



LABORATORIUM KIMIA FISIKA

Jurusan Kimia - FMIPA

Universitas Gadjah Mada (UGM)

MATEMATIKA KIMIA

Besaran Skalar dan Vektor

(Sumber : Barrante, Applied Mathematics fo Physical Chemistry, Bab 8)

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LATIHAN

1. Determine the magnitude and direction of the following vectors:

- | | |
|--------------------------|------------------------------|
| (a) $\mathbf{A}(1, 3)$ | (f) $\mathbf{A}(1, 1, 3)$ |
| (b) $\mathbf{A}(2, 2)$ | (g) $\mathbf{A}(2, 3, 4)$ |
| (c) $\mathbf{A}(3, -4)$ | (h) $\mathbf{A}(-1, 2, -1)$ |
| (d) $\mathbf{A}(-2, 0)$ | (i) $\mathbf{A}(-1, -1, -3)$ |
| (e) $\mathbf{A}(-1, -6)$ | (j) $\mathbf{A}(1, 0, -1)$ |

2. Determine the magnitude and direction of the following sums:

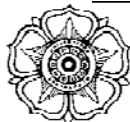
- | | |
|--|---|
| (a) $\mathbf{A}(1, 3) + \mathbf{B}(3, 1)$ | (d) $\mathbf{A}(1, 1, 1) + \mathbf{B}(2, 3, 4)$ |
| (b) $\mathbf{A}(-1, 2) + \mathbf{B}(2, 2)$ | (e) $\mathbf{A}(-2, 3, 4) + \mathbf{B}(-1, -4, -6)$ |
| (c) $\mathbf{A}(3, -1) + \mathbf{B}(0, 4)$ | (f) $\mathbf{A}(2, 0, 3) + \mathbf{B}(-3, 6, -9)$ |

3. Find the following scalar products:

- | | |
|--|---|
| (a) $\mathbf{A}(1, 3) \cdot \mathbf{B}(3, 1)$ | (d) $\mathbf{A}(1, 1, 1) \cdot \mathbf{B}(2, 3, 4)$ |
| (b) $\mathbf{A}(-1, 2) \cdot \mathbf{B}(2, 2)$ | (e) $\mathbf{A}(-2, 3, 4) \cdot \mathbf{B}(-1, -4, -6)$ |
| (c) $\mathbf{A}(3, -1) \cdot \mathbf{B}(0, 4)$ | (f) $\mathbf{A}(2, 0, 3) \cdot \mathbf{B}(-3, 6, -9)$ |

4. Find the magnitude and direction of the following vector products:

- | | |
|---|--|
| (a) $\mathbf{A}(1, 3) \times \mathbf{B}(3, 1)$ | (d) $\mathbf{A}(1, 1, 1) \times \mathbf{B}(2, 3, 4)$ |
| (b) $\mathbf{A}(-1, 2) \times \mathbf{B}(2, 2)$ | (e) $\mathbf{A}(-2, 3, 4) \times \mathbf{B}(-1, -4, -6)$ |
| (c) $\mathbf{A}(3, -1) \times \mathbf{B}(0, 4)$ | (f) $\mathbf{A}(2, 0, 3) \times \mathbf{B}(-3, 6, -9)$ |



LATIHAN

5. Show that

$$\mathbf{A} + (\mathbf{B} + \mathbf{C}) = (\mathbf{A} + \mathbf{B}) + \mathbf{C}$$

6. Show that scalar multiplication is commutative and vector multiplication is not. That is,

$$\mathbf{A} \cdot \mathbf{B} = \mathbf{B} \cdot \mathbf{A} \quad \text{but} \quad \mathbf{A} \times \mathbf{B} \neq \mathbf{B} \times \mathbf{A}$$

7. Show that

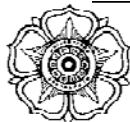
$$\mathbf{A} \cdot \mathbf{A} = |\mathbf{A}|^2$$

8. Angular momentum is given by the equation $\mathbf{L} = \mathbf{r} \times \mathbf{p}$, where $\mathbf{r} = ix + jy + kz$ is the radius of curvature and $\mathbf{p} = ip_x + jp_y + kp_z$ is the linear momentum. Assuming that

$$\mathbf{L} = iL_x + jL_y + kL_z$$

find the components of angular momentum in the x -, y -, and z -directions.

9. Show that the vectors $\mathbf{A} = \frac{1}{2}\mathbf{q}_1 + \frac{1}{2}\mathbf{q}_2 + \frac{1}{2}\mathbf{q}_3 + \frac{1}{2}\mathbf{q}_4$ and $\mathbf{B} = \frac{1}{2}\mathbf{q}_1 - \frac{1}{2}\mathbf{q}_2 + \frac{1}{2}\mathbf{q}_3 - \frac{1}{2}\mathbf{q}_4$, where \mathbf{q}_1 , \mathbf{q}_2 , \mathbf{q}_3 , and \mathbf{q}_4 are unit vectors, are orthogonal.



KUNCI JAWABAN

1. (a) $|A| = 3.16$
 $\theta = 71.57^\circ$
 (b) $|A| = 2.83$
 $\theta = 45^\circ$
 (c) $|A| = 5.00$
 $\theta = 306.87^\circ$
 (d) $|A| = 2.00$
 $\theta = 180^\circ$
 (e) $|A| = 6.08$
 $\theta = 260.53^\circ$
 (f) $|A| = 3.32$
 $\theta = 25.37^\circ$
 $\phi = 45^\circ$
2. (a) $|C| = 5.66$
 $\theta = 45^\circ$
 (b) $|C| = 4.12$
 $\theta = 75.97^\circ$
 (c) $|C| = 4.24$
 $\theta = 45^\circ$
 (d) $|C| = 7.07$
 $\theta = 45^\circ$
 $\phi = 53.13^\circ$
3. (a) 6 (c) -4
 (b) 2 (d) 9 (e) -34
 (f) -33
4. (a) $|C| = 8$
 $\theta = 180^\circ$
 $\phi = \text{undefined}$
 (b) $|C| = 6$
 $\theta = 180^\circ$
 $\phi = \text{undefined}$
 (c) $|C| = 12$
 $\theta = 0^\circ$
 $\phi = \text{undefined}$
 (d) $|C| = \sqrt{6}$
 $\theta = 65.91^\circ$
 $\phi = 296.57^\circ$
 (e) $|C| = 19.52$
 $\theta = 55.70^\circ$
 $\phi = 262.87^\circ$
 (f) $|C| = 23.43$
 $\theta = 59.20^\circ$
 $\phi = 153.43^\circ$
8. $L_x = y p_z - z p_y$ $L_y = z p_x - x p_z$ $L_z = x p_y - y p_x$

