

Questions 22 to 24

A particle of unit mass moves along the x -axis under the action of a force whose potential energy is

$$U(x) = 3x^2 - 9x.$$

The total mechanical energy of the particle during its motion is constant and equal to 12.

22 Select the option which is the force acting on the particle.

Options

- A $6x + 9$ B $6x - 9$ C $-6x + 9$ D $-6x - 9$
 E $x^3 + \frac{9}{2}x^2$ F $x^3 - \frac{9}{2}x^2$ G $-x^3 + \frac{9}{2}x^2$ H $-x^3 - \frac{9}{2}x^2$

23 Select the TWO options which give possible velocities of the particle when it is at the position $x = 1$ during its motion.

24 Select the TWO options which give values of x for which the particle is instantaneously at rest during its motion.

Options for Questions 23 and 24

- A -12 B -6 C -4 D -1
 E 1 F 4 G 6 H 12

$$F = -\frac{dU}{dx}$$

$$3x^2 - 3x - 4 = (x-4)(x+1)$$

$$12 = 3x^2 - 9x$$

$$4 = x(x-3)$$

$$\frac{1}{2}x^2 = 12 - 3 + 9 = 18$$

$$E = 3x^2 - 9x + \frac{1}{2}v^2$$

$$3x^2 - 9x - 12 = 0$$

$$x^2 - 3x - 4 = 0$$

$$v^2 = 24 - 3x^2 + 18x = 24 - 6 + 18 = 36$$