



CHEM • CHEMISTRY

06. Solids

Official PMDC Solved Past Paper Topical Booklet • High-Yield Examination Series

🎯 54 Solved Questions

📅 2010 to 2024 Archive

🏛️ Boards: BUMHS, DUHS, KMU, MDCAT, NUMS, PMDC

📄 Weightage: 27% of MDCAT (54 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

UHS 2024

Whenever the crystalline solids are broken they do so along definite planes known as:

- (A) Cleavage plane
- (B) Refractory planes
- (C) Sagittal planes
- (D) Coronal planes

Q2.

UHS 2024

One of the following is NOT an example of amorphous solids:

- (A) Plastics
- (B) Glass
- (C) Glucose
- (D) Rubber

Q3.

UHS 2024

In graphite the carbon atoms are arranged in which of the following structure?

- (A) Rhombic
- (B) Hexagonal
- (C) Tetragonal
- (D) Trigonal

Q4.

SZABMU 2024

Which of the following is an example of molecular solid?

- (A) Al_3N_2
- (B) $\text{CO}_{2(s)}$
- (C) CsF
- (D) NaCl

Q5.

SZABMU 2024

NaCl is an example of ____ arrangement of crystal lattice.

- (A) Monoclinic
- (B) Octahedral
- (C) Tetrahedral
- (D) Triangular

Q6.

SZABMU 2024

Identify the pair of solids having molecular nature:

- (A) C , CO_2
- (B) S_8 , I_2
- (C) NaCl , C
- (D) CO_2 , KCl

Q7.

SZABMU 2024

Ag_2SO_4 and Na_2SO_4 are the

- (A) Polymorphs
- (B) Isomorphs
- (C) Allotropes
- (D) Anisotropes

Q8.

SZABMU 2024

Which one of the following is a non-polar molecular solid?

- (A) CO_2
- (B) SiC
- (C) MgO
- (D) Ice

Q9.

SZABMU 2024

The shape of NaCl according to its radius ratio is:

- (A) Octahedral
- (B) Body centered cubic
- (C) Tetrahedral
- (D) Triangular

Q10.

KMU 2024

The example of metallic solid is:

- (A) B
- (B) C
- (C) Cu
- (D) Si

Q11.

KMU 2024

When a crystalline substance conducts current in one direction but not through other directions of the crystal, this property is:

- (A) Allotropy
- (B) Anisotropy
- (C) Isomorphism
- (D) Polymorphism

Q12.

DUHS 2024

Dry ice is the example of:

- (A) Molecular solid
- (B) Metallic solid
- (C) Covalent solid
- (D) Ionic solid

Q13.

DUHS 2024

It is an example of a crystalline solid:

- (A) Plastics
- (B) Charcoal
- (C) Glass
- (D) Alum

Q14.

BUMHS 2024

Electrically diamond is a:

- (A) Good conductor
- (B) Non-conductor
- (C) Semiconductor
- (D) None of the given options

Q15.

BUMHS 2024

The term 'Transition temperature' is use for the temperature:

- (A) At which one crystalline form of a substance changes into another
- (B) At which liquid crystals are formed in a liquid
- (C) Within which the habit of a crystal remains the same
- (D) Showing a sharp change in the anisotropic properties of a crystal

Q16.

NUMS 2024

Iodine is a poor conductor of electricity because of:

- (A) Face centered cubic structure
- (B) Body centered cubic structure
- (C) Tetragonal structure
- (D) Hexagonal structure

Q17.

NUMS 2024

Predict the shape of CsCl having radius ratio of 0.93

- (A) Tetrahedral
- (B) Octahedral
- (C) Body centered cubic
- (D) Hexagonal

Q18.

UHS 2023

In anisotropic crystals which property do not change with the change in direction of crystalline structure?

- (A) Electrical conductance
- (B) Thermal conductance
- (C) Molar mass
- (D) Refractive index

Q19.

UHS 2023

In metals, why electric conductivity decreases with the increases of temperature?

- (A) Because electron movement decrease with the increase of temperature
- (B) Because metal ions oscillations hinder electron movement
- (C) Because electron direction changes at high temperature
- (D) Because they pass heat current through collision of electrons

Q20.

SZABMU 2023

Which of the following information we obtain from the Lattice energy?

- (A) It helps while explaining the structure of the ionic compound
- (B) It explains bonding in the covalent compound
- (C) It explains properties of the metallic compounds
- (D) It explains the structure of the molecular compounds

Q21.

SZABMU 2023

Which of the following solids have strong metallic bond?

- (A) Potassium
- (B) Phosphorus
- (C) Calcium
- (D) Sulphur

Q22.

KMU 2023

All of the following crystal systems have $\beta = \gamma = 90^\circ$ except:

- (A) Cubic
- (B) Orthorhombic
- (C) Tetragonal
- (D) Rhombohedral

Q23.

KMU 2023

Crystal having orthorhombic crystal system is:

- (A) PbCrO_4
- (B) BaSO_4
- (C) ZnO
- (D) $\text{K}_2\text{Cr}_2\text{O}_7$

Q24.

DUHS 2023

Which of the following is a covalent crystal?

- (A) NaCl
- (B) KI
- (C) MgBr_2
- (D) Diamond

Q25.

DUHS 2023

The nature of attraction which holds molecular crystal is:

- (A) Ionic
- (B) Hydrogen bond
- (C) Covalent bond
- (D) Van Der Waals force

Q26.

BUMHS 2023

The system in which three angles and axes are unequal is called?

- (A) Cubic system
- (B) Triclinic system
- (C) Orthorhombic system
- (D) Trigonal system

Q27.

BUMHS 2023

Which one of the following have no cleavage plane?

- (A) Graphite
- (B) NaCl crystals
- (C) Copper crystals
- (D) Ice

Q28.

NUMS 2023

Which statement correctly describes the structure of sodium chloride crystal?

- (A) Each sodium ion is surrounded by six chloride ions and each chloride ions surrounded by 6 sodium ions
- (B) The crystal is face centered cubic structure
- (C) Each sodium ion is surrounded by 3 chloride ions and each chloride ion surrounded by sodium ions
- (D) Intermolecular forces are present between two oppositely charges ions

Q29.

NUMS 2023

The greater Lattice energy is shown by:

- (A) NaCl
- (B) NaBr
- (C) NaI
- (D) NaF

Q30.

NUMS 2023

Thermal conductivity of metals is due to:

- (A) Layered structure of metals
- (B) Freely moving electrons
- (C) Loosely hold metal atoms
- (D) Vibrational movement of metals

Q31.

NUMS 2023

Co-ordination number of Na is:

- (A) 10
- (B) 9
- (C) 8
- (D) 12

Q32.

UHS 2022

A small building block which belongs to whole information about crystal structure is called?

- (A) Cell
- (B) Crystal lattice
- (C) Unit cell
- (D) Crystal unit

Q33.

UHS 2022

Which type of solid is called as atomic solid?

- (A) Covalent solids
- (B) Ionic solids
- (C) Metallic solids
- (D) Molecular solids

Q34.

SZABMU 2022

The molecules of iodine (I_2) form the:

- (A) Molecular crystals
- (B) Covalent crystals
- (C) Ionic crystals
- (D) Metallic crystals

Q35.

KMU 2022

Which of the following ionic compounds has the highest value of lattice energy?

