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| --- | --- | --- |
| ………………UNIT-1………………… | | |
| 1 |  | Give and Explain the nerest Equation ? |
|  |  | What Is Nernst Equation? The **Nernst equation** provides the relavjasdgfgfiuf.isdugf/tion between the cell potential of an electrochemical cell, the standard cell potential, temperat hjfkuyrtrtyrure, and the reaction quotient.  **Expression of Nernst Equation**  The Nernst equation is an equation relating the capacity of an atom/ion to take up one or more electrons (reduction potential) measured at any conditions to that measured at standard conditions ([standard reduction potentials](https://byjus.com/chemistry/standard-electrode-potential/)) of 298 K and one molar or one atmospheric pressure.  **Nernst Equation for Single Electrode Potential**  Ecell = E0 – [RT/nF] ln Q  Where,   * Ecell = cell potential of the cell * E0 = cell potential under standard conditions * R = universal gas constant * T = temperature * n = number of electrons transferred in the redox reaction * F = Faraday constant * Q = reaction quotient |
| 2 | A | Give Definitions Hybridization |
|  |  | What is Hybridization? *When two*[*atomic orbitals*](https://www.geeksforgeeks.org/shapes-and-energies-of-atomic-orbitals/)*combine to form a hybrid orbital in a molecule, the energy of the orbitals of individual atoms is redistributed to give orbitals of equivalent energy. This is known as hybridization.*  The atomic orbitals of comparable energies are mixed together during the hybridization process, which mostly involves the merging of two orbitals or two ‘p’ orbitals or the mixing of an ‘s’ orbital with a ‘p’ orbital as well as an ‘s’ orbital with a ‘d’ orbital.  **Hybrid orbitals** are the new orbitals formed as a result of this process. More importantly, hybrid orbitals can be used to explain atomic bonding properties and molecular geometry. [Carbon](https://www.geeksforgeeks.org/carbon-definition-properties-occurrence-applications/), for example, forms four single bonds in which the valence-shell s orbital combines with three valence-shell p orbitals. This combination generates four equivalent sp3 mixtures. These will be arranged in a tetrahedral pattern around the carbon, which is bonded to four different atoms. ****Features of Hybridization****  * Hybridization occurs between atomic orbitals with equal energies. * The number of hybrid orbitals formed equals the number of atomic orbitals that mix. * It is not required for all half-filled orbitals to participate in hybridization. Even orbitals that are completely filled but have slightly varying energy can participate. * Hybridization occurs only during bond formation, not in a single gaseous atom. * If the hybridization of the molecule is known, the molecule’s shape can be predicted. * The larger lobe of the hybrid orbital is always positive, while the smaller lobe on the opposite side is always negative.  Types ****of Hybridization**** Hybridization can be classified as sp3, sp2, sp, sp3d, sp3d2, or sp3d3 based on the types of orbitals involved in mixing. ****sp Hybridization**** It occurs when one s and one p orbital in an atom’s main shell combine to form two new equivalent orbitals. The newly formed orbitals are known as sp hybridized orbitals. It produces linear molecules at a 180° angle. It entails combining one’s orbital and one ‘p’ orbital of equal energy to produce a new hybrid orbital known as an sp hybridized orbital.   * It’s also known as diagonal hybridization. * Each sp hybridized orbital contains the same amount of s and p characters. * All beryllium compounds, such as BeF2, BeH2, and BeCl2, are examples.   sp Hybridization   ****sp2 Hybridization**** It occurs when one s and two p orbitals of the same atom’s shell combine to form three equivalent orbitals. The newly formed orbitals are known as sp2 hybrid orbitals. It’s also known as trigonal hybridization. It entails combining one’s orbital with two ‘p’ orbitals of equal energy to create a new hybrid orbital known as sp2. A trigonal symmetry mixture of s and p orbitals is kept at 120 degrees. All three hybrid orbitals remain in the same plane and form a 120° angle with one another.   * Each hybrid orbital formed has a 33.33 % and a 66.66 % ‘p’ character. * The molecules with a triangular planar shape have a central atom that is linked to three other atoms and is sp2 hybridized. Boron compounds are examples.   