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LIQUIDS AND SOLIDS

DEFINITIONS FOR LIQUIDS

(May be used in short questions with examples)

(1) Boiling point: **(Faisalabad 2012)**

The temperature at which the vapour pressure of liquid becomes equal to the external pressure. If the external pressure is one atmosphere, then the boiling point is called normal boiling point. The B.P of H_2O is 100°C and that of ethanol is 78.5°C at 1 atm pressure.

(2) Dipole:

It is that molecule which has two poles in it. These poles are created due to difference of electronegativities. HCl has dipoles. H is partial positive while Cl is partial negative.

(3) Dipole-dipole forces: **(Rwp. 2010)**

Those forces of attractions which are present between positive ends of one polar molecule and the negative end of the other polar molecule. Molecules of H_2O attract each other due to dipole-dipole attractions.

(4) Dipole-induced dipole forces:

Those forces of attractions which exist between already polar molecules and the molecule having induced polarity.

(5) Evaporation: **(Faisalabad 2010)**

It is the spontaneous change of liquid into vapours. It happens at all temperatures. Higher the temperature higher the rate of evaporation.

(6) Hydrogen bonding: **(D.G. Khan 2014)**

The electrostatic forces of attraction between electronegative atoms like oxygen, nitrogen or fluorine etc., and partial positive hydrogens. NH_3, $H_2\ddot{O}$, C_2H_5OH etc. have H-bonding for their molecules in their pure states.

(7) Induced dipole:

A molecule in which polarity is created due to other polar molecule is called induced dipole. Atoms of He create dipoles in other atoms of He during their collisions in the gaseous state.

(8) Instantaneous dipole:

The temporary dipole which is produced in non-polar atoms or molecules due to a certain reason. Non-polar gaseous molecules create instantaneous dipoles. He is best example.

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(9) Intermolecular forces:

Those forces of attractions, which are present among the individual particles. These particles may be atoms, ions or molecules. These forces may be dipole-dipole, induced dipole or H-bonding.

(10) Intermolecular hydrogen bonding:

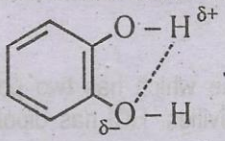
Electrostatic forces of attraction between partial negative atoms of one molecule and partial positive hydrogens of another molecule. H_2O exsits in solid state due to strong H-bonding.

(11) Intramolecular forces:

Those forces of attractions, which are present within the same molecule. These forces of attractions are due to the covalent bonds, which are produced due to the sharing of the electrons. The shared pair of electrons in H_2O molecule make σ-bonds. These forces are due to sharing of electrons and are instramolecular forces.

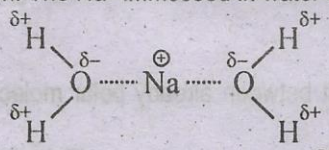
(12) Intramolecular hydrogen bonding:

Electrostatic forces of attraction between partial negative atoms of a molecule and partial positive hydrogens of the same molecule. In catechol two OH groups of same molecule do intramolecular hydrogen bonding



(13) Ion-dipole forces: **(Rwp. 2010)**

Those forces of attractions in which negative ends of polar molecules are attracted towards the positive ion and the positive ends of the polar molecules are attracted towards the negative ion. The Na^+ immessed in water creates ion-dipole forces.



OR

The forces of attraction between ions and water molecules are called as ion-dipole forces.

(14) Liquid crystals:

Those molecules which are large, somewhat rigid and linear having some of the structure of solids and some of the freedom of motion of liquids are called liquid crystals. They have long range of their M.P.

(15) Molar heat of fusion: **(Guj. 2010, Sarg. 2010)**

It is the amount of heat which is absorbed by one mole of a solid to melt it into liquid at its melting point, with the external pressure of one atmosphere.

(16) Molar heat of sublimation: **(Sarg. 2010)**

It is amount of heat which is required by one mole of a solid substance to convert it directly into one mole of its vapours at a particular temperature and one atmospheric pressure. Naphthalene can sublime and its heat of fusion is not that much.

(17) Molar heat of vaporization: **(Guj. 2010)**

It is the amount of heat which is required to vaporize one mole of a liquid at its boiling point. Water can vaporize and its molar heat of vaporization is sufficiently high.

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(18) Non-polar molecule:

A molecule in which there is no polarity. This is due to the absence of electronegativity difference between two bonded atoms. H_2, O_2, N_2, Cl_2 etc are perfectly non-polar molecules.

(19) Polar molecule:

The molecule which has partial positive and partial negative charge on it, due to the difference of electronegativity between the two bonded atoms is called polar molecule. H – Cl is a polar molecule.

(20) Polarizability:

The quantitative measurement of extent to which the electronic cloud can be polarized or distorted. This happens due to the collision or forces of attractions or repulsion among the molecules. Greater the size of atoms or molecules greater the polarizability. I_2 is more polarizale that Cl_2.

(21) Van der Waal's forces:

Those forces of attractions which exist between atoms, ions or molecules, when they are sufficiently close to each other. Dipole-dipole, ion-dipole, dipole induced dipole are van der Waal's forces.

(22) Vapour pressure: **(Faisalabad 2009, Faisalabad 2010)**

The pressure which is exerted by the vapours of a liquid on the surface of the liquid at equilibrium state, under the given conditions of the temperature.

It depends upon the temperature and nature of the liquid that what will be the vapour pressure of a liquid.

DEFINITIONS FOR SOLIDS

(May be used in short questions with examples)

(23) Allotrope:

Those elements which show allotropy are called allotropes or allotropic forms. Graphite and diamond are allotropes of each other.

(24) Allotropy: **(D.G. Khan 2014)**

Existence of an element in more than one crystalline form is called allotropy. Carbon, tin, phosphorus show allotropy.

(25) Amorphous solids: **(Sarg. 2011, Lahore 2014)**

Those solids in which the atoms, ions, or molecules are arranged in a random manner are called amorphous solids. Glass, pitch, plastic, rubber etc. are best examples of amorphous solids.

(26) Anisotrope: **(F. Abad 2014)**

That substance which shows variation in property in different directions is called anisotrope. Graphite can conduct electricity in one direction but not perpendicular to it.

(27) Anisotropic properties: **(Sargodha 2008, F. Abad 2014)**

Those properties which have variable intensity in different directions are called anisotropic properties. The properties like electrical conductivity, thermal conductivity, refractive index and cleavage are anisotropic properties.

(28) Anisotropy: **(F. Abad 2014)**

The variation of a certain physical property in different directions in the crystal is called anisotropy.

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(29) **Cleavage plane:**

That plane along which a crystal undergoes cleavage is called cleavage plane. All the crystalline substances have cleavage planes.

(30) **Cleavage:** **(Faisalabad 2010)**

It is a breaking of a crystal along definite planes.

(31) **Covalent solids:**

Those crystalline solids in which the atoms of similar elements or different elements are held together through covalent bonds are called covalent solids. Diamond, SiC and AlN are covalent solids.

(32) **Crystal lattice:** **(Bahawalpur 2009, Guj. 2014)**

The arrangement of the lattice point in a crystal in a definite pattern in three-dimensional space is called crystal lattice. It is also called space lattice. It has definite lengths and angles between sides of lattice.

(33) **Crystalline solids:** **(Sarg. 2011, Lahore 2014, Lahore 2014)**

Those solid substances in which the atoms, molecules or ions are arranged in regular, repeating, three-dimensional well-ordered pattern. NaCl, KNO_3 are crystalline solids.

