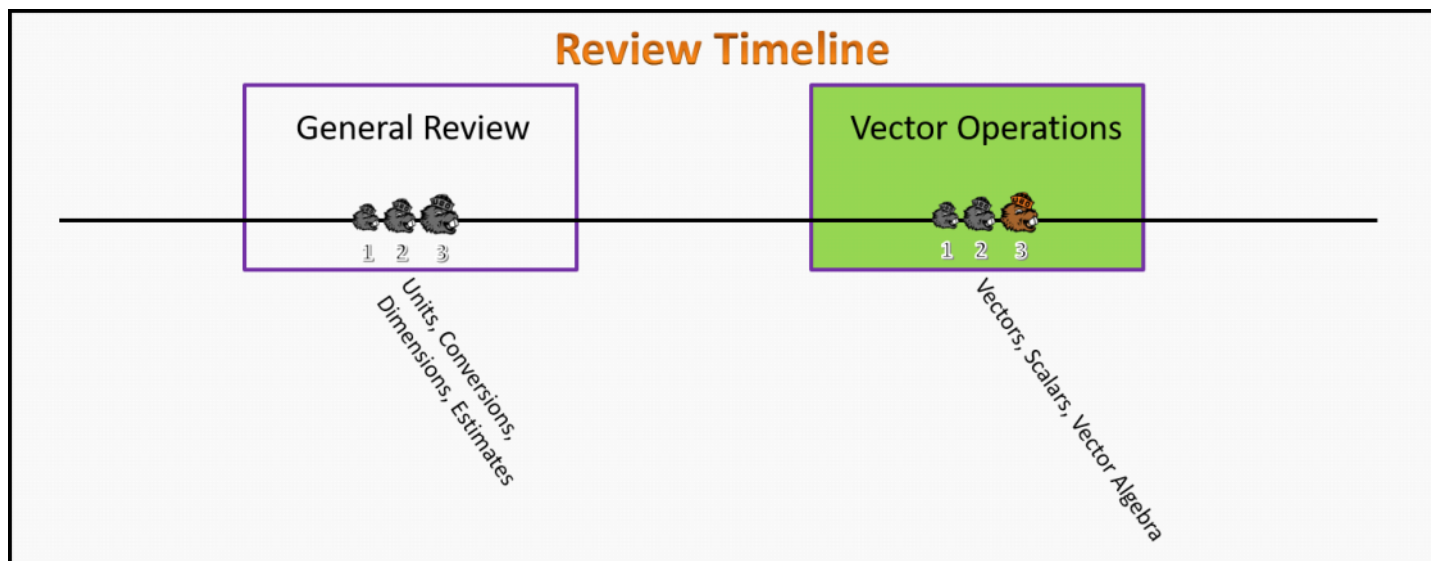


General Review Practice Stage (VO.L1.3)

Post-Lecture 1 Vectors, Scalars, Vector Algebra



Questions

VO.L1.3-01

Description: Vector components question

Learning Objectives: [x]

Problem Statement: Which of the following represents the vector below.

① $\vec{v} = |\vec{v}| \langle \cos \theta, \sin \theta \rangle$

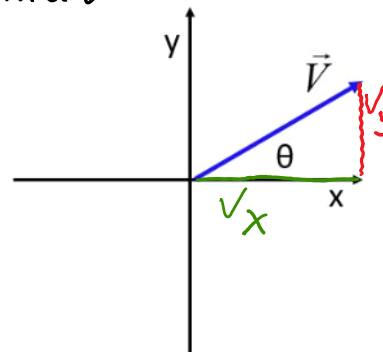
(2) $\vec{v} = |\vec{v}| \langle \sin \theta, \cos \theta \rangle$

(3) $\vec{v} = |\vec{v}| \langle -\sin \theta, \cos \theta \rangle$

(4) $\vec{v} = -|\vec{v}| \langle -\cos \theta, -\sin \theta \rangle$

$v_x = |\vec{v}| \cos \theta$ $v_y = |\vec{v}| \sin \theta$

$\vec{v} = \langle v_x, v_y \rangle$



VO.L1.3-02

Description: Vector components question

Learning Objectives: [x]

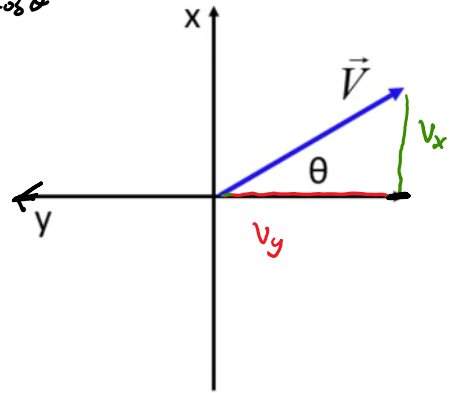
Problem Statement: Which of the following represents the vector below. Note the non-standard coordinate system.

