Homework 4 Corrections

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1 1-D Work

A linear spring is compressed from 8 cm to 10 cm and the force increases from 24 N to 30 N. Determine the spring constant and the work done during the compression.

$$W_k = \frac{k(.1)^2}{2} - \frac{k(.08)^2}{2}$$

$$\boxed{W_k = .54J}$$

2 2-D Work

Consider the 2-D force field:

$$F(r) = -2\hat{x} - 3y\hat{y}$$

Calculate the work moving a particle from (4,3) to (4,5) in a straight line.

$$W =< F > \bullet \Delta r = [-2, -12] \bullet [0, 2]$$

$$\boxed{W = -24J}$$

3 Electric Potential Energy

Consider a situation where two electrons are shot at each other from 10 meters apart with an initial speed $v_o = 2.0 \times 10^6 \frac{m}{s}$. The two electrons slow as they approach each other until they are separated by a mimimim distance R.

Determine the PE, KE, and E of the system initially.

$$PE = \frac{KEe^2}{r} = \frac{(8.99 \times 10^9 \frac{Nm^2}{c^2})(1.6 \times 10^{-19}))^2}{(10m)}$$

$$\boxed{PE = 2.3 \times 10^{-29} v}$$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2}(9.1 \times 10^{-31})(2 \times 10^6)$$

$$\boxed{KE = 3.64 \times 10^{-18} J}$$

$$E = KE + PE = 3.64 \times 10^{-18} J + 2.3 \times 10^{-29} v$$

$$\boxed{E = 3.64 \times 10^{-18} J}$$

Determine the PE, KE, and E when the electrons are 5 meters away from another.
Determine the minimum separation distance R.
When $r_{min} = R$, $KE = 0$, $PE = PE_{max} = 3.64 \times 10^{-18} J$, $E = 3.64 \times 10^{-18}$

$$PE = \frac{K_e e^2}{R}$$

$$R = \frac{K_e e^2}{PE} = \frac{(9 \times 10^9)(1.6 \times 10^{-19})^2}{(3.64 \times 10^{-18})}$$

$$\boxed{R = 6.32 \times 10^{-11} m}$$

4 Loop

Consider a frictionless ramp of height H leading down to a frictionless vertical loop of radius R. How high must the ramp be so that objects sliding down it will clear the loop?

$$KEi_i + PE_i = KE_f + PE_f$$

$$0 + mgh = \frac{1}{2}m(v_f)^2 + mg(2r)$$

$$\frac{mv_f^2}{r} = F_c = mg$$

$$0 + mgh = \frac{mg(r)}{2} + 2mgr$$

$$h = \frac{r}{2} + 2r$$

$$\boxed{h = 25r}$$