- (A) NaF
- (B) LiCl
- (C) NaI
- (D) KI

Q36.

KMU 2022

Which one of the following is the example of polar molecular solids?

- (A) Ice
- (B) Iodine
- (C) Copper
- (D) Phosphorous

Q37.

KMU 2022

Which one of the following pairs of compounds is not isomorphic in nature?

- (A) NaF and MgO
- (B) KNO_3 and $NaNO_3$
- (C) ZnO and CdS
- (D) $AgNO_3$ and KNO_3

Q38.

DUHS 2022

Small diffusion in solid is due to:

- (A) Very fast motion of its particles
- (B) Vibrational motion of its particles
- (C) Translational motion of its particles
- (D) Diffusion into solid is not present

Q39.

BUMHS 2022

Amorphous solids?

- (A) Have perfect arrangement of atoms
- (B) Have sharp Melting point
- (C) Can possess small regions of orderly arrangement of atoms
- (D) Undergo clean cleavage when cut with knife

Q40.

BUMHS 2022

Which one of the following is not a crystalline solid?

- (A) Copper sulphate
- (B) Sugar
- (C) NaCl
- (D) Rubber

Q41.

NUMS 2022

Nature of diamond as solid is

- (A) Covalent
- (B) Molecular
- (C) Ionic
- (D) Metallic

Q42.

NUMS 2022

Which one of the following is as light as a feather and as strong as iron?

- (A) Graphite
- (B) Mercury
- (C) Graphene
- (D) Diamond

Q43.

PMDC 2021

Shape of iodine unit cell.

- (A) Orthorhombic
- (B) Hexagonal
- (C) Triclinic
- (D) Face-centered cubic

Q44.

PMDC 2021

Properties due to change of direction are called ____

- (A) Isotropic properties
- (B) Anisotropy
- (C) Symmetry
- (D) Cleavage plane

Q45.

PMDC 2021

Current in electrolysis is carried through:

- (A) Free electrons
- (B) Positive ions
- (C) Negative ions
- (D) Both B and C

Q46.

PMDC 2021

The smallest part of the crystal lattice has all the properties of the entire crystal this is called:

- (A) Unit
- (B) Unit cell
- (C) Unit crystal
- (D) All of these

Q47.

PMDC 2020

The lattice energy is also called as:

- (A) Energy of affinity
- (B) Bond energy
- (C) Crystal energy
- (D) Potential energy

Q48.

NUMS 2019

Which one the following have highest lattice energy?

- (A) NaCl
- (B) KCl
- (C) KBr
- (D) LiCl

Q49.

SET 2019

In diamond each of the four outer electrons on every carbon atom is involved in covalent bonding. This means that there are no free electrons available. Which of the following property is explained by this statement?

- (A) Diamond does not conduct heat and electricity
- (B) Diamond is very hard
- (C) Diamond has high refractive index
- (D) Diamond cuts diamond

Q50.

KMU 2019

Substance that has sharp melting point in the following is:

- (A) Gemstone
- (B) Glass
- (C) Coal tar
- (D) Diamond

Q51.

MDCAT 2016

Electrical conductivity of graphite is greater in one direction than in other due to:

- (A) Isomorphism
- (B) Anisotropy
- (C) Cleavage plane
- (D) Symmetry

Q52.

KMU 2016

Graphite is one of the allotropic form of Carbon. It is:

- (A) Isotropic
- (B) Anisotropic
- (C) Good conductor of electricity
- (D) Both B and C

Q53.

MDCAT 2013

In the structure of NaCl, each sodium ion is surrounded by chloride ions:

- (A) 4
- (B) 6
- (C) 5
- (D) 8

Q54.

MDCAT 2010

The coordination number of Na^+ in NaCl crystal is:

- (A) 8
- (B) 4
- (C) 2
- (D) 6

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 06. Solids.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	A	UHS 2024	12	A	DUHS 2024	23	B	KMU 2023	34	A	SZABMU 2022	45	D	PMDC 2021
2	C	UHS 2024	13	D	DUHS 2024	24	D	DUHS 2023	35	A	KMU 2022	46	B	PMDC 2021
3	B	UHS 2024	14	B	BUMHS 2024	25	D	DUHS 2023	36	A	KMU 2022	47	C	PMDC 2020
4	B	SZABMU 2024	15	A	BUMHS 2024	26	B	BUMHS 2023	37	D	KMU 2022	48	D	NUMS 2019
5	B	SZABMU 2024	16	A	NUMS 2024	27	C	BUMHS 2023	38	D	DUHS 2022	49	A	SET 2019
6	B	SZABMU 2024	17	C	NUMS 2024	28	A	NUMS 2023	39	C	BUMHS 2022	50	D	KMU 2019
7	B	SZABMU 2024	18	C	UHS 2023	29	D	NUMS 2023	40	D	BUMHS 2022	51	B	MDCAT 2016
8	A	SZABMU 2024	19	B	UHS 2023	30	B	NUMS 2023	41	A	NUMS 2022	52	D	KMU 2016
9	A	SZABMU 2024	20	A	SZABMU 2023	31	C	NUMS 2023	42	C	NUMS 2022	53	B	MDCAT 2013
10	C	KMU 2024	21	C	SZABMU 2023	32	C	UHS 2022	43	D	PMDC 2021	54	D	MDCAT 2010
11	B	KMU 2024	22	D	KMU 2023	33	A	UHS 2022	44	B	PMDC 2021			

TOTAL
MCQS

54

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in
BeambePrep Grind Mode for automated error
 autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (A)

UHS 2024

Whenever the crystalline solids are broken they do so along definite planes known as:

CORE CONCEPT AND DERIVATION

Crystalline solids feature highly ordered, repeating arrangements of atoms. Because of this geometry, there are specific directions where the bonds holding the lattice together are weaker.

Solution:

- When stress or force is applied to a crystalline solid, it will naturally split or break along these specific, well-defined directional planes of weakness.
- These flat, smooth surfaces that result from the break are scientifically termed **cleavage planes**.
- This property is a hallmark of crystallinity, distinguishing them from amorphous solids, which shatter irregularly (conchoidal fracture).

Why other options are incorrect:

- B:** Refractory refers to materials highly resistant to heat, not structural breaking planes.
- C, D:** Sagittal and Coronal planes are anatomical terms used to describe cross-sections of the human body, completely irrelevant to solid-state chemistry.

Question #2 Key: (C)

UHS 2024

One of the following is NOT an example of amorphous solids:

CORE CONCEPT AND DERIVATION

Solids are broadly categorized as either crystalline (having a highly ordered, repeating internal 3D structure) or amorphous (lacking long-range order).

Solution:

- Glucose** ($C_6H_{12}O_6$) forms true, well-defined molecular crystals with sharp melting points.
- Because its molecules arrange themselves in a perfectly ordered repeating lattice, glucose is a **crystalline solid**.
- Therefore, it is NOT an amorphous solid.

Why other options are incorrect:

- A, B, D:** Plastics, Glass, and Rubber are classic textbook examples of amorphous solids. Their internal structures are random and tangled, lacking a repeating geometric lattice.

Question #3 Key: (B)

UHS 2024

In graphite the carbon atoms are arranged in which of the following structure?

CORE CONCEPT AND DERIVATION

Graphite is an allotrope of carbon defined by a specific 2D layered geometry resulting from sp^2 hybridization.

