

## Chapter 2

P.2-1 (a)  $\bar{a}_A = \frac{\bar{A}}{A} = \frac{\bar{a}_x + \bar{a}_y 2 - \bar{a}_z 3}{\sqrt{1^2 + 2^2 + (-3)^2}} = \frac{1}{\sqrt{14}} (\bar{a}_x + \bar{a}_y 2 - \bar{a}_z 3)$

(b)  $|\bar{A} - \bar{B}| = |\bar{a}_x + \bar{a}_y 6 - \bar{a}_z 4| = \sqrt{1^2 + 6^2 + 4^2} = \sqrt{53}$

(c)  $\bar{A} \cdot \bar{B} = 0 + 2(-4) + (-3) = -11$

(d)  $\theta_{AB} = \cos^{-1}(\bar{A} \cdot \bar{B} / AB) = \cos^{-1}(-11 / \sqrt{14} \sqrt{17}) = 135.5^\circ$

(e)  $\bar{A} \cdot \bar{a}_C = \bar{A} \cdot \frac{\bar{C}}{C} = \bar{A} \cdot \frac{1}{\sqrt{29}} (\bar{a}_x 5 - \bar{a}_z 2) = \frac{11}{\sqrt{29}}$

(f)  $\bar{A} \times \bar{C} = -\bar{a}_x 4 - \bar{a}_y 13 - \bar{a}_z 10$

(g)  $\bar{A} \cdot (\bar{B} \times \bar{C}) = (\bar{A} \times \bar{B}) \cdot \bar{C} = -42$

(h)  $(\bar{A} \times \bar{B}) \times \bar{C} = \bar{B}(\bar{A} \cdot \bar{C}) - \bar{A}(\bar{C} \cdot \bar{B}) = \bar{a}_x 2 - \bar{a}_y 40 + \bar{a}_z 5$   
 $\bar{A} \times (\bar{B} \times \bar{C}) = \bar{B}(\bar{A} \cdot \bar{C}) - \bar{C}(\bar{A} \cdot \bar{B}) = \bar{a}_x 35 + \bar{a}_y 44 - \bar{a}_z 11$

P.2-2 Position vectors of the three corners:

$$\overline{OP}_1 = \bar{a}_y - \bar{a}_z 2, \quad \overline{OP}_2 = \bar{a}_x 4 - \bar{a}_y - \bar{a}_z 3, \quad \overline{OP}_3 = \bar{a}_x 6 + \bar{a}_y 2 + \bar{a}_z 5$$

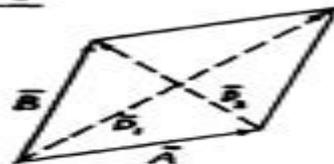
Vectors representing the three sides of the triangle:

$$\overline{P_1 P_2} = \overline{OP}_2 - \overline{OP}_1 = \bar{a}_x 4 - \bar{a}_z, \quad \overline{P_2 P_3} = \bar{a}_x 2 + \bar{a}_y + \bar{a}_z 8, \quad \overline{P_3 P_1} = -\bar{a}_x 6 - \bar{a}_y - \bar{a}_z$$

(a)  $\overline{P_1 P_2} \cdot \overline{P_2 P_3} = 0. \quad \therefore \Delta P_1 P_2 P_3$  is a right triangle.

(b) Area of triangle =  $\frac{1}{2} |\overline{P_1 P_2} \times \overline{P_2 P_3}| = 17.1$

P.2-3



$$\bar{D}_1 = \bar{B} + \bar{A}, \quad \bar{D}_2 = \bar{B} - \bar{A}$$

$$\bar{D}_1 \cdot \bar{D}_2 = (\bar{B} + \bar{A}) \cdot (\bar{B} - \bar{A})$$

$$= \bar{B} \cdot \bar{B} - \bar{A} \cdot \bar{A} = 0$$

$$\therefore \bar{D}_1 \perp \bar{D}_2$$

P.2-4 From  $\bar{A} \cdot \bar{B} = \bar{A} \cdot \bar{C}$ , we have  $\bar{A} \cdot (\bar{B} - \bar{C}) = 0. \quad (1)$

From  $\bar{A} \times \bar{B} = \bar{A} \times \bar{C}$ , we have  $\bar{A} \times (\bar{B} - \bar{C}) = 0. \quad (2)$

(1) implies  $\bar{A} \perp (\bar{B} - \bar{C})$  and (2) implies  $\bar{A} \parallel (\bar{B} - \bar{C})$ . Since  $\bar{A}$  is not a null vector, (1) and (2) cannot hold at the same time unless  $(\bar{B} - \bar{C})$  is a null vector. Thus,  $\bar{B} - \bar{C} = 0$  or  $\bar{B} = \bar{C}$ .

P.2-5  $\bar{a}_\alpha \cdot \bar{a}_\beta = \cos(\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta.$

# Cheng Solution Manual

**S Ben Porath**



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