(1) $\vec{v} = |\vec{v}| \langle \cos \theta, \sin \theta \rangle$ $v_x = |\vec{v}| \sin \theta$ $v_y = |\vec{v}| \cos \theta$

(2) $\vec{v} = |\vec{v}| \langle \sin \theta, -\cos \theta \rangle$ $\vec{v} = \langle v_x, v_y \rangle$

(3) $\vec{v} = |\vec{v}| \langle -\sin \theta, \cos \theta \rangle$

(4) $\vec{v} = -|\vec{v}| \langle -\cos \theta, -\sin \theta \rangle$



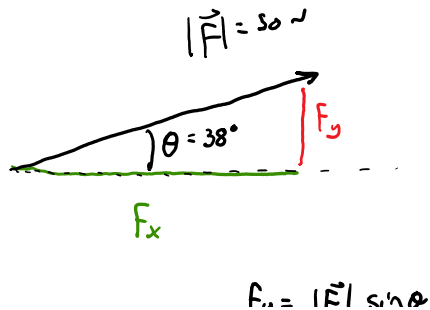
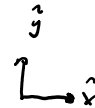
VO.L1.3-03

Description: Finding vector components from words

Learning Objectives: [x]

Problem Statement: If a child pulls a sled through the snow with a force of 50 N exerted at an angle of 38° above the horizontal, find the horizontal and vertical components of the force.

- (1) horizontal = 14.4 N , vertical = 38.6 N
- (2) horizontal = 14.4 N , vertical = 42.1 N
- (3) horizontal = 14.4 N , vertical = 33.8 N
- (4) horizontal = 39.4 N , vertical = 30.8 N
- (5) horizontal = 39.4 N , vertical = 32.2 N
- (6) horizontal = 39.4 N , vertical = 29.6 N



F_x

$$\begin{aligned} F_x &= |\vec{F}| \cos \theta \text{ N} \\ &= 50 \cos 38^\circ \text{ N} \\ &= 39.4005 \text{ N} \end{aligned}$$

$$\boxed{F_x = 39.4 \text{ N}} \text{ HORIZONTAL}$$

$$\begin{aligned} F_y &= |\vec{F}| \sin \theta \\ &= 50 \sin 38^\circ \text{ N} \\ &= 30.7831 \text{ N} \end{aligned}$$

$$\boxed{F_y = 30.8 \text{ N}} \text{ VERTICAL}$$

VO.L1.3-04

Description: Adding vectors

Learning Objectives: [x]

Problem Statement: Use the figure to determine a single vector that is equivalent to the summation of vectors shown. Note: \overrightarrow{PQ} represents a vector pointing from point P to point Q.

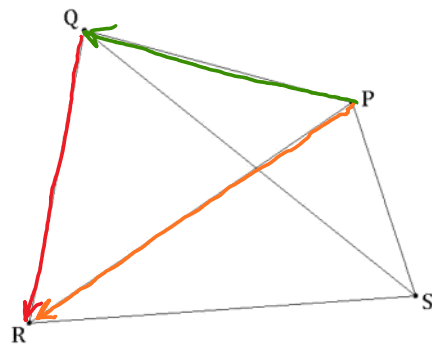
(a) $\overrightarrow{PQ} + \overrightarrow{QR} = \overrightarrow{PR}$

(1) \overrightarrow{PR}

(2) \overrightarrow{RS}

(3) \overrightarrow{RQ}

(4) \overrightarrow{PQ}



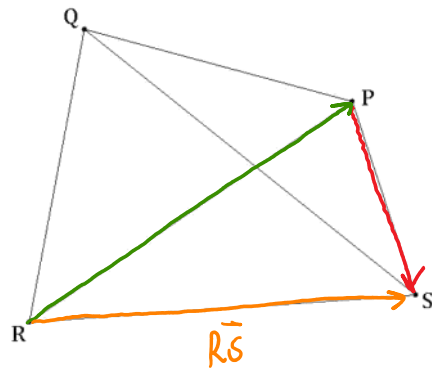
(b) $\overrightarrow{RP} + \overrightarrow{PS} = \overrightarrow{RS}$

