Leaving Cert Chemistry Definitions (Higher Level)

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Absorption spectrum

A spectrum of electromagnetic radiation transmitted through a substance, showing dark lines or bands due to absorption at

specific wavelengths.

Acid (according to Arrhenius theory)

A substance which dissociates in water to provide H^+ ions

Acid (according to Bronsted-Lowry theory)

A proton donor

Acid-base indicator

Acid – Base indicators (also known as pH indicators) are substances which change colour with pH

Activation energy (E_{ACT})

The minimum amount of energy which colliding molecules must have before they can react together

Addition polymer

A polymer made by the combining together of small unsaturated molecules of the same compound.

Addition reaction

A reaction in which the double or triple bond of an unsaturated compound opens up and other atoms add on to the molecule. Addition reactions are characteristic of the alkenes and alkynes.

Alcohols

In chemistry, an alcohol is any organic compound in which the –OH (hydroxyl group) is bound to a saturated carbon atom

Aldehydes

An organic compound containing a functional group with the structure –CHO (carbonyl group)

Aliphatic hydrocarbon

Compound whose molecules contain only chains of carbon atoms.

Alkali Metals

The elements of Group 1 of the Periodic Table.

Alkanes

Hydrocarbons in which there are only single bonds between carbon atoms.

Alkenes

Hydrocarbons in which there is a double bond between two carbon atoms.

Alkynes

Hydrocarbons in which there is a triple bond between two carbon atoms.

Allotropes

Allotropes are different physical forms of the same element (and are due to different arrangements of the atoms of the element). The allotropes of carbon are diamond, graphite and charcoal.

Alloy

A mixture of metals

Alpha particle

A high speed, positively charged helium nucleus

Amphoteric substance

A substance which shows both acidic and basic properties (i.e.,

it can react with both alkalis and acids).

Anion

The ion which is attracted to the anode.

Anode

The positive electrode in electrolysis.

Anodising

A process in which the normal thin layer of oxide on the surface of aluminium is artificially thickened to give it added protection from corrosion. It is done by making aluminium the anode in an electrolysis cell in which dilute sulphuric is electrolysed.

Aromatic compound

Compounds whose molecules contain a 6-membered ring of carbon atoms.

Atom

The smallest particle of a chemical element that can exist

Atomic number

The number of protons that is characteristic of an element

Atomic orbital

A region in space where there is a high probability of finding an electron

Atomic radius

Half the distance between the nuclei of atoms of that element when bonded together by a single covalent bond

Aufbau principle

Electrons occupy the lowest available energy level.

Auto-ignition

The explosion of the petrol-air mixture in the engine before the spark is produced.

Autocatalysis

The catalysis of a reaction by one of the products of that reaction.

Avogadro constant

The number of particles in a mole of a substance – 6×10^{23}

Avogadro's law

states that equal volumes of gases under the same conditions of temperature and pressure contain equal numbers of molecules

Balmer Series

Visible line spectrum of Hydrogen

Base (according to Arrhenius theory)

A substance which dissociates in water to produce OH^- ions

Base (according to Bronsted-Lowry theory)

A proton acceptor

Base hydrolysis of esters (saponification)

A soap is prepared by the alkaline hydrolysis of an animal fat such as lard and vegetable fats.

Beta particle

A high speed electron emitted from the nucleus of an unstable atom

Biochemical oxygen demand (BOD)

A measure of the amount of organic pollution in water. It is defined as the amount of dissolved oxygen consumed by biochemical action, when a sample of water is kept in the dark at 20° C for 5 days.

Bond energy

The average amount of energy required to break one mole of bonds of the same type with all reactants being in the gaseous state.

Boyle's law

For a fixed mass of gas is kept at constant temperature, the volume is inversely proportional to the pressure.

Carbonium ion

Unstable positive carbon intermediate

Carboxylic acid

an organic compound that contains a carboxyl group (-COOH)

Catalyst

A substance that alters the rate of a chemical reaction but which is not used up during the reaction, and which is chemically unchanged at the end of it.

Catalyst poison

A substance which destroys the activity of a catalyst.

