ANSWERS TO NUCLEAR CHEMISTRY PROBLEM SET

1. (a) ^{228}Th ----> ^{4}He + ^{224}Ra
   (b) ^{110}In ----> β^{+} + ^{110}Cd
   (c) $^{110}In + e^{-}$ ----> ^{110}Cd + X-ray
   (d) $^{127}I + {}^{1}H$ -----> 7n + ^{121}Xe
   (e) $^{10}B + n$ ----> $^{1}H + {}^{10}Be$
   (f) $^{10}B + n$ ----> $^{4}He + {}^{7}Li$
   (g) $^{95}Mo + {}^{1}H$ ----> $^{95}Tc + n$

2. (a) $\alpha \equiv {}^{4}He$
   (b) ^{234}U
   (c) ^{11}B
   (d) ^{90}Sr
   (e) ^{15}N
   (f) ^{214}Pb
   (g) β^{+}

3. (a) mass defect = 0.2003 amu
   (b) 186.5 MeV/atom; 2.988×10^{-11} J/atom; 1.80×10^{13} Joule/mole

4. (a) The ratio of n/p for ^{132}Sn is <u>too high</u> since all stable isotopes have A less than 124. Therefore, β decay (loss of β^{-} particles)mis the only possible mode of decay.

   $$^{132}Sn \text{ ----> } ^{132}Sb + \beta^{-}$$

   (b) Since the atomic mass of U is 238, the ^{226}U isotope has a n/p ratio which is <u>too low</u>. Since A > 209 and Z >82, the decay mode must be α emission.

   $$^{226}U \text{ ----> } ^{222}Th + \alpha$$

   (c) ^{26}Si probably undergoes β^{+} emission since it is neutron defficient (all stable isotopes have A >26).

   $$^{26}Si \text{ ----> } ^{26}Al + \beta^{+}$$

   (d) Since atomic mass of N is 14, the ^{19}N isotope is neutron rich (i.e. n/p ratio is too high) and therefore it has to undergo β emission.

   $$^{19}N \text{ ----> } ^{19}O + \beta^{-}$$

5. (a) $^{7}Li + {}^{1}H$ ----> $2\ {}^{4}He$
   (b) 17.3 MeV/atom of Li-7

6. (a) $^{14}N + {}^{4}He$ ----> $^{17}O + {}^{1}H$
   (b) 1.20 MeV per atom ^{14}N is needed.

7. (a) 7.47 MeV/nucleon
   (b) 7.98 MeV/nucleon
   (c) 7.57 MeV/nucleon
   Oxygen-16 is the most stable isotope since it has the highest binding energy per nucleon.

8. 0.408 hr^{-1}

9. 1.6×10^3 years

10. (a) 50%
    (b) 25%
    (c) 12.5%
    (d) 6.25%
    (e) 3.125%

11. 1.15×10^4 years