61621

Sixth Semester B.Sc. Degree Examination, September/October 2023
(CBCS Scheme)
PHYSICS – VII
Atomic, Molecular and Nuclear Physics

Time : 3 Hours Max. Marks : 70

PART – A

Answer **any five** of the following. **Each** question carries **eight** marks. **(5×8=40)**

1. Explain the quantum numbers associated with the vector atom model. **8**

2. a) Distinguish between Normal and Anomalous Zeeman effect.
   b) Explain Debye's quantum theory of Normal Zeeman effect. **(2+6)**

3. a) Mention the different types of molecular spectra.
   b) Obtain an expression for rotational energy levels of a diatomic molecule. **(3+5)**

4. Assuming the relation between impact parameter and angle of scattering, derive Rutherford's scattering formula. **8**

5. a) Explain the different types of beta decay.
   b) What is Pauli's Neutrino hypothesis ? **(6+2)**

6. With a neat diagram explain the variation of ionization current with applied voltage in gas ionization detectors. **8**

7. a) Distinguish between direct nuclear reaction and compound nuclear reaction.
   b) Derive an expression for threshold energy of an endoergic reaction. **(4+4)**

8. a) What are elementary particles ?
   b) Explain the classification of elementary particles. **(1+7)**

P.T.O.

PART – B

Answer **any five** of the following problem. **Each** problem carries **four** marks. **(5×4=20)**

9. The experimental value of Bohr magneton is $9.274 \times 10^{-24}\ JT^{-1}$ and Planck's constant is 6.625×10^{-34} Js. Calculate the specific charge of electron.

10. A beam of silver atoms in the Stern-Gerlach experiment, obtained from an oven pass through an inhomogeneous magnetic field of field gradient 5 Tm^{-1} perpendicular to the beam. The pole pieces are 0.15 m long. Calculate the separation between the two traces on a photographic plate kept closed to the magnets if the velocity of silver atoms is 589 ms^{-1}. Given : $\mu = 9.2 \times 10^{-24}\ JT^{-1}$, Mass of silver atoms = 1.79×10^{-25} kg.

11. The spacing between vibrational levels of CO molecule is 0.082 eV. Calculate the value of force constant.

    Given : Reduced mass of CO molecule = 1.14×10^{-26} kg.

    $h = 6.625 \times 10^{-34}$ Js

    $e = 1.6 \times 10^{-19}$ C

12. Calculate the distance of closest approach of α-particle of energy 3 MeV being scattered by a gold nucleus (Z = 79). Given : $\varepsilon_0 = 8.85 \times 10^{-12}\ \frac{f}{m}$.

13. Neptunium ($_{93}Np^{237}$) emits α-particles of energy 4.19 MeV. Calculate the kinetic energy of daughter nucleus and alpha disintegration energy.

14. Potassium – 40 is an isotope which decays by β^- emission. Find the Q-value of the decay and write the reaction.

    Given : Mass of K^{40} = 39.96399 u

    Mass of Ca^{40} = 39.96259 u

15. A self quenched GM counter operates at 1000 V and has a wire of diameter of 0.2 mm. The radius of the cathode is 2×10^{-2} m and the tube has a guaranteed life time of 10^9 counts. What is the maximum radial field and how long will the counter last if it is used on an average for 30 hours per week at 3000 counts per minute ?

    Assume 52 weeks per year.

16. Calculate the Q value of the reaction

$_1H^2$ (d, n) $_2He^3$

Given : $_1H^2 = 2.0141$ u

$_2He^3 = 3.0160$ u

$_0n^1 = 1.00866$ u

Is it exoergic or endoergic ?

PART – C

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

17. a) Can an electron revolve round the nucleus in an orbit of any radius ? Justify.
    b) Why α-particles have high ionising power ?
    c) Can radioactivity be controlled ? Explain.
    d) Do electron exist in atomic nuclei ? Explain.
    e) Can ionization chambers be used to detect electrons ? Explain.
    f) Can we accelerate neutron in a cyclotron ? Explain.
    g) Give the quart composition of a proton and a neutron.
    h) Does a weak interaction obey strangeness ? Explain.