Catalytic converter

Change poisonous molecules like carbon monoxide and nitrogen oxides in car exhausts into less harmful molecules such as CO2 and Nitrogen.

Catalytic cracking

is the breaking down of long-chain hydrocarbon molecules into short-chain molecules for which there is a greater demand, using heat and catalysts.

Cathode

The negative electrode in electrolysis

Cation

The ion which is attracted to the cathode.

Charles's law

For a fixed mass of gas kept at constant pressure, the volume is directly proportional to the absolute temperature.

Chemical equilibrium (dynamic)

A system is said to be in chemical equilibrium when the rate of forward reaction is equal to the rate of reverse reaction

Chlorofluorocarbons (CFCs)

Ozone is damaged by chlorofluorocarbons (CFCs) in the atmosphere. In the stratosphere the CFCs break down and release chlorine free radicals which attack ozone.

Chromatography

a separation technique in which a mobile phase carrying a

mixture is caused to move in contact with a selectively absorbent stationary phase and this separates the components of the mixture.

Compound

a substance that is made up of two or more elements combined together chemically.

Conjugate acid

A base which has accepted a proton

Conjugate base

An acid which has donated a proton

Conjugate acid-base pair

Two substances that differ from each other by a H^+ (a single proton).

Co-product

Co-products are any substances formed alongside the main product being manufactured.

Covalent bond

involves the sharing of pairs of electrons to achieve a full outer shell.

Dehydration

An elimination reaction where an alcohol is converted to an alkene

Dehydrocyclisation

involves the use of catalysts to convert straight-chained alkanes

into cyclic compounds.

Deionised water

Contains no ions but may contain soluble covalent compounds such as sucrose, bacteria, ethanol, oxygen.

Dibasic acid

A molecule that dissociates in solution to produce two H^+ ions, e.g. H2SO4

Diffusion

The spontaneous spreading out of a substance due to the natural movement of its particles

Dipole-dipole force

Occurs when a permanently polarised molecule attracts another permanently polarised molecule. The positive end of a polarised molecule attracts the negative end of another polarised molecule.

Dissociation constant (k_a)

a specific type of equilibrium constant that measures the propensity of a larger object to separate (dissociate) reversibly into smaller components

Distilled water

completely pure as all dissolved and suspended solids have been removed as well as dissolved gases

Electrochemical series

A list of elements in decreasing order of ease with which they lose electrons.

Electrolysis

The process in which an electrolyte is decomposed by passing a current through it.

Electrolyte

A compound which in liquid state conducts electricity and is decomposed in doing so.

Electroplating

The process of covering one metal (usually a cheap and/or plentiful one) with a thin layer of a more expensive one, to provide protection and/or better appearance.

Electronegativity

A measure of the attraction of an atom of an element for the shared pair of electrons in a covalent bond.

Element

A substance that cannot be chemically broken down further

Elimination reaction

Occurs when a small molecule, such as H_2O or HCl, is removed from a molecule, resulting in the formation of a double bond.

Emission spectrum

When this light is passed through a prism or diffraction grating, the resulting spectrum is called an emission spectrum.

Empirical formula

The formula of a compound that shows only the ratio in which

the different types of atom are present in the molecule.

Endothermic reaction

A reaction in which heat is taken in or “used up”.

Energy level

A measure of the amount of energy possessed by an electron when it is in an atom.

Energy sub-level

Within a main energy level, sublevels are arranged from lowest to highest energy, i.e. s<p<d<f

Enzyme

A biological catalyst e.g. amylase

Equation of state for an ideal gas

$pV = nRT$, where p is the pressure (in pascals (Pa)), V is the volume (in m^3), n is the number of moles, R is the general gas constant, T is the temperature (in kelvins).

Equilibrium constant (k_c)

For a reversible system, a constant that tells how far the reaction has gone to the right-hand side, by the time equilibrium has been established. For the system: $A + B \rightleftharpoons C$, the equilibrium constant is given by: $K_c=$

Esterification

A reaction in which an acid and alcohol react together, to form an ester and water.

Eutrophication

The enrichment of natural waters by nutrients (nitrates and phosphates in particular); it causes the very rapid growth of algae which, when they die and decay, consume large amounts of oxygen. The water is then depleted of oxygen, and fish and aquatic life die.

