CHAPTER TEST

STD: XII PHYSICS –ATOMS,NUCLEI AND SEMICONDUCTOR

TIME: 1 HR 45 MINS MARKS: 35

General Instructions: Answer all the questions. Section A carries 1 mark, Section B carries 2 marks, Section C carries 3 marks, Section D carries 5 marks, Section E carries 4 marks.

SECTION – A

1. Total energy of an electron in the ground state of hydrogen atom is −13.6 eV. its total energy, when hydrogen atom is in the first excited state is:
   a) +13.6 eV b) +3.4 eV c) −3.4 eV d) −54.4 eV
2. The ratio of the radii of the nuclei $_{13}AI^{27}$ and $_{52}Te^{125}$ is
   a) 3:5 b) 13:52 c) 27:125 d) 14:73
3. The curve of binding energy per nucleon against mass number has sharp peak for helium nucleus. This means that helium nucleus:
   a) Is very stable b) is radioactive
   c) Is easily fissionable d) none of these
4. The depletion layer in the p–n junction is formed by.
   a) Diffusion of charge career
   b) Drift of electrons
   c) Drift of holes
   d) Migration of impurity ions.
5. Assertion (A): Bohr postulated that the electrons in stationary orbits around the nucleus do not radiate.
   Reason (R): According to classical physics, all moving electrons radiate.
   a) Both A and R is true and R is correct explanation of A.
   b) Both A and R is true but R is NOT correct explanation of A.
   c) A is true but R is false
   d) A is false and R is true
6. Assertion (A): Ideal diode shows zero resistance in forward bias and infinite resistance in reverse bias.
   Reason (R): Depletion region of a p–n junction diode extends in reverse bias and contracts in reverse bias.
   a) Both A and R is true and R is correct explanation of A.
   b) Both A and R is true but R is NOT correct explanation of A.
   c) A is true but R is false
   d) A is false and R is true

SECTION – B

7. Mention any one postulate of Bohr's theory of hydrogen atom.

8. What is potential barrier in the junction diode?
9. What is binding energy?
10. How much the energy will be created if 1.0 g of matter is destroyed completely? How much kilowatt-hour energy will be obtained by it?

SECTION – C

11. On the basis of Bohr's theory, derive the expression for the radius of the nth orbit of an electron of hydrogen atom.
12. Draw a circuit diagram for p–n junction diode in forward bias. Sketch and discuss the voltage versus current graph for the same.
13. What do you understand by 'binding energy of a nucleus'? Derive binding energy equation for the nucleus of an atom XAZ in terms of atomic masses and neutron mass. States the approximation involved and justify it.
14. A hydrogen atom rises from its n=1 state to the n=4 state by absorbing energy. If the potential energy of the atom in n=1 state be −13.6 eV. Then calculate :
    (i) Potential energy in n=4 state.
    (ii) Energy absorbed by the atom in the transition.
    (iii) Wavelength of the emitted radiation if the atom returns back to its original state. (h=6.6×10−34 Js. speed of light, c=3.0×108 ms−1)

SECTION – D

15. Explain the use of p–n junction diode as a rectifier. Draw the circuit diagram of a full-wave rectifier and explain its working. Draw the input and output waveform.

SECTION – E

16. Case Study Based Question:

    A group of Class XII students set up an experiment to study the emission spectrum of atomic hydrogen in the school laboratory. They use a discharge tube filled with hydrogen gas at low pressure and observe the emitted light through a diffraction grating. The bright lines seen correspond to the Balmer series in the visible region. With a precise instrument, one student measures the wavelength of a prominent Balmer line as 656.3nm, which is the red line. They also discuss the model of the atom and try to relate their observations with Bohr's postulates.

    During the experiment, the teacher asks them to investigate:

- The theoretical model explaining the line spectra of hydrogen,
- The physical reason behind discrete line formation,
- The calculation of energy transitions for given lines,
- The consequences if the atom could emit a continuous spectrum.

Based on the scenario above, answer the following:

i) State Bohr's second postulate for quantization in the hydrogen atom.

ii) Write the expression for the radius of the nth orbit of the hydrogen atom.

iii) Calculate the energy difference between the second and third energy levels of hydrogen (in eV). (En= $\frac{-13.6}{n^2}$ $eV\ for\ the\ nth\ orbit.$)

iv) Explain, using the model of the atom, why discrete lines (not a continuous spectrum) are observed in the hydrogen emission spectrum.