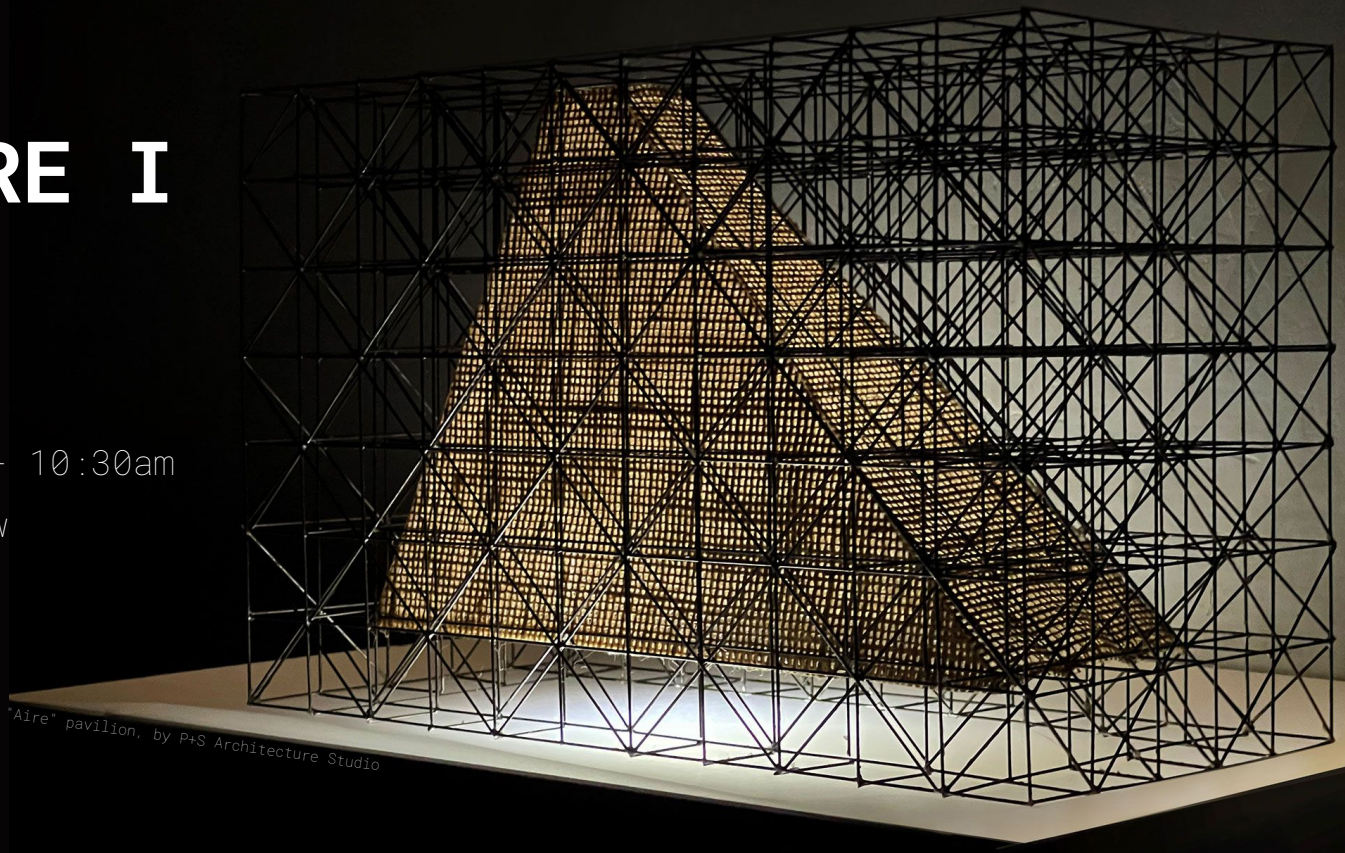
STRUCTURE I

ARCH-314

Friday(s): 9:30am - 10:30am

East Review

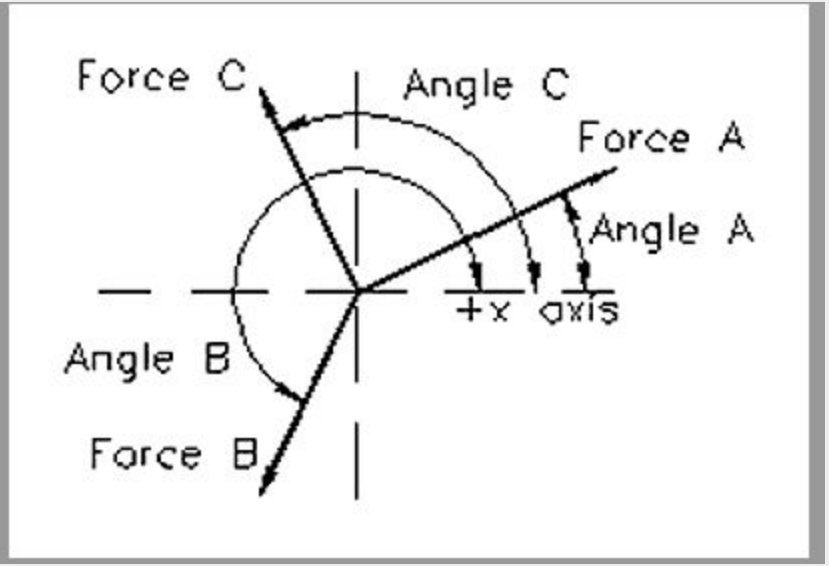


PROBLEM NO.2

Find the horizontal and vertical components of each of the three forces shown. Then find the resultant of all forces and the angle measured counter-clockwise from the + x-axis.

DATASET: 1 -2- -3-

Force A	21 LBS
Angle A	6 DEGREES
Force B	68 LBS
Angle B	210 DEGREES
Force C	39 LBS
Angle C	284 DEGREES



PROBLEM NO.2

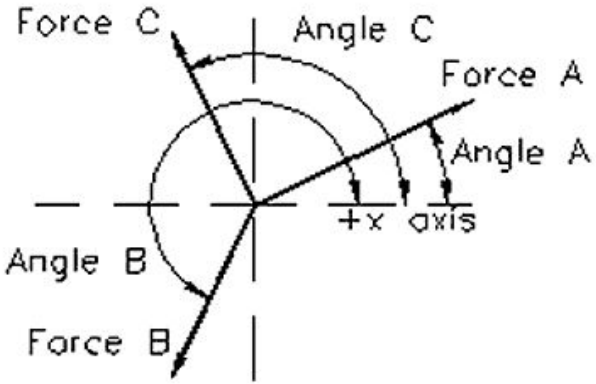
Question 1:Horizontal component of Force A (+ upward: - downward)

$$F_{AX}\ (\textit{horizontal component of Force A}) = F_A\ (\textit{Force A}) \times \cos\theta_A\ (\textit{Angle A})$$

$$F_{AX} = 21 \times \cos 6$$

$$F_{AX} = 21 \times 0.99$$

$$\boxed{F_{AX} = 20.88\ LBS}$$



2. Three Vector Addition