(34) **Cubic close packing:**

The arrangement of the metal atoms in which the atoms of the fourth layer are just above the first layer and the coordination number of any one of the metal atom is twelve.

(35) **Ductility:**

The property of the metals to be converted into wires is called ductility. Almost all the metals have this property.

(36) **Habit of a crystal:**

The shape of a crystal in which it usually grows is called habit of a crystal.

(37) **Hexagonal close packing:**

The arrangement of the metal atoms in which the atoms of the third layer are just above the atoms of the first layer and the coordination number of any one of the metal atoms is twelve. They are ABAB ..... type crystals.

(38) **Interstices:**

The vacant spaces in the crystal structure due to circular shape of atoms and molecules are called interstices. They are also called crevices. They are part and parcel of every solid crystalline substance.

(39) **Ionic solids:**

Those crystalline solids in which positively and negatively charged ions are held together through ionic bond is called ionic crystal or ionic solid. NaCl, KI, CsI, etc are ionic solids.

(40) **Isomorphism:** **(Lahore 2007, Gujranwala 2009)**

The phenomenon in which two different substances exist in the same crystalline form is known as isomorphism. $NaNO_3$ and KHO_3 are both rhombohedral.

(41) **Isomorphs:**

Different substances which have the same crystalline shape are called isomorphs of each other. K_2SO_4 and K_2CrO_4 are isomorphs of each other.

(42) **Lattice constants:** **(Bahawalpur 2009, R. Pindi 2012) (Faisalabad 2008)**

The dimensions and the angles of a unit cell are called lattice constants. These are a, b, c, α, β, γ. They are also called unit cell dimensions. For NaCl $a = b = c$, $\alpha = \beta = \gamma = 90^\circ$.

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(43) Lattice energy: **(R. Pindi 2012, Rwp. 2014)**

It is defined in two ways:

(i) The energy which is released when one mole of the ionic crystal is formed from the gaseous ions.

(ii) It is amount of energy to break down one mole of ionic lattice into isolated gaseous ions which are infinitely separated from each other.

The lattice energy of NaCl and NaBr are –787 and –728 kJ mol^{-1} respectively.

(44) Lattice points: **(Sargodha 2008, Bahawalpur 2009, R. Pindi 2012)**

A crystal is consisted of atoms, ions or molecules which are located at definite positions in space. These definite positions are called lattice points. These points are shown by dots in the diagram.

(45) Malleability:

The property of the metals to be converted into thin sheets is called malleability. This property is almost present in every metal.

(46) Metallic bonds:

The force of attraction which bind the positive metal ions due to the presence of free electrons is called the metallic bond. This is due to free electrons in the metallic lattice.

(47) Metallic solids:

Those crystalline solids in which the metal atoms are held together by metallic bonds are called metallic solids. Fe, Co, Ni, Au etc. are metallic solids.

(48) Molecular solids:

Those crystalline solids in which polar and non-polar molecules or atoms are held together by intermolecular forces are called molecular solids.

(49) Polymorphism: **(Gujranwala 2009, F. Abad 2014)**

The phenomenon in which a compound exists in more than one crystalline form is called polymorphism. $AgNO_3$ exists in rhombohedral and orthorhombic forms.

(50) Polymorphs:

Those structures which exist for a compound are called polymorphs of each other. Rhombohedral and orthorhombic structure are polymorph for $AgNO_3$.

(52) Symmetry:

The repetition of faces and angles of a crystal, when it is rotated by 360° along its axis is called symmetry. A cubic crystal has 4-fold axis for symmetry and it is for NaCl solid.

(53) Unit cell dimensions:

Unit cell lengths "a" "b" and "c" along with unit cell angles as "α" "β" and "γ" are called unit cell dimensions. They give the complete picture of the crystal lattice. Their values give birth to seven crystal systems.

(54) Unit cell: **(Guj. 2014, Sahiwal 2014)**

The smallest part in the crystal lattice which shows all the characteristics of entire crystal, is known as unit cell. It is the smallest portion of the entire lattice, and can give us the information about values of a, b, c, α, β and γ of a crystal.

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ANSWERS TO THE SHORT QUESTIONS

(LIQUIDS)

Intermolecular Forces

Q.1 What are dipole-induced dipole forces? (Lahore 2014)

-1 ڈائی پول۔انڈوسڈ ڈائی پول طاقتیں کیا ہیں؟

Ans: These are those forces which are present among a molecule having a dipole and that molecule in which dipole has been induced (بھر دیا گیا ہو). This induced dipole (بھرا ہوا ڈائی پول) is due to the polar molecule which collides with that.

Q.2 London dispersion forces are weaker than dipole-dipole forces. Why? (Faisalabad 2008, Multan 2009, Rwp. 2013, Lahore 2014)

-2 لنڈن کی ڈسپرشن قوتیں ڈائی پول ڈائی پول قوتوں سے کمزور کیوں ہیں؟

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Ans: London forces are short range (کم فاصلے پر مار کرنے والی) forces. Dipoles are created due to the disturbance (دخل اندازی) of electronic cloud momentarily (وقتی طور پر). These forces only operate when dipoles are there. The dipole-dipole forces continue operating (کام جاری رکھتی ہیں) due to presence of permanent (مستقل) dipole and forces are strong.

Q.3 Why the melting and boiling points of halogens and noble gases increase down the group? (Rawalpindi 2007, Fd. 2009, Bahawalpur 2011, Guj. 2014)

-3 ہیلوجنز کے M.P اور B.P گروپ میں اوپر سے نیچے آتے ہوئے کیوں بڑھتے ہیں؟

Ans: The atomic sizes increase from fluorine to iodine. Same is the case with noble gases. The number of shells increase, polarizability (پولرز بنانے کی صلاحیت) increase and the tendency of overlapping (ایک دوسرے کے اوپر آنا) of loosely held electrons in orbitals increase in both groups. This makes the melting and boiling points high down the group.

Q.4 Why intermolecular forces are weaker than intramolecular forces? (Bahawalpur 2011)

-4 مالیکیولز کے درمیان باہمی کشش کی قوتیں کمزور ہوتی ہیں اُن قوتوں کے مقابلہ میں جو ایک ہی مالیکیول کے اندر ایٹمز کی آپس میں ہوتی ہیں۔ ایسا کیوں ہے؟

Ans: Intermolecular forces are present between two different molecules of the same kind or different kinds. Valence electrons are not responsible (ذمہ دار) for these forces, that is why they are weak forces. Hydrogen bonding and dipole-dipole forces are such forces. Intramolecular forces are present within the same molecule due to sharing of electrons (الیکٹرانز کی حصے داری) and overlapping of the orbitals. In H_2O the forces making σ-bonds are intramolecular forces.

Q.5 Is it true that polar compounds are soluble in polar solvents? (B.Pur 2009)

-5 کیا یہ سچ ہے کہ پولر مرکبات پولر سالونٹس میں حل ہوتے ہیں؟

Ans: Polar compounds have separation (الگ الگ ہونا) of positive and negative charges. If the solvent has also separation of positive and negative charges then the interaction (قوتِ کشش) takes place between the opposite poles. These interactions are responsible (ذمہ دار ہیں) to mix them with each other.

Q.6 Why dipole-dipole forces are much stronger than dipole-induced dipole forces? (Multan 2009, Lahore 2014)

-6 ڈائی پول۔ڈائی پول کشش والی قوتیں ڈائی پول۔انڈیوسڈ ڈائی پول کی کشش کی قوتوں سے زیادہ کیوں ہوتی ہیں؟

Ans: In dipole-dipole forces, the atoms have sufficient (کافی) partial positive (جزوی مثبت) and partial negative (جزوی منفی پن) charges to attract each other.

