

Required Procedures and Format for Solution Sheets (Applicable to Written Assignments, Quizzes, and Exams)

When solving the assigned problems, you must follow a step-by-step procedure, including providing data in tabular form and/or diagrams where they are needed.

In general, the solution sheet for a particular problem should include:

- Reasoning, for example, “Based on the definition of direction cosines, we have ...”.
- Figure(s): Based a particular question, all necessary figures must be provided.
- Equations, for example, $U_x = |U| \cos \theta_x = (50)(0.5) = 25.0$; note that you should not report only $U_x = (50)(0.5) = 25.0$.
- If a unit of a physical quantity is involved, you need include the proper unit.
- All necessary steps must be reported; for an example of the required procedures and format for presenting solutions to problems, see the sample solution below.

Sample of Problem-Solving Procedures and Format

Sample Problem 1:

In the figure, the magnitude of vector \mathbf{U} is $|\mathbf{U}| = 50$, and the angles between the vector \mathbf{U} and x -, y -, z -axes are 60° , 75° , and 34.265° , respectively.

- (a). Find the direction cosines, and components of \mathbf{U} on three axes, respectively.
 (b). Find the unit vector \mathbf{e} with the same direction as \mathbf{U} .

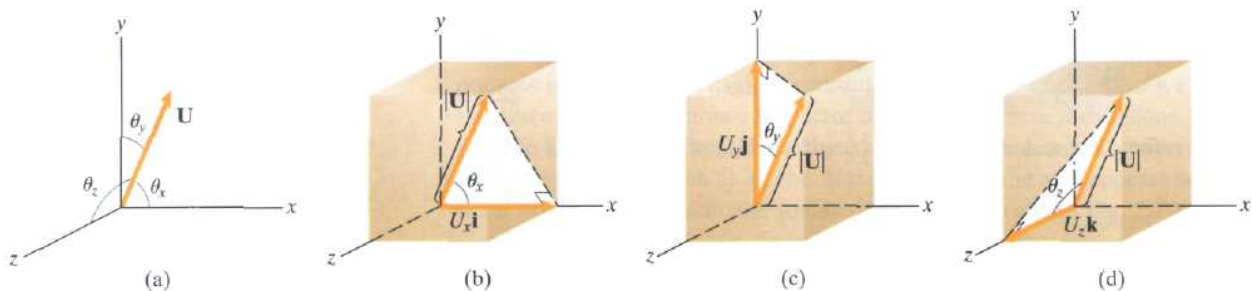


Figure Problem 1

- (a) A vector \mathbf{U} and the angles θ_x , θ_y , and θ_z .
 (b)–(d) The angles θ_x , θ_y , and θ_z and the vector components of \mathbf{U} .

Sample Solution:

(a). Based on the definition of direction cosines, we have

$$\cos \theta_x = \cos 60^\circ = 0.5, \quad \cos \theta_y = \cos 75^\circ = 0.2588, \quad \cos \theta_z = \cos 34.265^\circ = 0.8264$$

The components of the vector \mathbf{U} are respectively given in terms of the angles θ_x , θ_y , and θ_z by

$$U_x = |\mathbf{U}| \cos \theta_x = (50) \cos 60^\circ = (50)(0.5) = 25.0$$

$$U_y = |U| \cos \theta_y = (50) \cos 75^\circ = (50)(0.2588) = 12.94$$

$$U_z = |U| \cos \theta_z = (50) \cos 34.265^\circ = (50)(0.8264) = 41.32$$

[Note: The direction cosines satisfy the relation

$$\cos^2 \theta_x + \cos^2 \theta_y + \cos^2 \theta_z = 1.$$

Please use the numerical data here to verify.

(b). Suppose that \mathbf{e} is a unit vector with the same direction as \mathbf{U} , so that

$$\mathbf{U} = |U|\mathbf{e}.$$

In terms of components, this equation is

$$U_x\mathbf{i} + U_y\mathbf{j} + U_z\mathbf{k} = |U|(e_x\mathbf{i} + e_y\mathbf{j} + e_z\mathbf{k}).$$

so the relations between the components of \mathbf{U} and \mathbf{e} are

$$U_x = |U|e_x, \quad U_y = |U|e_y, \quad U_z = |U|e_z.$$

Thus, we see that

$$\cos \theta_x = e_x, \quad \cos \theta_y = e_y, \quad \cos \theta_z = e_z.$$

from which, we have

$$e_x = \cos \theta_x = \cos 60^\circ = 0.5 \qquad e_y = \cos \theta_y = \cos 75^\circ = 0.2588$$

$$e_z = \cos \theta_z = \cos 34.265^\circ = 0.8264$$

Therefore, $\mathbf{e} = e_x\mathbf{i} + e_y\mathbf{j} + e_z\mathbf{k} = 0.5\mathbf{i} + 0.2588\mathbf{j} + 0.8264\mathbf{k}$

The unit vector \mathbf{e} will have the same direction as \mathbf{U} .