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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 $F_{net}(x) = (-3.53\text{Nm}x - 1.78\text{Nm}x^3)\text{j}$.

The block is initially at x=0m moving with velocity $\vec{v} = -3.64\text{ms}^{-1}\hat{i}$.

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
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1.

Given that, $F = (-3.3x - 1.78x^3)\text{ i}$

From Newton's second law,

$F = m \cdot a$

here, m = mass of block = 4.52 kg

then, a = acceleration of block = $F/m = [(-3.3/4.52)x - (1.78/4.52)x^3]\text{ i}$

$a = (-0.73x - 0.3938x^3)\text{ i}$

As, $a = v \cdot dv/dx$

$(-0.73x - 0.3938x^3) = v \cdot dv/dx$

$v \cdot dv = (-0.73x - 0.3938x^3) \cdot dx$

by integrate on both sides,

$$\int_{-3.64}^v v \cdot dv = \int_0^x (-0.73 \cdot x - 0.3938 \cdot x^3) \cdot dx$$

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

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

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

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

Now at smallest value of x, v = 0

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

By solving using scientific calculator,

x = 2.56, -2.56

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

2.

Now at x = 1.41 m:

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

v = 11.0 m/s

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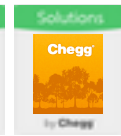
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