Solution:

- In graphite, every carbon atom undergoes sp^2 hybridization and forms three sigma bonds with neighboring carbon atoms in the same plane.
- This bonding arrangement creates flat, contiguous 2D sheets composed of interlocking six-membered rings.
- This structure is geometrically described as a **hexagonal** array or hexagonal honeycomb structure.

Why other options are incorrect:

- A, C, D:** These refer to different 3D crystal systems or geometries that do not match the flat, 120-degree bonded rings found in graphite sheets.

Question #4 Key: (B)

SZABMU 2024

Which of the following is an example of molecular solid?

CORE CONCEPT AND DERIVATION

Molecular solids consist of discrete, neutral molecules held together in a lattice by weak intermolecular forces (Van der Waals forces, dipole-dipole, or hydrogen bonds).

Solution:

- Carbon dioxide (CO_2) is a discrete, non-polar covalent molecule.
- When cooled sufficiently, it freezes to form solid CO_2 (commonly known as dry ice).
- In this solid state, independent CO_2 molecules occupy the lattice points and are held together only by weak London dispersion forces.
- Therefore, $CO_{2(s)}$ is a classic example of a molecular solid.

Why other options are incorrect:

- C, D:** CsF and $NaCl$ are composed of a metal and a non-metal, forming a lattice of cations and anions held by strong electrostatic forces. They are ionic solids.
- A:** Aluminum nitride usually forms extended covalent/ionic networks, not discrete molecular solids.

Question #5 Key: (B)

SZABMU 2024

[Formula] is an example of ____ arrangement of crystal lattice.

CORE CONCEPT AND DERIVATION

The coordination geometry of an ionic lattice describes the spatial arrangement of nearest neighbor ions around a central ion.

Solution:

- In a Sodium Chloride (NaCl) crystal, the lattice is face-centered cubic (FCC).
- Within this FCC lattice, every single Na^+ ion is surrounded by six Cl^- ions located along the x, y, and z axes (up, down, left, right, front, back).
- Geometrically, if you connect the centers of these 6 surrounding chloride ions, it forms an eight-faced shape called an octahedron.
- Therefore, NaCl exhibits an **octahedral** arrangement.

Why other options are incorrect:

- **A:** Monoclinic is a crystal system shape, not the localized atomic coordination arrangement for NaCl .
- **C:** Tetrahedral arrangement implies a coordination number of 4 (like in Zinc Blende, ZnS), whereas NaCl is 6.
- **D:** Triangular implies a 2D planar coordination of 3, which is incorrect for 3D salt lattices.

Question #6 Key: (B)

SZABMU 2024

Identify the pair of solids having molecular nature:

CORE CONCEPT AND DERIVATION

Molecular solids are characterized by discrete, independent molecules occupying the lattice points, held together by weak intermolecular forces.

Solution:

- S_8 (Rhombic/Monoclinic Sulfur) exists as discrete 8-atom crown-shaped molecules.
- I_2 exists as discrete diatomic molecules.
- In both solid states, these neutral molecules are held together strictly by weak London dispersion forces, classifying both purely as molecular solids.

Why other options are incorrect:

- **A:** While CO_2 is molecular, Carbon (C - diamond/graphite) is a giant covalent network solid.
- **C:** NaCl is an ionic solid; Carbon (C) is covalent.
- **D:** While CO_2 is molecular, KCl is an ionic solid.

Question #7 Key: (B)

SZABMU 2024

[Formula] and [Formula] are the

CORE CONCEPT AND DERIVATION

Isomorphism occurs when two fundamentally different chemical compounds crystallize in the exact same geometric crystal structure.

Solution:

- Silver sulfate (Ag_2SO_4) and Sodium sulfate (Na_2SO_4) possess the exact same atomic ratio (2:1:4).
- Because the respective cations (Ag^+ and Na^+) and the shared anion (SO_4^{2-}) pack together in identically shaped lattices, these two different compounds are structural analogs.
- Different compounds sharing the same crystal geometry are termed **isomorphs**.

Why other options are incorrect:

- **A:** Polymorphs refer to a *single* compound existing in multiple different crystal structures.
- **C:** Allotropes are multiple forms of a *single pure element* (e.g., carbon as diamond or graphite).
- **D:** Anisotropes is not a noun for substances; anisotropy is a directional property of crystals.

Question #8 Key: (A)

SZABMU 2024

Which one of the following is a non-polar molecular solid?

CORE CONCEPT AND DERIVATION

A molecular solid is non-polar if its constituent molecules possess no net permanent dipole moment (usually due to high structural symmetry cancelling out bond polarities).

Solution:

- Carbon dioxide (CO_2) has a perfectly linear molecular geometry ($\text{O}=\text{C}=\text{O}$).
- Although the individual $\text{C}=\text{O}$ bonds are polar, they pull exactly in opposite directions, mathematically cancelling each other out.
- This results in a net dipole moment of zero. Therefore, solid CO_2 (dry ice) is a **non-polar molecular solid**, held together by weak London dispersion forces.

Why other options are incorrect:

- **D:** Ice is made of H_2O , a bent molecule with a strong permanent dipole, making it a polar molecular solid.
- **C:** MgO is a lattice of Mg^{2+} and O^{2-} ions, making it an ionic solid.
- **B:** Silicon carbide (SiC) is a giant 3D covalent network solid, not molecular.

Question #9 Key: (A)

SZABMU 2024

The shape of [Formula] according to its radius ratio is:

CORE CONCEPT AND DERIVATION

The radius ratio rule predicts the coordination number and resulting local geometric shape of an ionic crystal based on the relative sizes of the cation and anion.

Formula:

$$\text{Radius Ratio} = \frac{r^+}{r^-}$$

Solution:

- For sodium chloride (NaCl), the radius ratio of the sodium cation to the chloride anion is approximately $\frac{r^+}{r^-} = 0.52$.
- According to standard crystallographic rules, a radius ratio falling exactly between 0.414 and 0.732 dictates a coordination number of 6.
- A coordination number of 6 corresponds geometrically to an **octahedral** spatial arrangement, where each ion sits in the center of an octahedron formed by 6 oppositely charged neighbors.

Why other options are incorrect:

- B:** Body Centered Cubic requires a coordination number of 8 (radius ratio 0.732 to 1.0).
- C:** Tetrahedral requires a coordination number of 4 (radius ratio 0.225 to 0.414).

Question #10 Key: (C)

KMU 2024

The example of metallic solid is:

CORE CONCEPT AND DERIVATION

Metallic solids are formed exclusively by metallic elements. They consist of positive metal kernels surrounded by a delocalized "sea" of free valence electrons.

Solution:

- Among the choices, **Copper (Cu)** is the only transition metal.
- In its solid state, copper atoms pool their outer electrons, creating a robust metallic lattice held together by non-directional metallic bonds.
- Therefore, Copper is the pure example of a metallic solid.

Why other options are incorrect:

- A, B, D:** Boron (B), Carbon (C), and Silicon (Si) are non-metals and metalloids that typically form giant covalent network solids in their standard states (e.g., diamond or silicon lattice), not metallic solids.

Question #11 Key: (B)

KMU 2024

When a crystalline substance conducts current in one direction but not through other directions of the crystal...

CORE CONCEPT AND DERIVATION

Crystalline solids have highly ordered internal geometric arrangements, meaning the spacing between atoms often varies depending on the axis (x, y, or z) being observed.

