your name(s) KEY

*Physics 321 Quiz #2 - Friday, September 14th*

Pair up to complete this assignment. You will need to demonstrate functioning versions of the programs to receive credit for the latter two problems. Feel free to access the course lecture notes during class.

1. (10 pts) Nancy has an iceboat which glides on a frictionless lake. The boat is equipped with a really cool slingshot that fires little pebbles. The pebbles are fired one at a time with a speed $v_p$ relative to the boat. The boat initially has a mass $M_0$, which includes the mass of the pebble arsenal, and is sliding along the lake with velocity $v_0$. Nancy wishes to stop the boat by firing pebbles forward. What mass of pebbles must Nancy fire in order to stop the boat? Give answer in terms of $v_0$, $v_p$ and $M_0$.

$$(-\delta M_p)V_B + M_B \delta V_B + \delta M_p(V_p + V_B) = 0$$

$$V_p dM_p = -M_B \delta V_B \quad , \quad dM_p = -dM_B$$

$$\int \frac{dM_B}{M_B} = \int \frac{dV_B}{V_p} = -\frac{V_0}{V_p} = \ln \frac{M_f}{M_0}$$

$$M_f = M_0 e^{-V_0/V_p}$$

$$M_{pebbles} = M_0 - M_f = M_0\left(1 - e^{-V_0/V_p}\right)$$

2. (5 pts) A particle of mass $m$ moves according to the potential

$$V(x, y, z) = \frac{A}{x^2 + a^2},$$

where $A$ and $a$ are constants. Circle the conserved (constants of motion) quantities:

$$E,\ T,\ V,\ L_x,\ L_y,\ L_z,\ p_x,\ p_y,\ p_z.$$

Here, $T$ is the kinetic energy, $V$ is the potential energy, $E = T + V$, and the momenta and angular momenta are $\vec{p}$ and $\vec{L}$.