Question: A block of mass m=4.52kg moves along the x-axis subject to a ...

A block of mass m=4.52kg moves along the x-axis subject to a net force which depends on position.
The force is $\vec{F}net(x)$=(−3.53Nmx−1.78Nm3x3)$\hat{i}$.
The block is initially at x=0m moving with velocity $\vec{v}$=−3.64ms$\hat{i}$.

What is the smallest value of x the block reaches?

What is the block's speed when it reaches x=1.41m?

Expert Answer

simzzzz answered this
18,079 answers

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1.

Given that, F = (-3.3*x - 1.78*x^3) i

From Newton's second law,

F = m*a

here, m = mass of block = 4.52 kg

then, a = acceleration of block = F/m = [(-3.3/4.52)*x - (1.78/4.52)*x^3] i

a = (-0.73*x - 0.3938*x^3) i

As, a = v*dv/dx

(-0.73*x - 0.3938*x^3) = v*dv/dx

v*dv = (-0.73*x - 0.3938*x^3)*dx

by integrate on both sides,

$$\int_{-3.64}^{v} v * dv = \int_{0}^{x} (-0.73 * x - 0.3938 * x^3) * dx$$

$$(\frac{v^2}{2})_{-3.64}^{v} = -(\frac{0.73 * x^2}{2} + 0.3938 * \frac{x^4}{4})_0^x$$

$$v^2 - (-3.64^2) = -(0.73 * x^2 + 0.3938 * \frac{x^4}{2})$$

$$v^2 = 13.25 - (0.73 * x^2 + 0.3938 * \frac{x^4}{2})$$

$$v = \sqrt{13.25 - (0.73 * x^2 + 0.3938 * \frac{x^4}{2})}$$

Now at smallest value of x, v = 0

$$13.25 - (0.73 * x^2 - 0.3938 * \frac{x^4}{2}) = 0$$

By solving using scientifc calculator,

x = 2.56, -2.56

minimum value of x = **-2.56 m**

2.

Now at x = 1.41 m:

$$v = \sqrt{13.25 - (0.73 * 1.41^2 - 0.3938 * \frac{1.41^4}{2})}$$

v = 11.0 m/s

"Let me know if you have any query."

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