

SSR DEGREE & PG COLLEGE (AUTONOMOUS)

M.SC. PHYSICS

Solid state

Sem – II Internal – 1

QUESTION BANK

I. Multiple choice questions

1. A translational vector in a crystal lattice connects:

- A) Two arbitrary points
- B) Two equivalent lattice points
- C) Two atoms only
- D) Two unit cells only

Answer: B) Two equivalent lattice points

2. How many Bravais lattices are possible in three dimensions?

- A) 7
- B) 14
- C) 21
- D) 28

Answer: B) 14

3. The body-centered cubic (BCC) lattice contains:

- A) 1 atom per unit cell
- B) 2 atoms per unit cell
- C) 4 atoms per unit cell
- D) 6 atoms per unit cell

Answer: B) 2 atoms per unit cell

4. The packing efficiency of BCC is approximately:

- A) 52%
- B) 68%
- C) 74%
- D) 90%

Answer: B) 68%

5. The crystal structure of NaCl is:

- A) Zinc blende
- B) CsCl type
- C) Rock salt structure
- D) Diamond structure

Answer: C) Rock salt structure

6. In ZnS (zinc blende) structure, each Zn atom is surrounded by:

- A) 4 S atoms

- B) 6 S atoms
 - C) 8 S atoms
 - D) 12 S atoms
- Answer: A) 4 S atoms

7. Bragg's law is given by
 $n\lambda = 2d\sin\theta$

- A) $n\lambda = d\sin\theta$
 - B) $n\lambda = 2d\sin\theta$
 - C) $n\lambda = 2d\cos\theta$
 - D) $\lambda = d\tan\theta$
- Answer: B

8. Bragg's law is mainly used to determine

- A) resistance of metals
- B) crystal structure
- C) magnetic field
- D) viscosity

Answer: B

9. The lattice parameter of a cubic crystal depends on:

- A) Density only
- B) Atomic number only
- C) Interplanar spacing and Miller indices
- D) Temperature only

Answer: C) Interplanar spacing and Miller indices

10. Brillouin zones are constructed in:

- A) Direct lattice space
- B) Coordinate space
- C) Reciprocal lattice space
- D) Momentum space only

Answer: C

11. The boundary of a Brillouin zone consists of:

- A) Crystal defects
- B) Planes perpendicular bisectors of reciprocal lattice vectors
- C) Atomic planes
- D) Real lattice vectors

Answer: B

12. Elastic waves in a one-dimensional lattice are examples of:

- A) Electromagnetic waves
- B) Matter waves
- C) Mechanical waves
- D) Radio waves

Answer: C) Mechanical waves

13. A diatomic linear lattice contains:

- A) Only one type of atom
- B) Two different atoms alternating periodically
- C) Randomly placed atoms
- D) Only molecules

14. In Einstein's model, all atoms in a solid are assumed to:

- A) Vibrate with different frequencies
- B) Remain stationary
- C) Vibrate with the same frequency
- D) Rotate freely

Answer: C) Vibrate with the same frequency

15. Einstein introduced the concept of quantization to explain:

- A) Thermal expansion
- B) Black body radiation
- C) Specific heat of solids
- D) Electrical conductivity

Answer: C) Specific heat of solids

16. Lattice vibrations in a crystal are quantized as:

- A) Electrons
- B) Magnons
- C) Phonons
- D) Excitons

Answer: C) Phonons

17. Which factor decreases lattice thermal conductivity?

- A) Crystal perfection
- B) Low temperature
- C) Impurities and defects
- D) Strong bonding

Answer: C) Impurities and defects

18. Phonon mean free path mainly affects:

- A) Electrical charge only
- B) Nuclear stability
- C) Thermal conductivity of solids
- D) Atomic number

Answer: C

19. Which of the following reduces phonon mean free path?

- A) Crystal purity
- B) Lattice defects
- C) Lower scattering

D) Perfect periodicity

Answer: B

20. Which scattering mechanism dominates phonon mean free path at very low temperatures?

- A) Electron scattering
- B) Impurity scattering
- C) Boundary scattering
- D) Nuclear scattering

II. Fill in the blanks

1. The unit commonly used for atomic spacing is **angstrom (Å)**.
2. The diffraction of electrons was experimentally verified by **Davisson and Germer**
3. The powder method is used to determine the **crystal structure** and **lattice parameters**
4. The Laue method is mainly used to determine the **orientation** of crystals
5. Reciprocal lattice is useful in **X-ray diffraction** analysis.
6. A crystal system with all sides equal and all angles 90° is called ___ system. **Cubic**
7. The rhombohedral system is also called the ___ system. **Trigonal**
8. Bravais lattices were proposed by **Auguste Bravais**
9. The coordination number of diamond is **4**.
10. The bonding in CsCl is mainly **ionic** bonding.
11. A diatomic linear lattice contains **two** different atoms in each primitive cell.
12. The relation between angular frequency ω and wave vector k is called the **dispersion relation**.
13. The frequency of the acoustic mode at $k = 0$ is **zero**.
14. The slope of the acoustic branch near the origin gives the velocity of **sound**.
15. Infrared radiation interacts with the crystal through its **electric** field.
16. A vibration is infrared active if it produces a change in **dipole moment**.
17. The quantized lattice vibration responsible for infrared absorption is called a **phonon**.
18. The characteristic temperature in Einstein theory is called the **Einstein temperature**.
19. At high temperatures, Einstein theory gives the **Dulong and Petit** law.
20. Einstein treated atoms as **harmonic oscillators**.

III. Descriptive questions

1. Describe the different methods of X-ray diffraction
2. State and explain Bragg's law of diffraction

3. write crystal structure of NaCl
4. Obtain vibrational modes of a diatomic linear lattice
5. discuss the failures of Einstein theory of specific heat
6. explain Debye theory