VCE Chemistry Unit 1 Revision Notes + Practice Questions

SECTION A THEMES (Multiple Choice)

1. Atomic Structure and Isotopes

Revision Dot Points

- Atomic number = number of protons
- Mass number = protons + neutrons
- Isotopes have same number of protons but different neutrons
- Neutral atoms have equal protons and electrons
- Electrons occupy shells, subshells and orbitals
- Maximum electrons:
    - s = 2
    - p = 6
    - d = 10
    - f = 14
- Ions form by gain/loss of electrons

Practice Questions

Q1 How many neutrons are in $^{35}_{17}Cl$?

A. 17
B. 18
C. 35
D. 52

Neutrons = mass number − atomic number = 35 − 17 = 18.

Q2 Which pair are isotopes?

A. Na and Mg
B. ^{12}C and ^{14}C
C. Cl and Cl^-
D. O and O^{2-}

Isotopes => same number of protons different number of neutrons. Eg same atomic number different mass number

Q3 Which electron configuration belongs to Mg^{2+}?

A. $1s^2 2s^2 2p^6 3s^2$
B. $1s^2 2s^2 2p^6$
C. $1s^2 2s^2 2p^6 3s^1$
D. $1s^2 2s^2 2p^5$

Mg^{2+} loses 2 electrons leaving $1s^2$, $2s^2$, $2p^6$

2. Periodic Table Trends

Revision Dot Points

- Atomic radius decreases across a period
- Atomic radius increases down a group
- Ionisation energy increases across a period
- Metals lose electrons easily
- Non-metals gain electrons easily
- Electronegativity increases across a period

Practice Questions

Q1 Which element has the highest electronegativity?

A. Na
B. Mg
C. Cl
D. Ar

Chlorine has highest electronegativity

Q2 Which element has the largest atomic radius?

A. Li
B. Na
C. K
D. Rb

Rb has the largest atomic, as radius increases down group.

Q3 Which element is most metallic?

A. F
B. Cl
C. Na
D. O

Na

3. Ionic and Covalent Bonding

Revision Dot Points

- Ionic bonding = attraction between oppositely charged ions
- Covalent bonding = sharing electrons
- Metals + non-metals = ionic
- Non-metal + non-metal = covalent
- Ionic compounds:
    - high melting points
    - conduct electricity when molten or aqueous
    - brittle
- Polar bonds form due to electronegativity differences

Practice Questions

Q1 Which compound is ionic?

A. CO_2
B. NH_3
C. NaCl
D. H_2O

NaCl

Q2 Which bond is most polar?

A. H–H
B. Cl–Cl
C. O–H
D. C–C

O-H

Q3 Which property belongs to ionic compounds?

A. Low melting point
B. Conducts electricity as solid
C. Brittle
D. Insoluble in water

Brittle.
Not all ionic compounds are insoluble in water

4. Lewis Structures and Molecular Shape

Revision Dot Points

- Valence electrons determine bonding
- Single bond = 2 shared electrons
- Lone pairs affect shape
- Common shapes:
    - linear
    - bent (V-shaped)
    - pyramidal
    - tetrahedral
- Use VSEPR theory (simplified meaning = electron cloud, such as bonding and non-bonding pairs, repulsion in 3D space)

Practice Questions

Q1 What is the shape of NH_3?

A. Linear
B. Bent
C. Pyramidal
D. Tetrahedral

Q2 How many lone pairs are on oxygen in H_2O?

A. 0
B. 1
C. 2
D. 3

Q3 What is the shape of CO_2?

A. Bent
B. Linear
C. Pyramidal
D. Tetrahedral

5. Intermolecular Forces and Boiling Point

Revision Dot Points

- London dispersion forces occur in all molecules
- Dipole–dipole forces occur in polar molecules
- Hydrogen bonding occurs when H bonded to N, O or F
- Stronger intermolecular forces → higher boiling point
- Larger molecules usually have stronger dispersion forces

Practice Questions

Q1 Which compound shows hydrogen bonding?

A. CH_4
B. HCl
C. NH_3
D. CO_2

Q2 Which has the highest boiling point?

A. Methane
B. Ethanol
C. Ethanoic acid
D. Propane

Q3 Why does water have a high boiling point?