Find the horizontal and vertical components of each of the three forces shown. Then find the resultant of all forces and the angle measured counter-clockwise from the + x-axis.

DATASET: 1 -2- -3-

Force A	21 LBS
Angle A	6 DEGREES
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Angle B	210 DEGREES
Force C	39 LBS
Angle C	284 DEGREES

PROBLEM NO.2

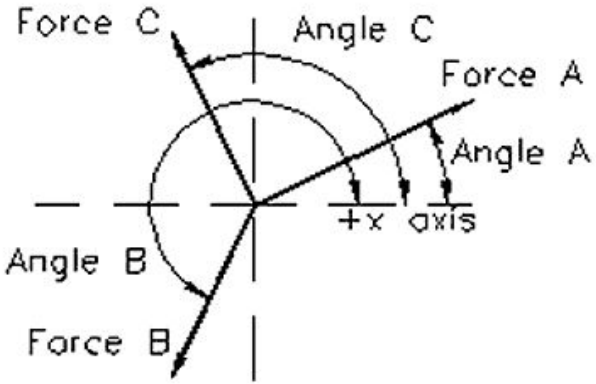
Question 2: Vertical component of Force A (+ to right: - to left

$$F_{AY}\ (\textit{vertical component of Force A}) = F_A\ (\textit{Force A}) \times \sin\theta_A\ (\textit{Angle A})$$

$$F_{AY} = 21 \times \sin 6$$

$$F_{AY} = 21 \times 0.10$$

$$\boxed{F_{AY} = 2.10\ LBS}$$



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Angle A	6 DEGREES
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Angle B	210 DEGREES
Force C	39 LBS
Angle C	284 DEGREES

