0179478

11621

Reg. No. | | | | | | | | |

VI Semester B.Sc. Degree Examination, September - 2021

PHYSICS

Atomic, Molecular and Nuclear Physics

Paper : VII

(CBCS Scheme Fresh + Repeaters 2018-19 and onwards)

Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

1. Answer any **five** questions from each part.
2. Use of non - programmable scientific calculator is allowed.

PART - A

Answer any **Five** of the following questions. Each question carries Eight marks. **(5×8=40)**

1. Describe with a diagram Stern and Gerlach experiment. Write the importance of results of experiment. **(6+2)**

2. a. What is meant by pure rotational spectrum?

b. Derive an expression for rotational energy levels of a diatomic molecule and hence obtain the frequency of rotational spectra. **(1+7)**

3. a. Define impact parameter.

b. Assuming the relation between the impact parameter and the angle of scattering derive Rutherford's formula. **(1+7)**

4. a. Derive an expression for Q - value in α - decay.

b. Write a note on Geiger - Nuttal law. **(5+3)**

5. With the help of a diagram describe the construction and working of cyclotron. Arrive at the expression for energy of the emerging particle. **(8)**

6. a. What is nuclear cross - section? How is it determined?

b. Derive an expression for the number of particles emerging out of a slab of finite thickness **(3+5)**

7. a. Explain the formation and decay of a compound nucleus.

b. Give the properties of electrons and muons. **(4+4)**

8. Explain the various types of interactions among the elementary particles mentioning their characteristics and life time. **(8)**

[P.T.O.

PART - B

Solve any **FIVE** problems. Each problem carries **FOUR** Marks. **(5×4=20)**

9. Write the spectral terms and the ground state for P^4 state.

10. The value of specific charge of electron is $1.76\times10^{11}Ckg^{-1}$. Calculate the value of Bohr magneton. ($h=6.625\times10^{-34}Js$).

11. The spacing between the vibrational levels of a CO molecule is 0.08 eV. Calculate the value of force constant. Given the mass of carbon atom = 12 amu and that of oxygen = 16 amu & 1 amu = 1.67×10^{-27} kg.

12. Find the activity of 1 mg of randon - 222 whose half life is 3.8 days. [$h = 6.625\times10^{-34}Js$].

13. Potassium - 40 decays into calcium by β emission. Calculate the Q-value of the decay. Given, mass of potassium = 39.96399 amu and that of calcium = 39.96255 amu, 1 amu = 1.67×10^{-27} kg).

14. An α particle of energy 5 MeV passes through an ionisation chamber at the rate of 10 per second. Assuming all the energy is used in producing ion pairs, calculate the current produced. Given 35eV is required to produce each ion pair and e = 1.6×10^{-19} C.

15. Calculate the Q-value and threshold energy of the reaction ${}_3Li^7(p,n){}_4Be^7$ in MeV. Given the masses of ${}_3Li^7$, ${}_4Be^7$, ${}_1H^1$ and ${}_0n^1$ are 7.0160 amu, 7.0169 amu, 1.0078 amu and 1.0087 amu respectively, and 1 amu = 1.67×10^{-27}kg).

16. Verify the conservation of hyper charge, baryon number, strangeness and z - component of isospin for the reaction given below.

$p + p \rightarrow n + p + \pi^+$

PART - C

Answer any **FIVE** of the following questions. Each question carries **TWO** marks. **(5×2=10)**

17. a. Can the value to principal quantum number be zero? Explain.

b. What is meant by Larmor precession? Define the frequency of Larmor precession.

c. What are the selection rules for rotational Rayleigh and Raman lines?

d. Why is quenching necessary in GM counter?

e. Why are heavy nuclei unstable and start disintegration? Explain.

f. What happens if the Q-value of a nuclear reaction is zero? Explain.

g. What are strange particle? Give an example.

h. How many quarks are required to form mesons and baryons?