A. Ionic bonding
B. Hydrogen bonding
C. Covalent bonding
D. Metallic bonding

6. Stoichiometry and Empirical Formula

Revision Dot Points

- Mole = amount of particles (6.02×10^{23})
- Avogadro constant = 6.02×10^{23}
- Empirical formula = simplest whole number ratio
- Molecular formula = actual number of atoms
- Steps for empirical formula:
    1. Assume 100 g
    2. Convert g to mol by dividing by molar mass
    3. Divide by smallest number of mol
    4. Multiply to whole numbers if needed

Practice Questions

Q1 How many moles are in 22 g of CO_2?

A. 0.25
B. 0.50
C. 1.0
D. 2.0

Q2 What is the empirical formula of C_2H_4?

A. CH
B. CH_2
C. C_2H_4
D. C_4H_8

Q3 How many particles are in 0.1 mol?

A. 6.02×10^{22}
B. 3.01×10^{23}
C. 6.02×10^{23}
D. 1.20×10^{24}

7. Organic Chemistry and Naming

Revision Dot Points

- Alkanes: single bonds
- Alkenes: double bonds
- Alcohols contain –OH
- Carboxylic acids contain –COOH
- Prefixes:
    - meth = 1 carbon
    - eth = 2
    - prop = 3
    - but = 4
    - pent = 5
- Longest chain chosen first
- Priority functional group gets lowest numbered carbon
- Substituent groups are placed in alphabetical order

Practice Questions

Q1 What is the formula of pentane?

A. C_5H_{10}
B. C_5H_{12}
C. C_5H_8
D. C_5H_{14}

Q2 What functional group is in ethanol?

A. Carboxyl
B. Amino
C. Hydroxyl
D. Carbonyl

Q3 What is the name of $CH_3CH(OH)COOH$?

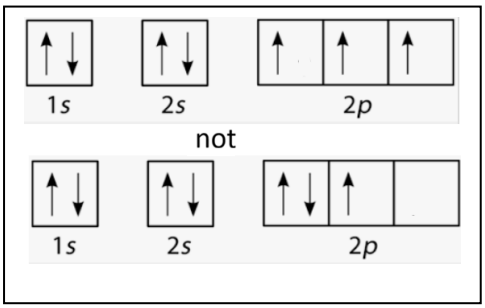
A. 1-carboxypropan-2-ol
B. 2-hydroxypropanoic acid
C. 2-olpanoic acid
D. Butanoic acid

SECTION B THEMES (Short Answer)

1. Electron Configurations

Revision dot points

- Lowest energy levels fill first
- Orbitals Regions of space around the nucleus where electrons are likely to occupy) singly filled first , as shown on the right.



- Each orbital holds 0, 1 or 2 electrons (Pauli exclusion principle)
- Transition metals use d orbitals

Practice questions

Q1 Write the electron subshell configuration for :

- sulfur._____
- Copper _____

Q2 How many electrons fit in the 3d subshell?

_____

Q3 Explain the exceptions to the dot point "Lowest energy levels fill first" and give an example.

_____

_____

_____

_____

_____

_____

2. Lewis Structures and Shape

Revision dot points

- Count valence electrons
- Central atom usually least electronegative
- Add lone pairs last
- Shape determined by bonding lone pairs

Practice questions

Q1 Draw the Lewis structure for H_2O_2.

Q2 Describe the shape of PH_3. Draw its structure

Q3 Explain why NH_3 is polar, draw the molecular structure.

3. Percentage Composition and Mole Calculations

Revision dot points

- Percentage composition:

$$\% = \frac{\text{mass of element}}{\text{total molar mass}} \times 100$$

- Use molar masses correctly
- Convert between moles, mass and particles

Practice questions

Q1 Find the percentage of oxygen in Al_2O_3.

Q2 Calculate the percentage composition of $CaCO_3$.

Q3 How many atoms are in 2 mol of H_2SO_4?

4. Ionic Compounds and Reactivity

Revision dot points

- Group 1 metals very reactive
- Reactivity increases down Group 1
- Metals lose valence electrons
- Ionic compounds conduct only when molten or in solution

Practice questions

Q1 Why is potassium more reactive than lithium?

_____

_____

_____

_____

_____

Q2 State two properties of ionic compounds and explain your answer.