In dipole-induced dipole forces, one of the atoms and molecules is non-polar (جس کے پولرز نہ ہوں) and dipole has to be induced in that. This induced dipole (بھرا ہوا ڈائی پول) is temporary (وقتی ہے) and that is why the attraction between a dipole and the induced dipole is comparatively (مقابلتاً) less strong.

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Q.7 What are London dispersion forces?
(Rwp 2005, 2008, Fd. 2009, Sarg. 2009, Sarg. 2010)

-7 لنڈن ڈسپرشن قوتیں کیا ہوتی ہیں؟

Ans: In London dispersion forces, there are no polarities (پولز کا وجود نہیں ہوتا) before the collisions. Due to collisions the electronic clouds (الیکٹرانز کے بادل) in outermost orbitals of atoms or molecules are dispersed. Temporary dipoles are created and these temporary dipoles are responsible for attractive forces. These forces are very weak.

Q.8 What is polarizability? How its increase down the group in noble gases is responsible for increase in melting and boiling points?
(D.G Khan 2011, Federal Board 2013, Sarg. 2014, Guj. 2014)

-8 پولیرائزیبلٹی کیا ہوتی ہے؟ نوبل گیسوں میں جب اوپر سے نیچے آتے ہیں تو اُن میں پولیرائز ہونے کی صلاحیت بڑھنے سے اُن کے M.P اور B.P کس طرح بڑھتے ہیں؟

Ans: The polarizability (پولز بنانے کی صلاحیت) is the capability (بلا صلاحیت پن) of an atom, molecule or an ion to be distorted (اپنی شکل بگاڑنا) for its electronic cloud. From upper to the downward direction in a group, the atomic sizes increase in noble gases. Their outermost electronic clouds are disturbed (خلل ڈالنا) due to collisions. Temporary dipoles are developed and forces of attractions are created, hence melting and boiling points increase down the group.

Q.9 Why the melting and boiling points of alkanes increase with increase in molar masses and are less than that of H_2O?
(Lahore 2007, Rwp. 2009, Sarg. 2009, M. Pure 2012, Guj. 2014)

-9 اَلکینز کے M.P اور B.P اُن کے مولر ماسز بڑھنے سے کیوں بڑھتے ہیں؟

Ans: Alkanes are saturated hydrocarbons (کاربن ہائیڈروجن کے مرکبات جو سیر شدہ ہوں). Greater the length of carbon chain, greater the interaction of one molecule with the other. Higher alkanes are zig-zag (ٹیڑے) in structure and they are called macromolecules (بڑے بڑے مالیکیولز) as well. These features (نمایاں وصف) are responsible for the forces of interactions and cause the increase of M.P. and B.P. of alkanes. H_2O is a polar liquids but alkanes are non-polar.

Hydrogen Bonding

Q.10 In the hydrogen bonded structure of HF, which is the stronger bond: the shorter covalent bond or the longer hydrogen bond between different molecules? **(Bahawalpur 2007, D. G. Khan 2012)**

-10 HF کی ساخت میں دو قسم کے بانڈز ہیں۔ اُن میں سے کیا کوویلنٹ بانڈ مضبوط ہے یا ہائیڈروجن بانڈ؟

Ans: The covalent bond (شریک گرفتی تعلق) between H and F is stronger because it is produced by the overlapping of orbitals and two electrons are shared to give a sigma bond.

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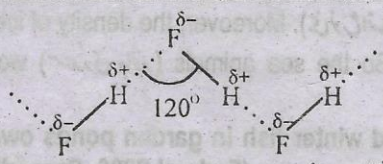

The bond which is shown by the dotted lines (نقطے دار لائن) is the hydrogen bond due to electrostatic forces (برق سکونی) of attraction. So it is a weaker bond.

Q.11 What is the origin of the intermolecular forces in water?
(B.P-2007, 2008, D.G. Khan 2013)

-11 پانی میں مالیکیولز کے درمیان کشش کی طاقتیں کہاں سے آتی ہیں؟

Ans: Due to difference of electronegativity between hydrogen and oxygen in water, polarity is developed. This causes hydrogen bonding among oxygen and hydrogen atoms in water molecules.

Q.12 Water is a liquid at room temperature but H_2S is a gas. Give reason.
(Rwp. 2009, Lahore 2009, Rwp. 2011, Guj. 2011, Multan 2012, D.G. Khan 2013)

-12 پانی کمرے کے درجہ حرارت پر مائع ہے لیکن H_2S گیس ہے۔ وجہ بتائیں۔

Ans: This is due to high electronegativity of oxygen as compared (مقابلتاً) to sulphur. Water has hydrogen bonding, but H_2S does not have. Due to absence (نہ ہونے کے) of hydrogen bonding in H_2S at room temperature, it is a gas.

Q.13 Lower alcohols are water soluble, but corresponding alkanes are insoluble in water. Why? (Lahore 2007, Lahore 2012, Lahore 2014, D.G. Khan 2014)

-13 تھوڑے مولر ماس والی الکوحلز پانی میں حل ہو جاتی ہیں لیکن الکینز حل نہیں ہوتے؟

Ans: Alcohols have –OH group which is a polar and makes hydrogen bonds with water. This hydrogen bonding develops solubility (حل پذیری). Hydrocarbons are non-polar molecules. They do not have any functional group (کام کرنے والا گروپ). So, no hydrogen bonding and hence no solubility in water.

Q.14 Water and ethanol can mix easily in all proportions. Why?
(Lahore 2013, Lahore 2014, Lahore 2014)

-14 پانی اور الکحل ایک دوسرے میں ہر نسبت میں حل پذیر کیوں ہیں؟

Ans: Water (HOH) and ethanol (C_2H_5OH) have both OH groups, so they can do the hydrogen bonding extensively (دور دور تک یا وسیع و عریض). That is why they can mix with each other in all proportions.

Q.15 How do you justify that the structure of ice is just like that of diamond?

-15 آپ کیسے صحیح ثابت کریں گے کہ برف کی ساخت ہیرے کی ساخت سے مشابہت رکھتی ہے؟

Ans: The oxygen of water molecule is sp^3-hybridized just like the carbon of diamond. Oxygen of water molecules makes two covalent bonds and two hydrogen bonds. So the hydrogen bonded water molecule in ice is just like the carbon of a diamond.

Q.16 Briefly consider some of the effects on our lives, if water has only a very weak hydrogen bonding present among its molecules.

-16 اگر پانی میں کمزور H.B ہوتی تو اس کا ہماری زندگی پر کیا اثر ہونا تھا؟

Ans: Due to the expected (جس کی اُمید کی جا سکتی ہے) weak hydrogen bonding in water the freezing point of water would be less than 0°C. This would have its own problem

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for human being (بنی نوع انسان). Moreover, the density of ice would not have been less than liquid water. So the sea animals (سمندری جانور) would have different pattern (طریقہ) of living.