Solution:

- If a physical property—like electrical conductivity—changes in magnitude depending on the direction it is measured within the crystal, the phenomenon is termed **anisotropy**.
- A classic example is graphite, which conducts electricity parallel to its internal carbon layers (due to delocalized electrons), but acts as an insulator perpendicular to them.

Why other options are incorrect:

- A:** Allotropy is when one element exists in multiple structural forms (e.g., carbon as diamond and graphite).
- C:** Isomorphism is when different compounds share the same crystal structure.
- D:** Polymorphism is when a single compound can crystallize in more than one structure.

Question #12 Key: (A)

DUHS 2024

Dry ice is the example of:

CORE CONCEPT AND DERIVATION

Dry ice is the common name for the solid form of Carbon Dioxide (CO₂).

Solution:

- In dry ice, the fundamental building blocks occupying the crystal lattice points are independent, discrete CO₂ molecules.
- Because these molecules are completely non-polar, they are held in place exclusively by weak Van der Waals forces (London dispersion forces).
- Any solid constructed of discrete molecules held by intermolecular forces is classified as a **molecular solid**.

Why other options are incorrect:

- C:** It is not a covalent solid because there is no continuous, infinite network of covalent bonds between the molecules, only weak dispersion forces.
- B, D:** It contains no ions or free electrons.

Question #13 Key: (D)

DUHS 2024

It is an example of a crystalline solid:

CORE CONCEPT AND DERIVATION

Crystalline solids possess a sharp melting point and a perfectly ordered, repeating 3D internal arrangement of particles. Amorphous solids do not.

Solution:

- **Alum** (such as potash alum, $\text{KAl}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$) is an ionic double salt.
- When it solidifies, its constituent ions arrange themselves into a highly regular, repeating geometric lattice, yielding distinct, faceted crystals with sharp physical properties.
- Therefore, alum is a true crystalline solid.

Why other options are incorrect:

- **A, B, C:** Plastics, charcoal (a form of carbon), and glass are classic examples of amorphous solids. They have disordered, random internal structures and melt over broad temperature ranges.

Question #14 Key: (B)

BUMHS 2024

Electrically diamond is a:

CORE CONCEPT AND DERIVATION

Electrical conductivity in a solid lattice requires the presence of mobile charge carriers, such as free, delocalized electrons.

Solution:

- In a diamond crystal, every single carbon atom is sp^3 hybridized.
- This means all four of its valence electrons are strictly localized, participating in strong covalent sigma bonds with four neighboring carbon atoms.
- Because all electrons are tightly locked in place to form the rigid 3D tetrahedral network, there are absolutely **zero free electrons** available to transport electrical charge.
- Therefore, electrically, diamond is a strict **non-conductor** (insulator).

Why other options are incorrect:

- **A, C:** Diamond lacks the free electrons required to be a good conductor or even a semiconductor under standard conditions (unlike its allotrope, graphite, which has delocalized pi electrons).

Question #15 Key: (A)

BUMHS 2024

The term 'Transition temperature' is use for the temperature:

CORE CONCEPT AND DERIVATION

Many substances can exist in more than one crystalline structural form (polymorphism or allotropy). These different forms are stable at different temperatures.

Solution:

- The specific equilibrium temperature at which one distinct crystalline form (polymorph/allotrope) of a substance reversibly transforms into a different crystalline form is defined as its **transition temperature**.
- For example, Rhombic Sulphur transforms into Monoclinic Sulphur at exactly 95.5°C . At this specific temperature, both solid crystalline forms stably co-exist in equilibrium.

Why other options are incorrect:

- **B:** This describes the formation of mesophases, not standard transition temperature between solid states.
- **C:** Crystal habit refers to the macroscopic external shape, which is related but not the fundamental thermodynamic definition of transition temperature.
- **D:** While properties may change during the transition, the definition is strictly based on the structural change from one crystalline phase to another, not just the properties themselves.

Question #16 Key: (A)

NUMS 2024

Iodine is a poor conductor of electricity because of:

CORE CONCEPT AND DERIVATION

Solid iodine (I_2) is a non-polar molecular solid. (Note: The original question stem phrasing is an artifact of the historical textbook's formatting, conflating conductivity with crystalline shape. We address the intended structural answer here.)

Solution:

- Iodine is fundamentally a poor conductor of electricity because its valence electrons are localized in discrete, neutral I_2 covalent molecules, leaving no free electrons.
- Regarding its solid-state structural geometry—which the options are querying—solid iodine crystallizes such that the I_2 molecules occupy the lattice points of a **face-centered cubic (FCC)** unit cell (according to this specific textbook curriculum).
- Therefore, recognizing the structural characteristic highlighted by the textbook key, the face-centered cubic structure is the designated answer.

Why other options are incorrect:

- **B, C, D:** Standard entry-level chemistry curricula for this region designate the solid iodine unit cell as face-centered cubic, making BCC, tetragonal, and hexagonal incorrect in this context.

Question #17 Key: (C)

NUMS 2024

Predict the shape of [Formula] having radius ratio of 0.93

CORE CONCEPT AND DERIVATION

The radius ratio ($\frac{r_{\text{cation}}}{r_{\text{anion}}}$) of an ionic compound allows us to predict the coordination number and the resulting 3D geometric shape of its crystal lattice.

Solution:

- Crystallographic rules map specific radius ratio ranges to specific geometries:
- Ratio 0.225 – 0.414 → Tetrahedral (Coordination = 4)
- Ratio 0.414 – 0.732 → Octahedral (Coordination = 6)
- Ratio 0.732 – 1.000 → Cubic (Coordination = 8)
- The given radius ratio for Cesium Chloride (CsCl) is **0.93**, which is greater than 0.732.
- This high ratio indicates that the large Cs^+ ion can comfortably fit 8 Cl^- ions around it, resulting in a coordination number of 8.
- A coordination number of 8 corresponds to a **body-centered cubic (BCC)** structural shape (often specifically termed a simple cubic lattice with a body-centered interstitial, but commonly accepted as BCC in multiple-choice formats).

Why other options are incorrect:

- **A:** Tetrahedral requires a much smaller ratio (< 0.414).
- **B:** Octahedral requires a ratio between 0.414 and 0.732 (like NaCl).

Question #18 Key: (C)

UHS 2023

In anisotropic crystals which property do not change with the change in direction of crystalline structure?

CORE CONCEPT AND DERIVATION

Anisotropy affects physical properties that depend on the internal geometric arrangement of atoms, but it cannot alter intrinsic chemical constants.

Solution:

- Properties like electrical conductance, thermal conductance, and refractive index all depend on how light, heat, or electrons navigate through the specific arrangement of atoms in the crystal lattice. If the lattice spacing varies by direction, these properties vary (anisotropy).
- However, **Molar mass** is an intrinsic, fundamental property of the substance, defined by the atomic weights of the constituent atoms.
- Molar mass depends solely on the chemical formula, totally independent of crystallographic direction.

Why other options are incorrect:

- **A, B, D:** These are classic examples of anisotropic properties that explicitly change depending on the axis of measurement in anisotropic crystals.

Question #19 Key: (B)

UHS 2023

In metals, why electric conductivity decreases with the increases of temperature?

CORE CONCEPT AND DERIVATION

Metallic conduction relies on the free flow of a "sea of electrons" past positively charged metal kernels (ions) situated at the lattice points.

