QUES 07

For the one-dimensional motion, described by x = t – sin t.

(a) x(t) > 0 for all t > 0 (b) v(t) > 0 for all r > 0

(c) a(t) > 0 for all t > 0 (d) v(t) lies between 0 and 2

Sol: (a, d) Position of the particle is given as a function of time i.e. x = t – sint By differentiating this equation w.r.t. time we get velocity of the particle as a function of time.

Velocity $v = \frac{dx}{dt} = \frac{d}{dt}[t - \sin t] = 1 - \cos t$

If we again differentiate this equation w.r.t. time we will get acceleration of the particle as a function of time.

Acceleration $a = \frac{dv}{dt} = \frac{d}{dt}[1 - \cos t] = \sin t$

As acceleration $a > 0$ for all $t \ngtr 0$

Hence, $x(t) > 0$ for all $t > 0$

Velocity $v = 1 - \cos t$

When, $\cos t = 1$, velocity $v = 0$

$$v_{max} = 1 - (\cos t)_{min} = 1 - (-1) = 2$$
$$v_{min} = 1 - (\cos t)_{max} = 1 - 1 = 0$$

Hence, v lies between 0 and 2.

Acceleration $a = \frac{dv}{dt} = -\sin t$

When $t = 0$; $x = 0$, $v = 0$, $a = 0$

When $t = \frac{\pi}{2}$; x = positive, $v = 0$, $a = -1$ (negative)

When $t = \pi$; x = positive, v = positive, $a = 0$

When $t = 2\pi$; $x = 0$, $v = 0$, $a = 0$