Q.17 How in a very cold winter fish in garden ponds owe their lives to hydrogen bonding? (Federal-2006, Sargodha 2008, D. G. Khan 2012)

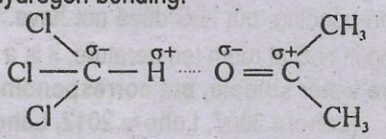
-17 پانی میں موجود ہائیڈروجن بانڈنگ ایک جوہڑ کی مچھلی کو سردیوں کے موسم میں زندہ رکھنے میں کیا رول ادا کرتی ہے۔

Ans: When water is frozen at 0°C, then it expands (پھیل جاتا ہے). The hydrogen bonding in the solid state of H_2O adjust the molecules of water in such a way that empty spaces (خالی جگہیں) are left behind. In this way the density of water in the solid state becomes less. So ice floats (تیرتی ہے) on water.

Q.18 H-bonding is present in chloroform and acetone. Justify it. (Multan 2009, Multan 2013)

-18 کس طرح صحیح ثابت کریں گے کہ کلوروفارم اور ایسی ٹون میں ہائیڈروجن بانڈنگ ہوتی ہے؟

Ans: Chloroform is a polar compound. Acetone is also a polar compound. When chloroform and acetone are mixed with each other, then they create the forces of attractions due to hydrogen bonding.



chloroform acetone

Q.19 Why the boiling points of the hydrides of the second period in group IV-A, V-A, VI-A and VII-A are greater than the B.P. of hydrides of third period for these groups?

-19 گروپس IV-A، V-A، VI-A، VII-A کے دوسرے پیرڈ کے عناصر کے ہائیڈرائڈز کے B.P انہی گروپس کے تیسرے، پیریڈ سے زیادہ کیوں ہیں؟

Ans: The elements of second period are more electronegative than the respective elements of third period. So, the polarities of the bonds with hydrogen are greater than the third period elements.

$$\ddot{H_2O} > H_2\ddot{S}, \ddot{N}H_3 > \ddot{P}H_3, HF > HCl; CH_4 < SiH_4$$

These enhanced (بڑھی ہوئی) polarities of the compounds of second period with hydrogen make them to have greater boiling points. Anyhow, CH_4 shows exceptional (غیر معمولی، استثنائی) behaviour. The reason is that CH_4 has a very small size.

Q.20 Give the reason for low boiling point of HF (19.5°C) as compared to H_2O (100°C), although the hydrogen bonding in HF is stronger than that of water. (Bahawalpur-2006, 2008, D.G. Khan 2013, Rwp. 2014, Lahore 2014)

-20 یہ وجہ بیان کریں کہ HF کا B.P پانی سے کم ہے۔ حالانکہ HF میں ہائیڈروجن بانڈنگ زیادہ طاقت ور ہے۔

Ans: In water each molecule can make 2 hydrogen bonds with two neighbouring (ہمسائے) water molecules. In this way the links (تعلقات) of H_2O molecule are greater. In case

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of HF, these is only one partial positive hydrogen which can make only one H-bond with another fluorine atom.

Q.21 How the cleaning action of soaps and detergents is partially due to the hydrogen bonding? (R. Pindi 2012, Sarg. 2014)

-21 صابن اور ڈی ٹرجنٹس میں صفائی کرنے کا عمل کس طرح ہائیڈروجن بانڈنگ سے منسلک ہے؟

Ans: Soaps and detergents (مُصفّاکار) are the sodium salts of long chain carboxylic acids and benzene sulphonates.

The $\overset{\ominus}{C}OO\overset{\oplus}{N}a$-group of soaps and $SO_3\overset{\ominus}{N}a\overset{\oplus}{}$ group of detergents have a negative charge on oxygen atom and create hydrogen bonding with water. The rest of the portion of the soaps and detergents remain outside water. In this way, water can do the cleaning action and removes the dirt and greasy (چپٹنے والا مٹیریل) material from the fabric (کپڑے).

Q.22 How the hydrogen bonding plays a major role in the determination of structure of proteins? (R. Pindi 2012)

-22 پروٹینز کی ساخت میں ہائیڈروجن بانڈنگ کس طرح اہم رول ادا کرتی ہے؟

Ans: There are two types of important groups in proteins i.e. $>N^{\delta-}-H^{\delta+}$ and $>C^{\delta+}=O^{\delta-}$. These groups are vertically adjacent (عموداً ایک دوسرے کے قریب) to each other in helix (مرغولہ۔ بل دار شے). They link together through hydrogen bonding.

Q.23 Ice floats on water. Justify it. (Multan 2007, Bahawalpur 2007) (Multan 2008, Faisalabad 2008, B.P. 2008, Lahore 2009, Sarg. 2009, Rwp 2010, Sarg. 2011, Faisalabad 2011, Bahawalpur 2011, Lahore 2013)

-23 برف پانی پر تیرتی ہے۔ اس کو صحیح ثابت کریں۔

Ans: Ice is solid water. Water expands when it is solidified (پانی جم کر پھیلتا ہے). This expansion (پھیلاؤ) is due to empty spaces which are left behind due to the hydrogen bonding. The density of ice is close to 0.91 g cm^{-3} as compared to that of liquid water which is 1.00 g cm^{-3} at 4°C. For this reason ice floats on water.

Q.24 In a very cold winter, fish in garden ponds owe their lives to hydrogen bonding. (Bahawalpur 2007, Multan 2008, Bahawalpur 2011, F. Abad 2013, D.G. Khan 2013)

-24 سخت سردی کے موسم میں مچھلیاں اپنے باغیچے کے تالاب میں کس طرح اپنی زندگی برقرار رکھتی ہیں؟

Ans: The hydrogen bonding in the solid state of H_2O adjust the molecules of water in such a way that empty spaces are left behind. So, the density of water in the solid state being less, floats on water. The liquid water at 4 °C underneath ice (برف کے نیچے), accommodates fish (مچھلی کو جگہ دیتا ہے) to survive (زندہ رہنے کے لئے) in winter.

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Vaporization and Vapour Pressure

Q.25 Why the heat of vaporization of water is greater than that of CH_4?
(D.G. Khan 2011)

-25 پانی کی بخارات بننے کی حرارت CH_4 سے زیادہ کیوں ہے؟

Ans: Water is a polar liquid and due to strong hydrogen bonding high energy is required to separate (الگ کرنا) the molecules from each other at its boiling point. CH_4 is a non-polar and has weak London dispersion forces.

Q.26 How the rate of evaporation depends on the surface area? (Lah. 2009)

-26 بخارات بننے کی رفتار کس طرح کر کے سطح کے ایریا پر منحصر ہے؟

Ans: Evaporation is a surface phenomenon (عمل تبخیر ایک سطحی عمل ہے). Greater the surface area, greater the number of molecules present on the surface; greater the chances to leave the surface and greater the evaporating tendency (بخارات بننے کا رجحان).

Q.27 Steam causes more severe burns than does the boiling water. Give reason.
(Guj. 2010)

-27 ابلتے پانی کے مقابلہ میں بھاپ زیادہ جلانے کا اثر رکھتی ہے۔ وجہ بتائیں۔

Ans: No doubt, the temperature of boiling water and steam are same but the heat content (جو حرارت رکھی ہوئی ہے) of steam is greater that of boiling water. The latent heat of vaporization (بخارات بنانے والی چھپی ہوئی انرجی) is responsible (ذمہ دار ہے) for severe burns.

Q.28 Why do we feel cooling effect after taking bath?
(Faisalabad 2004, Gujranwala 2008, Fd. 2009)

-28 نہانے کے بعد ہم کیوں ٹھنڈ محسوس کرتے ہیں؟

Ans: Body is warmer (گرم تر) as compared to water. Water evaporates from the body due to high temperature of the body and larger surface area. Evaporation for the surface of body becomes fast. Evaporation needs energy, which is supplied by the body which gets a sense of cooling.

