This Summary is yet to Finalized!

VCE Chemistry Unit 2 – Chemistry in Everyday Life

Atoms of isotopes of an element have the same number of protons but differing numbers of neutrons

Specific Heat Capacity

Amount of energy needed to raise 1 gram of substance by 1°C.
Water SHC = **4.18J/g/°C**
Gases dissolving in water – When the temperature rises, less gas dissolves.
Solid dissolving in water – When the temperature rises, more solid dissolves.

Concentration

Concentration – How much solute you have in a certain amount of solution
Solute + Solvent → Solution
Eg. Concentrated cordial + water → Drink

g/L	**No.of grams of solute in 1 L of solution** Eg. 5g/L sugar solution 5g Sucrose in 1L solution
Ppm	Parts per million parts for very low concentration Eg. 8 ppm Hg in creek 8g Hg in 10^6g water (solution)
%w/w solute/solution	Percentage of weigh (gram) for weigh (gram)
%w/v	5% w/v NaCl Solar 5g Nacl in 100ml solution
%v/v	5% ethanol solar 5ml ethanol in 100ml solution
μg/g	10^{-6}g (solute)/g (solution)

Precipitation Reactions

Precipitation occurs when ions in solution combine to form a new compound of low solubility in water. This low-solubility compound forms as solid particles which eventually settle.
To determine if the reactions will form a precipitate or not, we need to:
Write the skeleton equation for the reactants.

1. Na2CO3 + CuSO4 →
2. **Look at the solubility table** to decide which of the ions are soluble. Sodium carbonate will be aqueous (since all group I ions are soluble) and copper(II) sulfate will also be aqueous (since most sulfates form soluble compounds). A double replacement reaction involves 'swapping' cations, so that sodium sulfate and copper (II) carbonate will form.

3. Sodium sulfate will be aqueous, whereas copper (II) carbonate is an insoluble compound.

4. Na_2CO_3(aq) + $CuSO_4$ (aq) → Na_2SO_4(aq) + $CuCO_3$(s) (Precipitates has formed)

Solubility in water of compounds of common ions

NAME OF ION	SYMBOL	SOLUBLE COMPOUNDS OF ION	INSOLUBLE COMPOUNDS OF ION
Group I ions	Li^+, Na^+, K^+, Rb^+, Cs^+, Fr^+	All	None
Ammonium	NH_4^+		
Hydrogen	H^+		
Nitrate	NO_3^-		
Nitrite	NO_2^-		
Chlorides	Cl^-	Most	Ag^+, Pb^{2+}, Hg^{2+} ($PbCl_2$ is moderately soluble in hot water.)
Bromides	Br^-		
Iodides	I^-		

Sulfates	SO_4^{2-}		Ba^{2+}, Pb^{2+} (Ag_2SO_4 and $CaSO_4$ are slightly soluble)
Carbonates	CO_3^{2-}	Na^+, K^+, NH_4^+	Most
Phosphates	PO_4^{3-}		
Sulfides	S2$^-$	Na^+, K^+	Most (MgS, CaS, BaS, Al_2S_3 and Fe_2S_3 decompose in water)
Hydroxides	OH^-	Na^+, K^+, Ba^{2+}	Most ($Ca(OH)_2$ is slightly soluble)
Oxides	O2$^-$		

Stoichiometry
Concerned with calculations in reactions

Eg. Nitrogen gas + Hydrogen gas → ammonia
If 10g nitrogen reacts, what mass of hydrogen is needed?
If 10g nitrogen reacts, what mass of ammonia is needed?

1. **Need balanced equation**

   $N_2(g)$ + **3**$H_2(g)$ → **2**NH_3 (g)
   10g m? m?

2. **Calculate moles**

   N(N2) = m/M = 10/28

3. **Use the equation to calculate moles of required substance**

1 mole of nitrogen reacts with 3 moles of hydrogen
$n(H_2)$ = 3 X $n(H_2)$
= 3 X 10/28 X 2
= 60/28 = 2.14 g

Limiting Reagents

25g nitrogen and 5 g hydrogen are placed in a container and reaction occurs as much as possible. What mass of ammonia forms?

Dilution

n = CV
$C_1V_1 = C_2V_2$
Percentage yield = (actual yield / theoretical yield) X 100%

Properties of Acids	Properties of Base
Taste sour	Taste bitter
Corrosive	Corrosive
	Feel Slippery
Molecular in structure	
Turn litmus red	Turn litmus blue
HCl, HNO_3, H_2SO_4, H3O$^+$, H_3PO_4, HF, CH_3COOH, H_2CO_3	H^-, O^{2-}, OH^-, LiOH, NaOH, KOH, S^{2-}, CO3^{2-}, NH_3
[H3O$^+$] > [OH^-]	[H3O$^+$] < [OH^-]

Chemical reactions of Acid:
Acid + metal → Salt + Hydrogen gas
Acid + metal hydrogen carbonate → salt + carbon dioxide gas + water
Acid + metal hydrogen carbonate → salt + carbon dioxide gas + water
Acid + metal sulfite → salt + sulfur dioxide gas + water
Acid + metal sulfide → salt + hydrogen sulfide gas