Solution:

- As the temperature of a metal increases, the thermal energy is converted into kinetic energy.
- This causes the positive metal ions at the lattice points to oscillate/vibrate much more vigorously around their mean positions.
- These intense oscillations increase the frequency of collisions between the flowing free electrons and the vibrating metal ions.
- This scattering essentially "hinders" the electron movement, increasing resistance and thus **decreasing electric conductivity**.

Why other options are incorrect:

- **A:** The kinetic energy and movement of the electrons themselves actually increase with temperature, they just face more obstacles.
- **C, D:** These do not accurately describe the mechanism of electrical resistance in metallic lattices.

Question #20 Key: (A)

SZABMU 2023

Which of the following information we obtain from the Lattice energy?

CORE CONCEPT AND DERIVATION

Lattice energy is a measure of the strength of the electrostatic forces holding ions together in a crystal lattice.

Formula:

$$\text{Lattice Energy} \propto \frac{\text{Charge}}{\text{Size}}$$

Solution:

- Because lattice energy depends directly on the ionic charges and the ionic radii (size of the ions), it dictates how tightly the ions can pack together.
- The packing efficiency and the relative sizes of the cations and anions directly determine the geometric shape and overall **structure of the ionic compound** (e.g., whether it forms an octahedral or cubic lattice).

Why other options are incorrect:

- **B, C, D:** Lattice energy is a concept strictly applicable to ionic lattices. It does not explain covalent, metallic, or molecular bonds.

Question #21 Key: (C)

SZABMU 2023

Which of the following solids have strong metallic bond?

CORE CONCEPT AND DERIVATION

Metallic bond strength depends on two main factors: a smaller atomic radius and a larger number of delocalized valence electrons.

Solution:

- First, Phosphorus (P) and Sulphur (S) are non-metals; they form covalent molecular solids, not metallic bonds. This eliminates B and D.
- We compare the two remaining metals: Potassium (Group 1) and Calcium (Group 2).
- Calcium provides two valence electrons per atom to the electron sea, whereas Potassium provides only one.
- Additionally, Calcium has a smaller atomic radius and a higher effective nuclear charge compared to Potassium.
- The combination of more mobile electrons and a smaller ionic core results in a significantly stronger electrostatic attraction in **Calcium**.

Why other options are incorrect:

- **A:** Potassium has fewer valence electrons and a larger size, making its metallic bond weaker (evident by its much lower melting point).

Question #22 Key: (D)

KMU 2023

All of the following crystal systems have [Formula] except:

CORE CONCEPT AND DERIVATION

Crystal systems are classified by their unit cell dimensions: edge lengths (a, b, c) and interfacial angles (α, β, γ).

Solution:

- In Cubic, Orthorhombic, and Tetragonal systems, all three interfacial angles are strictly 90 degrees: $\alpha = \beta = \gamma = 90^\circ$.
- However, in the **Rhombohedral** (or Trigonal) crystal system, all edge lengths are equal ($a = b = c$), and all angles are equal to each other, but they are **not** equal to 90 degrees: $\alpha = \beta = \gamma \neq 90^\circ$.
- Therefore, the rhombohedral system is the exception.

Why other options are incorrect:

- **A, B, C:** These systems explicitly require all angles to be exactly 90 degrees.

Question #23 Key: (B)

KMU 2023

Crystal having orthorhombic crystal system is:

CORE CONCEPT AND DERIVATION

Different chemical compounds crystallize into specific lattice geometries based on their molecular symmetry and ionic sizes.

Solution:

- The orthorhombic crystal system is defined by having three unequal axes ($a \neq b \neq c$) intersecting at 90-degree angles ($\alpha = \beta = \gamma = 90^\circ$).
- Barium sulfate (BaSO_4), commonly known as the mineral barite, is a classic textbook example that crystallizes in the **orthorhombic** system.

Why other options are incorrect:

- **C:** Zinc oxide (ZnO) typically crystallizes in a hexagonal system (wurtzite structure).
- **A, D:** These compounds belong to other crystalline systems (e.g., monoclinic/triclinic).

Question #24 Key: (D)

DUHS 2023

Which of the following is a covalent crystal?

CORE CONCEPT AND DERIVATION

Covalent crystals (network solids) consist of atoms connected by a continuous, giant network of covalent bonds.

Solution:

- **Diamond** is composed entirely of carbon atoms.
- Every carbon atom is covalently bonded to four others in a rigid, 3D tetrahedral geometry.
- Because there are no discrete molecules or ions, and the entire structure is one massive covalent molecule, diamond is a quintessential covalent crystal.

Why other options are incorrect:

- **A, B, C:** NaCl , KI , and MgBr_2 are formed by a metal and a non-metal, creating lattices held together by electrostatic forces between cations and anions. These are ionic crystals.

Question #25 Key: (D)

DUHS 2023

The nature of attraction which holds molecular crystal is:

CORE CONCEPT AND DERIVATION

Molecular crystals possess lattice points occupied by discrete molecules (like I_2 , S_8 , or CO_2).

Solution:

- Because the atoms within the molecules have already satisfied their bonding requirements via covalent bonds, the molecules themselves are entirely neutral.
- To hold these separate, neutral molecules together in a solid lattice, weak intermolecular forces must act between them.
- These overarching weak intermolecular forces (such as London dispersion forces or dipole-dipole interactions) are collectively termed **Van Der Waals forces**.

Why other options are incorrect:

- **A:** Ionic bonds hold ionic crystals together.
- **C:** Covalent bonds hold the atoms *inside* the molecule together, not the molecules to each other (unless it's a giant covalent network like diamond).
- **B:** While hydrogen bonds are a specific, strong type of dipole-dipole interaction found in polar molecular crystals like ice, Van der Waals force is the broader, universally applicable answer for molecular crystals as a whole.

Question #26 Key: (B)

BUMHS 2023

The system in which three angles and axes are unequal is called?

CORE CONCEPT AND DERIVATION

Crystal systems are identified by their degrees of symmetry, mapped by the equality of their edge lengths (axes) and angles.

Solution:

- The most asymmetric crystal system is the **triclinic system**.
- In a triclinic unit cell, all three axes are of different lengths ($a \neq b \neq c$).
- Furthermore, all three interfacial angles are different from each other, and none are equal to 90 degrees ($\alpha \neq \beta \neq \gamma \neq 90^\circ$).

Why other options are incorrect:

- **A:** Cubic has all equal axes and all 90-degree angles.
- **C:** Orthorhombic has unequal axes, but all angles are strictly 90 degrees.
- **D:** Trigonal (rhombohedral) has equal axes and equal angles (but not 90 degrees).

Question #27 Key: (C)

BUMHS 2023

Which one of the following have no cleavage plane?

CORE CONCEPT AND DERIVATION

Cleavage is the tendency of a crystalline solid to split cleanly along definite, flat structural planes when struck.

Solution:

- Ionic and covalent network solids often have distinct planes of weakness where they can snap or cleave cleanly (e.g., NaCl or graphite).
- However, **Copper** is a metallic crystal.
- Metals consist of a flexible, non-directional "sea of electrons" surrounding positive metal cores. Because metallic bonds are non-directional, properties remain the same in all directions.
- When struck, instead of cleaving, the planes of atoms simply slide past one another without breaking the continuous metallic bond. This makes copper malleable and ductile, meaning it lacks distinct cleavage planes.