(1) \overrightarrow{PR}

(2) \overrightarrow{RS}

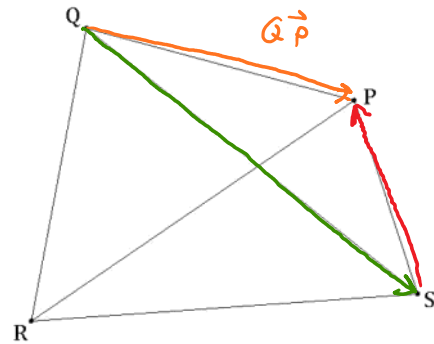
(3) \overrightarrow{RQ}

(4) \overrightarrow{PQ}



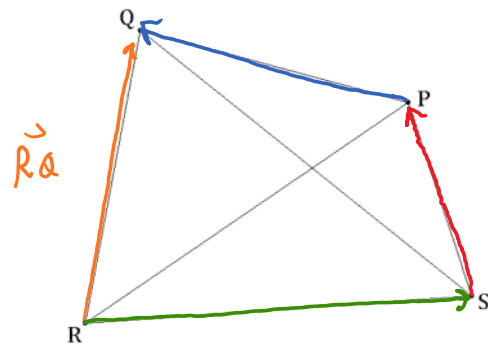
(c) $\vec{QS} - \vec{PS} = \vec{QP}$

- (1) \vec{PR}
- (2) \vec{RS}
- (3) \vec{RQ}
- (4) \vec{QP}



(d) $\vec{RS} + \vec{SP} + \vec{PQ} = \vec{RQ}$

- (1) \vec{PR}
- (2) \vec{RS}
- (3) \vec{RQ}
- (4) \vec{PQ}



VO.L1.3-05

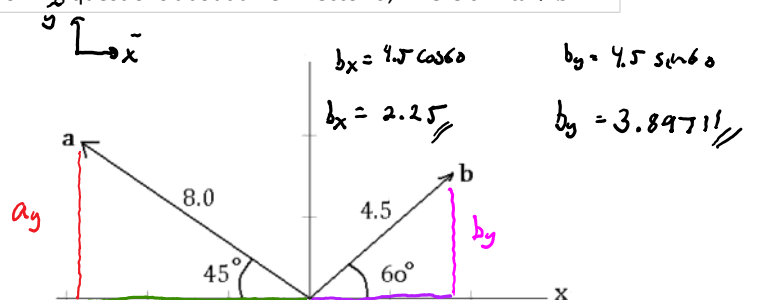
Description: Adding vectors

Learning Objectives: [x]

Problem Statement: Use the figure to answer the following questions about a new vector \vec{c} , where $\vec{c} = \vec{a} + \vec{b}$.

(a) What is the magnitude of the vector \vec{c} ?

- (1) 9.12
 - (2) 9.81
 - (3) 10.1
 - (4) 12.5
 - (5) 13.7
- $a_x = -8 \cos 45$ $a_y = 8 \sin 45$
 $a_x \approx -5.65685$ $a_y \approx 5.65685$

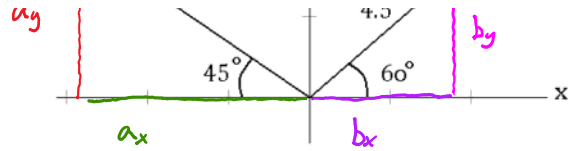


- (4) 12.5
- (5) 13.7

$$\vec{c} = \langle a_x + b_x, a_y + b_y \rangle$$

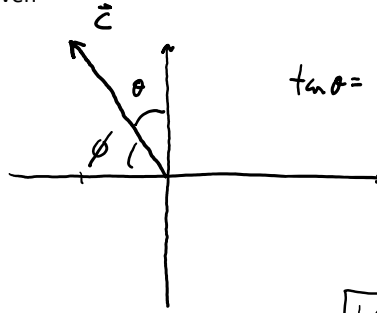
$$\vec{c} = \langle -3.40685, 9.55396 \rangle$$

$$|\vec{c}| = 10.1432 \approx \boxed{10.1}$$



(b) What is the angle, in reference to the given direction, for vector \vec{c} ?