sp2 Hybridization   ****sp3 Hybridization**** When one ‘s’ orbital and three ‘p’ orbitals from the same shell of an atom combine to form four new equivalent orbitals, the hybridization is known as tetrahedral hybridization or sp3. The newly formed orbitals are known as sp3 hybrid orbitals. These are pointed at the four corners of a regular tetrahedron and form a 109°28′ angle with one another.   * The sp3 hybrid orbitals form a 109.28-degree angle. * Each hybrid orbital has a 25% s character and a 75% p character. * [Ethane](https://www.geeksforgeeks.org/ethane-formula-structure-properties-uses-sample-questions/)and [methane](https://www.geeksforgeeks.org/methane-formula-structure-properties-uses-sample-questions/)are two examples.   sp3 Hybridization   ****sp3d Hybridization**** The mixing of 1s orbitals, 3p orbitals, and 1d orbitals results in 5 sp3d hybridized orbitals of equal energy. Their geometry is trigonal bipyramidal. The combination of s, p, and d orbitals results in trigonal bipyramidal symmetry. The equatorial orbitals are three hybrid orbitals that are oriented at a 120° angle to each other and lie in the horizontal plane.   * The remaining two orbitals, known as axial orbitals, are in the vertical plane at 90 degrees plane of the equatorial orbitals. * Hybridization in Phosphorus Pentachloride, for example (PCl5).   sp3d Hybridization   sp3d2 ****Hybridization**** When 1s, 3p, and 2d orbitals combine to form 6 identical sp3d2 hybrid orbitals, the hybridization is called sp3d2 Hybridization. These seven orbitals point to the corners of an octahedron. They are inclined at a 90-degree angle to one another.  sp3d2 Hybridization   ****sp3d3 Hybridization**** It has 1s, 3p, and 3d orbitals, which combine to form 7 identical sp3d3 hybrid orbitals. These seven orbitals point to the corners of a pentagonal bipyramidal. e.g. IF6.  sp3d3 Hybridization   Shapes of Hybridization  * **Linear**: The sp hybridization is caused by the interaction of two-electron groups; the orbital angle is 180°. * **Trigonal planar:** Three electron groups are involved, resulting in sp2 hybridization; the orbitals are 120° apart. * **Tetrahedral:** Four electron groups are involved, resulting in sp3 hybridization; the orbital angle is 109.5°. * **Trigonal bipyramidal:** Five electron groups are involved, resulting in sp3d hybridization; the orbital angles are 90° and 120°. * **Octahedral:** Six electron groups are involved, resulting in sp3d2 hybridization; the orbitals are 90° apart. |
|  | B | Chemical bond : |
|  |  | A chemical bond: A chemical bond may be defined as the force of attraction between any two atoms, in a molecule, to form chemical compounds which stabilize the atoms. |
|  | c | transport number |
|  |  | Ion transport number, also called the transference number, is the fraction of the total current carried in an electrolyte by a given ion. Differences in transport number arise from the difference in electrical mobility. |
|  | D | Solubility Product |
|  |  | What is the Solubility Product, Ksp? The solubility product constant is the equilibrium constant for the dissolution of a solid substance into an aqueous solution. It is denoted by the symbol Ksp.  The solubility product is a kind of equilibrium constant and its value depends on temperature. Ksp usually increases with an increase in temperature due to increased solubility.  Solubility is defined as a ***property of a substance called solute to get dissolved in a solvent in order to form a solution.*** The solubility of [ionic compounds](https://byjus.com/chemistry/formation-of-ionic-compounds/) (which dissociate to form cations and anions) in water varies to a great deal. Some compounds are highly soluble and may even absorb moisture from the atmosphere, whereas others are highly insoluble. |
|  | E | electrolytic dissociation |
|  |  | Define Electrolytic DissociationDissociation is a process in which compounds separate or split into smaller particles. In electrolytic dissociation, molecules or crystals breaks into ions by addition of energy or solvent. Example: NaCl(s) -----→ Na+(aq) + Cl−(aq) In this case, the solid NaCl consists of Na+ and Cl− ions. When it is dissolved in water or melted, ions separate from each other. This process is dissociation. When the substance already contains ions, the process is often called dissociation.Discuss the evidence of Arrhenius theory of electrolytic dissociation A large number of experimental observations are available which support Arrhenius theory. Some of them are given below:   * X-ray diffraction studies have shown that electrolytes are composed of ions. * The electrolytic solutions like metallic conductors obey Ohm's law * Evidence for the existence of ions in aqueous solutions of electrolytes is furnished by well known reactions in inorganic chemistry. * The abnormal behaviour towards colligative properties as observed in the case of electrolytes can be explained on the basis of ionic theory. |
