PROBLEMS

2-1. Determine the magnitude of the resultant force \( F_R = F_1 + F_2 \) and its direction, measured counterclockwise from the positive \( x \) axis.

\[ F_1 = 600 \text{ N} \]
\[ F_2 = 800 \text{ N} \]
\[ F_3 = 450 \text{ N} \]

Prob. 2-1

2-4. Determine the magnitude of the resultant force \( F_R = F_1 + F_2 \) and its direction, measured clockwise from the positive \( u \) axis.

2-5. Resolve the force \( F_1 \) into components acting along the \( u \) and \( v \) axes and determine the magnitudes of the components.

2-6. Resolve the force \( F_2 \) into components acting along the \( u \) and \( v \) axes and determine the magnitudes of the components.

2-13. A resultant vertical force of 350 lb is necessary to hold the balloon in place. Resolve this force into components along the tether lines \( AB \) and \( AC \), and compute the magnitude of each component.

Prob. 2-13

2-25. The boat is to be pulled onto the shore using two ropes. Determine the magnitudes of forces \( T \) and \( P \) acting in each rope in order to develop a resultant force of 80 lb, directed along the keel \( aa \) as shown. Take \( \theta = 40^\circ \).

2-26. The boat is to be pulled onto the shore using two ropes. If the resultant force is to be 80 lb, directed along the keel \( aa \) as shown, determine the magnitudes of forces \( T \) and \( P \) acting in each rope and the angle \( \theta \) of \( P \) so that the magnitude of \( P \) is a minimum. \( T \) acts at 30° from the keel as shown.
2-32. Determine the magnitude of the resultant force and its direction, measured clockwise from the positive x axis.

2-38. Determine the magnitude of the resultant force and its direction, measured counterclockwise from the positive x axis.

2-50. Express each of the three forces acting on the column in Cartesian vector form and compute the magnitude of the resultant force.
2-89. Determine the magnitude and coordinate direction angles of the force \( \mathbf{F} \) acting on the stake.

2-67. The beam is subjected to the two forces shown. Express each force in Cartesian vector form and determine the magnitude and coordinate direction angles of the resultant force.

2-73. The pole is subjected to the force \( \mathbf{F} \) which has components \( F_x = 1.5 \text{ kN} \) and \( F_z = 1.25 \text{ kN} \). If \( \beta = 75^\circ \), determine the magnitudes of \( \mathbf{F} \) and \( F_y \).
2-1. Determine the magnitude of the resultant force \( F_R = F_1 + F_2 \) and its direction, measured counterclockwise from the positive x axis.

\[
F_R = \sqrt{(600)^2 + (800)^2 - 2(600)(800)\cos75^\circ} = 866.91 = 867 \text{ N} \quad \text{Ans}
\]

\[
\theta = \tan^{-1}\left(\frac{800}{600}\right) = 53.13^\circ = 63.05^\circ 
\]

\( \phi = 63.05^\circ + 45^\circ = 108^\circ \quad \text{Ans} \)

4. Find the magnitude of \( F_r \) and its direction.

\[
F_r = 300\cos(30) \hat{i} - 300\sin(30) \hat{j} = 259.8 \hat{i} - 150.0 \hat{j} \]

\[
F_2 = -500\sin(25) \hat{i} - 500\cos(25) \hat{j} = -211.3 \hat{i} - 453.2 \hat{j} \]

\[
F_r = 48.5 \hat{i} - 603.2 \hat{j} 
\]

\[
\Theta = \tan^{-1}\left(\frac{603.2}{48.5}\right) = 85.4^\circ \quad \text{clockwise} \quad \text{from the positive u-axis.} 
\]
32) Find: the magnitude of \( F_r \) and its direction clockwise from the positive x-axis.

\[
F_r = 50 \cos(30) \hat{i} - 50 \sin(30) \hat{j} \\
= 43.3 \hat{i} - 25.0 \hat{j}
\]

\[
F_r = -65 \cos(45) \hat{i} - 65 \sin(45) \hat{j} \\
= -46.0 \hat{i} - 46.0 \hat{j}
\]

38) Find: the magnitude of \( F_r \) and its direction counterclockwise from positive x-axis.

\[
F_r = 26 \text{ KN} 
\]

\[
F_r = -26 \cdot \frac{5}{13} \hat{i} + 26 \cdot \frac{12}{13} \hat{j} \\
= -10 \hat{i} + 24 \hat{j} 
\]

\[
F_r = -25 \hat{i} - 7 \hat{j}, \theta = \tan^{-1}(\frac{7}{25}) = 4.57^\circ + 180^\circ \\
F_r = 25.1 \text{ KN}, \theta = 184.6^\circ \text{ counterclockwise from positive x-axis}
\]
50) Find the components of $F_1$, $F_2$, $F_3$ and magnitude

$F_1 = 150 \cdot \frac{3}{5} \hat{i} - 150 \cdot \frac{4}{5} \hat{j}$

$F_2 = 275 \hat{j}$

$F_3 = 75 \cos(60) \hat{i} - 75 \sin(60) \hat{j}$

$F_F = 52.5 \hat{i} - 460 \hat{j}$

$F_F = 463.0 \text{ lb}$

59) Find the magnitude and coordinate direction angles of $F_F$

$F = \sqrt{50^2 + 460^2} = 50 \text{ N}$

$\alpha = \cos^{-1}\left(\frac{13.7}{50}\right) = 74.1^\circ$

$\beta = \cos^{-1}\left(\frac{37.6}{50}\right) = 41.2^\circ$

$F_x = 40 \cos(78) = 13.7 \text{ N}$

$F_y = 40 \cos(20) = 37.6 \text{ N}$
73.) Find: the magnitudes of $F$ and $F_y$.

$$F_x = \sqrt{(1.25)^2 + (1.5)^2} = 1.95 \text{ KN}$$

$$F_y = \frac{1.95}{\tan(75)} = 0.52 \text{ KN}$$

$$F = \frac{1.95}{\sin(75)} = 2.02 \text{ KN}$$

67.) Find: the components of $F_1, F_2, F_r$, and determine magnitude and coordinate direction angles of $F_r$.

$$F_1 = 620 \cdot \frac{7}{25} \hat{j} - 620 \cdot \frac{24}{25} \hat{k} = 176.4 \hat{j} - 604.8 \hat{k}$$

$$F_2 = 250 \cos(60) \hat{i} + 250 \cos(135) \hat{j} + 250 \cos(120) \hat{k}$$

$$= 125 \hat{i} - 176.8 \hat{j} + 125 \hat{k}$$

$$F_r = 125 \hat{i} - 0.4 \hat{j} - 479.8 \hat{k}$$

$$F_r = 495.8 \text{ lb}$$

$$\alpha = \cos^{-1}\left(\frac{125}{495.8}\right) = 75.4^\circ$$

$$\beta = \cos^{-1}\left(\frac{4.4}{495.8}\right) = 90.05^\circ$$

$$\gamma = \cos^{-1}\left(\frac{479.8}{495.8}\right) = 165.4^\circ$$