Topic 2 - Kinematics

1 Basic quantities

Scalar	Vector
Distance, x the total length of path followed by object	**Displacement, s** The distance moved in a specified direction from a reference point
speed, v instantaneous speed is the rate of change of distance wrt time $v = \frac{dx}{dt}$	**velocity, v** instantaneous velocity is the rate of change of displacement wrt time $v = \frac{ds}{dt}$
average speed is the total distance travelled over total time taken $\langle v \rangle = \frac{\Delta x}{\Delta t}$	average velocity is the total change in displacement over total time taken $\langle v \rangle = \frac{\Delta x}{\Delta t}$
	Acceleration, a instantaneous acceleration is the rate of change of velocity wrt time $a = \frac{dv}{dt}$
	Average acceleration is the total change in velocity over total time $\langle a \rangle = \frac{\Delta v}{\Delta t}$

2 Equations for uniformly accelerated motion

$$v = u + at \tag{1}$$

$$s = \frac{1}{2}(u + v)t \tag{2}$$

$$s = ut + \frac{1}{2}at^2 \tag{3}$$

$$v^2 = u^2 + 2as \tag{4}$$

3 kinematics of free fall and the effect of air resistance

objects in the uniform gravitational field of earth undergo uniformly accelerated motion downwards, and experience a constant acceleration with magnitude

$$g = 9.81 ms^{-2}$$

Objects experience air resistance, whose magnitude is proportional to velocity and whose direction is opposite to velocity

- on an object's way up, it experiences air resistance in the direction of downward acceleration due to gravity, hence

$$a_{up} > g$$

- on its way down, it experiences air resistance opposite gravity, hence

$$a_{down} < g$$

4 non-linear motion