Why other options are incorrect:

- **A, B, D:** Graphite cleaves easily between its sheets, NaCl cleaves along its cubic faces, and ice also has structural cleavage planes due to rigid hydrogen bond networks.

Question #28 Key: (A)

NUMS 2023

Which statement correctly describes the structure of sodium chloride crystal?

CORE CONCEPT AND DERIVATION

The crystal structure of Sodium Chloride ($NaCl$) is defined by its highly ordered, face-centered cubic (FCC) lattice geometry.

Solution:

- In the NaCl lattice, every Na^+ cation sits in an octahedral void created by the larger Cl^- anions.
- This specific geometric arrangement dictates that exactly **six chloride ions surround each sodium ion**.
- Because the lattice is perfectly symmetrical and infinite in 3D, the reverse is also true: **each chloride ion is surrounded by exactly six sodium ions**.
- Thus, it has a 6:6 coordination ratio.

Why other options are incorrect:

- **C:** A 3-ion coordination is incorrect; it is a 6:6 ratio.
- **D:** The forces between oppositely charged ions are strong, intramolecular electrostatic ionic bonds, not weak intermolecular forces.
- **B:** While NaCl is FCC, Option A provides the most complete and specific functional description of the ionic interactions in the structure. (Note: Option A is recognized as the best, most comprehensive answer in standard MCQ keys).

Question #29 Key: (D)

NUMS 2023

The greater Lattice energy is shown by:

CORE CONCEPT AND DERIVATION

Lattice energy is inversely proportional to the ionic radius (size) of the ions involved, assuming the charges are identical.

Formula:

$$\text{Lattice Energy} \propto \frac{1}{r_{\text{cation}} + r_{\text{anion}}}$$

Solution:

- In all options, the cation is kept constant as Sodium (Na^+) with a +1 charge.
- The anions belong to the halogen group, all with a -1 charge. Therefore, we must compare the sizes of the halide anions: F^- , Cl^- , Br^- , I^- .
- Down the group, ionic size increases: $\text{F}^- < \text{Cl}^- < \text{Br}^- < \text{I}^-$.
- Because the Fluoride ion (F^-) has the smallest ionic radius, it allows the oppositely charged ions to pack the closest together.
- This shorter internuclear distance maximizes electrostatic attraction, giving NaF the greatest lattice energy.

Why other options are incorrect:

- **A, B, C:** As the size of the anion increases (Cl, Br, I), the internuclear distance increases, weakening the electrostatic bond and lowering the lattice energy.

Question #30 Key: (B)

NUMS 2023

Thermal conductivity of metals is due to:

CORE CONCEPT AND DERIVATION

Metals are excellent conductors of both heat and electricity due to their unique atomic structure, specifically the "electron sea" model.

Solution:

- In a metallic lattice, the valence electrons detach from individual atoms and become delocalized, forming a "sea" of **freely moving electrons**.
- When heat is applied to one end of a metal, these highly mobile free electrons gain kinetic energy.
- Because they can move freely and rapidly throughout the entire crystal lattice, they quickly transfer this thermal energy to cooler regions via collisions.
- Therefore, the high thermal conductivity of metals is primarily due to freely moving electrons.

Why other options are incorrect:

- **D:** While vibrational movement of atoms (phonons) does contribute slightly to thermal conductivity, the overwhelmingly dominant mechanism in metals is electron transport.
- **A, C:** Metals do not generally have "layered structures" (unlike graphite), and their atoms are tightly packed, not "loosely held".

Question #31 Key: (C)

NUMS 2023

Co-ordination number of [Formula] is:

CORE CONCEPT AND DERIVATION

In metallic solids, the coordination number refers to the number of nearest neighbor atoms immediately surrounding a central atom in the crystal lattice.

Solution:

- Metallic Sodium (Na) crystallizes in a **Body-Centered Cubic (BCC)** lattice structure.
- In a BCC arrangement, one atom is located at the center of the cube, surrounded by 8 atoms situated at the corners of the cube.
- Therefore, the central sodium atom has exactly 8 nearest neighbors touching it.
- Thus, the coordination number of metallic Na is 8.

Why other options are incorrect:

- **A, B:** These are not standard coordination numbers for simple cubic lattice systems.
- **D:** A coordination number of 12 is found in Close-Packed structures (FCC/HCP), not BCC metals like sodium.

Question #32 Key: (C)

UHS 2022

A small building block which belongs to whole information about crystal structure is called?

CORE CONCEPT AND DERIVATION

Crystals are constructed by stacking identical geometric structural blocks in three dimensions.

Solution:

- The smallest representative building block that holds all the symmetry and proportional structural information of the entire crystal lattice is called the **unit cell**.

Why other options are incorrect:

- B:** The crystal lattice is the entire macroscopic 3D framework, not the small building block.
- A, D:** These are incomplete or non-standard terms in solid-state chemistry.

Question #33 Key: (A)

UHS 2022

Which type of solid is called as atomic solid?

CORE CONCEPT AND DERIVATION

Solids can be classified by the type of particles that occupy their lattice points.

Solution:

- In a **covalent solid** (also known as a network solid), the lattice points are occupied by neutral, individual atoms (e.g., Carbon atoms in diamond or Silicon/Oxygen in quartz).
- Because their structural particles are purely neutral atoms bonded via a continuous network of covalent bonds, they are frequently termed **atomic solids**.

Why other options are incorrect:

- B:** Ionic solids have cations and anions at their lattice points.
- C:** Metallic solids have positive metal kernels immersed in a sea of electrons.
- D:** Molecular solids have discrete molecules (like I_2 or H_2O) at their lattice points.

Question #34 Key: (A)

SZABMU 2022

The molecules of iodine ([Formula]) form the:

CORE CONCEPT AND DERIVATION

The nature of a crystal depends on the constituent particles and the forces holding them together.

Solution:

- Iodine exists as stable, discrete non-polar diatomic molecules (I_2).
- In the solid state, these independent I_2 molecules occupy the lattice points.
- They are held together by weak intermolecular forces (specifically London dispersion forces).
- Therefore, solid iodine forms **molecular crystals**.

Why other options are incorrect:

- B:** Covalent crystals feature a giant continuous network of atoms, not discrete molecules.
- C, D:** Iodine does not contain ions or free electrons.

Question #35 Key: (A)

KMU 2022

Which of the following ionic compounds has the highest value of lattice energy?

CORE CONCEPT AND DERIVATION

Lattice energy is governed by Coulomb's law. It increases as the charge on the ions increases and as the size of the ions decreases.

Formula:

$$E \propto \frac{q^+ q^-}{r^+ + r^-}$$

Solution:

- All the options listed (NaF , $LiCl$, NaI , KI) consist of singly charged ions ($+1$ and -1). Thus, charges are identical.
- We must evaluate the ionic radii. The smallest cation and smallest anion will yield the shortest internuclear distance and the highest lattice energy.
- Comparing NaF and $LiCl$: Fluoride (F^-) is significantly smaller than Chloride (Cl^-). While Lithium (Li^+) is slightly smaller than Sodium (Na^+), the extremely small size of the fluoride ion dominates, giving NaF an exceptionally high charge density.
- Therefore, NaF has the highest lattice energy among the given choices.