Q.29 The vapour pressure of liquids depend upon intermolecular forces, sizes of molecules and temperature of liquids. Why solids have low V.P.?
(Rwp. 2011, Lahore 2012, B. Pur 2014, Multan 2014)

-29 مائعات کے بخارات کا دباؤ مالیکیولز کی درمیانی کشش کی قوتوں، مالیکیولز کے سائز اور درجہ حرارت پر منحصر ہے۔ ٹھوس اشیاء کا بخاراتی دباؤ بہت کم کیوں ہوتا ہے؟

Ans: Greater the intermolecular forces, lesser the evaporating tendency and lesser the vapour pressure. When the molecules are big sized then evaporation tendency (بخارات بننے کی رجحان) is less and vapour pressure is lower. Higher temperature increases the kinetic energies of liquid molecules and the vapour pressure is also increased. The particles of a solid are tightly held with each other.

Q.30 Evaporation of a liquid causes cooling. Why?
(Multan, Lahore 2005, Lahore-2006, Fd. 2009, Lahore 2010, Lahore 2011, D. G. Khan 2012, Lahore 2012, B. Pure 2013, B. Pur 2014, Lahore 2014, Sahiwal 2014)

-30 کسی مائع کا بخارات میں تبدیل ہونا ٹھنڈک کا باعث کیوں بنتا ہے؟

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Ans: High energy molecules escape and change into vapours during evaporation. So, the temperature of liquid falls. To compensate that, heat flows from surrounding to the region of lower temperature (حرارت اردگرد سے کم درجہ حرارت والی سائڈ پر آتی ہے). This causes the temperature of surrounding to decrease (اردگرد کا درجہ حرارت گرتا ہے). So, evaporation causes cooling.

Q.31 Evaporation takes place at all temperatures. How?
(Faisalabad 2007, B.P. 2008, Guj. 2010, D.G. Khan 2013, F. Abad 2014, Lahore 2014)

-31 عمل تبخیر ہر درجہ حرارت پر ہوتا ہے۔ کیسے؟

Ans: The molecules whose kinetic energies are greater than the average kinetic energy of the molecules, escape (بھاگتے ہیں) from the surface of liquid. If temperature of the liquid is increased, rate of evaporation also increases. Anyhow, evaporation takes place at all temperatures and only the rate differs (صرف ریٹ کا فرق پڑتا ہے).

Q.32 Why earthenware vessels keep water cool?
(Multan 2007, B. Pure 2012, Guj 2012, Lahore 2012, Guj. 2014, Sahiwal 2014)

-32 مٹی کے بنے برتن پانی کو کیوں ٹھنڈا رکھتے ہیں؟

Ans: Earthenware vessels are porous (مٹی کے برتن سوراخ دار ہوتے ہیں). Water molecules comes out from these pores and evaporate. These molecules of water need energy to overcome intermolecular attractive forces. They get this energy from other molecules of water. Thus temperature of remaining water decreases.

Q.33 One feels sense of cooling under the fan after bath.
(B.P. 2008, Mtn 2009, F. Abad 2012, Guj. 2013, B. Pur 2014, Multan 2014)

-33 نہانے کے بعد پنکھے کے نیچے ٹھنڈک کا احساس کیوں ہوتا ہے؟

Ans: When one takes bath (نہاتا ہے) and sits in front of a fan, water on the surface of body evaporates with greater rate. The high energy molecules escape from surface of the body and one feels sense of cooling. The reason is that heat of body is used up to evaporate water.

Q.34 Vacuum distillation can be used to avoid decomposition of a sensitive liquid.
(Gujranwala 2009, Lahore 2012)

-34 نازک مرکبات کو کم دباؤ پر رکھ کر عمل کشید کرنے سے ٹوٹ پھوٹ سے بچایا جاسکتا ہے؟

Ans: The boiling points depend upon external pressure. In vacuum distillation (خلا پیدا کر کے عمل کشید کرنا), external pressure is reduced by vacuum (باہر کا دباؤ خلا کی وجہ سے کم ہو جاتا ہے). So, boiling point of liquids decrease. Hence sensitive (حساس) liquids like glycerine can be distilled safely without (بغیر) decomposition (ٹوٹ پھوٹ) by vacuum distillation.

Q.35 Why the vapour pressure of water, ethyl alcohol and diethyl ether are different from each other at 0°C? (Model Paper-2006, Rwp-2007)

-35 پانی، الکحل، ورایتھر کے 0°C پر بخاراتی دباؤ ایک دوسرے سے مختلف کیوں ہیں؟

Ans: Water, ethyl alcohol and diethyl ether have different extents of hydrogen bondings in their molecules. Water has maximum hydrogen bonding, ethyl alcohol has less hydrogen bonding while diethyl ether has no hydrogen bonding. For this reason, vapour pressure of water at 0°C is 4.529 torr, that of alcohol is about 15 torr and is 200 torr for diethyl ether at 0°C.

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Q.36 Dynamic equilibrium is established during evaporation of a liquid in a closed vessel at constant temperature.

-36 مستقل درجہ حرارت پر ایک بند برتن میں مائع اور اس کے بخارات کے درمیان ایک حرکی توازن برقرار کیسے ہوتا ہے؟

Ans: We know that the liquid molecules escape from the surface of liquid and change into vapours. These vapours are recaptured (دوبارہ پکڑے جانا) by the liquid, and process is called condensation (بخارات کا مائع بننے کا عمل). At constant temperature the rate of both the processes becomes equal and this is the state of dynamic equilibrium (حرکی توازن).

Boiling Point

Q.37 The boiling point of water is different at Murree Hills and at Mount Everest. Justify it. (Faisalabad 2007, Faisalabad 2010, D.G. Khan 2014, Guj. 2014)

-37 مری کی پہاڑیوں اور ماؤنٹ ایوریسٹ پر پانی کا B.P مختلف کیوں ہے؟

Ans: Boiling point of a liquid changes as the external pressure (باہر کا دباؤ) changes. At Murree Hills, atmospheric pressure is less than standard pressure (760 torr). So water boils at 98°C instead of 100°C. At Mount Everest, atmospheric pressure is further reduced. So water boils at 69°C.

Q.38 What are the advantages of vacuum distillation? (Guj. 2011, Sahiwal 2014, B. Pur 2014)

-38 خلا پیدا کر کے عمل کشید کرنے کے کیا فائدے ہیں؟

Ans: In vacuum distillation, the boiling point of the liquid is decreased by reducing the pressure by suction pump (گیس کھینچنے والا پمپ):

(i) It reduces the time.
(ii) Apparatus is saved from high temperature.
(iii) Sensitive (حساس) compound is not decomposed.
(iv) Fuel is saved (ایندھن کی بچت ہوتی).

Q.39 Liquid boils at that temperature when its vapour pressure becomes equal to the external pressure. Why? (Model Paper-2006-07, Faisalabad 2012)

-39 ایک مائع اس وقت ابلتی ہے جب اس کے بخارات کا پریشر باہر کے پریشر کے برابر ہو جاتا ہے۔ کیوں؟

Ans: Increase in temperature increases the vapour pressure of liquids. When the vapour pressure of the liquid becomes equal to the external pressure, then the vapour pressure inside the bubbles (بلبلے) of the liquid is such that it can face the external pressure, so the bubbles burst in the outward direction on the surface. This bursting of the bubbles outwardly is called boiling.