- (1) 19.6°, from +y towards +x
- (2) 19.6°, from +x towards -y
- (3) 19.6°, from +y towards -x
- (4) 25.0°, from +y towards +x
- (5) 25.0°, from +x towards -y
- (6) 25.0°, from +y towards -x



$$\tan \theta = \frac{3.40685}{9.55396}$$

$$\theta \approx 19.6257^\circ$$

$$\boxed{\theta \approx 19.6^\circ} \quad +\hat{y} \text{ to } -\hat{x}$$

$$\phi = 90 - \theta$$

$$\phi = 70.4^\circ \quad -\hat{x} \text{ to } \hat{y}$$

VO.L1.3-06

Description: Adding vectors

Learning Objectives: [x]

Problem Statement: Use the figure to answer the following questions about a new vector \vec{c} , where $\vec{c} = \vec{a} + \vec{b}$.

(a) What is the magnitude of the vector \vec{c} ?

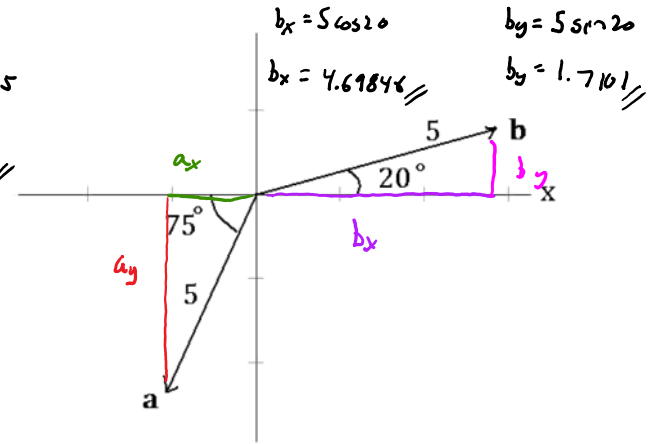
- (1) 1.54
- (2) 7.62
- (3) 10.0
- (4) 4.62
- (5) 13.2

$$a_x = -5 \cos 75 \quad a_y = -5 \sin 75$$

$$a_x = -1.2941 \quad a_y = -4.82963$$

$$b_x = 5 \cos 20 \quad b_y = 5 \sin 20$$

$$b_x = 4.69846 \quad b_y = 1.7101$$



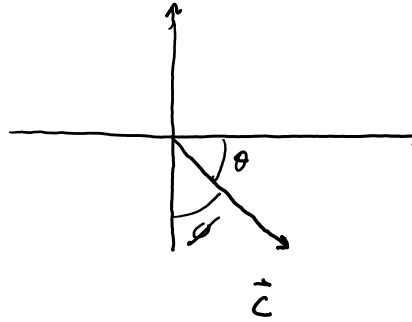
$$\vec{c} = \langle a_x + b_x, a_y + b_y \rangle$$

$$\vec{c} = \langle 3.40436, -3.11953 \rangle$$

$$|\vec{c}| = 4.6175 \approx \boxed{4.62}$$

(b) What is the angle, in reference to the given direction, for vector \vec{c} ?

- (1) 42.5° , from +y towards +x
- ② 42.5° , from +x towards -y
- (3) 42.5° , from +y towards -x
- (4) 38.6° , from +y towards +x
- (5) 38.6° , from +x towards -y
- (6) 38.6° , from +y towards -x



$$\theta = \tan^{-1} \left(\frac{3.11953}{3.40436} \right)$$

$$\boxed{\theta = 42.5^\circ} \quad \hat{x} \text{ to } -\hat{y}$$

$$\beta = 90 - \theta$$

$$\beta = 47.5^\circ \quad -\hat{y} \text{ to } \hat{x}$$

VO.L1.3-07

Description: Adding vectors

Learning Objectives: [x]

Problem Statement: Use the figure to answer the following questions about a new vector \vec{c} , where $\vec{c} = \vec{a} - \vec{b}$.

(a) What is the magnitude of the vector \vec{c} ?

- (1) 12.5
- (2) 11.7
- (3) 9.81
- ④ 8.10
- (5) 6.54

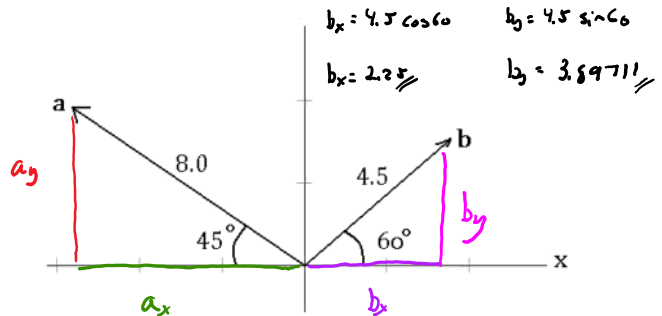
$$a_x = 8 \cos 45 \quad a_y = 8 \sin 45$$

