Answer on Question 57618, Physics – Mechanics | Relativity

Question:

The displacement of a block attached to a horizontal spring whose spring constant is 6 N/m is given by

x = 0.4 \cos(4.1 t - 0.8) m.

What is the earliest time (t > 0) when the kinetic energy equals one-half the potential energy?

Answer:

$$PE = 2\,KE$$

$$k\frac{x^2}{2} = 2\,m\frac{\dot{x}^2}{2}$$

$$\dot{x} = -1.64\cos(4.1\,t - 0.8)$$

$$\omega^2\,x^2 = 2\,\dot{x}^2$$

$$\omega^2\,x^2 = 2\,\dot{x}^2, \qquad where \quad \omega = 4.1\frac{rad}{s}$$

$$\omega^2 \cdot 0.16 \cdot \cos^2(4.1\,t - 0.8) = 2 \cdot 2.7 \cdot \sin^2(4.1\,t - 0.8)$$

$$\tan(4.1\,t - 0.8) = 0.707$$

$$4.1\,t - 0.8 = 0.614$$

$$t = 0.34\,s$$