Energy Test Review Questions

1. Find the efficiency of the kettle heating water as demonstrated in class.

Replacement Q: What is the efficiency of your 1200W burner if it takes you 1 minute to heat 300g of chocolate from 23C to its melting point of 30C. The specific heat capacity of chocolate is 1.6kJ/kgC

$\text{Efficiency} = \frac{W_{out}}{W_{in}} \times 100\%$ $\quad W_{in} = Pt = 1200W(60s) = 72000\,J$ $\quad W_{out} = mc\Delta T = 0.3(1600)(30-23) = 3360\,J$

$= \frac{3360\,J}{72000\,J} \times 100\%$

$= 4.67\%$

2. Find the missing information in the following reactions:

a. $^{14}_{6}C \rightarrow \underline{\ ^{0}_{-1}\beta\ } + {}^{14}_{7}N$

b. $^{9}_{4}Be + {}^{1}_{1}H \rightarrow \underline{\ ^{4}_{2}\alpha\ } + {}^{6}_{3}Li$

c. $^{239}_{92}U \rightarrow \underline{\ ^{0}_{0}\gamma\ } + {}^{239}_{92}U$

d. $^{252}_{98}Cf \rightarrow {}^{140}_{54}Xe + 4\,{}^{1}_{0}n + \underline{\ ^{108}_{44}Ru\ }$

3. What is the change in energy of the reaction in Question 2a given the following: $m_e = 0.000549\,u$

$m_{C\text{-}14} = 14.003241$ u, $m_{N\text{-}14} = 14.003\,074$ u (use subatomic particle masses from notes)

$E = \Delta m c^2$

$= [(14.003074 + 0.000549) - 14.003241]_u\, c^2$

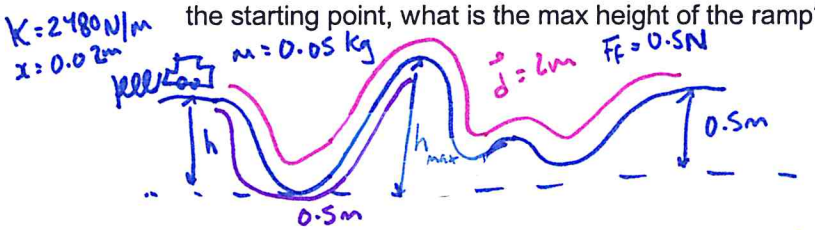
$= [0.000382\,u \times \frac{1.66 \times 10^{-27}\,kg}{1\,u}]\,(3 \times 10^8)^2$

$= 5.71 \times 10^{-14}\,J$

4. This is a conservation of energy question. Please use $E_T = E_T'$ to solve. Then write which energies are present at each step, then identify what you're trying to calculate, then solve for that variable. It just makes sense. Remember your old set of hot wheels with the super cool ramp with the hills and curves? Your car (50g) started at the top of a hill and was set in motion by a spring (2480 N/m) that compressed 2cm when you hit the button. After a series of curves and crests for a total travel distance of 2 m, it was designed to come to a stop up a slight incline 50 cm above the floor. The car experienced an average frictional force of 0.5N.

a. At what height did the car start its journey?

b. If the speed is 2m/s slower at the max height, which occurs 50 cm of track from the starting point, what is the max height of the ramp?



$E_T = E_s + E_p \qquad E_T' = E_p' + E_k' \qquad E_T' = E_p' + E_f'$

Cont'd

a) $E_T = E_T''$

$E_s + E_p = E_p'' + E_f''$

$\frac{1}{2}kx^2 + mgh = mgh' + F_f d$

$\frac{1}{2}(2480)(0.02)^2 + 0.05(9.8)h = \underbrace{0.05(9.8)(0.5) + 0.5(2)}_{1.245\ J}$

$h = \underline{1.53\ m}$

b) Velocity at beginning

$E_s = E_k$

$\frac{1}{2}kx^2 = \frac{1}{2}mv_i^2$

$\frac{1}{2}(2480)(0.02)^2 = \frac{1}{2}(0.05)v_i^2$

$4.45\ m/s = v_i$

$\therefore v' = 2.45\ m/s$

$E_T' = E_T''$

$E_p' + E_k' = 1.245$

$mgh + \frac{1}{2}mv^2 = 1.245$

$0.05(9.8)h + \frac{1}{2}(0.05)(2.45)^2 = 1.245$

$h_{max} = \underline{2.23\ m}$