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Updated to 2016-18 Syllabus

CIEVIEW Fage EVEL CHENNESTRY 9701

SUMMARIZED NOTES ON THE SYLLABUS

CIE AS LEVEL- CHEMISTRY [9701]

• Fullerenes:



4.5 Ceramics

- Ceramic: an inorganic non-metallic solid prepared by heating one or a mixture of substance(s) to a high temp.
- Most ceramic are giant molecular structures
- Properties of ceramics:
- ○High m.p./b.p. and hard stronger valent bonds
- Don't conduct electricity/hetr-no mobile ions of
- \circ Chemically threactive e⁻s held in corporations

4.6 Recycling

- Finite resource: resource which doesn't get replaced at the same rate that it is used up.
- Examples of finite resources: copper, aluminium, glass
- Advantage of Recycling: O Saves energy O Reduces environmental issues O Conserves ore supplies O Less wastage O Cheaper than extracting

5. CHEMICAL ENERGETICS

5.1 Energy Change in Reactions

Exothermic Reactions	Endothermic Reactions
 Energy given out 	 Energy taken in
 Surrounding warmer 	 Surrounding cooler
 Bond making 	 Bond breaking
• ΔH negative	 ΔH positive
$E_{Reactants} > E_{Products}$	$E_{Reactants} < E_{Products}$



5.2 Enthalpy Change Definitions

 \circ Solution Conc.: 1mol dm⁻³



5.3 Bond Energy

- Energy needed to break a specific covalent bond
- Also how much energy is released when a bond forms

$\frac{5.4 \ Calculating \ Enthalpy \ Changes}{\Delta H = -mc\Delta T}$

- When substance dissolved in water use c & m of water
- ΔT is change in temp.: add –ve or +ve to show rise/fall

<u>5.5 Hess's Law</u>

• The total enthalpy change in a chemical reaction is independent of the route by which the chemical reaction takes place as long as the initial and final conditions are the same.

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<u>13.3 Types of Formulae</u>

Hexane	
Displayed Formula	Structural Formula
H H H H H H	CH ₃ -CH ₂ CH ₂ CH ₂ CH ₂ -CH ₃ or CH ₃ (CH ₂) ₄ CH ₃
Skeletal Formula	Molecular Formula
	C ₆ H ₁₄

<u>13.4 Nomenclature</u>

- Select longest chain as the main chain
- Other carbon chains as substituent alkyl groups
- Give lowest number C in main chain to substituent
- If different alkyl groups present on identical position, give simpler alkyl smaller number
- Two or more alkyl groups present, order alphabetically
- If same substituent repeated use di, tri, tetra prefix
- If ring of carbon present, use prefix cyclo
- Write position of double bond in alkene e.g. but-1-ene

<u>13.5 Breaking of Covalent Bonds</u>

Homolytic Fission:

- Two atoms sharing e⁻ pair of similar electro-tivity
- When bond breaks, each at bot takes one e⁻ from re- o electrons for sing free radicals
- Free radicals: electrically neutral atoms or group of atoms with unpaired electrons → very reactive
- Free radical reaction catalysed by heat or light

Heterolytic Fission:

- Two atoms sharing e⁻ pair are of different electro-tivity
- When bond breaks, one of the bonded atoms takes both bonding es
- Results in formation of +ve and –ve ions
- If +ve charge on C, its called carbocation or carbonium
- If -ve charge on C, its called carbanion

<u>Note</u>: homolytic fission require less energy than heterolytic

<u>13.6 Types of Reagents</u>

Nucleophilic reagent (nucleophile): donator of pair of e⁻

- Must have lone pair of es
- Attack centre of +ve charge (positive pole)
- Reaction with nucleophile called nucleophilic reactions
- Examples: CH⁻, Cl⁻, NH₃, H₂O, CN⁻

Electrophilic reagent (electrophile): acceptor of pair of e

- +ve ions or e⁻ deficient molecules
- Attack regions of high e⁻ density
- Examples: Br⁺, CH₃⁺, AlCl₃