$$a_x = -5.65685 \quad a_y = 5.65685$$

$$\vec{c} = \langle a_x - b_x, a_y - b_y \rangle$$

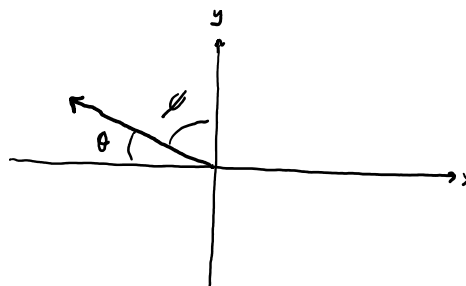
$$\vec{c} = \langle -7.90685, 1.75974 \rangle$$

$$|\vec{c}| = 8.10031 = \boxed{8.1}$$



(b) What is the angle, in reference to the given direction, for vector \vec{c} ?

- (1) 23.1° , from +y towards +x
- (2) 23.1° , from -x towards +y
- (3) 23.1° , from +y towards -x
- (4) 12.5° , from +y towards +x
- ⑤ 12.5° , from -x towards +y
- (6) 12.5° , from +y towards -x



- Ⓒ 12.5°, from -x towards +y
- (6) 12.5°, from +y towards -x

$$\theta = \tan^{-1} \left(\frac{1.75974}{7.40685} \right)$$

$$\theta \approx 12.54719^\circ$$

$$\boxed{\theta = 12.5^\circ} \quad -\hat{x} \text{ to } \hat{y}$$

$$\phi = 90 - \theta$$

$$\phi = 77.5^\circ \quad \hat{y} \text{ to } -\hat{x}$$

VO.L1.3-08

Description: Adding vectors

Learning Objectives: [x]

Problem Statement: Use the figure to answer the following questions about a new vector \vec{c} , where $\vec{c} = \vec{a} - \vec{b}$.

(a) What is the magnitude of the vector \vec{c} ?

- Ⓐ 8.87
- (2) 11.7
- (3) 13.2
- (4) 15.5
- (5) 23.6

$$a_x = -5 \cos 75^\circ \quad a_y = -5 \sin 75^\circ$$

$$b_x = 5 \cos 20^\circ \quad b_y = 5 \sin 20^\circ$$

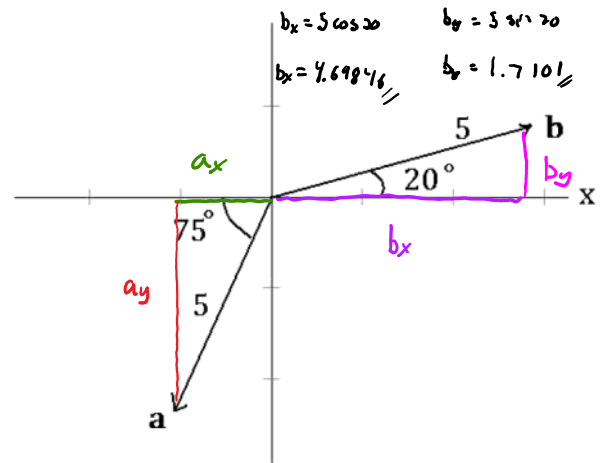
$$a_x = -1.29410 \quad a_y = -4.82963$$

$$b_x = 4.69846 \quad b_y = 1.7101$$

$$\vec{c} = \langle a_x - b_x, a_y - b_y \rangle$$

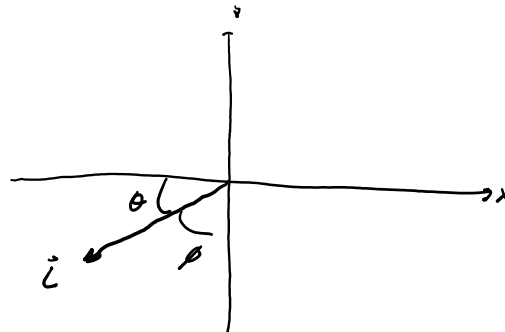
$$\vec{c} = \langle -5.99256, -6.53973 \rangle$$

$$|\vec{c}| = 8.8701 = \boxed{8.87}$$



(b) What is the angle, in reference to the given direction, for vector \vec{c} ?