_____

_____

_____

_____

_____

_____

Q3 Using the table of valencies found in your data book predict the formula of:

- magnesium fluoride. _____
- `potassium phosphate _____
- Aluminium dichromate _____

5. Chemical Equations and Ionic Equations

Revision dot points

- Equations must balance
- Include states
- Spectator ions removed in net ionic equations
- Precipitates are insoluble solids (use the data book to gauge the solubility of compounds)

Practice questions

Q1 Balance:

$$Al(s) + O_2(g) \rightarrow Al_2O_3(s)$$

Q2 Write the net ionic equation for silver nitrate reacting with sodium chloride.

_____

Q3 What is a precipitate? Use the reaction between calcium nitrate solution and sodium phosphate solution, provide a balanced equation to support your answer.

6. Organic Structures and Isomers

Revision dot points

- Structural isomers have same molecular formula (different connectivity)
- Draw structural formulae of organic compounds
- Draw condensed structural formulas carefully

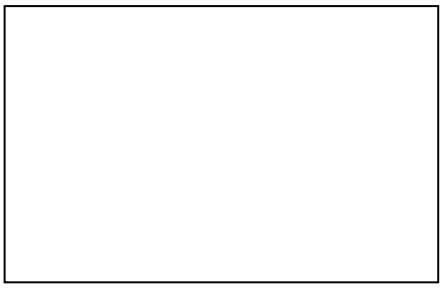
Practice questions

Q1 Draw pent-2-ene. And give its semistructural formula

Q2 Name a structural isomer of hexane. Draw the structural and give the semistructural formula of this isomer.

Q3 Explain why methanoic acid is more soluble than methanol. Draw a diagram to support your answer.

Q4 Give the name and semistructural formula of the molecule shown on the right.



Name _____

Semistructural formula

_____

7. Empirical Formula Experiment

Revision dot points

A student determines the empirical formula of a metal oxide using a crucible experiment.

Results:

Item	**Mass (g)**
Crucible + lid	28.412
Crucible + lid + metal (before heating)	28.840
Crucible + lid + product (after heating)	28.921

The metal (X) has a molar mass of 56.0 g/mol and reacts with oxygen in air to form an oxide.

1. Calculate the empirical formula of the metal oxide. Show all working clearly.

8. Chromatography and Solubility

Revision dot points

- More soluble in solvent => travels further
- Polar substances dissolve in polar solvents
- Rf value

$$\text{Rf} = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$$

$$\text{Rf} = \frac{\text{distance travelled by substance}}{\text{distance travelled by solvent}}$$

- Amino acids differ due to polarity

Practice questions

Q1 What does a larger Rf value indicate?

_____

_____

_____

_____

Q2 Why do different amino acids separate?

_____

_____

_____

_____

Q3 Would a polar amino acid travel further in water than hexane?