| 3 | A | Write short note on:- hybridization |
|  |  |  |
|  | B | Type of chemical bonds |
|  |  | Types of Chemical Bonds When substances participate in chemical bonding and yield compounds, the stability of the resulting compound can be gauged by the type of chemical bonds it contains.  The type of chemical bonds formed varies in strength and properties. There are 4 primary types of chemical bonds which are formed by [atoms or molecules](https://byjus.com/chemistry/atoms-and-molecules/) to yield compounds. These types of chemical bonds include   * Ionic Bonds * Covalent Bonds * Hydrogen Bonds * Polar Bonds   These types of bonds in chemical bonding are formed from the loss, gain or sharing of electrons between two atoms/molecules. Ionic Bonding Ionic bonding is a type of chemical bonding which involves a transfer of electrons from one atom or molecule to another. Here, an atom loses an electron, which is, in turn, gained by another atom. When such an electron transfer takes place, one of the atoms develops a negative charge and is now called the anion.  The other atom develops a positive charge and is called the cation. The [ionic bond](https://byjus.com/chemistry/ionic-bond-or-electrovalent-bond/) gains strength from the difference in charge between the two atoms, i.e., the greater the charge disparity between the cation and the anion, the stronger the ionic bond.  Ionic bonding  Types of Chemical Bonds – Ionic bonding Covalent Bonding A [covalent bond](https://byjus.com/jee/covalent-bond/) indicates the sharing of electrons between atoms. Compounds that contain carbon (also called organic compounds) commonly exhibit this type of chemical bonding. The pair of electrons which are shared by the two atoms now extend around the nuclei of atoms, leading to the creation of a molecule.  Covalent Bonding in CH4  Covalent Bonding Polar Covalent Bonding Covalent bonds can be either polar or non-polar in nature. In polar covalent chemical bonding, electrons are shared unequally since the more electronegative atom pulls the electron pair closer to itself and away from the less electronegative atom. Water is an example of such a polar molecule.  A difference in charge arises in different areas of the atom due to the uneven spacing of the electrons between the atoms. One end of the molecule tends to be partially positively charged, and the other end tends to be partially negatively charged. Hydrogen Bonding Compared to ionic and covalent bonding, Hydrogen bonding is a weaker form of chemical bonding. It is a type of polar covalent bonding between oxygen and hydrogen, wherein the hydrogen develops a partial positive charge. This implies that the electrons are pulled closer to the more electronegative oxygen atom.  This creates a tendency for the hydrogen to be attracted towards the negative charges of any neighbouring atom. This type of chemical bonding is called a [hydrogen bond](https://byjus.com/jee/hydrogen-bonding/) and is responsible for many of the properties exhibited by water.  Hydrogen bonding in water |
|  | C | Bond order |
|  |  | Bond order is the number of chemical bonds between a pair of atoms. For example, in diatomic nitrogen N≡N the bond order is 3, in acetylene H−C≡C−H the bond order between the two carbon atoms is also 3, and the C−H bond order is 1. Bond order gives an indication of the stability of a bond. |
|  | D | Arrhenius theory of electrolysis. |
|  |  | 1.**Arrhenius theory of electrolysis** proposed that when an electrolyte is dissolved in water, it will dissociates into its charged particles i.e. cation and anion.  AB(aq)⇌A(aq)++B(aq)-  Here, Compound AB undergoes electrolysis in aqueous solution will dissociate into A+and B- ions.  2. In the solution, the ions formed the neutral compound by attaining the equilibrium state between the undissipated molecules and the ions.  3. The charged ions are moving freely in the solution and show electrical conductivity in the electrolytic solution which depends on the number of ions present in the solution.  4. Degree of dissociation shows whether an electrolyte is weak or strong. It is donated by alpha.  alpha =no.of moles dissociated / initial no.of moles  5. Strong electrolytes dissociate completely into their ions whereas weak electrolytes dissociate partially.  E.g. NaCl (sodium chloride) is a strong electrolyte.  CH3COOH(acetic acid) is a weak electrolyte |