- (1) 47.5°, from +y towards +x
- (2) 47.5°, from -x towards +y
- Ⓒ 47.5°, from -y towards -x
- (4) 56.7°, from +y towards +x
- (5) 56.7°, from -x towards +y
- (6) 56.7°, from -y towards -x



$$\theta = \tan^{-1} \left(\frac{6.539737}{5.99256} \right)$$

$$\boxed{\theta = 47.5^\circ} \quad -\hat{x} \text{ to } -\hat{y}$$

$$\phi = 90 - \theta$$

$$\phi = 42.5^\circ \quad -\hat{y} \text{ to } -\hat{x}$$

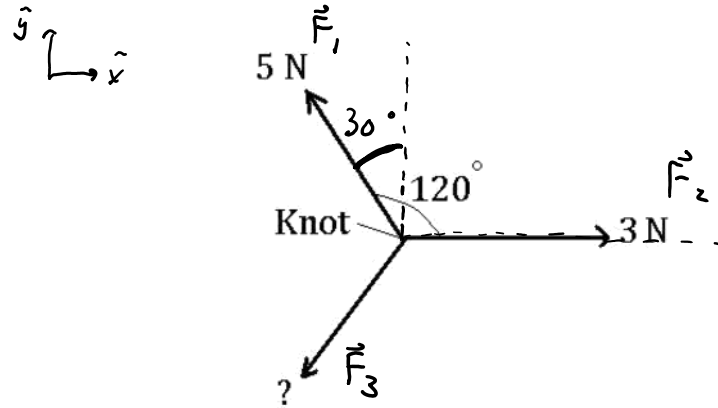
VO.L1.3-09

Description: Adding vectors

Learning Objectives: [x]

Problem Statement: The figure shows three ropes tied together in a knot. One of your friends pulls on a rope with a force of 3 N and another pulls on a second rope with a force of 5 N. How hard, and in what direction must you pull on the third rope to keep the knot from moving? Use a standard coordinate system. (Hint: if you don't want the knot to move, the net force must be equal to zero)

- (1) 8.0 N , 60° from -x towards -y
- (2) 8.0 N , 40° from -x towards -y
- (3) 6.4 N , 65° from -x towards -y
- (4) 6.4 N , 68° from -x towards -y
- (5) 4.4 N , 76° from -x towards -y
- Ⓒ 4.4 N , 83° from -x towards -y



$$\sum \vec{F} = \vec{0}$$

$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 = \vec{0}$$

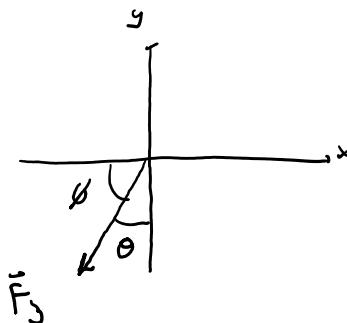
$$\begin{aligned} \underline{x} \\ F_{1x} + F_{2x} + F_{3x} &= 0 \\ -2.5 + 3 + F_{3x} &= 0 \\ F_{3x} &= -0.5 \text{ N} \end{aligned}$$

$$\begin{aligned} \underline{y} \\ F_{1y} + F_{2y} + F_{3y} &= 0 \\ 4.33013 + 0 + F_{3y} &= 0 \\ F_{3y} &= -4.33013 \text{ N} \end{aligned}$$

$$\begin{aligned} F_{1x} &= -5 \sin 30^\circ = -2.5 \\ F_{1y} &= 5 \cos 30^\circ = 4.33013 \\ \vec{F}_1 &= \langle -2.5, 4.33013 \rangle \text{ N} \\ \vec{F}_2 &= \langle 3, 0 \rangle \text{ N} \end{aligned}$$

$$\vec{F}_3 = \langle -0.5, -4.33013 \rangle \text{ N}$$

$$|\vec{F}_3| = 4.358902 \text{ N} = 4.36 \text{ N}$$



$$\theta = \tan^{-1} \left(\frac{0.5}{4.33013} \right)$$

$$\theta \approx 6.59^\circ \text{ from } -x \text{ to } -y$$

\vec{F}_3

|

7.250's ~

$$\theta \approx 6.58677^\circ = \boxed{6.59^\circ \text{ } -\hat{y} \text{ to } -\hat{x}}$$

$$\phi = 90 - \theta$$

$$\boxed{\phi = 83.4^\circ \text{ } -\hat{x} \text{ to } -\hat{y}}$$