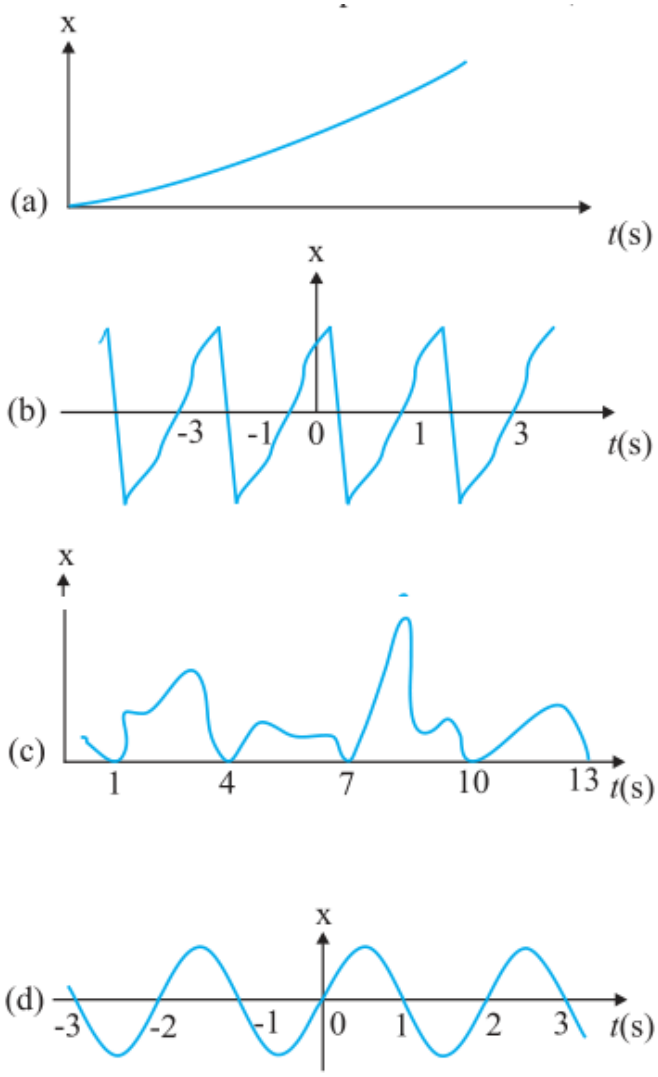
# NCERT Class 11 Physics Solutions: Chapter 14 – Oscillations-Part 2



**Question 14.3**:

Figure depicts four $x-t$ plots for linear motion of a particle. Which of the plots represent periodic motion? What is the period of motion (in case of periodic motion) ?




**Answer**:

$(b)$ and $(d)$ Are periodic

**Explanation**:

$(a)$

It is not a periodic motion. This represents a unidirectional, linear uniform motion. There is no repetition of motion in this case.

$(b)$

In this case, the motion of the particle repeats itself after $2s$. Hence, it is a periodic motion, having a period of $2s$.

$(c)$

It is not a periodic motion. This is because the particle repeats the motion in one position only. For a periodic motion, the entire motion of the particle must be repeated in equal intervals of time.

$(d)$

In this case, the motion of the particle repeats itself after $2s$ . Hence, it is a periodic motion, having a period of $2s$.

**Question 14.4**:

Which of the following functions of time represent,

(a) Simple harmonic,

(b) Periodic but not simple harmonic, and

(c) Non-periodic motion?

Give period for each case of periodic motion ( $\omega$ is any positive constant) :

$(a)\ \sin\omega t - \cos\omega t$

$(b)\ \sin^3\omega t$

$(c)\ 3\cos\left(\frac{\pi}{4} - 2\omega t\right)$

$(d)\ \cos\omega t + \cos 3\omega t + \cos 5\omega t$

$(e)\ \exp\left(-\omega^2 t^2\right)$

$(f)\ 1 + \omega t + \omega^2 t^2$

**Answer**:

$(a)$ : Simple harmonic motion

**Explanation**:

The given function is:

$$\sin\omega t - \cos\omega t$$

$$= \sqrt{2}\left[\frac{1}{\sqrt{2}}\sin\omega t - \frac{1}{\sqrt{2}}\cos\omega t\right]$$

$$= \sqrt{2}\left[\sin\omega t \times \cos\frac{\pi}{4} - \cos\omega t \times \sin\frac{\pi}{4}\right]$$

$$= \sqrt{2}\sin\left(\omega t - \frac{\pi}{4}\right)$$

This function represents SHM as it can be written in the form:

$$a\sin(\omega t + \phi)$$

Its period is: $\frac{2\pi}{\omega}$

$(b)$ :

Periodic, but not Simple harmonic motion

**Explanation**:

The given function is:

$$\sin^3\omega t$$

$$= \frac{1}{2}[3\sin\omega t - \sin 3\omega t]$$

The terms $\sin\omega t$ and $\sin\omega t$ individually represent simple harmonic motion.

However, the superposition of two simple harmonic motion is periodic and not simple harmonic.

$(c)$ :

Simple harmonic motion.

**Explanation**:

The given function is:

$$3\cos\left[\frac{\pi}{4} - 2\omega t\right]$$

$$= 3\cos\left[2\omega t - \frac{\pi}{4}\right]$$

This function represents simple harmonic motion because it can be written in the form:

$$a\cos(\omega t + \phi)$$

Its period is: $\frac{2\pi}{2\omega} = \frac{\pi}{\omega}$

$(d)$ : Periodic, but not simple harmonic motion

**Explanation**:

The given function is $\cos\omega t + \cos 3\omega t + \cos 5\omega t$ . Each individual cosine function represents simple harmonic motion. However, the superposition of three simple harmonic motions is periodic, but not simple harmonic.

$(e)$ : Non-periodic motion

**Explanation**:

The given function $\exp\left(-\omega^2 t^2\right)$ is an exponential function. Exponential functions do not repeat themselves. Therefore, it is a non-periodic motion.

$(f)$ :

The given function $1 + \omega t + \omega^2 t^2$ is non-periodic.