| 3 |  | explain in detail vsepr and vbt and mot theory with example |
|  |  | (i)Valence shell electron pair repulsion (VSEPR) theory is used to predict the molecular shapes of various molecules from the electron pairs that surround the central atoms of the molecule. Some pairs of the valence electrons take part in covalent bond formation are called bond pairs. While some pairs of electrons do not participate in any bond formation, hence called lone pairs. The theory states that the electron pairs arrange themselves in such a way that they minimize the repulsion between them.  Decreasing order of repulsions between electron pairs are: lone pair-lone pair > lone pair-bond pair > bond pair-bond pair.  Some examples of VSEPR model of molecules are:  1. Water (Bent shape)  https://df0b18phdhzpx.cloudfront.net/ckeditor_assets/pictures/1513975/original_Picture3.png  2. Ammonia (Trigonal pyramidal)  https://df0b18phdhzpx.cloudfront.net/ckeditor_assets/pictures/1513977/original_Picture2.png 3. Boron trifluoride (Trigonal planar)  https://df0b18phdhzpx.cloudfront.net/ckeditor_assets/pictures/1513979/original_Picture6.png(ii)What is Valance Bond (VB) Theory? According to the valence bond theory,  Electrons in a molecule occupy atomic orbitals rather than molecular orbitals. The overlapping of atomic orbitals results in the formation of a chemical bond and the electrons are localized in the bond region due to overlapping.  The metal bonding is essentially covalent in origin and metallic structure involves resonance of electron-pair bonds between each atom and its neighbors. (iii)What Is Molecular Orbital Theory? The **molecular orbital theory** (often abbreviated to MOT) is a theory on chemical bonding developed at the beginning of the twentieth century by F. Hund and R. S. Mulliken to describe the structure and properties of different molecules. The valence-bond theory failed to adequately explain how certain molecules contain two or more equivalent bonds whose bond orders lie between that of a single bond and that of a double bond, such as the bonds in resonance-stabilised molecules. This is where the molecular orbital theory proved to be more powerful than the valence-bond theory (since the orbitals described by the MOT reflect the geometries of the molecules to which it is applied).  The key features of the molecular orbital theory are listed below.   * The total number of molecular orbitals formed will always be equal to the total number of atomic orbitals offered by the bonding species. * There exist different types of molecular orbitals: bonding molecular orbitals, anti-bonding molecular orbitals and non-bonding molecular orbitals. Of these, anti-bonding molecular orbitals will always have higher energy than the parent orbitals, whereas bonding molecular orbitals will always have lower energy than the parent orbitals. * The electrons are filled into molecular orbitals in the increasing order of orbital energy (from the orbital with the lowest energy to the orbital with the highest energy). * The most effective combinations of atomic orbitals (for the formation of molecular orbitals) occur when the combining atomic orbitals have similar energies.   In simple terms, the molecular orbital theory states that each atom tends to combine together and form molecular orbitals. As a result of such an arrangement, electrons are found in various atomic orbitals, and they are usually associated with different nuclei. In short, an electron in a molecule can be present anywhere in the molecule.  One of the main impacts of the molecular orbital theory after its formulation is that it paved a new way to understand the process of bonding. With this theory, molecular orbitals are basically considered linear combinations of atomic orbitals. The approximations are further done using the Hartree–Fock (HF) or the density functional theory (DFT) models to the Schrödinger equation. |
| 4 |  | Draw energy level digram for O2+ , N2 ,HF ? |
|  |  | Bond order of${{\\text{O}}_{\\text{2}}}$,  $\\text{O}_{\\text{2}}^{\\text{+}}$, $O_{2}^{-}$ and  \\[\\text{O}_{\\text{2}}^{\\text{2-}}\\] is in order. (A)  $\\text{O}_{\\text{2}}^{\\text{- }}\\langle \\text{ O}_{2}^{2-}\\text{  }\\langle \\text{ }{{\\text ...Draw a molecular orbital diagram of ${N_2}$ or ${O_2}$ with magnetic  behavior and bond order.Which is the molecular orbital diagram for HF? - Quora |

. UNIT 2.

