Nuclear Physics Review:

① B ② H

③ • The nucleus is composed of protons and neutrons only
- The protons repel each other electrically
- The repulsion INCREASES as the protons get closer together
- In a nucleus the protons are very very very very close together
- To get the protons close enough to be bound by the neutrons requires EXTREME temperature and pressure
- Those conditions only exist inside of stars and within early universe.

④ C, D, F

⑤ A. • Find the change in mass or MASS DEFECT.

$$\Delta m = 100\,kg - 99.87\,kg = 0.13\,kg$$

- Use $\mathcal{E} = mc^2$ to find $\mathcal{E}$

$$\mathcal{E} = 0.13\,kg\,(3\times10^{8}\,m/s)^2 = 1.17\times10^{16}\,J$$

B. This is essentially a unit conversion question.

Given: $1\,L\ gasoline = 3.2\times10^{7}\,J$

$$1.17\times10^{16}\,J \times \left(\frac{1\,L\ gasoline}{3.2\times10^{7}\,J}\right) = 3.65625\times10^{8}\,L\ gasoline$$

(6) $^{35}_{16}S \longrightarrow {}^{0}_{-1}\beta + {}^{35}_{17}Cl$

69.938062 mg → 0.001098 mg + 69.936606 mg

69.937704 mg

A. MASS DEFECT: $69.938062\,mg - 69.937704\,mg = 0.000358\,mg$

B. Convert to kg $0.000358\,mg \times \left(\frac{1\,g}{1000\,mg}\right) \times \left(\frac{1\,kg}{1000\,g}\right) = 3.58 \times 10^{-10}\,kg$

C. $E = mc^2 = 3.58 \times 10^{-10}\,kg\,(3.0 \times 10^{8}\,m/s)^2 = 3.222 \times 10^{7}\,J$

(7) $^{226}_{88}Ra \longrightarrow {}^{222}_{86}Rn + {}^{4}_{2}\alpha$

226.025402 u → 222.017570 u + 4.002603 u

226.020173 u

- MASS DEFECT: $226.025402\,u - 226.020173\,u = 0.005229\,u$
- CONVERT TO kg: $0.005229\,u \times \left(\frac{1.66 \times 10^{-27}}{1\,u}\right) = 8.68014 \times 10^{-30}\,kg$
- $E = mc^2 = 8.68014 \times 10^{-30}\,kg\,(3.00 \times 10^{8}\,m/s)^2 = 7.812 \times 10^{-13}\,J$

(8) $E = mc^2 \Rightarrow m = \frac{E}{c^2} = \frac{4.0 \times 10^{-13}\,J}{(3.00 \times 10^{8}\,m/s)^2} = 0.000\overline{4}\,kg = 0.444\,g$

(9) A. $^{6}_{3}Li + {}^{4}_{2}He \longrightarrow {}^{10}_{5}B$

B. $^{228}_{90}Th \longrightarrow {}^{4}_{2}\alpha + {}^{224}_{88}Ra$

C. $^{1}_{0}n + {}^{235}_{92}U \longrightarrow {}^{236}_{92}U \longrightarrow {}^{96}_{37}Rb + {}^{137}_{55}Cs + 3\,{}^{1}_{0}n$