PROBLEM NO.2

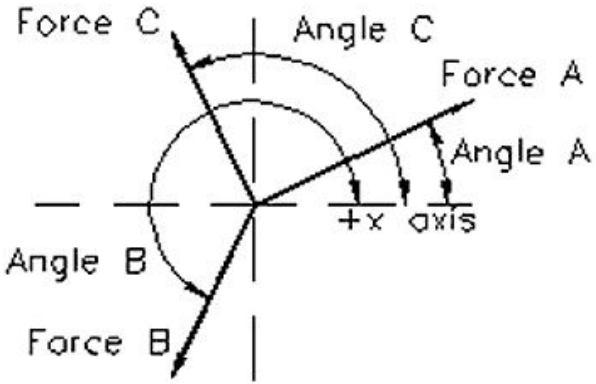
Question 3: Horizontal component of Force B (+ to right: - to left)

$$F_{BX}\ (horizontal\ \ component\ of\ \ Force\ B) = F_B\ (Force\ B) \times \cos\theta_B (Angle\ B)$$

$$F_{BX} = 68 \times \cos 210$$

$$F_{BX} = 68 \times (-0.86)$$

$$F_{BX} = -58.88\ LBS$$



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Angle A	6 DEGREES
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Angle B	210 DEGREES
Force C	39 LBS
Angle C	284 DEGREES

PROBLEM NO.2

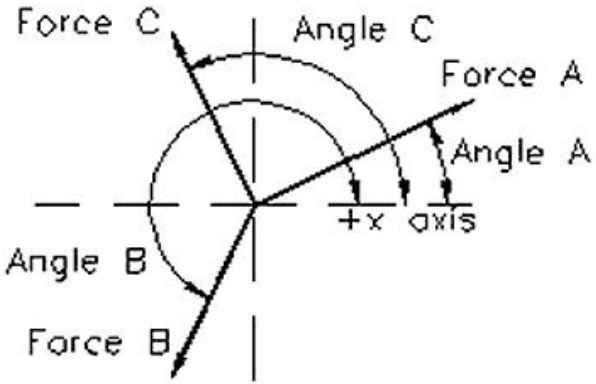
Question 4: Vertical component of Force B (+ to right: - to left)

$$F_{BY}\ (\textit{vertical component of Force B}) = FB\ (\textit{Force B}) \times \sin\theta_B\ (\textit{Angle B})$$

$$F_{BY} = 68 \times \sin 210$$

$$F_{BY} = 68 \times (-0.5)$$

$$\boxed{F_{BY} = -34\ LBS}$$



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Find the horizontal and vertical components of each of the three forces shown. Then find the resultant of all forces and the angle measured counter-clockwise from the + x-axis.

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Angle A	6 DEGREES
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Angle B	210 DEGREES
Force C	39 LBS
Angle C	284 DEGREES

PROBLEM NO.2

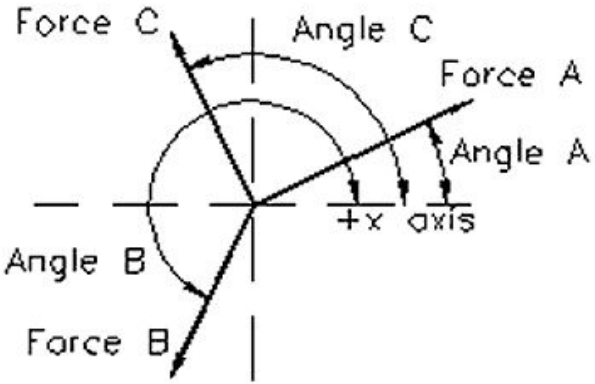
Question 5:Horizontal component of Force C (+ to right: - to left)

$$F_{CX}\ (\textit{horizontal component of Force B}) = FC\ (\textit{Force C}) \times \sin\theta_C\ (\textit{Angle C})$$

$$F_{CX} = 39 \times \cos 284$$

$$F_{CX} = 39 \times 0.24$$

$$\boxed{F_{CX} = 9.43\ LBS}$$



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Find the horizontal and vertical components of each of the three forces shown. Then find the resultant of all forces and the angle measured counter-clockwise from the + x-axis.

DATASET: 1 -2- -3-

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Angle A	6 DEGREES
Force B	68 LBS
Angle B	210 DEGREES
Force C	39 LBS
Angle C	284 DEGREES

PROBLEM NO.2

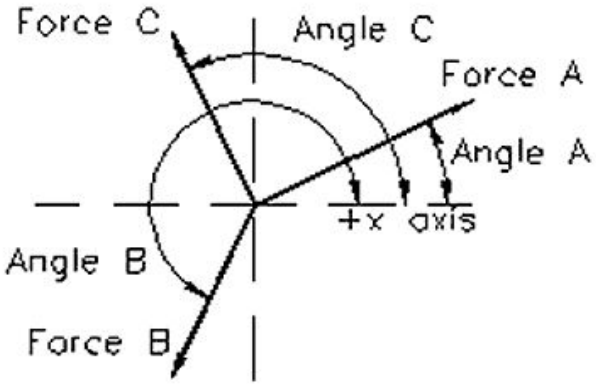
Question 6:Vertical component of Force C (+ to right: - to left)

$$F_{CY}\ (\textit{vertical component of Force C}) = FC\ (\textit{Force C}) \times \sin\theta_C(\textit{Angle C})$$

$$F_{CY} = 39 \times \sin 284$$

$$F_{CY} = 39 \times (-0.97)$$

$$F_{CY} = -37.84\ LBS$$



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Angle A	6 DEGREES
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Angle C	284 DEGREES

