

HW 9/13

1.28)

mass of pencil $\approx 2 \text{ g} = 0.002 \text{ kg}$

$$E = mc^2 \rightarrow E = 1.8 \cdot 10^{11} \text{ J}$$

$$\Delta t = \frac{\Delta E}{P} = 1.8 \cdot 10^{12} \text{ s}$$

This would run a lightbulb for about 5700 years.

1.29)

$\Delta U = mgh$ - Change in potential energy

$$\Delta m = \frac{\Delta E}{c^2} = \frac{\Delta U}{c^2} = \frac{mgh}{c^2} = \Delta m$$

$$\frac{\Delta m}{m} = \frac{gh}{c^2} = 3.3 \cdot 10^{-13} \%$$

1.30) $W = \frac{1}{2} kx^2 = 125 \text{ J}$

$$\Delta m = \frac{W}{c^2} = 1.39 \cdot 10^{-15} \text{ kg}$$

ep 6)

Invariant - remains constant in all frames of reference

example: speed of light

Conserved - energy and momentum. The total amount remains the same within a system.