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Procedures and Strategies for Solving Problems Involving Rectangular Components in Three-Dimensional Force Systems

1. If the magnitude $F$ of a force and its direction angles, $\theta_x$, $\theta_y$, and $\theta_z$, are known, then compute the components of the force from the equations:

\[ F_x = F \cos \theta_x \quad F_y = F \cos \theta_y \quad F_z = F \cos \theta_z \]

If only two angles are known, then find the third angle from the equation

\[ \cos^2 \theta_x + \cos^2 \theta_y + \cos^2 \theta_z = 1 \]

2. If the magnitude $F$ is known and the direction of the force is defined through its projection on a horizontal plane, then compute the horizontal components by projecting the projection onto the horizontal axes.

3. If the rectangular components $F_x$, $F_y$, and $F_z$ are known, then compute the magnitude $F$ of the force from the equation

\[ F = \sqrt{F_x^2 + F_y^2 + F_z^2} \]

and the direction angles from

\[ \cos \theta_x = \frac{F_x}{F} \quad \cos \theta_y = \frac{F_y}{F} \quad \cos \theta_z = \frac{F_z}{F} \]

4. To compute the resultant of several force, express each force in rectangular component and add the components:

\[ R_x = \Sigma F_x \quad R_y = \Sigma F_y \quad R_z = \Sigma F_z \]
2.3 Rectangular Components in Three-Dimensional Force Systems Problem Statement for Example 1

1. Express the force $F$ in terms of $x$, $y$, and $z$ components.
2.3 Rectangular Components in Three-Dimensional Force Systems Problem Statement for Example 2

2. Express $F$ in terms of $x, y,$ and $z$ components.
2.3 Rectangular Components in Three-Dimensional Force Systems Problem Statement. for Example 3

3. Express $F$ in terms of $x$, $y$, and $z$ components.
2.3 Rectangular Components in Three-Dimensional Force Systems Problem Statement for Example 4

4. Determine the x, y, and z components of the 26-N force shown. Also determine the coordinate direction angles of the force.

\[ F = 26 \text{ N} \]

\[ \begin{align*}
\text{vector components:} & \\
F_x &= \text{component along x-axis} \\
F_y &= \text{component along y-axis} \\
F_z &= \text{component along z-axis}
\end{align*} \]
5. Determine the magnitude and coordinate direction angles of the resultant of the three forces acting on the mast.
6. Determine the magnitude and coordinate direction angles of the resultant of the forces acting on the eye-bolt.
2.3 Rectangular Components in Three-Dimensional Force Systems Problem Statement. for Example 7

7. A 300-lb vertical force is required to pull the pipe out of the ground. Determine the magnitude and direction angles of the force $F_2$ which, when applied together with the 150-lb force $F_1$ shown, will produce a 300-lb vertical resultant.
8. Two forces, $F_1$ and $F_2$ act on the bracket as shown. If the resultant of $F_1$ and $F_2$ lies in the xy plane, determine the magnitude of $F_2$. Also determine the magnitude of the resultant.

$F_1 = 60$ N