E–983

M. Sc. (Fourth Semester) (Main/ATKT) EXAMINATION, May-June, 2021

PHYSICS

Paper Third

(Solid State Physics—II)

Time : Three Hours]   [*Maximum Marks : 80*

Note : Attempt all Sections as directed.

Section—A   1 each

(Objective/Multiple Choice Questions)

Note : Attempt all questions.

Choose the correct answer :

1. Dielectric constant $\in$ of electrostatic μ defined in terms of the electric field $\overrightarrow{E}$ and polarization $\overrightarrow{P}$, then the dipole moment density [in S. I. unit] :

    (a) $\overrightarrow{D} = \in_0 E + P$

    (b) $\overrightarrow{D} = \in_0 + P$

    (c) $\overrightarrow{D} = \in_0 E + 1$

    (d)   None of the above

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2. Which one is a correct equation for plasma frequency $\left[\omega_p\right]$?

   (a) $\omega_p = \dfrac{n_e}{\epsilon_0 \ m}$

   (b) $\omega_p = e\sqrt{\dfrac{n}{\epsilon_0 \ m}}$

   (c) $\omega_p = \sqrt{\dfrac{en}{\epsilon_0 \ m}}$

   (d) $\omega_p = \dfrac{n_{e^2}}{\epsilon_0 \ m}$

3. Phenomenon of cross slip occurs in :

   (a)   Point imperfection

   (b)   Line imperfection

   (c)   Volume imperfection

   (d)   Surface imperfection

4. An atom containing unpaired electrons shows :

   (a)   Diamagnetism

   (b)   Ferromagnetism

   (c)   Paramagnetism

   (d)   None of the above

5. In a non-magnetic isotropic medium the electromagnetic wave equation is :

   (a)　$\mu_0 \dfrac{\partial^2 D}{\partial t^2} = \nabla^2 E$

   (b)　$\mu_0 \dfrac{\partial^2 D}{\partial t^2} = \nabla E$

   (c)　$\mu_0 \dfrac{\partial D}{\partial t} = \nabla E$

   (d)　None of the above

6. The electric field $\vec{E}(r)$ at a point $\vec{r}$ from a dipole moment p is given by :

   (a)　$\vec{E}(r) = \dfrac{3(p.r)r - r^2 p}{4\pi\epsilon_0 \, r^5}$

   (b)　$\vec{E}(r) = \dfrac{3r - r^2 p}{4\pi\epsilon_0 \, r^5}$

   (c)　$\vec{E}(r) = \dfrac{3r - r^2 p}{4\pi\epsilon_0}$

   (d)　None of the above

7. Density of crystal remains unchanged as a result of :

   (a)　Frenkel defect

   (b)　Schottky defect

   (c)　Vacancy defect

   (d)　None of the above

8. According to Hund's rule which statement is correct ?

    (a) Lowest l is of lowest energy.

    (b) Highest l is of lowest energy.

    (c) Highest l is of highest energy.

    (d) None of the above

9. Which one is a correct Lorentz relation ?

    (a) $E_{local} = \vec{E} + P$

    (b) $E_{local} = \vec{E} + 3 \in_0 P$

    (c) $E_{local} = E + \dfrac{P}{3 \in_0}$

    (d) None of the above

10. $\dfrac{\in - 1}{\in + 2} = \dfrac{\Sigma N_i \, \alpha_i}{3 \in_0}$ is :

    (a) Clausius-Mossotti relation

    (b) Einstein relation

    (c) Lorentz relation

    (d) None of the above

11. The bound electron-hole pair is called as :

    (a) Exciton

    (b) Cooper pair

    (c) Polaritons

    (d) All of the above

12. The magnetic moment of an atom or ion in free space is given by :

   (a) $\mu = -g\mu_B J$

   (b) $\mu = -g\mu_B$

   (c) $\mu = -gJ$

   (d)   None of the above

13. In anti-ferromagnetic substances χ is equal to :

   (a) $\dfrac{C}{T}$

   (b) $\dfrac{C}{Q}$

   (c)   Both (a) and (b) are correct

   (d)   None of the above

14. Edge dislocations imperfection is a sub-type of :

   (a)   point imperfection

   (b)   line imperfection

   (c)   volume imperfection

   (d)   None of the above

15. In an antiferromagnet the susceptibility above the Neel temperature has the form :

   (a) $\chi = \dfrac{2C}{T+Q}$

   (b) $\chi = \dfrac{T+Q}{2C}$

   (c) $\chi = \dfrac{Q}{2C}$

   (d)   None of the above

16. Electron capture in a negative ion vacancy is :

    (a) K-centre

    (b) F-centre

    (c) V-centre

    (d) None of the above

17. At the Neel temperature the susceptibility of anti-ferromagnetic substance is :

    (a) maximum

    (b) minimum

    (c) zero

    (d) infinite

18. The value of permeability of paramagnetic substance is :

    (a) Less than 1

    (b) More than 1

    (c) Equal to 1

    (d) None of the above

19. The particles associated with plasma oscillations are known as :

    (a) Polarons

    (b) Plasmons

    (c) Excitons

    (d) None of the above

20. In which materials the magnetic anisotropy is followed ?

    (a) Diamagnetic

    (b) Ferromagnetic

    (c) Paramagnetic

    (d) None of the above

Section—B 2 each

(Very Short Answer Type Questions)

Note : Attempt all questions.

1. What do you mean by Polarions ?
2. What do you mean by piezoelectricity ?
3. Give LST relation.
4. What is meant by rare earth ions ?
5. Define Burger vector.
6. What are optical ceramic ?
7. Define Curie point.
8. Define Frenkel defect.

Section—C 3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. Explain mott-metal-insulator transition.
2. Explain the dislocation in the crystal structure.
3. Explain the quenching of orbital angular momentum.
4. What is screened Coulomb potential ?
5. Explain the color centers.
6. Explain diamagnetism and paramagnetism.
7. Discuss the thermal excitation of magnon.
8. Explain the Landau's theory of the phase transition.

Section—D 4 each

(Long Answer Type Questions)

Note : Attempt any *five* questions.

1. Discuss the dielectric function of electron gas.

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2. What is magnon ? Describe the neutron magnetic scattering.

3. Discuss the quantum theory of paramagnetism.

4. What are excitons ? Describe the different types of excitons giving difference between them.

5. Describe ferrimagnetic order and susceptibility of ferrimagnets.

6. Discuss various types of dislocation in crystal.

7. Explain the plasma optics on transverse optical mode in a plasma.