Q.40 Define boiling point. Is it related with the external pressure? (Lahore Board 2005, Rwp. 2010, Faisalabad 2011, Multan 2013)

-40 نقطہ جوش کی تعریف کریں۔ کیا یہ باہر کے دباؤ پر منحصر ہوتا ہے؟

Ans: Boiling point is that temperature of the liquid at which the vapour pressure of the liquid is equal to the external pressure. If the external pressure is higher, then the boiling point of the liquid is increased. If the external pressure is decreased, then the boiling point decreases. The boiling point of water is low at mountains (پہاڑوں پر پانی کا نقطہ جوش کم ہوتا ہے).

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Q.41 Boiling needs a constant supply of heat. Why? (Lahore 2010, D.G. Khan 2014)

-41 اُبلنے کے دوران حرارت کی سپلائی مستقل طور پر دینی پڑتی ہے؟

Ans: When liquid boils excess heat does not increase the temperature of liquid. It is used to break the intermolecular forces of attractions among the molecules and convert liquid into vapours. So boiling needs constant supply of heat (اُبلنے کے لئے حرارت کا متواتر دینا ضروری ہے). Moreover, the molecules with more energy constantly leave the liquid.

Q.42 Why the water, ethyl alcohol and diethyl ether have their vapour pressures equal to 760 torr at 100°C, 78.5°C and 34.4°C, respectively? (Multan 2013)

-42 پانی، الکحل اور ایتھر اپنے بخاراتی دباؤ 760 ٹار رکھتے ہیں جب اُن کا درجہ حرارت 100°C، 78.5°C اور 34.4°C ہو۔ ایسا کیوں ہے؟

Ans: These three liquids have different extents of H-bonding. The liquids boil normally at that temperature, when their vapour pressures are equal to external pressure. The normal external pressure is equal to 760 torr. So, these liquids have to maintain their vapour pressures equal to 760 torr at their boiling points.

Q.43 Why the things can be easily cooked in a pressure cooker? (Sarg. 2011, Sarg. 2014)

-43 پریشر کوکر میں کھانا پکانا آسان کیوں ہے؟

Ans: If the vapours of H_2O at high temperature are available to the food particles (خوراک کے ذرّے), the things can be cooked easily. In the pressure cooker, the external pressure is increased artificially (مصنوعی طور پر). This thing increases the boiling point of the H_2O. The high boiling water can cook things easily.

Sublimation

Q.44 Why the heat of sublimation of a substance is greater than that of heat of vaporization? Give example of iodine. (Faisalabad 2010, Faisalabad 2013, Guj. 2014)

-44 عمل تسعید کی حرارت مائع کا بخارات میں تبدیل کرنے کی حرارت سے زیادہ کیوں ہے؟

Ans: During sublimation (عمل تسعید) two stages are crossed in a single step *i.e.*, conversion of solid to liquid and liquid to vapours. In vaporization, liquid changes into vapours. Therefore, heat required for sublimation is greater than for vaporization. Iodine molecules have greater forces of attractions due to polarizability of I_2 molecule.

Liquid Crystals

Q.45 How liquid crystals can act as temperature sensors? (Lahore 2007, Sargodha 2008, Rwp. 2013, Multan 2013, Guj. 2013, B. Pur 2014, F. Abad 2014)

-45 Liquid crystals کس طرح درجہ حرارت کو ماپ سکتی ہیں؟

Ans: Liquid crystals can reflect light (روشنی کو منعکس کرنا). When any of the wavelength of light is reflected, the liquid crystal look coloured, when the temperature is changed the distances between layers of molecules are changed. So, the reflected light also changes colours. Due to this property of cholesteric liquid crystals, they are used as temperature sensors.

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Q.46 State the biological applications of liquid crystals?
(Azad Jammu & Kashmir Board 2005, Faisalabad-2006, Rwp. 2009, Lahore 2011, Multan 2012, D. G. Khan 2012, Faisalabad 2013, Guj. 2013, Multan 2014, Rwp. 2014)

-46 Liquid crystals کی حیاتیاتی استعمالات بیان کریں۔

Ans: Cholestric liquid crystals are used to locate (جگہ معلوم کرنا) the effected parts of the body by applying them to the surface of skin, venis, arteries. They are also used to check the breast cancer (چھاتی کا کینسر). The reason is that the effected part is warmer than the surrounding.

ANSWERS TO THE SHORT QUESTIONS
(SOLIDS)

General Features of Solids

Q.1 What is cleavage plane? **(Rwp. 2011, Rwp. 2012)**

-1 کلیوج پلین کیا ہوتا ہے؟

Ans: Crystalline substances have definite planes (خاص ہموار جگہیں) along which the crystals can be broken. This is anisotropic (ایک جیسا نہ ہونا) behaviour of the crystals. This property is associated (منسلک) with crystalline substances.

Q.2 Solid sodium is a good conductor of electricity but solid sodium chloride is not. Give reason? **(Sarg. 2011)**

-2 ٹھوس Na بجلی کا اچھا کنڈکٹر ہے لیکن ٹھوس NaCl نہیں ہے۔ سبب بتائیں۔

Ans: Sodium is an alkali metal and free electrons are available in the crystal lattice. These free electrons (آزاد الیکٹرانز) are responsible for the passage of electrical current. Free electrons are not available in the NaCl crystal.

Q.3 Sodium is softer than copper, but both are very good electrical conductors. **(Sarg. 2014)**

-3 Na نرم ہے Cu سے لیکن دونوں ہی بجلی کے اچھے کنڈکٹرز ہیں۔ کیوں؟

Ans: Sodium is an alkali metal. It has one electron in the outermost orbital. Copper is a transition element having ten electrons in outermost 3d orbitals. So, there are greater chances for overlapping of orbitals in copper and hardness (سختی) is developed.

Well, the availability (مہیا ہونا) of electrons to the applied potential difference (لگائی گئی طاقت کا فرق) is almost equal. So, they are equally good electrical conductors.

Q.4 How does the solid maintain a definite volume and shape?

-4 کس طرح ایک ٹھوس چیز اپنی خاص جسامت کو برقرار رکھتی ہے؟

Ans: Since the particles of solids are closely packed, so there are no empty spaces in the solid structure. For this reason they have definite volume. The shape of the solid depends upon the fixed arrangement of the constituent particles which gives them a definite shape.

Q.5 Amorphous solid like glass is also called super cooled liquid. Why?

-5 شیشے کی طرح کی امارفس ٹھوس چیز کو سپر کولڈ مائع بھی کہتے ہیں۔ کیوں؟

Ans: Amorphous (بے ترتیب ایٹمز والے) solids like glass have random structures and their particles are disarranged just like liquids. So the amorphous solids are no doubt hard and rigid but look like liquids. That is why glass is called a super cooled liquid.

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Q.6 Define polymorphism and isomorphism. Give one example of each.
(Guj. 2005, Rwp. 2007, Faisalabad 2007, Multan 2008, Lahore 2008, Lahore 2011, D.G. Khan 2013, Guj. 2013, Multan 2013)

-6 پولی مارفیزم اور آئسومارفیزم کی تعریفیں کریں۔

Ans: When a compound exists in more than one crystalline shape, then the phenomenon is called polymorphism. $AgNO_3$ has rhombohedral and orthorhombic crystals.

Isomorphism is a phenomenon in which two different substances exist in the same crystalline form. $NaNO_3$ and KNO_3 both show rhombohedral crystals. The atomic ratio in $NaNO_3$ and KNO_3 is 1:1:3.