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| 1 |  | Explain following Terms |
|  | A | Caustic embrittlement |
|  |  | **Caustic embrittlement** is the phenomenon in which the material of a [boiler](https://en.wikipedia.org/wiki/Boiler) becomes [brittle](https://en.wikipedia.org/wiki/Brittle) due to the accumulation of caustic substances |
|  | B | Slug |
|  |  | In wastewater treatment plant, the wastewater is passed through screens and then is allowed to settle down in a large tank. Semi-solids such as faeces that settle down during wastewater treatment are called sludge.  This sludge is removed using a skimmer and then is transferred to a tank where it is decomposed by anaerobic bacteria to produce biogas. This biogas is used as a low-cost fuel for heating, cooking, etc. It is also used to produce electricity. |
|  | C | Scale |
|  |  | **Scales:**  Definition: Scales are hared deposits firmly sticking to the inner surfaces of the boiler.  The scales are difficult to remove, even with the help of hammer and chisel and are the main source of boiler troubles. |
|  | D | Foaming and priming in boilers |
|  |  | Priming (foaming in North America) is a condition in the boiler of a steam locomotive in which water is carried over into the steam delivery. It may be caused by impurities in the water, which foams up as it boils, or simply too high a water level  Boiler water carry-over is the contamination of the steam with boiler-water solids. Bubbles or froth actually build up on the surface of the boiler water and pass out with the steam. This is called **foaming** and it is caused by a high concentration of any solids in the boiler water. |
|  | E | blow down operation |
|  |  | Boiler blowdown is the removal of water from a boiler. Its purpose is to control boiler water parameters within prescribed limits to minimize scale, corrosion, carryover, and other specific problems. Blowdown is also used to remove suspended solids present in the system |
| 2 |  | Explain water softening method |
|  | A | Lime-soda process |
|  |  | HARDNESS REMOVAL WITH LIME SODA PROCESS  AIM  The amount of lime and soda required to soften a hard water sample.  THEORY  The hardness of a water is defined as soap settling property of that water. The soap is sedimented by the presence of Ca+2 and Mg+2 ions in the water. Ions such as Fe+ 2, Zn+2, and Al+3 also help settling. However, the presence of high amounts of Ca+ 2 and Mg+ 2 ions in water usually leads to water hardness. This is the most common type of hardness in natural waters. The hardness caused by these materials is known as total hardness. The part of the total hardness corresponding to carbonate and bicarbonate ions in the water is defined as carbonate hardness. These ions also determine water alkalinity.  Waters are classified according to hardness grades as follows.  (mg/L) CaCO3 Degree of Hardness  0-75 Soft  75-150 Middle  150-300 Hard  300 and over Very hard  The Aim of Softening:  Hard water can cause various problems. The problems created by hard waters are as follows;  - They cause excessive soap consumption.  - They cause to skin irritation.  - They cause lime accumulation in boilers, hot water pipes and heaters.  - They cause discoloration in porcelain. Especially in homes, the white color of the sinks and bathtubs are discolored.  - They reduce the life of fabrics and cause them to wear out.  - They cause problems in canned food industr |
|  | B | Ion – Exchange process |
|  |  | [Ion exchange](https://www.sciencedirect.com/topics/chemical-engineering/ion-exchange) describes a specific chemical process in which unwanted dissolved ions in water and wastewater — like nitrate, fluoride, sulfate, and arsenic — are exchanged for other ions with a similar charge. Ions are atoms or molecules containing a total number of electrons that are not equal to the total number of protons.  There are two different groups of ions:   * Positively charged cations * Negatively charged anions   We have Michael Faraday to thank for these names, which he devised based on cations’ attraction to cathodes and anions’ attraction to anodes in a galvanic device. |
|  | C | Zeolite process |