Excited state

The state of an atom when one or more of its electrons have been promoted to higher energy levels.

Exothermic reaction

A reaction in which heat is liberated.

Fermentation

the chemical breakdown of a substance by bacteria, yeasts, or other microorganisms, typically involving effervescence and the giving off of heat.

First ionisation energy

The first ionisation energy is the energy required to remove one mole of the most loosely held electrons from one mole of gaseous atoms

Flocculation

The process in which small particles in water are made to coagulate (clump together) and form a precipitate. It is done by adding a FLOCCULATING AGENT such as aluminium sulphate or iron (III) sulphate.

Fluoridation

Addition of fluorine to drinking water.

Fractional distillation

The process in which a mixture of liquids is separated into components or fractions of different boiling points (or different boiling points ranges).

Free chlorine

Free chlorine refers to both hypochlorous acid (HOCl) and the hypochlorite (OCl-) ion or bleach, and is commonly added to water systems for disinfection

Free radical

A free radical is any atom or molecule that has a single unpaired electron in an outer shell.

Functional group

A group of atoms on which the characteristic properties of a particular compound depend.

Gamma radiation

Electromagnetic radiation with no charge and high penetrating power. Nucleus is unchanged

Gay Lussac's law of combining volumes

In a reaction between gases, the volumes of the reacting gases and the volumes of the products, if gaseous, are in the ratio of small whole numbers (at the same temperature and pressure).

Ground state

The state of an atom when all of its electrons are in their lowest available energy levels.

Half-life

The time taken for half of the undecayed atoms in a radioactive sample to decay

Hard water

Hard water is water which will not readily form lather with soap due to the presence of dissolved calcium or magnesium salts in the water.

Heat of combustion

The heat change which occurs when one mole of a substance is burnt in an excess of oxygen.

Heat of formation

The heat change which occurs when one mole of a compound is formed from its elements in their standard states.

Heat of reaction

The heat change which occurs when a reaction takes place according to a given chemical equation.

Heat of neutralisation

The heat change that occurs when one mole of H^+ ions from an acid reacts with one mole of OH^- ions from an alkali.

Heisenberg's uncertainty principle

It is not possible to ascertain both the position and the momentum of an electron in an atom simultaneously.

Hess' law

The heat change for a given reaction depends only on the initial and the final states of the system, and is independent of the path followed.

Heterogeneous catalysis

A system in which there is a distinct boundary between the catalyst and the reactants.

Heterolytic Fission

The breaking of a covalent bond so that one atom retains the two shared electrons and the other atom retains none. Ions are thus formed.

Hoffman Voltameter

A vessel fitted with electrodes in which electrolysis takes place

Homogenous catalysis

A system by which both the catalyst and the reactants are in the same phase or state.

Homologous series

A series of compounds, all members of which contain the same functional group, and successive members differ by CH_2.

Homolytic Fission

The breaking of a covalent bond so that each atom retains one of the shared electrons, forming two free radicals (or free atoms).

Hund's rule

When two or more orbitals of equal energy are available to electrons, the electrons occupy them single before filling them in pairs.

Hydrated

Addition of H_2O to a molecule e.g. addition of H_2O to ethane to produce ethanol

Hydrocarbon

An organic compound consisting of hydrogen and carbon only

Hydrogen bond

The electrical attraction between the slightly positive hydrogen atoms of one molecule and slightly negative atoms in another molecule.

Hydrolysis

The decomposition of a compound by means of water (or the OH^- ion), the water also being decomposed in the reaction.

Ideal gas

One that obeys the gas laws at all temperatures and pressures. In reality no such gas exists.

Indicator

A substance, which by means of a colour change, indicates the presence of another substance.

Intermolecular force

The force of attraction between a molecule and a neighbouring molecule

Intramolecular force

The forces of attraction which hold an individual molecule together, e.g. ionic and covalent bonding.

Instantaneous rate of reaction

The rate of change in concentration of a reactant or product at a particular time

Ion

An atom or group of atoms which has either lost or gained electrons and has therefore become either positively or negatively charged.