Q.7 The transition temperature is given by elements having allotropic forms and by compounds showing polymorphism. Justify.
(Lahore 2010, Rwp 2011, Multan 2011, D. G. Khan 2012, Lahore 2014, Rwp. 2014)

-7 ٹرانزیشن درجہ حرارت صرف اُن مرکبات کے لیے ہے جو پولی مارفیزم کا اظہار کرتے ہیں یا وہ عناصر جو ایلوٹراپی دیتے ہیں صحیح ثابت کریں۔

Ans: The elements having two or more than two crystalline forms have allotropes (بہروپ). Polymorphism is a property of a compound having two or more than two crystalline forms.

At transition temperature (تھوڑی دیر قائم رہنے والا درجہ حرارت) one crystalline form changes to other. So transition temperature is for all those elements which show allotropy and those compounds which show polymorphism.

Q.8 How is that some of crystalline solid substances show anisotropy?
(Multan 2011)

-8 کچھ ٹھوس اشیاء کس طرح اِن آئسوٹروپی دیتے ہیں؟

Ans: The variation of a certain physical property in different direction is known as anisotropy. Some of the crystalline substances are anisotropic for certain properties. Like electrical conductivity (برقی رو کا بہنا), thermal conductivity (حرارت کا بہنا), passage of light (روشنی کا گزرنا) and cleavage (خاص متوازی جگہوں سے ٹوٹنا).

Q.9 Why graphite is anisotropic in electrical conductivity? (Rwp-2007)

-9 گریفائیٹ بجلی کی رو کو گزرنے دینے کے حوالے سے اِن آئسوٹروپک کیوں ہے؟

Ans: Graphite has hexagonal plats (چھ کونوں والی سطحیں) structure. Electrical current can pass parallel to the layers, but not perpendicular to the layers. The reason is that mobile electrons are available parallel to the layers.

Q.10 Cleavage of crystals is anisotropic behaviour.
(Multan Board 2004, Bahawalpur 2007, B.P. 2008, Guj. 2010, Bahawalpur 2011, Guj. 2012, Rwp. 2013, B. Pure 2014, Lahore 2014)

-10 ٹوٹنا ایک اِن آئسوٹروپک سلوک ہے۔ کیسے؟

Ans: Anisotropy is the property of a crystal to obey a certain property better in one direction than the other. Cleavage is the breakage (ٹوٹنا) of a crystal along definite planes (خاص سطحیں). Since cleavage of the crystals can take place only in particular directions, so it is anisotropic behaviour.

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Q.11 Symmetry is one of the properties of a crystalline solid. Justify it.
(Multan 2007, Sarg. 2009)

-11 قلموں کی شکل والی ٹھوس اشیاء کی صفات میں ایک جیسا پن بھی ایک صفت ہے۔

Ans: Symmetry is the repetition of faces and angles (زاویوں اور سائیڈز کا بار بار دہرایا جانا) of a crystal, when rotated by 360° along its axis. There are many types of elements of symmetry (ایک جیسا پن) i.e.,
center of symmetry, plane of symmetry, axis of symmetry and inverse axis of symmetry.

Q.12 Crystals have their own habits. Justify it. (Gujranwala 2009)

-12 ثابت کریں کہ مرکبات میں بننے والی ہر قلم کی اپنی عادات ہوتی ہیں۔

Ans: The shape of a crystal which usually grows (بڑھتی پھولتی ہے) is called the habit of crystal. A crystal grows in various directions (مختلف سمتوں میں). The shape of the crystal remains the same, if the conditions remain the same.

Q.13 What are crystallographic elements?
(Model Paper-2006-07, Faisalabad 2011, Rwp. 2013, D.G. Khan 2013, D.G. Khan 2014, Guj. 2014)

-13 کسی مرکب کی قلم کو بتانے کے لئے کونسے کرسٹیلوگرافک ایلیمنٹس ہیں؟

Ans: The complete description of the unit cell is given by six parameters (چھ پیمائش کے پیمانے). These are three edge lengths *i.e.*, a, b, c and three interfacial angles (سائیڈز کے درمیان زاویے) *i.e.*, α, β, γ. These are called crystallographic elements.

Q.14 How unit cell is defined by unit cell dimensions?
(D.G. Khan-2006, Multan 2008, Faisalabad 2010)

-14 ایک یونٹ سیل کو یونٹ سیل کی پیمائش کے پیمانوں سے ہم کس طرح ماپتے ہیں؟

Ans: The distances between two adjacent particles along x, y and z axis are measured and denoted by 'a', 'b' and 'c'. These distances are called unit cell lengths (ایک سیل کی لمبائی کی اکائیاں). The angles in between these three axes are denoted by "α", "β" and "γ".These six parameters are also called crystallographic elements (قلمی مرکبات کی قلموں کو سمجھنے کے عناصر).

Ionic Solids

Q.15 What is reason for low lattice energy of NaCl as compared to $MgCl_2$?

-15 NaCl کی لیٹس انرجی $MgCl_2$ سے کم کیوں ہے؟

Ans: The charge density of $Mg^{\oplus 2}$ is much greater than $Na^{\oplus}$. The forces of attraction between $Mg^{\oplus 2}$ and $Cl^{\ominus}$ are greater than $Na^{\oplus}$ and $Cl^{\ominus}$. The close packing of $MgCl_2$ results in higher lattice energy.

Q.16 Napthalence can be purified by sublimation process. Why?
(Faisalabad 2007)

-16 نفتھالین کس طرح عمل تسعید سے صاف کی جاسکتی ہے؟

Ans: NaCl is an ionic compound and gives $Na^{\oplus}$ and $Cl^{\ominus}$ in aqueous solutions. There ions allow the electrical current to pass through it. Glucose is a covalent compound and is not ionized in water. It is not able to conduct in solutions state.

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Q.17 Solid and liquid sodium is a good conductor of electricity but $NaCl_{(s)}$ is only in molten state. Give reasons. (Lahore 2011)

-17 Na ٹھوس اور مائع حالت میں بجلی کا اچھا موصل ہے لیکن NaCl صرف مائع حالت میں۔ وجہ بتائیں۔

Ans: In ionic crystals, each ion is surrounded (گھرا ہوتا) by oppositely charged ions. If the size of the central ion is greater then the number of opposite ions surrounding it is also greater. It increases coordination number of central ion. The structure depends upon the coordination number (وہ تعداد جس سے مرکزی چیز گھیری جاتی ہے).

Q.18 Why the ionic crystalline solids have high melting points? (Faisalabad 2008, Lahore 2014)

-18 آئنک مرکبات کے نقطہ پگھلاؤ زیادہ کیوں ہوتے ہیں؟

Ans: In the ionic crystalline solids the strong electrostatic forces (برقی سکونی طاقتیں) of attraction are present in the crystal structure. The positively charged ion is surrounded by many negatively charged ions and vice versa. So the ionic solids have tightly packed (سختی سے پیک) structures and have high melting points.

Q.19 Ionic crystals don't conduct electricity in the solid state. Why? (Lahore 2008, Multan 2011, M. Pure 2012, B. Pure 2012, D.G. Khan 2012, Lahore 2013, F. Abad 2013, Multan 2013, Lahore 2014, B. Pur 2014, Multan 2014, D.G. Khan 2014)

-19 آئنک قلمیں ٹھوس حالت میں بجلی کو گزرنے کیوں نہیں دیتیں؟

Ans: In ionic crystals, ions are tightly packed in a three-dimensional (تین جہتوں میں) way. They don't have translatory motion (جگہ بدلنے والی حرکت). So they don't become responsible for carrying of current.

