PHY 101 LECTURE NOTE

- by
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KINEMATICS

- This is the branch of classical mechanics whish describes the motion of points, bodies (objects) and systems of bodies (group of Objects) without consideration of the causes of motion.

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- Kinematic as a field of study is often referred to as “geometry of motion”.
- Classical mechanics is the study of motion of bodies (including a special case in which the bodies remain at rest)

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- in accordance with the general principles first enunciated by Sir Isaac Newton on the Philosophiae Naturalis Principia mathematical (1687) commonly known as the Principia.

Converting between the Cartesian and Polar Coordinates

- X and y are used in representing the Cartesian Coordinates while r and θ values are used for the Polar Coordinates.
- $\text{Sin } \theta = \text{opp}/\text{hyp} = y/r$
- $\cos \theta = \text{adj}/\text{hyp} = x/r$
- $\tan \theta = \text{opp}/\text{adj} = y/x$

cont

$$\sin\theta = \frac{opp}{hypo} = \frac{y}{r} \qquad (1)$$

$$\cos\theta = \frac{adj}{hypo} = \frac{x}{r} \qquad (2)$$

$$\tan\theta = \frac{opp}{adj} = \frac{y}{x} \qquad (3)$$

$$r^2 = x^2 + y^2 \qquad (4)$$

Question 1

- The Cartesian coordinates of a point xy-planes are (x,y) – (3.50m, 2.50m), Find the polar coordinates of the point.
- From equation 4

$$r^2 = x^2 + y^2 \qquad (4)$$

cont

$$r^2 = (3.5)^2 + (2.5)^2 \qquad (5)$$

$$r = 4.3m \qquad (6)$$

For the angle θ

- Using any of the equations 1 to 3
- $\tan \theta = y/x$

- $\tan \theta = 3.50/2.50$
- $\theta = \arctan 0.714$

- $\theta = 35.5$ degree
- $R < \theta = 4.30 < 35.5$ degree
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Motion in one dimension

- The study of the causes of motion is called dynamics while the study of motion itself without an concern to the cause is called kinematics.
- It can be 1- D, 2- D or 3 -D
- The displacement of an object is defined as its change in position.

$$\Delta x \equiv x_f - x_i \qquad (7)$$

cont

- x_f denotes the initial position of the object
- x_i denotes the final position of the object
- Δx denotes change

Velocity

- Average Speed of an object is the length of path it travels divided b the total elapse time.

- Average Speed = Path Length/elapse time

$$v = \frac{d}{\Delta t} \qquad (8)$$

cont

- The average velocity of an object is defined as the displacement of an object divided by the total time

- Average Velocity = displacement/ elapse time

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} \qquad (9)$$

Note

- Average velocity can either be positive or negative (Average speed is always +ve) because we are in one dimension and the sign tells us the direction.

acceleration

- The change of an object's velocity is called acceleration.

$$\bar{a} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i} \tag{10}$$

Instantaneous acceleration

- This is defined b taking the limit as the end point gets closer and closer.

$$a \equiv \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} \qquad (11)$$

$$v = v_0 + at \qquad (12)$$

$$v_i = v_0 \quad and\, v_f = v \qquad (13)$$

The average velocity

- Could be calculated using
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- $$\bar{v} = \frac{v_0 + v}{2}$$
- $$v^2 = {v_0}^2 + 2a\Delta x \qquad (15)$$

$$v^2 = {v_0}^2 + 2as \qquad (16)$$

$$\Delta x = v_0 t + \frac{1}{2} a t^2 \qquad (17)$$

$$s = ut + \frac{1}{2} a t^2 \qquad (18)$$