CHAPTER 7

KINEMATICS OF PARTICLE

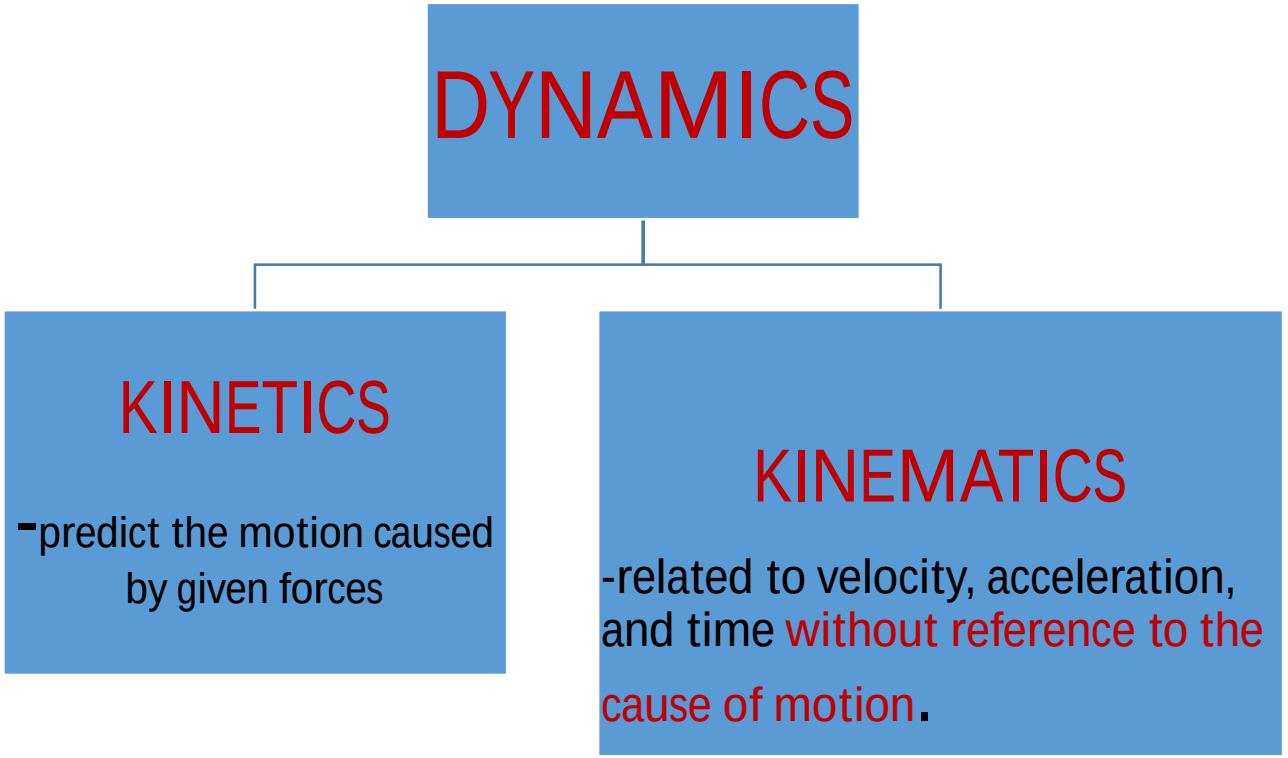
Expected Outcome:

- Able to solve problems involving curvilinear motions of a particle or several particles
- Able to determine a acceleration, velocity and position, given the forces acting or determine the force required to produce a certain acceleration