<u>13.7 Types of Reaction</u>

- Addition reaction: single product formed
- Electrophilic addition (alkenes)
- Nucleophilic addition (carbonyl compounds)
- Substitution reaction: two products formed
- Nucleophilic substitution (halogenoalkanes)
- o Free radical substitution (alkanes)
- Elimination reaction: more than one product formed, small molecule removed from reactant (alcohols and halogenoalkanes)
- Hydrolysis reaction: breaking down of molecule by water, sped up by acid or alkali (esters and alkenes)

13.8 Oxidation and Reduction

- Oxidation: addition of oxygen or removal of hydrogen
- Reduction: a cition of hydrogen or removal of oxygen

3.9 Shapes of Ethane and Ethene





<u>13.10 Isomerism</u>

• Existence of two or more compounds with the same molecular formula but different structural formula



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Cl → Cl

• Initiation:

- Energy of a photon of light absorbed
- $\circ Cl Cl$ bond breaks homolytically
- Propagation:
- $\circ\,$ Highly reactive $Cl\cdot$ collides with a CH_4 molecule forming a new free radical; $CH_3\cdot$
- $CH_4 + Cl \rightarrow CH_3 + HCl \qquad \qquad CH_3 + Cl_2 \rightarrow CH_3Cl + Cl + Cl_2$
- $\circ\,$ This can then react with another Cl_2 and process repeats if sufficient Cl_2 present until all H are replaced

• Termination:

- Reaction ends when 2 free radicals collide & combine $CH_3 \cdot +Cl \rightarrow CH_3Cl$ $CH_3 \cdot +CH_3 \rightarrow C_2H_6$
- Products: forms large amounts of CH₃Cl and HCl and small amount C₂H₆; separated by fractional distillation
- Products and free radicals differ due to:
- Halogen used: bromine requires more light
- Alkane used: ↑ no. of C = ↑ variety of products

<u>14.4 Cracking</u>

- Breaking of large less useful alkanes into useful, more energy value smaller products using heat & catalyst
- Products: smaller alkanes and alkenes or smaller alkenes and hydrogen as smaller alkenes
- Thermal cracking: high temp, & ore sur
- Catalytic cracking: high tyme & cataly

14.5 Hydrocarbons as Fuels

- Source of alkanes: crude oil
- Steady change in b.p. of alkanes allows crude oil to be separated by fractional distillation
- Catalytic conversion of CO and NO_x:
- 2NO₂ + 4CO → N₂ + 4CO₂
- \circ 2NO + 2CO → N₂ + 2CO₂

<u>14.6 Alkenes</u>

- Unsaturated hydrocarbons
- Contain at least one C<mark>=</mark>C double bond
- General formula: C_nH_{2n} (like cycloalkanes)
- Source of alkenes:
- Cracking alkanes
- Dehydration of alcohols
- More reactive than alkanes due to presence of double bond; pi electrons loose ly and more susceptible to attacks by e⁻ deficient groups like electrophiles
- Alkenes combust completely \rightarrow carbon dioxide + water
- Give energy but not used as fuels; have other uses

14.7 Electrophilic Addition Mechanism



- Electrophile forms by heterolytic fission
- Electrophile attacks double bond
- Pair of esciption from double bond migrate to electrophile and π bond breaks
- Carbocation formed which attacks the nucleophile

14.8 Carbocations



- **Valor Mikov's principle:** an electrophile adds to an unsymmetry with the most stable
- carbo cition is formed as an intermediate
- Hydrogen binds to carbon with more hydrogens
- Inductive effect of alkyl groups:
 - Alkyl groups donate e⁻ to the ring
 - Producing a positive inductive effect
 - A larger alkyl group has a weaker inductive effect

14.9 Addition Reactions

	Alkene + H ₂ \rightarrow Alkane	
u	• Reagent: H _{2(g)}	
nati	Condition:	
ger	 Catalyst: Nickel 	
dro	o Temp.: <mark>100°C</mark>	
Н	○ Press.: <mark>2 atm</mark> .	
	• Use: convert liquid oils to saturated solid fats	
ation	Alkene + X₂ → Dihaloalkane	
gen	 Reagent: Halogen_(aq) 	
Halo	 Condition: r.t.p./dark 	
Hydro- alogenation	Alkene + Hydrohalogen → Halogenoalkane • Reagent: Hydrohalogen _(g) • Condition: r.t.p.	