Acid + metal oxide → salt + water
Acid + base → salt + water

- Alkalis are bases that dissolve in water (eg. Group I hydroxides)
- **Lowry-Bronsted theory:**
  - An acid is a proton donor
  - A base is a proton acceptor
  - Acid-base reaction involve a proton transfer (H^+)
- Ionisation occurs when an acid donates a proton to water
- Hydrolysis occurs when an anion reacts with water to produce OH^-, or a cation reacts with water to produce $H3O^+$
- When an ionic base dissolves in water it dissociates or separates into its constituent ions

ph = $-\log_{10}$ [H_3O+]
[H_3O+] = 10-ph

- A **conjugate** acid-base pair is formed when an acid reacts with a base
  - HCl (acid) Cl^- (Base)
- **Monoprotic** acids can donate one proton (eg. HCl)
- **Polyprotic** acids can donate more than one proton
  - **Diprotic** acids can donate two protons (H2SO4)
  - **Triprotic** acids can donate three protons
- **Amphiprotic** substances can act as acids or bases depending on their chemical environment (eg. H2O, HS^-, HSO_4^-)

<u>Titrations</u>

- In acid- base titrations, we can use stoichiometry to find the relative amounts of aicd or base required for neutralisation. The process involves:
  - An **aliquot** (known volume) of the solution of unknown concentration
  - A **standard solution** of known concentration with which the solution of unknown concentration is reacted.
  - A suitable indicator to ensure that the **end point** (where the solution changes colour), closely matches the **equivalence point** where chemically equivalent amounts of acid and base, according to the mole ratio of the equation, are present
  - A **titre** is the volume of standard solution delivered from the burette during the titration.

<u>Carbon Oxygen Cycle:</u>

- **Photosynthesis** – uses carbon dioxide from the atmosphere and produces oxygen gas
  - $6CO_{2\,(g)} + 6H_2O_{\,(l)} \rightarrow 6O_{2\,(g)} + C_6H_{12}O_{6\,(aq)}$
- **Respiration** – release the energy stored in carbohydrates in pants and animals
  - $C_6H_{12}O_{6\,(aq)} + 6O_{2\,(g)} \rightarrow 6CO_{2\,(g)} + 6H_2O_{\,(l)}$ + energy
- **Combustion** releases carbon dioxide into the atmosphere

<u>Atmospheric pollution</u>

- Chlorofluorocarbons (CFCs) – extremely destructive to the ozonosphere with the action of ultraviolet light, break up and attack the ozone molecules
- Carbon monoxide – produced from the incomplete combustion of carbon or hydrocarbons
- Sulfur dioxide – reaction with rainwater causing acid rain

- **Greenhouse effect** results from the increased levels of pollutant gases in the atmosphere, which cause more heat to be trapped by the atmosphere, leading to **global warming**.
- **Smog** is heavily polluted, moisture-laden fog. It can be a health hazard, and is more likely to occur when there is a temperature inversion.
  - **Photochemical smog** is caused by the action of sunlight on emissions of nitrogen oxides and hydrocarbons, produced mainly by car engines.

<u>Properties of Gases</u>

- Have low densities
- Fill a container completely and uniformly
- Are compressible
- Exert a uniform pressure on all inner surfaces of a container

- Diffuse easily

Kinetic molecular theory of gases

- Are moving constantly and at random
- Experience an increase in kinetic energy and move more quickly when temperature is increased
- Have insignificant attractive or repulsive forces between them
- Are very far apart and their volume is small compared to the volume they occupy
- Collide with one another and the walls of their container, exerting pressure

Pressure (Pascal – Pa)	760 mmHg = 1 atm = 101325 Pa = 101.3 kPa
Temperature	K = ºC + 273
Volume	1 m^3 = 10^3 L = 10^6 mL
Quantity	Moles

Combine Gas Law: (Boyle, Charles, Gay-Lussac)

$$\frac{P1V1}{T1} = \frac{P2V2}{T2}$$

Dalton's law of Partial Pressure

$P_{total} = P_1 + P_2 + P_3$

Stand Temperature and Pressure (STP)	**Standard Laboratory conditions (SLC)**
Temperature = 0ºC = 273 K	Temperature = 25ºC = 298K
Pressure = 1 atm	Pressure = 1 atm
nSTP = V / **22.4** (V in litres)	nSLC = V / **24.5** (V in litres)

General Gas Equation

$$PV = nRT$$

P in kPa, T in Kelvin, V in L, R = 8.31J/K/mol

- Ideal gases obey all the gases laws perfectly
- Real Gases show discrepancies at high pressures and low temperatures. Kinetic molecular theory does not apply.

Oxidation-reduction reactions are:
Electrons are transferred from the reductant to the oxidant
There is a change in oxidation number
Complementary processes

Oxidation	**Reduction**
Gain of oxygen	Loss of oxygen
Loss of hydrogen	Gain of hydrogen
Loss of electrons	Gain of electrons
An increase in oxidation number	A decrease in oxidation number

Oxidant	**Reductant**
A substance that accepts electrons	That donates electrons
Whose oxidation number increases	Whose oxidation number increases
Undergoes oxidation	Undergoes oxidation

Oxidation number – imaginary charge an tom
The oxidation number of an atom in its elemental form is zero
The oxidation number of a simple ion is the charge on the ion
The oxidation number of hydrogen is +1
The oxidation number of oxygen in a compound is usually –2
In a neutral compound the sum of all the oxidation numbers must equal zero
In a polyatomic ion the sum the oxidation numbers must equal the charge on the ion

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Determine Mass of Brick Cleaner:

- No. moles Sodium Carbonate

- Formula
- Mole of acid in Titre
- Mole of Acid in Volumetric Flask
- Mass of Acid in Flask
- Percentage

Burette	Brick Cleaner Solution
Pipette	Brick Cleaner Solution
Conical Flask	Water

<u>Primary Standard</u>

A control solution of concentration
Mass can be measured exactly and solution will not detoriate

- Pure
- Soluble in Water
- Very heavy molecule
- Large molar mass
- Stable