lecture
nuclear decay

3/7/13

$^{235}_{92}U$ ← mass = neutrons + protons (not exact)
charge (# of protons)

$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}Ba + {}^{92}_{36}Kr + 3\,{}^{1}_{0}n$

mass conserved
charge conserved

$^{1}_{0}n \rightarrow {}^{1}_{1}p^{+} + {}^{0}_{-1}e^{-}$

decay (spontaneous):
$^{238}_{92}U \rightarrow {}^{234}_{90}Th + ({}^{4}_{2}He)$ α particle; $^{0}_{-1}e$ = β particle

fission – 2 reactants causing the reaction
$^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{80}_{38}Sr + {}^{153}_{54}Xe + 3\,{}^{1}_{0}n$
products are lower in energy
exothermic
$E = mc^2$ → change in energy = change in mass
$c = 3\times10^{8}\ \frac{m}{s}$ speed of light

$^{1}_{0}n \rightarrow {}^{1}_{1}p^{+} + {}^{0}_{-1}e^{-}$
$\Delta m = -1.394\times10^{-30}\ kg$ ← use kg to get J
$E = mc^2 = (1.394\times10^{-30}\ kg)(3\times10^{8}\ \frac{m}{s})^2 = 1.255\times10^{-13}\ J$ for 1 neutron

for 1 mol, $E \approx 7.\times10^{10}\ J$
(multiply by Avogadro's number)

nuclear – change in atoms, atomic identity changes

fusion (in the stars!)
$^{2}_{1}H + {}^{3}_{2}He \rightarrow [{}^{5}_{3}Li] \rightarrow {}^{4}_{2}He + {}^{1}_{1}H$
2.013553g 3.0149g 4.00150g 1.00728g $\Delta m = 0.01966g$
$\Delta E = (0.0196\times10^{-3}\ kg)(3\times10^{8}\ \frac{m}{s})^2$
$= 1.764\times10^{12}\ \frac{J}{mol}$

★ masses are different for nuclei than individual protons/neutrons