Learning Objectives for Chapter (1)

After studying this chapter you should be able to:

1. Describe the beginning and progress of nuclear physics;
2. name the constituent particles of nuclei;
3. explain the proton-electron hypothesis and the discovery of the neutron;
4. describe the importance of the neutron-proton ratio and number of nucleons in determining the stability of nuclei, and the decay mode;
5. state the typical dimensions of nuclei;
6. describe the evidence from alpha particle scattering and electron diffraction experiments;
7. show how the constancy of the density of nuclear material derives from such evidence;
8. extract information about nuclear masses, isotopic abundance and half lives from tables and charts of nuclides;
9. explain the importance of NMR;
10. calculate values of nuclear masses for different nuclides;
11. calculate values of mass defect for different nuclides;
12. use Einstein's equation $E=mc^2$ to relate mass defect and binding energy;
13. describe the variation of binding energy per nucleon with nucleon number A;
14. calculate values of neutron and proton separation energies from different nuclides;
15. state the relative importance of the strong nuclear, electrostatic and gravitational forces in holding nucleons together in a nucleus;
16. describe the characteristics of the strong nuclear force between nucleons;
17. explain the significance of the terms in the semi-empirical binding energy equation;
18. explain the significant importance of the shell model in explaining the role of magic numbers;
19. explain the idea of PET;

Learning Objectives for Chapter (2)

After studying this chapter you should be able to:

1. Write equations for nuclear decays involving α, β^+ and β^- emission, and electron capture;
2. define and use the following terms: radioactive decay constant, half-life, activity;
3. appreciate the random nature of radioactive decay;
4. use the radioactive decay law to calculate the activity and number of nuclei for a radioactive source at a certain time;
5. show how nuclides are related through decay chains;
6. describe several uses of radioactive nuclides such as : tracing technique, gamma cameras; radioactive dating;
7. describe the biological effects of radiation and use the suitable units;
8. Calculate the values of the energy Q released when an unstable nucleus decays;
9. determine, from values of Q, whether or not a particular radioactive decay is possible;
10. state the following properties of α,β and γ radiations: charge, mass, penetration of air and solid materials and any other properties;
11. describe how conservation laws apply in the case of of α ,β^+ , β^-, γ emission, and electron capture;
12. describe the appropriate models to explain the mechanisms of α ,β^+ , β^-, γ emission, and electron capture;
13. describe the evidence which supports these models;
14. describe the relation between the Geiger-Nuttal rule and the tunneling of α particles;
15. account for the continuous β spectrum;
16. outline the evidence for the existence of neutrinos and whether or not they have a mass;
17. describe the big bang theory and its account to the expansion of the universe;
18. use correctly the terms Doppler effect, Red shift, open and closed universe, dark matter;
19. describe the process of internal conversion;
20. describe the relation of nuclear resonance to Mössbauer Effect.