



LABORATORIUM KIMIA FISIKA
Jurusan Kimia - FMIPA
Universitas Gadjah Mada (UGM)

MATEMATIKA KIMIA

Sistem Koordinat

(Sumber : Barrante, Applied Mathematics fo Physical Chemistry, Bab 1)

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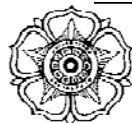
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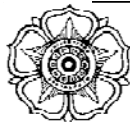
LATIHAN

1. What is the sign of the abscissa and ordinate of points in each of the quadrants of a two-dimensional coordinate system? Relate these to the sign of $\sin \theta$, $\cos \theta$, and $\tan \theta$ in each quadrant.
2. Determine the values of r and θ for the following points:
(a) (2, 2) (d) (4, -1) (g) (-2, 0)
(b) (1, $\sqrt{2}$) (e) (-3, -2) (h) (0, -5)
(c) (1, 5) (f) (2, 0) (i) (12, -6)
3. Determine the values of x and y for the following points:
(a) $r = 1.11$, $\theta = 54^\circ 22'$ (e) $r = 6.00$, $\theta = 145^\circ$
(b) $r = 1.00$, $\theta = 0$ (f) $r = 2.50$, $\theta = 270^\circ$
(c) $r = 3.16$, $\theta = 225^\circ$ (g) $r = 3.00$, $\theta = 35^\circ$
(d) $r = \sqrt{3}$, $\theta = 90^\circ$ (h) $r = 5.00$, $\theta = 71^\circ 34'$
4. Determine the values of r , θ , and ϕ for the following points:
(a) (1, 1, 1) (c) (2, 0, -1) (e) (-3, -6, -12)
(b) (3, 2, 1) (d) (-1, 0, 4) (f) (0, 0, -4)



LATIHAN

5. The *cylindrical coordinate system* can be constructed by extending a z -axis from the origin of a plane polar coordinate system perpendicular to the x - y plane. A point in this system is designated by the coordinates (r, θ, z) . What is the differential volume element in this coordinate system?
6. Determine the modulus and phase angle for the following complex numbers:
 - (a) 3
 - (b) $6i$
 - (c) $2 + 2i$
 - (d) $1 - 3i$
 - (e) $-4 - 4i$
 - (f) $-4 + 5i$
7. Show that $e^{-i\theta} = \cos\theta - i \sin\theta$.
8. Show that $\cos\theta = \frac{1}{2}(e^{i\theta} + e^{-i\theta})$ and $\sin\theta = \frac{1}{2i}(e^{i\theta} - e^{-i\theta})$.
9. Find the values of m that satisfy the equation $e^{2\pi im} = 1$. (*Hint: Express the exponential in terms of sines and cosines.*)
10. Show that $A e^{ikx} + B e^{-ikx}$, where A and B are arbitrary constants, is equivalent to the sum $A' \sin kx + B' \cos kx$, where A' and B' are arbitrary constants.
11. A *space-time* diagram is a two-dimensional coordinate system in which position is plotted on one axis (usually the y -axis) and time is plotted on the other (usually on the x -axis). A line on this coordinate system, called a *world line*, represents motion of a particle through space and time. Construct world lines on a space-time diagram showing the following:
 - (a) a particle at rest relative to the observer
 - (b) a particle moving slowly relative to the observer
 - (c) a particle moving very fast relative to the observer
 - (d) Would a vertical line be possible on this coordinate system?



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2. (a) $r = 2\sqrt{2}$, $\theta = 45^\circ$
(b) $r = \sqrt{3}$, $\theta = 54.74^\circ$
(c) $r = 5.10$, $\theta = 78.69^\circ$
(d) $r = 4.12$, $\theta = 345.96^\circ$
(e) $r = 3.61$, $\theta = 213.69^\circ$
3. (a) $x = 0.647$, $y = 0.902$
(b) $x = 1.00$, $y = 0$
(c) $x = -2.23$, $y = -2.23$
(d) $x = 0$, $y = \sqrt{3}$
4. (a) $r = \sqrt{3}$, $\theta = 54.74^\circ$, $\phi = 45^\circ$
(b) $r = 3.74$, $\theta = 74.50^\circ$, $\phi = 33.69^\circ$
(c) $r = 2.24$, $\theta = 116.57^\circ$, $\phi = 0^\circ$
5. $d\tau = r d\theta dr dz$
6. (a) $|z| = 3$, $\theta = 0^\circ$
(b) $|z| = 6$, $\theta = 90^\circ$
(c) $|z| = 2\sqrt{2}$, $\theta = 45^\circ$
9. $0, \pm 1, \pm 2, \dots$
- (f) $r = 2.00$, $\theta = 0^\circ$
(g) $r = 2.00$, $\theta = 180^\circ$
(h) $r = 5.00$, $\theta = 270^\circ$
(i) $r = 13.42$, $\theta = 333.43^\circ$
- (c) $x = -4.91$, $y = 3.44$
(f) $x = 0$, $y = -2.50$
(g) $x = 2.46$, $y = 1.72$
(h) $x = 1.58$, $y = 4.74$
(d) $r = 4.12$, $\theta = 14.04^\circ$, $\phi = 180^\circ$
(e) $r = 13.75$, $\theta = 150.78^\circ$, $\phi = 243.43^\circ$
(f) $r = 4.00$, $\theta = 180^\circ$, $\phi = \text{undefined}$
- (d) $|z| = 3.16$, $\theta = 288.43^\circ$
(e) $|z| = 4\sqrt{2}$, $\theta = 225^\circ$
(f) $|z| = 6.40$, $\theta = 128.68^\circ$