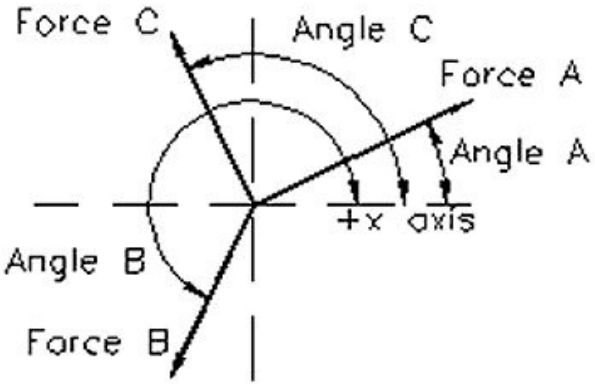
PROBLEM NO.2

Question 7: Sum of horizontal components (+ to right: - to left)

$$F\sum_X (\text{sum of horizontal component}) = F_{AX}(\text{Question 1}) + F_{BX}(\text{Question 3}) + F_{CX}(\text{Question 5})$$

$$F\sum_X = 20.88\ LBS + (-58.88)\ LBS + 9.43\ LBS$$

$$F\sum_X = -28.57\ LBS$$



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Angle C	284 DEGREES

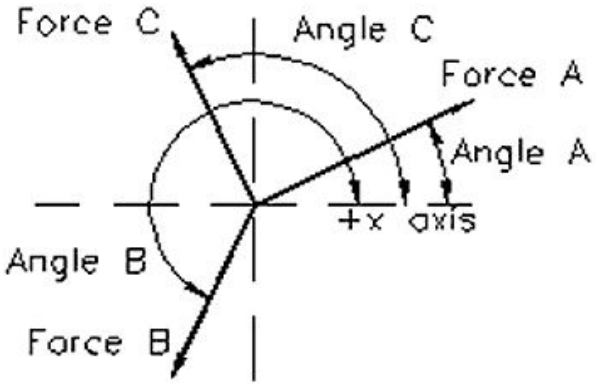
PROBLEM NO.2

Question 8: Sum of vertical components (+ to right: - to left)

$$F\sum_{Y}(\text{sum of vertical component}) = F_{AY}(\text{Question 2}) + F_{BY}(\text{Question 4}) + F_{CY}(\text{Question 6})$$

$$F\sum_{Y} = 2.10\ LBS + (-34)\ LBS + (-37.84)\ LBS$$

$$\boxed{F\sum_{Y} = -69.74\ LBS}$$



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PROBLEM NO.2

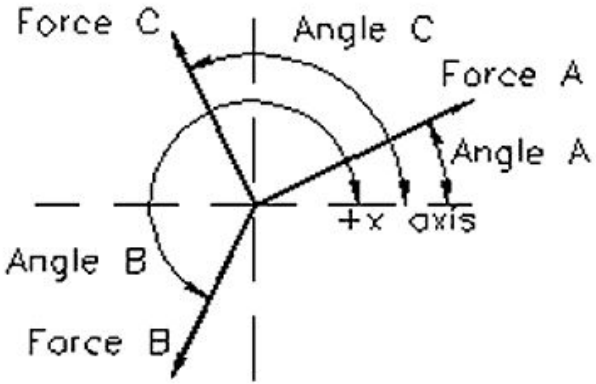
Question 9: Resultant of Forces A + B + C (absolute value)

$$F_R(\textit{Resultant of Forces } A + B + C) = \left[\sqrt{F_{RX}{}^2(\textit{Question 7}) + F_{RY}{}^2(\textit{Question 8})}\right]$$

