Assignment for Module-1
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1. Calculate nuclear density of 27Al and 56Fe if nuclear radius is given by the formula R=R0A1/3 where R0 is the nuclear radius constant and is equal to 1.4×10^{-13} cm.

2. Calculate the binding energy (B) for 6Li, 60Ni and 238U given that mass excess for n, p, 6Li, 60Ni and 238U are 8.071, 7.289, 14.087, -64.470 and 47.307 MeV respectively. Also calculate the average binding energy (B/A) for these nuclides and comment on the variation of B/A as a function of mass number A.

3. Calculate the binding energy gain after adding a neutron to 15O, 16O and 239Pu given that the masses of n, 15O, 16O, 17O, 239Pu and 240Pu are 1.008665, 15.003065, 15.994914, 16.999130, 239.052161 and 240.0538118 amu respectively. Explain the variation in the values.

4. Calculate the binding energy gain after adding a proton to 15N, 16O and 239Pu given that the masses of p, 15N, 16O, 17F, 239Pu and 240Am are 1.00782543, 15.0001095, 15.994914, 17.002096, 239.052161 and 240.055229 amu respectively.

5. Calculate the binding energy gain after adding an α particle to 9Be and 235U given that the masses of α, 9Be, 13C, 235U and 239Pu are 4.002603, 9.012183, 13.003355, 235.043927 and 239.052161 amu respectively. Compare the values obtained and comment on alpha decay.

6. Calculate the binding energy for 6Li, 60Ni and 238U using semi-empirical mass formula and compare the results with those obtained in Q2.

7. Calculate the volume energy (that represents nuclear attractive forces) and coulomb energy (repulsive forces) for 4He, 12C, 60Ni, 137Ba, 151Eu, 182W, 197Au, 206Pb, 238U, 252Cf, 257Fm and 264Ha. Based on this, explain why the periodic table cannot be extended indefinitely.

8. Beta decay energies associated with 131Te and 131I are 2.16 and 0.97 MeV respectively. Calculate the expected beta decay energy in the β decay of 131Sb → 131Te.

9. Based on the single particle shell model, calculate the ground state spin and parity for the following nuclei. (a) 12C, (b) 13C, (c) 39Ar, (d) 40Cl and (e) 196Pt.

10. Based on the shell model, the expected spin of 137Ba is 11/2 and the observed spin is 3/2. Explain why?