|  |  | **Zeolite softening process:**   * It is a method of removing the permanent as well as temporary hardness of the water. * It involves the precipitation of Calcium and Magnesium ions present in water. * The exchange of Ca2+ and Mg2+ ions occurs with the help of zeolite and therefore, it is known as Zeolite softening process.   **Example:**   * Hydrated zeolites are commonly utilized as ion exchangers in the process of hard-water softening. |
| 3 |  | Write short note on :- |
|  | A | Alkalinity |
|  |  |  |
|  | B | Hardness |
|  |  |  |
|  | C | COD |
|  |  |  |
|  | D | BOD |
|  |  |  |
| 4 |  | Explain ibn detailed Boiler Feed Water Problem. |
|  |  |  |
| 5 |  | All numericals problems related water hardness ,Alkalinity, Solubility product |
|  |  |  |
| 6 |  | Give units of water hardness. |
|  |  |  |
|  |  | UNIT – 3 |
|  |  |  |
| 1 |  | What is polymerization. Give its types with examples. |
|  |  |  |
| 2 |  | Define types of polymer with example. |
|  |  |  |
| 3 |  | Write a short note on Natural and Synthetic rubber. |
|  |  |  |
| 4 |  | Classify the polymers with example. |
|  |  |  |
| 5 |  | Give process of vulcanization with example in detail. |
|  |  |  |
| 6 |  | Give chemical reactions ,properties ,preparation and applications of |
|  | A | Nylon 66 |
|  |  |  |
|  | B | Bakelite |
|  |  |  |
|  | C | Teflon |
|  |  |  |
|  | D | Decron |
|  |  |  |
|  | E | PAN |
|  |  |  |
|  | F | PVC |
|  |  |  |
|  |  | UNIT-4 |
|  |  |  |
| 1 |  | What is lubrication ? Give functions and classification of lubricans. |
|  |  | A lubricant may be defined as a substance which reduces the friction when introduced between two surfaces and the phenomenon is known as lubrication.  FUNCTIONS OF LUBRICANTS   * Reduce friction. * reduce wear, tear and surface deformation * Act as coolant to carry away heat. * keep out dirt. * Lubricants act as a seal. * Lubricants prevents corrosion. * Lubricants improve the machine efficiency. * Lubricants transmit fluid power.   CLASSIFICATION OF LUBRICANTS  On the basis of their physical state, lubricants can be classified as   * Lubricating oils (or liquid lubricants) * Greases (or Semi-solid lubricants)- * Solid lubricants * Emulsion lubricants * Synthetic lubricants * Biodegradable lubricants. |
| 2 |  | Write a short note on |
|  | A | Solid lubricants |
|  |  | Solid lubricants reduce friction by separating two moving surfaces under boundary conditions. They are used either in the dry powder form or mixed with oil or water.  the fwo most commonly used solid lubricants are  Graphite  .Molybdenum disulphide |
|  | B | Liquid lubricants |
|  |  | Lubricating oils are also known as liquid lubricants Characteristics of good lubricating oils is High boiling point, low freezing point, adequate viscosity for proper functioning in service, high resistance to oxidation and heat, non-corrosive properties, and stability to decomposition at the operating temperatures. They are further classified into three categories.   1. Animal and Vegetable oils, 2. Mineral or Petroleum oils 3. Blended oils. |
|  | C | Semi-solid lubricants |
|  |  | A semi-solid lubricant obtained by combining lubricating oil with thickening agent is termed as "Grease".  greases are made by saponification of fat with alkali (like Caustic hot soda) followed by adding lubricating oils with constant mixing. Consistency of the finished grease is governed by the total amount of the mineral oil  Classification of Greases-   * Soda-based greases * Lithium-based greases * Calcium-based greases * Axle greases |
| 3 |  | Give terms :- |
|  | A | Cloud and pour point. |
|  |  | Cloud point is the minimum temperature at which the first crystal formation starts.  Pour point is the minimum temperature below which a liquid loses its flow characteristics. |
|  | B | Flash and Fire point |
|  |  | The flash point of an oil is the lowest temperature at which it gives off vapours that will ignite  for a moment when a small flame is brought near it.  The fire point of an oil is the lowest temperature at which the vapours of the oil burn continuously for at least 5 seconds when a small flame is brought near it. |
|  | C | Aniline point |
|  |  | The aniline point of an oil is defined as the minimum temperature at which equal volumes of aniline (C6H5NH2 ) and lubricant oil are miscible, i.e. form a single phase upon mixing.. |
