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Topic 16: Kinematics (4049)

THE ABOUT

CHAPTER ANALYSIS

- Application of differentiation and integration to problems involving displacement, velocity and acceleration of a particle moving in a straight line



MASTERY

- Relatively straight forward chapter
- 2 **key** concepts



EXAM

- Concepts usually tested as a stand-alone topic
- Easy to make mistakes if students are not careful of when to differentiate or integrate



WEIGHTAGE

- High overall weightage
- Tested consistently every year
- Typically, an 10m question, 1 question in one of the papers

KEY CONCEPT

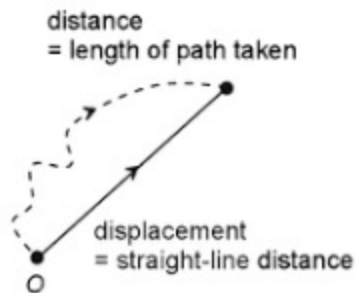
Kinematics Quantities

Relationship between the Quantities



Kinematics Quantities

Distance & Displacement

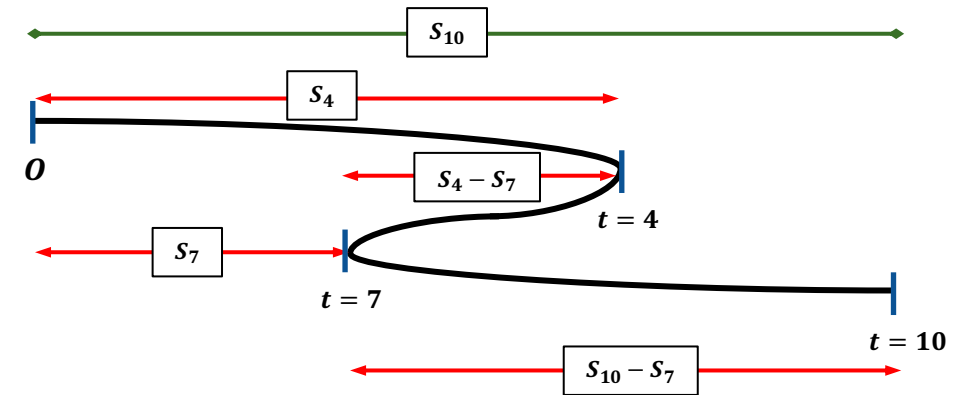


- **Distance**
 - The length of the path travelled by an object or a particle
 - **Scalar Quantity**, completely defined by its magnitude
- **Displacement**
 - The straight-line distance and direction of an object or a particle
 - **Vector Quantity**, defined by its magnitude and direction

$$s = \int v dt$$

Path Diagram

Distance & Displacement



Displacement is always calculated with respect to the origin

- **Distance:** $S_4 + (S_4 - S_7) + (S_{10} - S_7)$
- **Displacement:** S_{10}

Kinematics Quantities

Speed & Velocity

- **Speed**
 - The rate of change of distance travelled by an object or a particle travels with respect to time, t
 - **Scalar Quantity**, completely defined by its magnitude
- **Velocity**
 - The rate of change of displacement of an object or a particle with respect to time, t
 - **Vector Quantity**, defined by its magnitude and direction

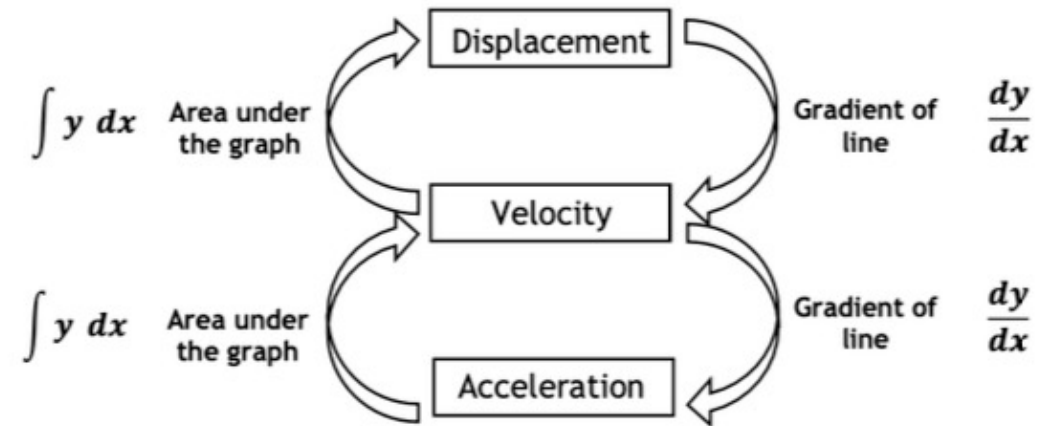
$$v = \frac{ds}{dt} \qquad v = \int a \, dt$$

Acceleration

- **Acceleration**
 - The rate of change of velocity of an object or a particle with respect to time, t
 - **Vector Quantity**, defined by its magnitude and direction

$$a = \frac{dv}{dt} \qquad a = \frac{d^2s}{dt^2}$$

Relationship Diagram



Important Phrases

Phrase	Implication
Instantaneous rest	$v = 0$, change in direction
n th second	Between the $(n - 1)$ th and the n th second

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