SARDAR PATEL UNIVERSITY
B.Sc., 6th Semester
Saturday 25th June 2022
Subject: Solid State Physics & Nuclear Physics (US06CPHY23)
Time : 10.00 am to 12:00pm

Total Marks: 70

Que 1 To answer the questions, choose the correct option. [10]

1. In X-ray diffraction, Laue method _____ material is use as a specimen.
   a) polycrystalline
   b) any
   c) single crystal
   d) all of these

2. Any diffraction pattern of a crystal is a map of the _____ lattice.
   a) direct
   b) reciprocal
   c) bravaius
   d) All of these

3. The wavelength of x rays is expressed as _____.
   a) $\lambda = E/hc$
   b) $\lambda = E/P$
   c) $\lambda = hc/E$
   d) $\lambda = E.hc$

4. According to Drude model assumptions, the average electron velocity immediately after the collision is _____.
   a) zero
   b) maximum
   c) minimum
   d) infinite

5. With the help of the Hall effect, _____ can be determined.
   a) The sign of charge carriers
   b) The no. of charge carriers per unit volume
   c) Electronic structure of the substance
   d) All of these

6. _____ is not a pair of mirror nuclei.
   a) $_1H^3$ $_2He^3$
   b) $_6C^{13}$ $_7N^{13}$
   c) $_1H^3$ $_2He^4$
   d) $_{19}K^{39}$ $_{20}Ca^{39}$

7. The deviation of a nucleus from a spherically symmetric shape is expressed by _____.
   a) Nuclear angular momentum
   b) Electric quadrupole moment
   c) Nuclear magnetic momentum
   d) parity

8. _____ of the following is not a type of accelerator.
   a) betatron
   b) cyclotron
   c) tandem
   d) bubble chamber

9. The formula for cyclotron frequency is _____.
   a) $\dfrac{Bq}{2\pi m}$
   b) $\dfrac{2\pi m}{Bq}$
   c) $\dfrac{Bm}{2\pi q}$
   d) $\dfrac{B}{2\pi mq}$

10. For the graph of variation of logarithm of number of ion pairs versus applied voltage, region-V is known as _____.
    a) Ionization region
    b) region of limited proportionality
    c) Proportional region
    d) Geiger-Muller region

Que 2   Fill in the blanks and True or False type questions.   [08]

1   X rays are invisible electromagnetic radiation. [TRUE/ FALSE]
2   The Kinetic energy of the electron gas decreases as its temperature increases.
     [TRUE/ FALSE]
3   If Q is positive, the nuclear reaction is exoergic. [TRUE/ FALSE]
4   A tandem accelerator is a two-stage accelerator. [TRUE/ FALSE]
5    $a^*.a = $ _____ .

6   R_H is known as _____ .
7   1 barn = _____ cm^2
8   In frequency modulated cyclotron, when particle reaches relativistic speed, the
     frequency of oscillator _____ .

Que- 3   Write answers of any ten questions in brief.   [20]

1   What are advantages of neutron diffraction over the x ray diffraction?

2   State and interpret the Bragg's law.

3   Draw Ewald sphere for Bragg reflections.

4   Define: (a) Fermi energy and (b) Degeneracy.

5   Define Hall effect.

6   Define drift velocity and give its expression.

7   Define: (a) isotopes and (b) isotones

8   With example, define pick-up nuclear reaction.

9   Write nuclear reaction for formation and decay of compound nucleus.

10   Mention any two differences between ionization chamber and Geiger-Muller counter.

11   Enlist advantages of cyclotron.

12   State principle of Geiger-Muller counter.

Que-4   Attempt any four of the following questions.   [32]
[1]   Enlist the experimental X ray diffraction methods and write a detail note on X ray
      diffraction powder method.
[2]   Explain: (i) Relation between σ_{hkl} and crystallographic axes and (ii) Reciprocal lattice
      vector.
[3]   Write a detail note on DC electrical conductivity of metals.
[4]   State the free particle Schrodinger equation in three dimension and derive the
      formula for free electron gas in three dimensions.
[5]   State principle, construction and working of Dempster's mass spectrometer.
[6]   For liquid drop model of nucleus, derive expressions for (i) Volume energy (ii) Surface
      energy and (iii) Coulomb energy terms.
[7]   State principle and construction of Betatron. Also, derive the formula for Betatron
      condition.
[8]   State principle, construction and working of Cloud chamber.

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