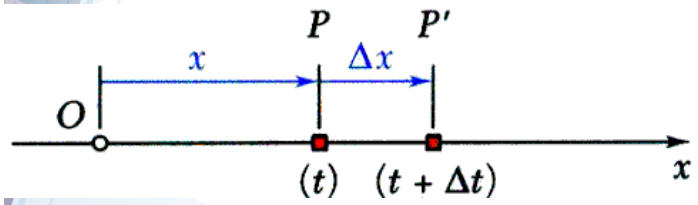
Application

Introduction

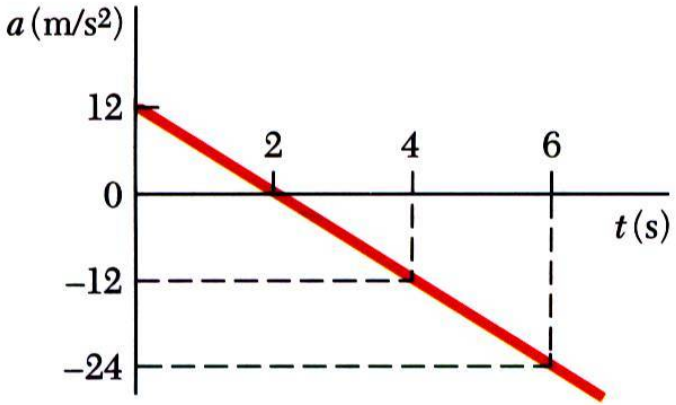
- What is DYNAMICS ???



Position, Velocity and Accelaration



- *Average velocity* $= \dfrac{\Delta x}{\Delta t}$

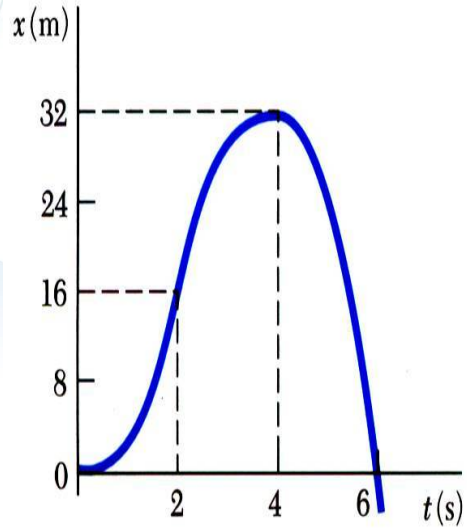


- Acceleration

$$a = \lim_{\Delta t \to 0} \frac{\Delta v}{\Delta t} = \frac{dv}{dt} = \frac{d^2x}{dt^2}$$

e.g. $v = 12t - 3t^2$

$$a = \frac{dv}{dt} = 12 - 6t$$



Example:

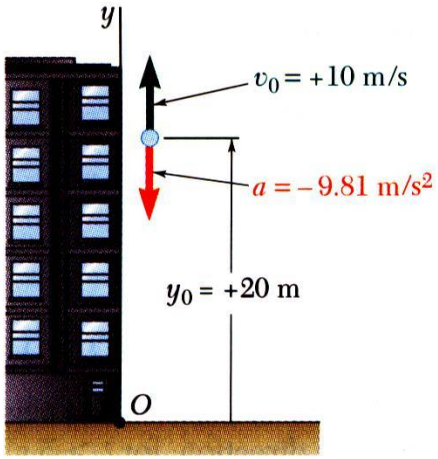
Consider particle with motion given by equations below, determine the x, v and a at t= 0s, 2s,4s and,6s?

$$x = 6t^2 - t^3$$

$$v = \frac{dx}{dt} = 12t - 3t^2$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = 12 - 6t$$

Problem 1



Ball tossed with 10 m/s vertical velocity from window 20 m above ground.

Determine:

- velocity and elevation above ground at time *t*,
- highest elevation reached by ball and corresponding time, and
- time when ball will hit the ground and corresponding velocity.

Problem 2

- Automobiles A and B are travelling in adjacent highway lanes and at t = 0 have the positions and speeds shown. Knowing that automobile A has a constant acceleration of 0.6 m/s^2 and that B has a constant deceleration of 0.4 m/s^2, determine (a) when and where A will overtake B, (b) the speed of each automobile at that time.

References:

1. Beer, Ferdinand P.; Johnston, E. Russell; “Vector Mechanics for Engineers - Statics”, 8th Ed., McGraw-Hill, Singapore, 2007.