簡諧振動的數學模式

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Method I:

Governing equation:

$$m\ddot{x}(t) + kx(t) = 0$$

subjected to

$$x(0) = x_0, \dot{x}(0) = \dot{x}_0$$

Physical point: equlibrium of Newton's law
Mathematical point: second order linear ODE subjected to two initial conditions

Method II:

Governing equation:

$$\frac{1}{2}m\dot{x}^2(t) + \frac{1}{2}kx^2(t) = \frac{1}{2}m\dot{x}_0^2 + \frac{1}{2}kx_0^2$$

subjected to

$$x(0) = x_0$$

Physical point: Conservation of mechanical eneregy (strain enegy and kinetic energy)
Mathematical point: first order linear ODE subjected to one initial condition

Method III:

In senior high school, we used projection concept to understand the motion of SHM.