Ionic bond

The electrical attraction between the oppositely charged ions which are produced when electrons are transferred from one atom to another.

Ionic product of water (k_w)

The product of the H^+ and the OH^- concentrations in water (and all aqueous solutions), or, $K_w = [H^+] [OH^-]$.

Isomerisation

The first ionisation energy of an element is the minimum energy required to completely remove the most loosely-bound electron from an isolated atom of the element.

Isotope

Atoms of the same element but which differ in the numbers of neutrons in their nuclei (or, have different mass numbers).

Kilogram calorific value

The quantity of heat liberated when 1 kg of a fuel is completely burnt.

Law of conservation of energy

This states that energy can neither be created nor destroyed.

Law of octaves

If the chemical elements are arranged according to increasing atomic weight, those with similar physical and chemical properties occur after each interval of seven elements

Le Chatelier's principle

If a system in equilibrium is subjected to a stress, then the system will alter so as to oppose the effect of the stress.

Limiting reagent

The reactant not present in excess

Line spectrum

An emission spectrum consisting of separate isolated lines of definite wavelengths

Lone pair

Pair of electrons in the outer shell of an atom not involved in bonding.

Lyman Series

Invisible emission spectrum of Hydrogen – ultraviolet region

Mass number

The number of proton and neutrons in the atom of an element

Mechanism

The step by step process of how the reaction occurs.

Metal

An element that ionises to give positive ions.

Metal Ore

A mineral that contains a compound of the metal and from which the metal is extracted.

Molarity (molar concentration)

The concentration of a solution in moles per litre.

Molar mass

The mass per mole of a substance

Molar volume at s.t.p.

The volume occupied by one mole of the gas. It is equal to 22.4 litres at s.t.p. and about 24 litres at room temperature.

Mole

That amount of a substance which contains the Avogadro Constant number of particles.

Molecular formula

The molecular formula of a compound indicates the number of atoms of each kind in the molecule.

Molecule

Two or more atoms chemically combined

Monobasic acid

A molecule that dissociates in solution to produce one H^+ ion, e.g. HCl

Neutralisation

The reaction between an acid and a base to form a salt and water

Non-polar covalent bond

When both atoms involved in bonding have equal share of the electron bond pair

Nuclear reaction

A reaction that occurs within the nucleus of an atom

Octane number

The percentage of iso-octane in an iso-octane/heptane mixture that gives the same engine performance of the fuel.

Octet rule

This states that when atoms bond together, they attain the stable structure of having eight electrons in the outer shell of their atoms. However, the Octet Rule is nothing more than just a guide and there are many exceptions to it.

Orbital

The region in space around the nucleus of an atom in which the electrons are most likely to be found.

Oxidation (two definitions)

Loss of electrons, increase in oxidation number

Oxidation number

The charge which an atom of the element has, or appears to have, in a compound.

Oxidising agent

A substance that causes oxidation. The oxidising agent takes the electrons and is therefore reduced in the process (since it

gains the electrons).

Oxygenate

A fuel that has a very high octane number because of the presence of some oxygen in it.

Paschen Series

Invisible line spectrum of Hydrogen – infrared region

Pauli exclusion principle

No more than two electrons can occupy an orbital, and this they can only do if they have opposite spin.

Permanent hardness

The type of hardness which cannot be removed by boiling the water; it is caused by dissolved sulphates. Sulphates are unaffected by heat.

Peroxide

An oxide in which contains two oxygen atoms joined to each other.

pH

Minus the log (to the base 10) of the H^+ concentration, or, pH = -log10 $[H^+]$. pH is thus a measure of the acidity or alkalinity of a solution.

pOH

Minus the log10 of the OH^- concentration. The sum of the pH and the pOH of any aqueous solution is 14.

Pi bond (π)

A covalent bond made by the sideways overlapping of two p orbitals. The second bond in a double bond is a pi bond.

Plastic

A material which can be softened and moulded by heat and pressure.

Plum pudding model

The atom consisted of a positive sphere with a negative particles embedded within it

Polar covalent bond

A covalent bond in which the shared pair of electrons is attracted more to one or the joined atoms than to the other (e.g., H-Cl and O-H bonds).