Why other options are incorrect:

- B, C, D:** These compounds contain larger anions (Cl^- , I^-) or larger cations (K^+), which increases the distance between the ions and lowers the lattice energy.

Question #36 Key: (A)

KMU 2022

Which one of the following is the example of polar molecular solids?

CORE CONCEPT AND DERIVATION

Molecular solids are formed by molecules held together by intermolecular forces. If the molecules possess a permanent dipole moment, the solid is a polar molecular solid.

Solution:

- **Ice** is the solid form of water (H_2O).
- The water molecule has a bent geometry and highly polar O-H bonds, resulting in a strong permanent net dipole moment.
- In ice, these polar molecules are held together by strong dipole-dipole interactions (specifically, hydrogen bonding), classifying it as a polar molecular solid.

Why other options are incorrect:

- **B, D:** Iodine (I_2) and Phosphorus (P_4) consist of identical non-metal atoms, forming completely non-polar molecules.
- **C:** Copper is a metal, forming a metallic solid, not a molecular one.

Question #37 Key: (D)

KMU 2022

Which one of the following pairs of compounds is not isomorphic in nature?

CORE CONCEPT AND DERIVATION

Isomorphism refers to the phenomenon where two different chemical substances exhibit the same crystalline structure. Isomorphs typically share the same atomic ratio and similar chemical formulas.

Solution:

- While AgNO_3 and KNO_3 share the same 1:1:3 atomic ratio, they do **not** share the exact same geometric crystal structure.
- Despite their similar formulas, their differing ionic radii and structural packing prevent them from being true isomorphs.
- Therefore, AgNO_3 and KNO_3 are NOT isomorphic.

Why other options are incorrect:

- **A, B, C:** These pairs commonly exhibit isomorphism, crystallizing in matching geometric lattice systems.

Question #38 Key: (D)

DUHS 2022

Small diffusion in solid is due to:

CORE CONCEPT AND DERIVATION

Diffusion is the net movement of particles from an area of higher concentration to lower concentration, relying heavily on the ability of particles to move freely through space (translational motion).

Solution:

- In ideal crystalline solids, particles (atoms, ions, or molecules) are tightly packed and locked into fixed lattice positions.
- They can only vibrate around these fixed mean positions; they lack the free **translational motion** required for macroscopic diffusion.
- Because of this absolute lack of translational mobility, practical, large-scale **diffusion into solids is considered not present** (or incredibly negligible compared to liquids and gases).

Why other options are incorrect:

- **A, C:** Particles in a solid do not have fast motion or translational motion.
- **B:** While solids do have vibrational motion, vibration alone at fixed lattice points does not facilitate diffusion.

Question #39 Key: (C)

BUMHS 2022

Amorphous solids?

CORE CONCEPT AND DERIVATION

Amorphous solids (like glass or plastic) lack a long-range, perfectly ordered internal structure, differentiating them from crystalline solids.

Solution:

- While amorphous solids are generally disordered, they are not always 100% chaotic.
- They can contain microscopic, localized pockets where atoms temporarily align in an orderly fashion.
- These tiny, ordered crystalline regions scattered throughout the amorphous bulk are known as **crystallites**.
- Therefore, amorphous solids can possess small regions of orderly arrangement.

Why other options are incorrect:

- **A, B, D:** Perfect long-range arrangement, sharp melting points, and clean, planar cleavage are all exclusive properties of true crystalline solids, not amorphous solids.

Question #40 Key: (D)

BUMHS 2022

Which one of the following is not a crystalline solid?

CORE CONCEPT AND DERIVATION

Crystalline solids possess a highly regular, repeating 3D arrangement of atoms. Amorphous solids have irregular, random arrangements.

Solution:

- **Rubber** is a polymer composed of long, tangled molecular chains.
- It lacks a regular, repeating internal geometric lattice.
- Because its structural arrangement is random and disordered, rubber is classified as an amorphous (non-crystalline) solid.

Why other options are incorrect:

- **A, C:** Copper sulphate and Sodium chloride are classic ionic crystalline solids.
- **B:** Sugar (sucrose) is a polar molecular crystalline solid.

Question #41 Key: (A)

NUMS 2022

Nature of diamond as solid is

CORE CONCEPT AND DERIVATION

The classification of a solid depends entirely on the type of bonds holding its constituent particles together in the lattice.

Solution:

- In diamond, the lattice points are occupied by carbon atoms.
- Every single carbon atom is bonded to four adjacent carbon atoms via strong, directional **covalent bonds**, forming a massive, continuous 3D tetrahedral network.
- Because the entire crystal is held together by this covalent network, diamond is unequivocally classified as a **covalent solid** (or network covalent solid).

Why other options are incorrect:

- **B:** It does not consist of discrete molecules held by Van der Waals forces.
- **C, D:** There are no ions or sea of free electrons in diamond.

Question #42 Key: (C)

NUMS 2022

Which one of the following is as light as a feather and as strong as iron?

CORE CONCEPT AND DERIVATION

Graphene is a revolutionary carbon allotrope known for its extreme structural properties despite its microscopic thickness.

Solution:

- **Graphene** consists of a single, two-dimensional (2D) planar layer of carbon atoms arranged in a hexagonal honeycomb lattice.
- Because it is only one atom thick, it is incredibly lightweight ("as light as a feather").
- Simultaneously, the sp^2 covalent bonds between the carbon atoms are immensely strong, giving it a tensile strength significantly greater than that of steel/iron.

Why other options are incorrect:

- **A:** Graphite is soft and flaky (used in pencils) because its layers easily slide over one another.
- **D:** Diamond is exceptionally strong and hard, but it is a dense, heavy 3D crystal, not "light as a feather".
- **B:** Mercury is a dense, heavy liquid metal.

Question #43 Key: (D)

PMDC 2021

Shape of iodine unit cell.

CORE CONCEPT AND DERIVATION

Molecular crystals like solid iodine (I_2) pack in specific geometric unit cells.

Solution:

- According to the provided source text and explanatory notes, the structural geometry of the solid iodine unit cell is defined as **face-centered cubic** (FCC).
- (Note: While advanced crystallographic data often defines iodine as base-centered orthorhombic, within the scope of this specific historical curriculum and textbook key, it is evaluated as face-centered cubic.)

Why other options are incorrect:

- **A, B, C:** Based on the strict parameters of the provided answer key, these shapes do not define the iodine unit cell.

Question #44 Key: (B)

PMDC 2021

Properties due to change of direction are called ____.

CORE CONCEPT AND DERIVATION

The dependency of physical properties on the crystallographic direction of measurement is a hallmark of crystalline solids.

Solution:

- When properties like electrical conductivity, refractive index, or thermal expansion vary depending on the angle or direction they are measured within a crystal, this phenomenon is defined as **anisotropy**.

Why other options are incorrect:

- A:** Isotropic properties remain identical regardless of the direction of measurement (typical of amorphous solids or liquids).
- C, D:** Symmetry relates to structural repetition, and cleavage planes are the physical planes where crystals break cleanly.

Question #45 Key: (D)

PMDC 2021

Current in electrolysis is carried through:

CORE CONCEPT AND DERIVATION

Electrical conduction in different mediums relies on different types of mobile charge carriers.

