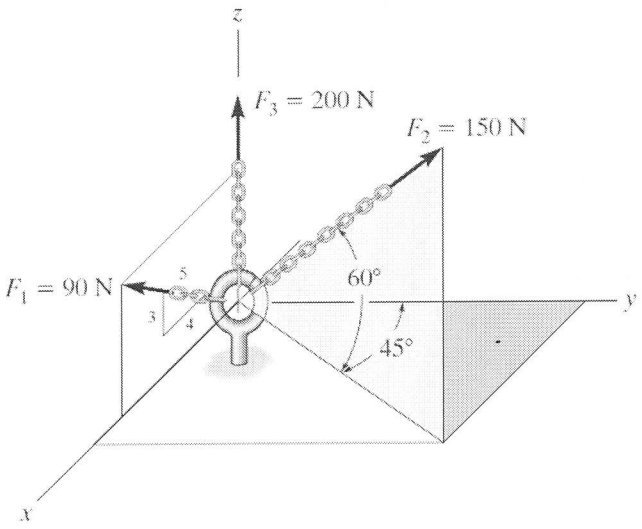
CME 250 – Statics
Exam #2 (09/13/2023)

StarID or TechID (no names) Grading

Show your work (you will not receive any credit if all you have is a final answer, right or wrong).
Do one of the two problems shown below (the second problem is on the back).

1. Determine the magnitude and coordinate direction angles of the resultant force.



$\vec{F}_1 = \frac{4}{5}(90)i + \frac{3}{5}(90)k\ (N) = 72i + 54k\ (N)$ (2 pts)

$\vec{F}_2 = 150\cos 60°\sin 45°\, i + 150\cos 60°\cos 45°\, j + 150\sin 60°\, k\ (N)$ (2 pts)

$= 53.03i + 53.03j + 129.9k\ (N)$

$\vec{F}_3 = 200k\ (N)$ (1 pt)

$\vec{F}_R = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 = 125.03i + 53.03j + 383.9k\ (N)$ (1 pt)

$F_R = \sqrt{(125.03)^2 + (53.03)^2 + (383.9)^2}\ (N) = 407.2\ N \rightarrow \boxed{407\ N}$ (1 pt)

$\cos\alpha = \frac{125.03\ N}{407.2\ N}$

$\alpha = \boxed{72.1°}$ (1 pt)

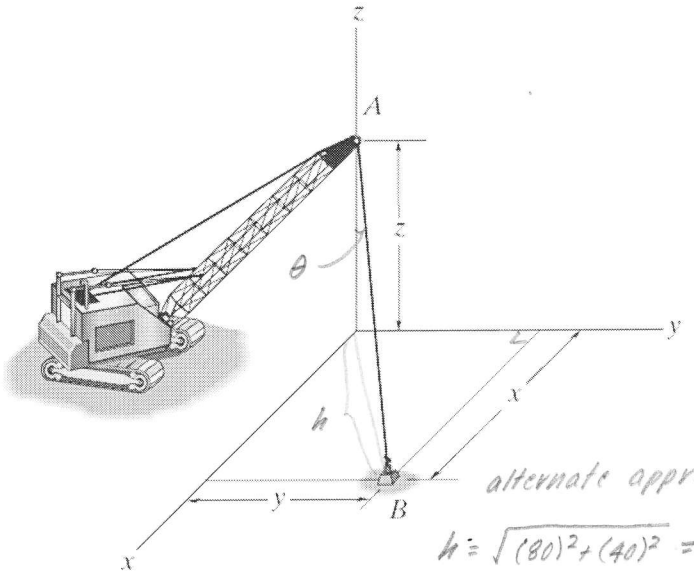
$\cos\beta = \frac{53.03\ N}{407.2\ N}$

$\beta = \boxed{82.5°}$ (1 pt)

$\cos\gamma = \frac{383.9\ N}{407.2\ N}$

$\boxed{\gamma = 19.5°}$ (1 pt)

2. The cable is attached to the boom at point A and to the ground (the x-y plane) at point B. Point A is located on the z-axis, 40 ft above the x-y plane. Point B lies in the x-y plane at the location x=80 ft and y=40 ft. Determine the length of the cable and the angle between the positive z-axis and the cable.



$\vec{r}_{AB} = 80i + 40j - 40k$ (ft) (4 pts)

$r_{AB} = \sqrt{(80)^2 + (40)^2 + (-40)^2}$ (ft) (2 pts)

$= 97.98$ ft $\rightarrow$ **98.0 ft** (1 pt)

$\cos\gamma = \frac{-40 \text{ ft}}{97.98 \text{ ft}}$ (2 pts)

$\gamma = 114°$ (1 pt)

alternate approach (using trig)

$h = \sqrt{(80)^2 + (40)^2} = 89.44$ ft (1 pt)

$\tan\theta = \frac{89.44 \text{ ft}}{40 \text{ ft}}$

$\theta = 65.91°$ (1 pt)

$\gamma = 180° - 65.91° =$ **114.1°** (1 pt)

$r_{AB} = \sqrt{h^2 + z^2}$

$= \sqrt{(89.44 \text{ ft})^2 + (40 \text{ ft})^2} = 97.98$ ft $\rightarrow$ **98.0 ft** (7 pts)