

Session 29

Important Terms:

Speed: The speed of a body may be defined as its rate of change of displacement with respect to its surroundings. The speed of a body is irrespective of its direction and is, thus, a scalar quantity.

Velocity: The velocity of a body may be defined as its rate of change of displacement with respect to its surroundings, in a particular direction. As the velocity is always expressed in particular direction, therefore it is a vector quantity.

Acceleration: The acceleration of a body may be defined as the rate of change of its velocity. It is said to be positive, when the velocity of a body increases with time, and negative when the velocity decreases with time. The negative acceleration is also called retardation. In general, the term acceleration is used to denote the rate at which the velocity is changing. It may be uniform or variable.

Uniform acceleration: If a body moves in such a way that its velocity changes in equal magnitudes in equal intervals of time, it is said to be moving with a uniform acceleration.

Variable acceleration: If a body moves in such a way, that its velocity changes in unequal magnitudes in equal intervals of time, it is said to be moving with a variable acceleration.

Types of Linear Motion

- I. Uniform motion ($V = C, a = 0$)
- II. Uniform acceleration ($V \neq C, a = C$)
- III. Variable acceleration ($V \neq C, a \neq C$)

List of formulae used

Type of motion	Name of motion	Conditions of motion	Equations of motion
I	Uniform motion	$V = C, a = 0$	$s = vt$
II	Uniform acceleration	$V \neq C, a = C$	$v = u \pm at$ $s = ut \pm \frac{1}{2}at^2$ $s = \left(\frac{u+v}{2}\right)t$ $v^2 = u^2 \pm 2as$ $s_{nth} = u \pm \frac{a}{2}(2n-1)$
III	Variable acceleration	$V \neq C, a \neq C$	$v = \frac{ds}{dt}$ $a = \frac{dv}{dt} = \frac{d^2s}{dt^2} = v \frac{dv}{ds}$

where +ve sign is for acceleration and -ve sign is for retardation.

Motion under Force of Gravity

This is the special case of type II motion for which $a = \pm g$, where +ve sign for vertically downward motion and -ve sign for vertically upward motion. The equations of motion in this case are:

$$v = u \pm gt$$

$$h = ut \pm \frac{1}{2}gt^2$$

$$h = \left(\frac{u + v}{2}\right)t$$

$$v^2 = u^2 \pm 2gh$$

$$h_{nth} = u \pm \frac{g}{2}(2n - 1)t$$