Solution:

- In metallic conduction (like wires), current is carried by free electrons.
- However, in an electrolytic cell (electrolysis), the conduction occurs through a molten liquid or an aqueous solution containing dissolved electrolytes.
- Here, the charge carriers are the actual mobile **positive ions** (cations) migrating to the cathode and **negative ions** (anions) migrating to the anode.
- Therefore, current in the electrolyte is carried by both positive and negative ions.

Why other options are incorrect:

- A:** Free electrons carry current in the external wire electrodes, but not through the electrolyte solution itself.

Question #46 Key: (B)

PMDC 2021

The smallest part of the crystal lattice has all the properties of the entire crystal this is called:

CORE CONCEPT AND DERIVATION

A crystal lattice is built from repeating fundamental 3D building blocks.

Solution:

- The **unit cell** is defined as the smallest repeating basic 3D structural unit of a crystal lattice.
- When translated across 3D space, the unit cell generates the entire macroscopic crystal.
- Because it contains the complete spatial arrangement of atoms/ions, it possesses all the fundamental chemical and geometric properties of the whole crystal.

Why other options are incorrect:

- A, C, D:** "Unit" and "Unit crystal" are not standard crystallographic terms. The precise scientific terminology is "unit cell".

Question #47 Key: (C)

PMDC 2020

The lattice energy is also called as:

CORE CONCEPT AND DERIVATION

Lattice energy represents the energy released when gaseous ions bind to form an ionic solid, or the energy required to break the solid into gaseous ions.

Solution:

- Because this energy is fundamentally tied to the formation and stability of the crystal lattice structure itself, it is synonymously referred to as **crystal energy**.

Why other options are incorrect:

- A, B, D:** Electron affinity relates to gaining electrons, bond energy usually refers to covalent bonds between atoms in a molecule, and potential energy is a general physics term, not specifically synonymous with lattice energy.

Question #48 Key: (D)

NUMS 2019

Which one the following have highest lattice energy?

CORE CONCEPT AND DERIVATION

Lattice energy is directly proportional to the product of ionic charges and inversely proportional to the sizes (radii) of the ions.

Formula:

$$\text{Lattice Energy} \propto \frac{q_1 q_2}{r_1 + r_2}$$

Solution:

- All the given options consist of +1 cations and -1 anions, so the charge product is constant.
- We must look at the ionic sizes. The smaller the ions, the closer they pack, resulting in higher lattice energy.
- Among the cations, Li^+ has the smallest ionic size compared to Na^+ and K^+ .
- Therefore, LiCl possesses the maximum lattice energy due to having the smallest internuclear distance.

Why other options are incorrect:

- A, B, C:** They contain larger cations (Na^+ , K^+) or larger anions (Br^-), which increases the distance between charges and weakens the lattice energy.

Question #49 Key: (A)

SET 2019

In diamond each of the four outer electrons on every carbon atom is involved in covalent bonding. This means t...

CORE CONCEPT AND DERIVATION

Electrical and thermal conductivity in solids primarily depend on the availability of mobile (free) charge carriers, such as delocalized electrons.

Solution:

- In diamond, every carbon atom is sp^3 hybridized and covalently bonded to four other carbon atoms.
- Because all four valence electrons are locked into strong, localized sigma bonds, there are absolutely zero free electrons available to carry a charge.
- Therefore, the lack of free electrons directly explains why diamond is a non-conductor of electricity (and fundamentally limits electronic heat conduction).

Why other options are incorrect:

- B, D:** The hardness of diamond is explained by the rigid, 3D tetrahedral network of strong covalent bonds, not just the lack of free electrons.
- C:** The refractive index is related to optical density and the rigid lattice, not directly to conductivity.

Question #50 Key: (D)

KMU 2019

Substance that has sharp melting point in the following is:

CORE CONCEPT AND DERIVATION

A sharp melting point is a characteristic feature of true crystalline solids, which have a highly ordered, repeating internal structure. Amorphous solids lack this order and melt over a range of temperatures.

Solution:

- Diamond** is a highly ordered, 3D covalent network crystalline solid. Because all its bonds are identical and ordered, they break at a specific, uniform temperature, yielding a very sharp melting point.

Why other options are incorrect:

- B, C:** Glass and coal tar are classic examples of amorphous solids; they soften gradually over a range of temperatures rather than melting sharply.
- A:** While some gemstones are crystalline, "gemstone" is a generic term that can include amorphous materials like opal or amber. Diamond is the specifically stated crystalline solid.

Question #51 Key: (B)

MDCAT 2016

Electrical conductivity of graphite is greater in one direction than in other due to:

CORE CONCEPT AND DERIVATION

The variation of physical properties (such as electrical conductivity, refractive index, or thermal expansion) with direction in a crystal is called anisotropy.

Solution:

- Graphite has a layered structure where carbon atoms are sp^2 hybridized.
- Electrons are delocalized and can move freely parallel to the layers, making graphite a good electrical conductor in that specific plane.
- Perpendicular to the layers, there are no free electrons, making it an insulator.
- This directional dependence of conductivity is the prime definition of **anisotropy**.

Why other options are incorrect:

- A:** Isomorphism refers to different substances having the same crystal structure.
- C, D:** Cleavage planes and symmetry describe structural geometry, not the phenomenon of direction-dependent properties.

Question #52 Key: (D)

KMU 2016

Graphite is one of the allotropic form of Carbon. It is:

CORE CONCEPT AND DERIVATION

Allotropes are different structural forms of the same element. Graphite is a crystalline allotrope of carbon with unique directional properties.

Solution:

- Graphite consists of layers of sp^2 hybridized carbon atoms, leaving one unhybridized p-electron per atom that becomes delocalized.
- Because these delocalized electrons can move freely parallel to the layers, graphite is a **good conductor of electricity** (Option C).
- However, it does not conduct electricity perpendicular to the layers. This directional dependency means it is **anisotropic** (Option B).
- Therefore, both B and C are correct.

Why other options are incorrect:

- A:** Isotropic means properties are identical in all directions (like in amorphous solids), which contradicts graphite's layered structure.

Question #53 Key: (B)

MDCAT 2013

In the structure of [Formula], each sodium ion is surrounded by chloride ions:

CORE CONCEPT AND DERIVATION

Ionic crystals arrange themselves in a lattice that maximizes electrostatic attraction and minimizes repulsion, dictating specific coordination numbers.

Solution:

- NaCl crystallizes in a face-centered cubic (FCC) structure.
- In this specific arrangement, every single Na^+ cation sits in an octahedral hole created by the Cl^- anions.
- This geometry inherently dictates that exactly 6 chloride ions surround each sodium ion.

Why other options are incorrect:

- A, C, D:** 4 (tetrahedral) and 8 (cubic) are coordination numbers for different lattice types (like ZnS or CsCl), not NaCl.

Question #54 Key: (D)

MDCAT 2010

The coordination number of [Formula] in [Formula] crystal is:

CORE CONCEPT AND DERIVATION

The coordination number is defined as the number of oppositely charged ions immediately surrounding a specific ion in a crystal lattice.

Solution:

- In the face-centered cubic (FCC) lattice structure of NaCl, each Na^+ ion is octahedrally surrounded by six Cl^- ions.
- Similarly, each Cl^- ion is surrounded by six Na^+ ions.
- Therefore, the coordination number for both ions is 6.

Why other options are incorrect:

- A, B, C:** These numbers do not correspond to the 6:6 octahedral geometry characteristic of the sodium chloride crystal lattice.