Question
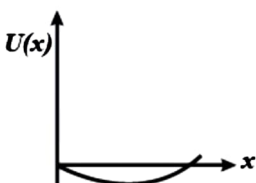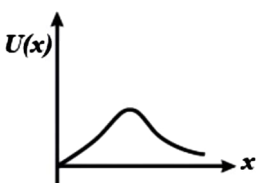
A particle which is constrained to move along the x-axis, is subjected to a force in the same direction which varies with the distance x of the particle from the origin as $F(x) = -kx + ax^3$. Here k and a are positive constants. For $x \geq 0$, the functional form of the potential energy $U(x)$ of the particle is
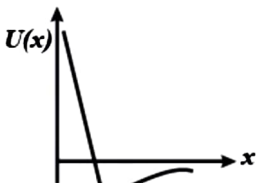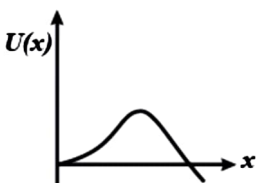
A

B

C

D

Solution

Correct option is D)

Given Force $F(x)$ = $-kx + ax^3$

We know that $U(x)$ =

$-\int_0^x F(x)dx$ = $\frac{kx^2}{2} - \frac{ax^4}{4}$

For $U(x)$ = 0 and $x \geq$

0 we have $x = 0$ and $x = \sqrt{\frac{2k}{a}}$

$\frac{d(U(x))}{dx} = kx - ax^3 = x(k - ax^2)$

Now, $\frac{d(U(x))}{dx} = 0 \Rightarrow x = 0, \sqrt{\frac{k}{a}}$