Q.20 Why the ionic crystals are highly brittle? (F. Abad 2007, B.Pur 2007, Guj. 2008, B.P. 2008, Guj. 2009, Sarg. 2009, Sarg. 2010, Bahawalpur 2011, Guj. 2013, Lahore 2014, Lahore 2014, Lahore 2014, B. Pur 2014, Sarg. 2014)

-20 آئنک قلمیں کیوں بڑی آسانی سے ٹوٹ جاتی ہیں؟

Ans: In ionic crystals, the boundaries (آخری حدود) of similarly charged ions touch each other in the crystal lattice. So when a crystal is broken under stress, they become loosely held then similar ions repel each other. This repulsion causes brittleness (آسانی سے ٹوٹنے کی صلاحیت).

Q.21 Why the lattice energy of NaCl is greater than that of KCl which is greater than KBr?

-21 NaCl کی لیٹس انرجی KCl سے زیادہ اور KCl کی KBr سے زیادہ ہے۔ وجہ بتائیں۔

Ans: Smaller the size of positive and negative ions, better the packing. In case of NaCl and KCl, the size of $Na^{\oplus}$ is smaller than $K^{\oplus}$. So, the lattice energy of NaCl is 788 kJ mol^{-1} while that of KCl is 690 kJ mol^{-1}.

The size of $Br^{\ominus}$ is greater than $Cl^{\ominus}$. The packing of KBr is less tight than KCl. So, the lattice energy of KBr is – 665 kJ mol^{-1}.

Covalent Solids

Q.22 Diamond an allotrope of graphite is hard and an electrical insulator. Why? (Lahore 2008, Faisalabad 2011, Guj. 2011, Multan 2012, Lahore 2013, Guj. 2013, Sarg. 2014, F. Abad 2014)

-22 ہیرا جو گریفائٹ کا بہروپ ہے سخت ہوتا ہے اور بجلی کو گزرنے کی اجازت نہیں دیتا۔ کیوں؟

Ans: There is $sp^3 - sp^3$ effective (بااثر) overlapping of the carbon atoms in diamond. Tetrahedral angles are produced around each carbon atom. The bond length of

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1.54 A° is most suitable for effective packing (اثر آفریں پیکنگ). That is why diamond has a hard structure. These are no free electrons so it is insulator (غیر موصل).

Q.23 Diamond and graphite which are allotropes are covalent solids. Graphite can be used as a lubricant but diamond cannot be.
(Rawalpindi 2008, Faisalabad 2011, Lahore 2013)

-23 ہیرا اور گریفائیٹ ایک دوسرے کے ایلوٹراپس ہیں۔ گریفائٹ کو ایک چکنے شے کے طور پر استعمال کرتے ہیں جبکہ ہیرے کو نہیں۔

Ans: The electrons of the sigma (σ) bond in diamond due to $sp^3 - sp^3$ overlapping are tightly held and are not available for delocalization in diamond.

In graphite weak bonds are produced with the bond length of 3.4 A° due to p-p head-on overlapping between the layers. These electrons of p-orbitals make weak bonds between adjacent layers, which can be broken. The layers can easily slip past each other.

Molecular Solids

Q.24 Why most of the molecular solids have low melting and boiling points?

-24 زیادہ تر مالیکیولر ٹھوس مرکبات کے M.P اور B.P کم کیوں ہوتے ہیں؟

Ans: In these solids the molecules are connected with each other through intermolecular forces. These forces are much weaker than normal bonds. So, the melting and boiling points of the molecular solids are very low. Ice and solid CO_2 are molecular solids.

Q.25 Molecular solids are soft and easily compressible. Why?
(Lahore Board 2004, Bahawalpur 2008)

-25 مالیکیولر ٹھوس اشیاء نرم ہوتی ہیں اور آسانی سے دبائی جاسکتی ہیں۔ کیوں؟

Ans: The molecules in such crystals are present at the lattice points (قلم کی جالی کے کونے). There are van der Waal's forces among the molecules of such solids. There forces are weak. So, there solids are soft and easily compressible (آسانی سے دبنے والے).

Metallic Solids

Q.26 Metals are good conductors of heat and electricity. The conduction of electrical current decreases with the increase of temperature. Why?
(Multan 2007, Multan 2009, Sarg. 2010, B. Pure 2013, Guj. 2014)

-26 دھاتیں حرارت اور بجلی کی اچھی موصل ہوتی ہیں۔ جب درجہ حرارت بڑھتا ہے تو بجلی کے گزرنے کی صلاحیت کم ہو جاتی ہے۔ کیوں؟

Ans: This is due to the availability (میسر آنا) of free electron. The particles at the lattice points have to and fro (ارتعاشی حرکت) motions. With the increase of temperature the extensions and compressions (لمبا ہونا اور دبایا جانا) are enhanced. So, the probability of electrons to more freely becomes less.

Q.27 Why most of the metals when freshly cut show metallic luster? (Federal 2013)

-27 جب اکثر دھاتوں کو کاٹا جاتا ہے تو ان کی سطح کیوں چمکتی ہے؟

Ans: In freshly cut metals (تازہ کٹی ہوئی دھات) the electrons present in the outermost orbitals are excited to the higher energy levels. The electrons come back to the original

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levels and emit the photons which they had absorbed. These emitted photons lie in the visible region of the spectrum. These photons create the sense of brilliance (چمک) to the nacked eye (کھلی آنکھ).

Q.28 Why the metals are malleable and ductile?
(Mirpure Board 2004, Sargodha 2008, D.G. Khan 2011, F. Abad 2012, Rwp. 2014)

-28 کیوں ہم دھاتوں کو کوٹ کر شیٹیں اور کھینچ کر تاریں بنا سکتے ہیں؟

Ans: In the metallic crystals the lattice points are occupied (جگہ گھیرتے ہیں) by positively charged ions (مثبت چارج والے آئنز) and free electrons are responsible (ذمہ دار ہیں) to hold them together. When stress is applied on the metals then the layers slide past over one another (ایک دوسرے کے اوپر گھستی ہیں). The layers are bounded by the free electrons and they play the role of glue (گوند). Due to this reason metals are malleable (کوٹ کر شیٹیں بنانا) and ductile (کھینچ کر تاریں بنانا).

Q.29 In the closest packing of atoms of metals, only 74% space is occupied. How?

-29 جب دھاتوں کے ایٹمز کو نزدیک ترین رکھ کر پیک کیا جاتا ہے تو صرف 74% جگہ گھیری جاتی ہے۔ کیسے؟

Ans: The coordination number of each atom in closely packed metal structures is 12. This is the maximum coordination number. But due to the circularity of atoms, certain vacant spaces (خالی جگہیں) are left behind which are called interstices (شگاف۔ دراڑ). These vacant spaces constitutes 26% of the crystal structure and 74% is occupied by the atoms.

(یعنی کسی ٹھوس شے کی قلم میں 26% جگہ خالی ہوتی ہے۔ یہ حصہ تمام شگافوں کی جسامت کے برابر ہے۔)

Q.30 Why the electrical conductivity of metal decrease with increase of temperature? (D.G. Khan 2014)

-30 بڑھے ہوئے درجہ حرارت پر دھاتوں کی بجلی کے لیے موصلیت کم کیوں ہو جاتی ہے؟

Ans: The atoms of metal atoms are vibrating at all temperatures. At higher temperature the vibrational motions increase their extent of compression and extensions. This hinders the mobility of electrons carrying the current.

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