

mid = 4.3

Q1 A/ $A = [12 \ -1 \ -5]$ $B = 8i + 7j - 12k$

$$A \times B = \begin{bmatrix} \overset{+}{12} & \overset{-}{-1} & \overset{+}{-5} \\ \underset{i}{-8} & \underset{j}{7} & \underset{k}{-12} \end{bmatrix}$$

$$= i [(-1 \times -12) - (-5 \times 7)] - j [(12 \times -12) - (-5 \times -8)] \\ + k [(12 \times 7) - (-1 \times -8)]$$

$$= (12 + 35)i - (-144 - 40)j + (84 - 8)k$$

$$= 47i + 184j + 76k$$

Angle about x-axis $\cos \theta = \frac{Vi}{|V|}$

$$\cos \theta = \frac{47}{\sqrt{(47)^2 + (184)^2 + (76)^2}} = \frac{47}{\sqrt{1209 + 33856 + 5776}}$$

$$\cos \theta = \frac{47}{204.5} = 0.2298 \Rightarrow \boxed{\theta = 76.714}$$

angle about y-axis

$$\cos \theta = \frac{184}{204.5} = 0.8998 \Rightarrow \boxed{\theta = 25.868}$$

angle about z-axis

$$\cos \theta = \frac{76}{204.5} = 0.3716 \Rightarrow \boxed{\theta = 68.186}$$

1/ B) $A = [12 \ -1 \ -5]$ $B = -8i + 7j - 12k$

$(A-B) = (12i - 1j - 5k) - (-8i + 7j - 12k)$

$12i - j - 5k + 8i - 7j + 12k$

$\boxed{20i - 8j + 7k} \leftarrow C$

$\hat{C} = \frac{C}{|C|} = \frac{20i - 8j + 7k}{\sqrt{(20)^2 + (-8)^2 + (7)^2}}$

$= \frac{20i - 8j + 7k}{3\sqrt{57}} = \boxed{0.88i - 0.35j + 0.31k}$

Q2

Shear
YZ

Move
 $X=2 \quad Z=-5$

$\begin{bmatrix} 1 & -8 & 3/4 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 2 & 0 & -5 & 0 \end{bmatrix}$

Mirror XZ

Translate about P

Scale

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 23 & 3 & -16 & 1 \end{bmatrix}$

$\begin{bmatrix} 2/3 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1/7 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

Rotate about Z

Translate back

$\begin{bmatrix} \cos 200 & \sin 200 & 0 & 0 \\ -\sin 200 & \cos 200 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ -23 & -3 & 16 & 1 \end{bmatrix}$

Q3/A/ perspective projection COP $(x_c, y_c, z_c) = (-3, 2, -7)$

$$X = [(X - x_c) * u] + x_c, \quad Y = [(y - y_c) * u] + y_c$$

$$Z = [(z - z_c) * u] + z_c$$

$$u = \frac{-z_c}{z - z_c} = \frac{7}{z + 7}$$

$$X_A^P = \left[(-2 + 3) * \frac{7}{3+7} \right] - 3 = \frac{7}{10} - 3 = \frac{7-30}{10} = \frac{-23}{10} = \boxed{-2.3}$$

$$Y_A^P = \left[(8-2) * \frac{7}{10} \right] + 2 = \frac{6 \times 7}{10} + 2 = 4.2 + 2 = \boxed{6.2}$$

$$Z_A^P = \left[(3 + 7) * \frac{7}{10} \right] - 7 = 7 - 7 = \boxed{0} \checkmark$$

$$X_B^P = \left[(4+3) * \frac{7}{10+7} \right] - 3 = \frac{7 \times 7}{17} - 3 = \frac{49-51}{17} = \boxed{\frac{-2}{17}}$$

$$Y_B^P = \left[(-9-2) * \frac{7}{17} \right] + 2 = \frac{-77}{17} + 2 = \frac{-77+34}{17} = \boxed{\frac{-43}{17}}$$

$$Z_B^P = \left[(10 + 7) * \frac{7}{17} \right] - 7 = 7 - 7 = \boxed{0}$$

$$X_C^P = \left[(8+3) * \frac{7}{-3+7} \right] - 3 = \frac{11 \times 7}{4} - 3 = \frac{77}{4} - 3 = \frac{77-12}{4} = \boxed{\frac{65}{4}}$$

$$Y_C^P = \left[(4+2) * \frac{7}{4} \right] + 2 = \frac{14}{4} + 2 = \frac{14+8}{4} = \boxed{\frac{22}{4}}$$

$$Z_C^P = \left[(-3 + 7) * \frac{7}{4} \right] - 7 = 7 - 7 = \boxed{0} \checkmark$$

PS/B

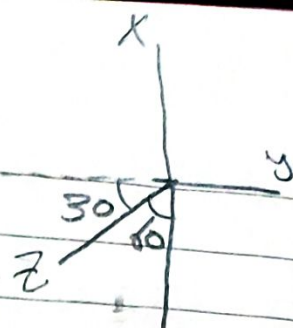
0.15

↓

$$\text{Horizontal} = y = y - z \times \cos 30$$

↓ -0.3

$$\text{Vertical} = X = X - z \times \sin 60$$



$$A \Rightarrow y = 8 - 3 \times \cos 30 = 8 - (3 \times 0.15) = 8 - 0.45 = \boxed{7.55}$$

$$X = -2 - 3 \times \sin 60 = -2 - (3 \times 0.3) = -2 + 0.9 = \boxed{-1.1}$$

$$A = (7.55, -1.1, 0)$$

$$B \Rightarrow y = -9 - 3 \times \cos 30 = -9 - 0.45 = \boxed{-9.45}$$

$$X = -4 - 3 \times \sin 60 = -4 + 0.9 = \boxed{-4.9}$$

$$B = (-9.45, -4.9, 0)$$

$$C \Rightarrow y = 4 - 3 \times \cos 30 = 4 - 0.45 = \boxed{3.55}$$

$$X = 8 - 3 \times \sin 60 = 8 + 0.9 = \boxed{8.9}$$

$$C = (3.55, 8.9, 0)$$

Q1/ Answer only one branch

A) $A = [12 \ -1 \ -5]$, $B = -8i + 7j - 12k$ find angle $(A \times B)$ in main axes.

B) $A = [12 \ -1 \ -5]$, $B = -8i + 7j - 12k$ find unit vector of $(A - B)$.

Q2/ Perform the following operation using matrix representation: move x by 2 and z by -5 after shear z by $3/14$ and y by -81 then Mirror about XZ plan, scale x by $2/3$ and reduce z by 7 and rotate at z -axis by 200 anticlockwise on point $P(-23, -3, 16)$.

Q3/ Answer only one branch

A/ Figure $\{A(-2, 8, 3), B(4, -9, 10), C(8, 4, -3)\}$ projection at plane XY where $COP(-3, 2, -7)$

B/ Figure $\{A(-2, 8, 3), B(4, -9, 10), C(8, 4, -3)\}$ where Z -axis oblique on Vertical by 60° for the figure below