Polymer

A substance formed by the combining together of large numbers of small molecules.

Polymerisation

A process in which many small and simple molecules (called monomers) join together to form a much larger molecule, called a polymer.

Primary sewage treatment

Screening and Settling

Primary standard

A substance that is available in a stable and pure enough state to be made up directly into a standard solution.

Principle quantum number

A number that indicates the main energy level, or shell number, of an electron in an atom.

Radioactivity

The spontaneous breaking up of an unstable nucleus with the release of energy.

Radioisotope

A radioactive isotope

Rate of reaction

The change in the amount (or of the concentration) of reactant (or product) per unit time.

Recrystallisation

A process used to purify substances. The impure substance is dissolved in a suitable solvent, the solution filtered and allowed to crystallise.

Reducing agent

A substance that causes reduction. The reducing agent supplies the electrons and is therefore oxidised in the process (since it loses the electrons).

Reduction (two definitions)

Gain of electrons. Decrease in oxidation number

Reflux

Technique involving the condensation of vapours and the return of this condensate to the system from which it originated.

Relative atomic mass (Ar)

The mass of an atom of that element compared with one twelfth of the mass of the carbon-12 isotope.

Relative molecular mass (Mr)

The mass of a molecule of that substance compared with one twelfth of the mass of the carbon-12 isotope.

Reversible reaction

A reaction that can go in either direction (i.e., from left to right, or from right to left).

Salt

The substance formed when the hydrogen of an acid is replaced by a metal.

Saponification

A hydrolysis of an ester carried out in the presence of alkali. (Saponification of natural fats and oils yields soaps and glycerol.)

Saturated compound

Compounds which contain only single bonds between atoms. The alkanes are saturated hydrocarbons.

Secondary sewage treatment

Physical phase separation to remove settleable solids and a biological process to remove dissolved and suspended organic compounds.

Sedimentation

The process of settling or being deposited as a sediment.

Sigma bond (σ)

A covalent bond made by the end-on overlapping of two p orbitals. A single covalent bond is a sigma bond.

Solvent extraction

the partial removal of a substance from a solution or mixture by dissolving it in another, immiscible solvent in which it is more soluble.

Standard solution

A solution whose concentration is accurately known

Standard temperature and pressure (s.t.p.)

273 K or 0°C and 101 kPa (101×10^3 Pa).

Steam distillation

distillation of a liquid in a current of steam, used especially to purify liquids that are not very volatile and are immiscible with water.

Steam reforming

A reaction used for the manufacture of hydrogen, by reacting steam with natural gas at high temperature.

Strong acid

An acid that is fully dissociated in solution

Strong base

A base that is fully dissociated in solution

Structural formula

The formula of a compound showing the way in which the

atoms are arranged in the molecule.

Structural isomers (isomers)

Compounds with the same molecular formula but different structural formula

Substitution reaction

A reaction in which an atom or group of atoms in a molecule is replaced by other atoms or groups of atoms. Substitution reactions are characteristic of the alkanes.

Temporary hardness

The type of hardness which can be removed by boiling the water; it is caused by dissolved hydrogencarbonates. These salts are decomposed on being heated

Tertiary sewage treatment

This involves the reduction of phosphate and nitrate levels

Transition element

One whose atoms have an incomplete d orbital.

Triad

a group of three elements with similar chemical properties in which the relative atomic mass of the middle element is approximately equal to the average of the other two. E.g. chlorine, bromine, iodine.

Unsaturated compound

Compounds which contain one or more double or triple bond between carbon atoms. The alkenes and alkynes are unsaturated.

Valency

The number of electrons which an atom of an element must either gain or lose to attain a noble gas structure.

Van der Waals' force

Temporary dipoles caused by the random movement of electrons, i.e. the 'sloshing around' of electrons within a molecule.

Volatile liquid

Liquids with low boiling points e.g. propanone

Water of crystallisation

water molecules forming an essential part of the crystal structure of some compounds.

Weak acid

An acid that is only slightly dissociated in solution.

Weak base

A base that is only slightly dissociated in solution.

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