STAEDTLER® No. 937 811E Engineer's Computation Pad

••50 A 0.30 kg ladle sliding on a horizontal frictionless surface is attached to one end of a horizontal spring (k = 500 N/m) whose other end is fixed. The ladle has a kinetic energy of 10 J as it passes through its equilibrium position (the point at which the spring force is zero). (a) At what rate is the spring doing work on the ladle as the ladle passes through its equilibrium position? (b) At what rate is the spring doing work on the ladle when the spring is compressed 0.10 m and the ladle is moving away from the equilibrium position?

$P = \vec{F} \cdot \vec{v}$

$\vec{F}_s = -kx\hat{x}$

EQUILIBRIUM @ $x \equiv 0$

SINCE $F_s = 0$

a) $P = \vec{F} \cdot \vec{v} = 0$ @ EQUILIBRIUM

$W^{net} = \Delta K$; $W_{net} = W_{spring} = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$

$\Rightarrow \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

Take i = initial as $x = x_i = 0$ = EQUILIBRIUM

when $v = v_i$ is such that $K_i = \frac{1}{2}mv_i^2 = 10J$

$\Rightarrow 0 - \frac{1}{2}kx_f = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$

$-\frac{1}{2}(500)(-0.10)^2 = \frac{1}{2}(0.30)v_f^2 - 10$

$v_f^2 = \frac{2}{0.30}\left[10 - 2.5\right] = 50$

$v_f = 7.07 \ m/s$

Since Ladle is moving away from Equilibrium $\vec{v} = -7.07\hat{x}$

Force $= -kx\hat{x} = -500(-0.10)\hat{x}$

$= +50\hat{x}$

$P = \vec{F} \cdot \vec{v} = (50\hat{x}) \cdot (-7.07\hat{x})$

$= -354 \left(\frac{Joules}{S} = Watts\right)$

$= \frac{dK}{dt} \Rightarrow$ K is decreasing @ rate of 354 joules/sec