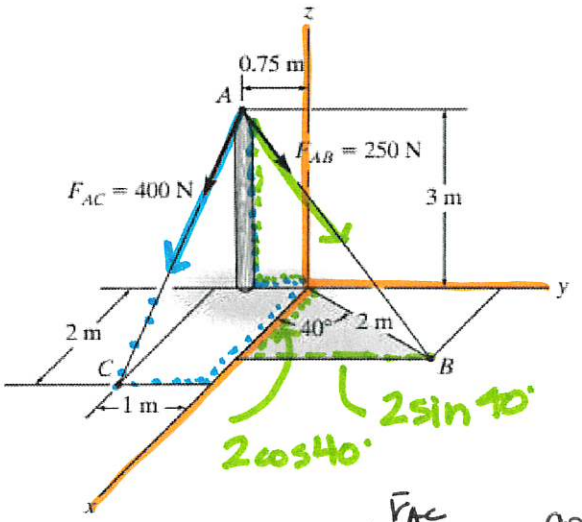
$$\alpha = \cos^{-1}\frac{R_x}{R} = \cos^{-1}\frac{575.5N}{610N} = 19.36°$$

$$\beta = \cos^{-1}\frac{R_y}{R} = \cos^{-1}\frac{131.5N}{610N} = 77.55°$$

$$\gamma = \cos^{-1}\frac{R_z}{R} = \cos^{-1}\frac{-153.55N}{610N} = 104.58°$$

$\alpha, \beta, \gamma = 19.36°, 77.6°, 104.6°$

Problem #3: Write each force in Cartesian Vector Form and then calculate the magnitude of the resultant force and its direction cosine angles (alpha, beta, and gamma).



$\bar{F}_{AC} = 400N\ \bar{u}_{AC} = 400N \frac{\bar{r}_{AC}}{|r_{AC}|}$

COORDINATES: A(0, −0.75, 3)m
C(2, −1, 0)m

$\bar{r}_{AC} = \{2\bar{i} - 0.25\bar{j} - 3\bar{k}\}m \quad |\bar{r}| = 3.614m$

$\bar{u}_{AC} = \{\frac{2}{3.614}\bar{i} - \frac{0.25}{3.614}\bar{j} - \frac{3}{3.614}\bar{k}\}$

$\bar{F}_{AC} = \{221.34\bar{i} - 27.67\bar{j} - 332.02\bar{k}\}N$

$\bar{F}_{AB} = 250N\ \bar{u}_{AB} = 250N \frac{\bar{r}_{AB}}{|r_{AB}|}$

COORDINATES: A(0, −0.75, 3)m
B(2cos40°, 2sin40°, 0)m
(1.53, 1.29, 0)m

$\bar{r}_{AB} = \{1.532\bar{i} + 2.036\bar{j} - 3\bar{k}\}m$

$|\bar{r}_{AB}| = 3.94m \quad \bar{u}_{AB} = \{.389\bar{i} + .517\bar{j} - .762\bar{k}\}$

$\bar{F}_{AB} = \{97.25\bar{i} + 129.25\bar{j} - 190.5\bar{k}\}N$

$\bar{R} = \Sigma\bar{F} = \bar{F}_{AC} + \bar{F}_{AB}$

$\bar{R} = \{(221.34 + 97.25)\bar{i} + (-27.67 + 129.25)\bar{j} + (-332.02 - 190.5)\bar{k}\}N$

$= \{318.59\bar{i} + 101.58\bar{j} - 522.52\bar{k}\}N$

$|R| = 620.4N$

$\alpha = \cos^{-1}\frac{R_x}{R} = \cos^{-1}\frac{318.59N}{620.4N} = 59.1°$

$\beta = \cos^{-1} R_y/R = \cos^{-1} 101.58N/620.4N = 80.6°$

$\gamma = \cos^{-1} R_z/R = -522.52N/620.4N = 147.4°$

$\angle\ \alpha, \beta, \gamma =$
59.1°, 80.6°, 147.4°