

# Fundamentals of Electromagnetics with Engineering Applications 1st Edition Wentworth Solutions Manual

## Solutions for Chapter 2 Problems

### 1. Vectors in the Cartesian Coordinate System

P2.1: Given  $P(4,2,1)$  and  $\mathbf{A}_{PQ} = 2\mathbf{a}_x + 4\mathbf{a}_y + 6\mathbf{a}_z$ , find the point  $Q$ .

$$\mathbf{A}_{PQ} = 2\mathbf{a}_x + 4\mathbf{a}_y + 6\mathbf{a}_z = (Q_x - P_x)\mathbf{a}_x + (Q_y - P_y)\mathbf{a}_y + (Q_z - P_z)\mathbf{a}_z$$

$$Q_x - P_x = Q_x - 4 = 2; \quad Q_x = 6$$

$$Q_y - P_y = Q_y - 2 = 4; \quad Q_y = 6$$

$$Q_z - P_z = Q_z - 1 = 6; \quad Q_z = 7$$

Ans:  $Q(6,6,7)$

P2.2: Given the points  $P(4,1,0)\text{m}$  and  $Q(1,3,0)\text{m}$ , fill in the table and make a sketch of the vectors found in (a) through (f).

	Vector	Mag	Unit Vector
a. Find the vector $\mathbf{A}$ from the origin to $P$	$\mathbf{A}_{OP} = 4\mathbf{a}_x + 1\mathbf{a}_y$	4.12	$\mathbf{a}_{OP} = 0.97\mathbf{a}_x + 0.24\mathbf{a}_y$
b. Find the vector $\mathbf{B}$ from the origin to $Q$	$\mathbf{B}_{OQ} = 1\mathbf{a}_x + 3\mathbf{a}_y$	3.16	$\mathbf{a}_{OQ} = 0.32\mathbf{a}_x + 0.95\mathbf{a}_y$
c. Find the vector $\mathbf{C}$ from $P$ to $Q$	$\mathbf{C}_{PQ} = -3\mathbf{a}_x + 2\mathbf{a}_y$	3.61	$\mathbf{a}_{PQ} = -0.83\mathbf{a}_x + 0.55\mathbf{a}_y$
d. Find $\mathbf{A} + \mathbf{B}$	$\mathbf{A} + \mathbf{B} = 5\mathbf{a}_x + 4\mathbf{a}_y$	6.4	$\mathbf{a} = 0.78\mathbf{a}_x + 0.62\mathbf{a}_y$
e. Find $\mathbf{C} - \mathbf{A}$	$\mathbf{C} - \mathbf{A} = -7\mathbf{a}_x + 1\mathbf{a}_y$	7.07	$\mathbf{a} = -0.99\mathbf{a}_x + 0.14\mathbf{a}_y$
f. Find $\mathbf{B} - \mathbf{A}$	$\mathbf{B} - \mathbf{A} = -3\mathbf{a}_x + 2\mathbf{a}_y$	3.6	$\mathbf{a} = -0.83\mathbf{a}_x + 0.55\mathbf{a}_y$

a.  $\mathbf{A}_{OP} = (4-0)\mathbf{a}_x + (1-0)\mathbf{a}_y + (0-0)\mathbf{a}_z = 4\mathbf{a}_x + 1\mathbf{a}_y$ .

$$|\mathbf{A}_{OP}| = \sqrt{4^2 + 1^2} = \sqrt{17} = 4.12$$

$$\mathbf{a}_{OP} = \frac{4}{\sqrt{17}}\mathbf{a}_x + \frac{1}{\sqrt{17}}\mathbf{a}_y = 0.97\mathbf{a}_x + 0.24\mathbf{a}_y$$

(see Figure P2.2ab)

b.  $\mathbf{B}_{OQ} = (1-0)\mathbf{a}_x + (3-0)\mathbf{a}_y + (0-0)\mathbf{a}_z = 1\mathbf{a}_x + 3\mathbf{a}_y$ .

$$|\mathbf{B}_{OQ}| = \sqrt{1^2 + 3^2} = \sqrt{10} = 3.16$$

$$\mathbf{a}_{OQ} = \frac{1}{\sqrt{10}}\mathbf{a}_x + \frac{3}{\sqrt{10}}\mathbf{a}_y = 0.32\mathbf{a}_x + 0.95\mathbf{a}_y$$

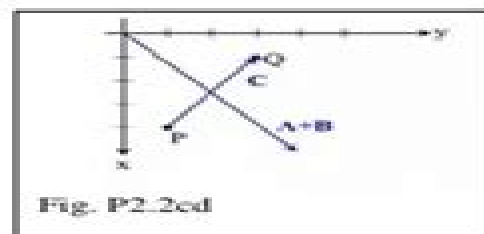
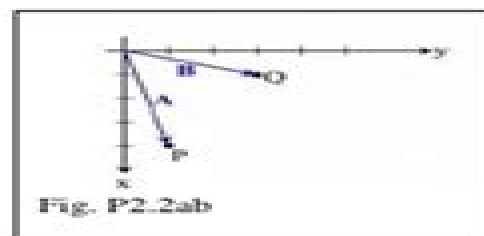
(see Figure P2.2ab)

c.  $\mathbf{C}_{PQ} = (1-4)\mathbf{a}_x + (3-1)\mathbf{a}_y + (0-0)\mathbf{a}_z = -3\mathbf{a}_x + 2\mathbf{a}_y$ .

$$|\mathbf{C}_{PQ}| = \sqrt{3^2 + 2^2} = \sqrt{13} = 3.61$$

$$\mathbf{a}_{PQ} = \frac{-3}{\sqrt{13}}\mathbf{a}_x + \frac{2}{\sqrt{13}}\mathbf{a}_y = -0.83\mathbf{a}_x + 0.55\mathbf{a}_y$$

(see Figure P2.2cd)



# Fundamentals Of Engineering Electromagnetics Lecture Notes

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