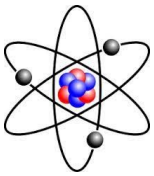
Physics 13-04 Mass-Energy Lab ***Name:*** _____

Objective: Use the Mass-Energy equivalency equation.



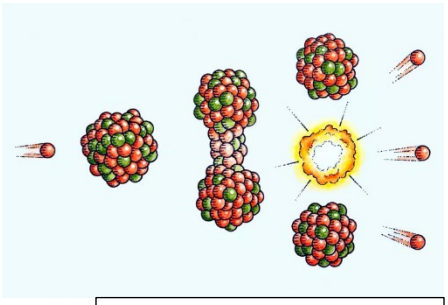
As part of his theory of relativity, Einstein came up with the mass-energy equivalency equation, $E = mc^2$. Use this to solve the following problems.

1. How much energy would be released if a 20-kg bowling ball was completely converted to energy?

2. How much mass must be converted to energy to supply the world's energy use for a year which is estimated at 580 million terajoules?

3. How much mass must be converted to energy to supply an average household in the USA for a year is they use $3.78 \times 10^{10}\ J$?

4. If each fission of uranium produces 180 MeV of energy, how many uranium nuclei must fission to supply the household from problem 3?



Calculate the energy released by the following reactions.

5. α-decay of thorium-232

6. α-decay of radon-222

7. β^--decay of cesium-137

8. β^--decay of tritium

9. Fission of $^{235}U + n \rightarrow {}^{146}La + {}^{87}Br + 3\ n$

10. Fission of $^{235}U + n \rightarrow {}^{137}Cs + {}^{96}Rb + 3\ n$

11. Fusion of $^{2}H + {}^{3}H \rightarrow {}^{4}He + n$

12. Fusion of $^{2}H + {}^{2}H \rightarrow {}^{3}H + {}^{1}H$

Masses
$\nu \approx 0$ u
$e^- = 0.000549$ u
n = 1.008665 u
$^{1}H = 1.007825$ u
$^{2}H = 2.014102$ u
$^{3}H = 3.016049$ u
$^{3}He = 3.016029$ u
$^{4}He = 4.002603$ u
$^{87}Br = 86.920674$ u
$^{96}Rb = 95.934273$ u
$^{133}I = 132.907797$ u
$^{137}Xe = 136.911563$ u
$^{137}Cs = 136.907089$ u
$^{137}Ba = 136.905827$ u
$^{146}La = 145.925793$ u
$^{218}Po = 218.008966$ u
$^{222}At = 222.022494$ u
$^{218}Rn = 218.005601$ u
$^{222}Rn = 222.017576$ u
$^{222}Fr = 222.017582$ u
$^{228}Ra = 228.03107$ u
$^{232}Ac = 232.042022$ u
$^{232}Th = 232.038054$ u
$^{232}Pa = 232.038593$ u
$^{235}U = 235.043930$ u