D. $^{11}_{6}C \longrightarrow {}^{0}_{1}\beta + {}^{11}_{5}B$

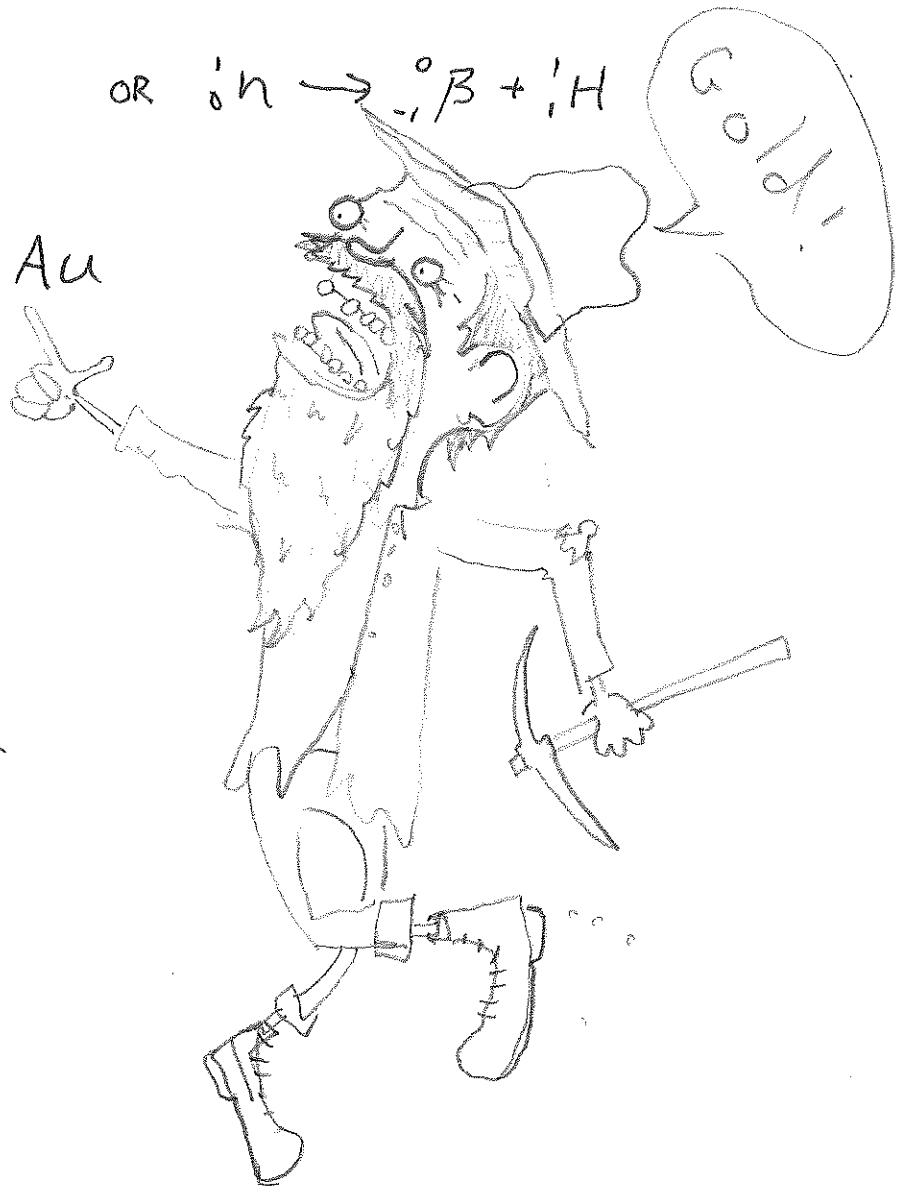
E. $^{1}_{0}n \longrightarrow {}^{0}_{-1}\beta + {}^{1}_{1}p$ OR $^{1}_{0}n \longrightarrow {}^{0}_{-1}\beta + {}^{1}_{1}H$

F. $^{6}_{3}Li + {}^{191}_{76}Os \longrightarrow {}^{197}_{79}Au$

G. $^{214}_{82}Pb^{*} \longrightarrow {}^{0}_{0}\gamma + {}^{214}_{82}Pb$

H. $^{242}_{94}Pu \longrightarrow {}^{4}_{2}\alpha + {}^{238}_{92}U$

~~I~~. $^{223}_{87}Fr \longrightarrow {}^{0}_{-1}\beta + {}^{223}_{88}Ra$



(10) The nuclear fusion of Hydrogen into Helium.

(11) A. $^{212}_{84}Po$: 84 protons, 128 neutrons

B. $^{140}_{58}Ce$: 58 protons, 82 neutrons

C. $^{37}_{17}Cl$: 17 protons, 20 neutrons

D. $^{45}_{21}Sc$: 21 protons, 24 neutrons.

E. $^{80}_{35}Br$: 35 protons, 45 neutrons

F. $^{209}_{83}Bi$: 83 protons, 126 neutrons

12. A. $^{32}_{15}P$ B. $^{172}_{70}Yb$ C. $^{16}_{8}O$ D. $^{140}_{59}Pr$

13. $^{100}_{41}Nb$ 14. $^{25}_{12}Mg$ 15. $^{-}_{-} \longrightarrow {}^{0}_{-1}\beta + {}^{31}_{15}P$

$^{31}_{14}Si \longrightarrow {}^{0}_{-1}\beta + {}^{31}_{15}P$

16. See #3. To create the temperature/pressure necessary would require more energy than the reaction would output. Thus it is unfeasable from an economic and energy standpoint.