CHEM 3423 001 Spring 2024 **Name:** KEY
ID:

Worksheet# 1 (Total number of points you can get is 3 **pts**)

1. **(1.0 pt)** Calculate the amount of work required to accelerate a 1000 kg car from 0 km/hr to 100 km/hr.

$E_K^{(0)} = 0\,J$, $E_K^{(1)} = \frac{1}{2} \cdot 1000\,kg \cdot \left(\frac{100 \cdot 10^3\,m}{3.6 \cdot 10^3\,s}\right)^2 = 385802\,J \left(\frac{kg\,m^2}{s^2}\right)$

$W = \Delta E_K = E_K^{(1)} = 385802\,J\ (3.9 \times 10^5\,J)\ (385.8\,kJ)$

2. **(1.0 pt)** Power is defined as the rate at which work is done. The unit of power is the watt (J/s). What is the power that a man can expend if all his food consumption of 10000 kJ a day is his only source of energy. Assume that 2000kJ will be stored as fat and not available for work.

$P = \frac{dW}{dt} = \frac{8000 \times 10^3\,J}{24 \times 60 \times 60\,s} \simeq \frac{8000 \times 10^3\,J}{86.4 \times 10^3\,s} = 92.59\,\frac{J}{s}$

3. The force to stretch a spring a distance x is given by F=-kx with k=100 N/m. Assume that all the mass of the spring (m= 1kg) is concentrated in a particle at its end. In rest, this particle sits at x = 0 m.

(A) **(0.5 pt)** How much work is done to stretch the spring 0.15 m?

$W = \int_0^{x_F} F\,dl = k \int_0^{x_F} x\,dx = \frac{kx^2}{2}\Big|_{0m}^{0.15m} = \frac{100\,N/m \cdot (0.15\,m)^2}{2}$

$= 1.125\,N\,m = 1.125\,J$

(B) **(0.5 pt)** Assume the spring is now released. What is the speed of the particle once it is back at x=0 m?

$x = 0.15\,m$: $E_K = 0\,J$ $E_p = 1.125\,J$ $E = E_K + E_p = 1.125\,J$

$x = 0\,m$: $E_p = 0\,J$ $E_K = E - E_p = 1.125\,J$

$E_K = \frac{1}{2} m v^2 \Rightarrow v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2.25\,J}{1\,kg}}$

$= \sqrt{\frac{2.25\,kg\,m^2/s^2}{1\,kg}}$

$= \sqrt{2.25\,m^2/s^2} = 1.5\,\frac{m}{s}$