$$F_R = \left[\sqrt{(-28.61)^2 LBS + (-69.74)^2 LBS}\right]$$

$$F_R = [75.38]$$

$$F_R = 75.38$$



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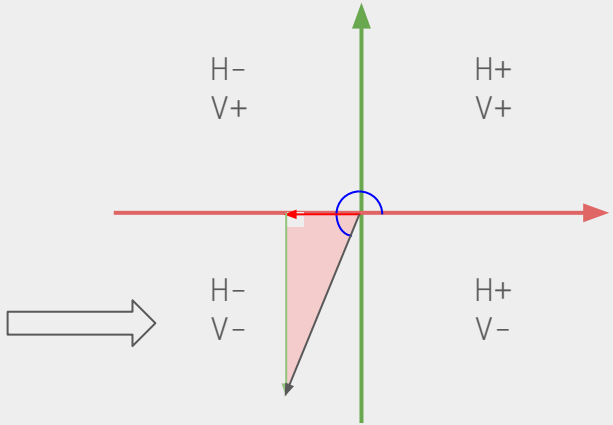
PROBLEM NO.2

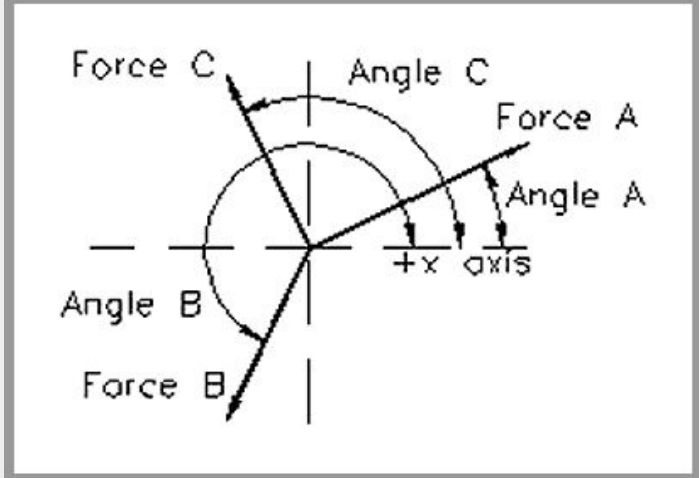
Question 10: Angle of the Resultant in DEGREES from + x axis counterclockwise

Where is our Resultant Vector?

Question 7:
Sum of **Horizontal** components was **- Negative**

Question 8:
Sum of **vertical** components was **- Negative**





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Question 10: Angle of the Resultant in DEGREES from + x axis counterclockwise

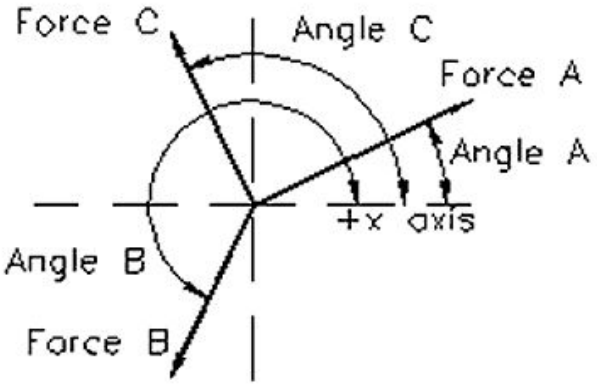
$$\theta_R = \tan^{-1}\left(\frac{FR_y \text{ (Question 8)}}{FRx \text{ (Question 7)}}\right)$$

$$\theta_R = \tan^{-1}\left(\frac{-69.74}{-28.57}\right)$$

$$\theta_R = 67.71$$

$$= 67.71 + 90^\circ \text{ (First Quarter)} + 90^\circ \text{ (Second Quarter)}$$

$$= 247.71$$



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PROBLEM NO.2

Lab Activity

Description

This project is intended to give a sense how forces combine in a system of equilibrium. A selection of 3 force equilibrium systems are modeled both physically and graphically to verify hand calculations.

Goals

To model two component forces of an equilibrant in tension using a physical model.
To show the vector addition of the same 2 forces to find the resultant
To make hand calculations of the same vector addition.

Procedure

1. Using a piece of string with some weight tied to the middle; hold the two string ends at 0° and 90° (horizontal and vertical). Observe that the horizontal is slack (no force in the string). Your hand on the vertical string is the equilibrant force to the force of gravity acting on the weight.
2. Move the vertical string so one string is at 45° and the other at 0° (horizontal).
3. Make a scaled sketch of equilibrant force (opposite to the weight) and its 2 component forces (the two strings in your hands). Scale the *force* not the string. Assume the weight to be 10 units. Scale the forces on the graph paper and estimate the force magnitude of each of the two component forces.
4. Use either trigonometry or similar triangles to calculate the forces in the strings. Compare your results with the graphic result.
5. Try another variation like the third figure below.
6. Try to pull the 2 strings horizontal (don't break the string). Observe that there tends to be a small sag in the string even when pulled fairly taught.