

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

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

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

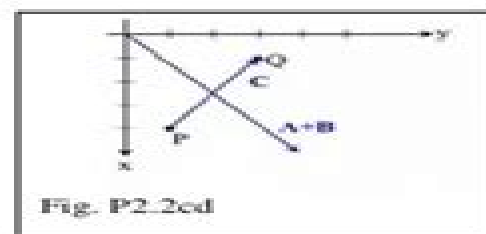
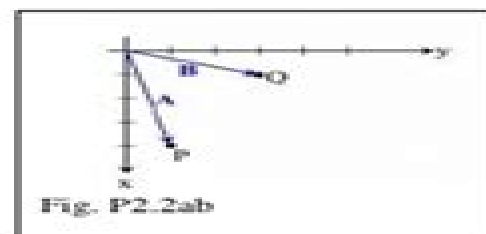
(see Figure P2.2ab)

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)



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This evolution improved the ability to explain the interaction between electromagnetic radiation and natural objects which in its turn allowed for better modelization and for the creation of refined mathematical tools in the processing of remotely sensed data and in the determination of the physical status of remote objects The community of research workers engaged in development and use of remote sensing methods changed accordingly from a modest group of scientists in the early 1970 s to a considerable branch of specialized and interdisciplinary activity The training of students had to be adapted to cope with the increasing number of people entering this new field and with the increasing quality of the material to be presented

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