

4) a) equation of motion: $-kx - b\frac{dx}{dt} = m\frac{d^2x}{dt^2}$

Total energy = KE + PE

$$= \frac{1}{2}mv^2 + \frac{1}{2}Kx^2 = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}Kx^2$$

$$\frac{dE}{dt} = m\dot{x}\ddot{x} + Kx\dot{x} = \dot{x}(m\ddot{x} + Kx)$$

from eq. of motion $-kx - b\dot{x} = m\ddot{x}$

we see that $m\ddot{x} + Kx = -b\dot{x}$

$$\therefore \frac{dE}{dt} = \dot{x}(-b\dot{x}) = -b\dot{x}^2$$