| 4 |  | Explain the terms Refractories and its classification. |
|  |  | A substance that is difficult to fuse is called a refractory. It is a material which does not melt easily and its fusion temperature is very high.  They are used in industries like glass, ceramic, oil-refining, power generation and cement.  The main role of a refractory is to confine heat in it.  Classification  1. On the basis of fusion temperature  (a) Normal refractories:-They have fusion temperature in the range of  1580-1780 degree Celsius.  Eg:- fire clay  (b) High refractories:- They have fusion temperature in the range of  1780-2000 degree Celsius.  Eg:- chromite  (c) Super refractories:- They have fusion temperature in the range of  about 2000 degree Celsius.  Eg:- zircon  2. Based on Chemical Composition   1. Acidic refractories- They consists of acidic materials like alumina and silica. 2. Basic refractories - They consist of basic materials like CaO, MgO etc. 3. Neutral refractories -They are made from weakly basic or acidic materials like carbon, zirconia and chromite   3. Based on Oxide Content  (a) Single oxide refractories  (b) Mixed oxide refractories  (c) Non oxide refractories |
| 5 |  | Explain the process of setting and hardness of cement. |
|  |  | Cement when mixed with water forms a plastic mass called cement paste. During hydration reaction, gel and crystalline products are formed. The inter-locking of the crystals binds the inert particles of the aggregates into a compact rock like material.  This process of solidification comprises of  (i) setting and then  (ii) hardening  Setting is defined as stiffening of the original plastic mass due to initial gel formation. Hardening is development of strength, due to crystallization.  Due to the gradual progress of crystallization in the interior mass of cement, hardening starts after setting. The strength developed by cement paste at any time depends upon the amount of gel formed and the extent of crystallization. The setting and hardening of cement is due to the formation of inter locking crystals reinforced by rigid gels formed by the hydration and hydrolysis of the constitutional compounds.  Reactions involved in setting and hardening of cement:- When cement is mixed with water, the paste becomes rigid within a short time which is known as initial setting. This is due to the hydration of tricalcium aluminates and gel formation of tetra calcium alumina ferrite.  enter image description here  Dicalcium silicate also hydrolyses to tobermonite gel which contributes to initial setting.  enter image description here  Final setting and hardening of cement paste is due to the formation of tobermonite gel and crystallization of calcium hydroxide and hydrated tricalcium aluminate.  enter image description here  During setting and hardening of cement, some amount of heat is liberated due to hydration and hydrolysis reactions. The quantity of heat evolved during Complete hydration of cement is 500 KJ/Kg.  **Function of gypsum in cement :-**  Tri calcium aluminate (C3A) combines with water very rapidly.  enter image description here  After the initial setting, the paste becomes soft and the added gypsum retards the dissolution of C3A by forming insoluble calcium sulpho aluminate. |
| 6 |  | Explain the process of manufacturing of cement. |
|  |  | Cement manufacturing process involves various raw materials and processes. Cement is a greenish grey coloured powder, made of calcined mixtures of clay and limestone. When mixed with water becomes a hard and strong building material.  **Manufacturing Process of Cement**  There are four stages in this whole process. • Mixing of raw material • Burning • Grinding  **Mixing of raw material**  Calcium, Silicon, Iron and Aluminium are the raw materials used majorly in manufacture of cement. There are two methods of mixing. Dry Process and Wet Process.   * **Dry Process:**The both calcareous and argillaceous raw materials are firstly crushed in the gyratory crushers to get 2-5cm size pieces separately. The crushed materials are again grinded to get fine particles into ball or tube mill. After screening this finely grinded materials are stored in hopper. Then powdered minerals are mixed and dry raw mix is stored in silos and ready to be sent into rotary kiln. * **Wet Process :**In this process first raw materials are crushed and made into powdered form and stored in silos. Then clay is washed and sticky organic matters are removed. Then powdered limestone and water washed clay are sent to flow in the channels and transfer to grinding mills where they are completely mixed and the paste is formed. Then grinding process is done in a ball or tube mill or even both. Then the slurry is led into collecting basin where composition can be adjusted. The slurry contains around 38-40% water that is stored in storage tanks and kept ready for the rotary kiln.   **Burning of Raw Materials** This process is carried out in rotary kiln while the raw materials are rotated at 1-2rpm at its longitudinal axis. The raw mix of dry process of corrected slurry of wet process is injected into the kiln from the upper end. Powdered coal or oil or hot gases are used to be heated up from the lower end of the kiln so that the long hot flames is produced. The lower part (clinkering zone) have temperature in between 1500-1700 degree Celsius where lime and clay are reacts to yielding calcium aluminates and calcium silicates. This aluminates and silicates of calcium fuse to gather to form small and hard stones are known as clinkers. The size of the clinker is varies from 5-10mm. The clinker coming from the burning zone are very hot. To bring down the temperature of clinkers, air is admitted in counter current direction at the base of the rotary kiln. The cooled clinkers are collected in small trolleys.  **Grinding of clinkers** The cooled clinkers are received from the cooling pans and sent into mills. The clinkers are grinded finely into powder in ball mill or tube mill. Powdered gypsum is added around 2-3% as retarding agent during final grinding. The final obtained product is cement that does not settle quickly when comes in contact with water. After the initial setting time of the cement, the cement becomes stiff and the gypsum retards the dissolution of tri-calcium aluminates by forming tricalciumsulfoaluminate which is insoluble and prevents too early further reactions of setting and hardening. |
| 7 |  | All numericals solve in viscosity. |
|  |  |  |
| 8 |  | Important functions of lubricants |
|  |  | **Function of lubrication:**  a) Reducing frictional effect: the primary purpose of the lubrication is to reduce friction and wear between two rubbing surfaces. Two rubbing surfaces always produce friction. This continuous friction produce heat which causes wearing of parts and loss of power. In order to avoid friction, the contact of two sliding surfaces must be reduced as far as possible. This can be done by proper lubrication only. Lubrication forms an oil film between two moving surfaces. Lubrication also reduces noise produced by the movement of two metals surfaces over each other.  b) Cooling effect: the heat, generated by piston, cylinder, and bearing is removed by lubrication to a great extent. Lubrication creates cooling effect on the engine parts.  c) Sealing effect: the lubricant enters into the gap between the cylinder liner, piston and piston rings thus; it prevents leakage of gases from engine cylinder.  d) Cleaning effect: lubrication keeps the engine clean by removing dirt or carbon from inside of the engine with the oil. |
| UNIT-5 | | |
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| 1 |  | Give different types of electronic excitation |
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| 2 |  | Explain in brief I.R. spectroscopy. |
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| 3 |  | Explain in brief U.V. spectroscopy |
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| 4 |  | Define:- |
|  | A | Hypsochromic |
|  |  |  |
|  | B | Hypochromic |
|  |  |  |
|  | C | Bathochromic |
|  |  |  |
|  | D | Hyperchromic |
|  |  |  |
| 5 |  | Explain the terms:- |
|  | A | Chromofor |
|  |  |  |
|  | B | Auxochromic |
|  |  |  |
| 6 |  | Classification of electronic transition of UV spectroscopy and give its applications. |
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| 7 |  | Explain the principle , instrumentation and application of IR spectroscopy |
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