_____

_____

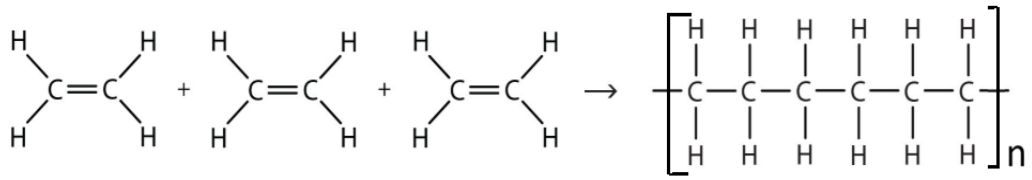
_____

_____

9. Polymerisation

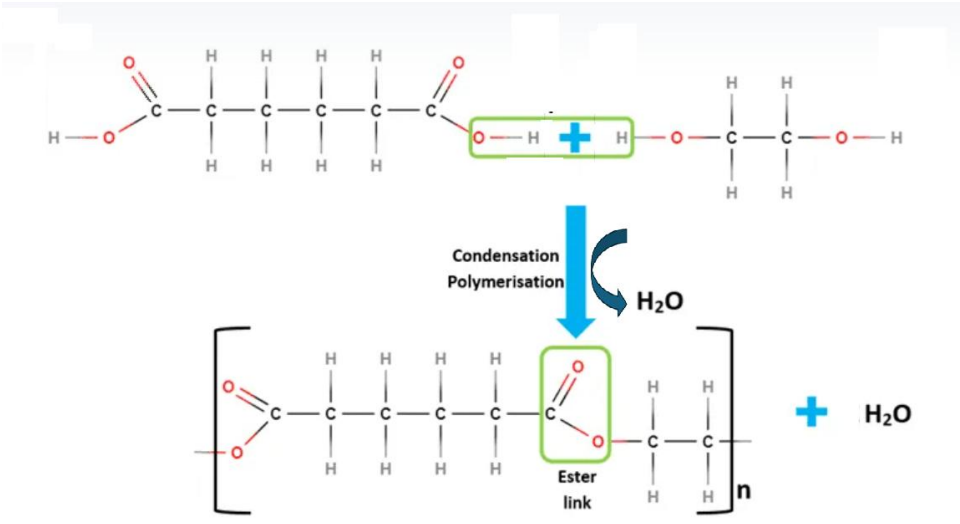
Revision Dot Points

- Monomers are relatively small molecules that covalently bond together to form large molecules called polymers.
- Addition polymerisation occurs between unsaturated molecules containing carbon–carbon double bonds (C=C).
- In ad***dition polymerisation***, monomers join by breaking the C=C double bond, and only the carbon atoms originally part of the double bond form the backbone of the polymer chain.



Formation of polyethene from ethene monomers

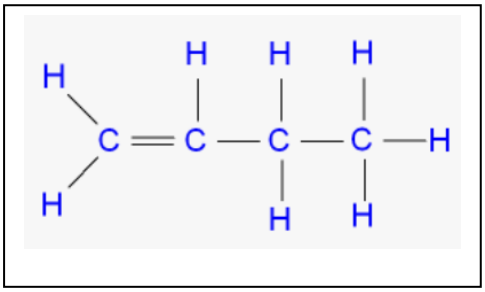
- ***Condensation polymerisation*** occurs between molecules that have at least two reactive functional groups.
- The functional groups from each monomer react to form a covalent bond between monomers, releasing a small molecule such as water (H_2O) or hydrogen chloride (HCl) as a byproduct.



Summary of condensation polymerisation

Practice questions

Q1 . Consider the monomer shown on the right.

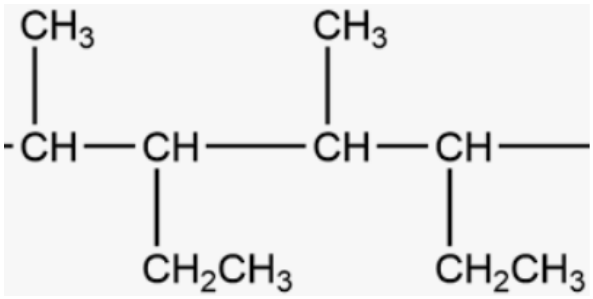


a. Give the systematic name of the hydrocarbon

_____

b. Draw the repeating unit of the polymer that will result using this monomer.

c. Consider the repeating unit of the polymer shown below.

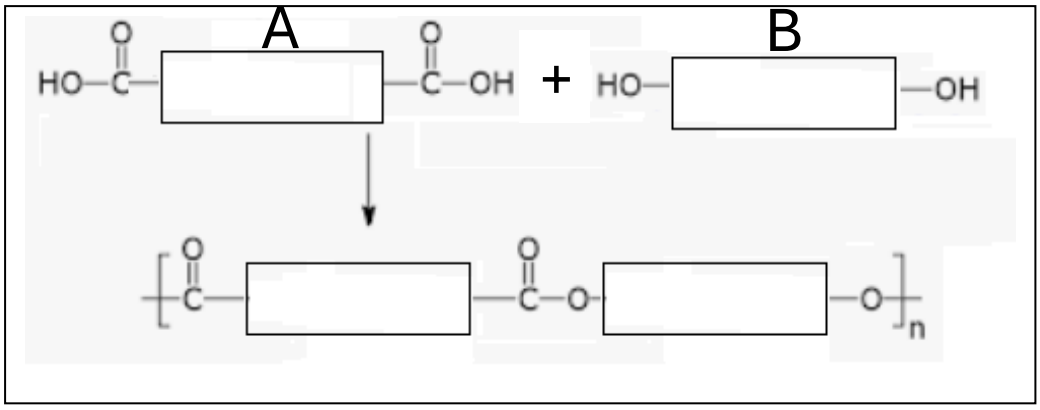


i. Give the systematic name of the monomer shown on the right.

ii. Draw its structural formula and write its semistructural formula in the space provided below.

Semistructural _____

Q2 Consider the monomers A and B shown below.



Monomer A is pentanedioic acid and B is ethane-1,2-diol.

i. Write the structural formula in the box provided for the polymer repeating unit.

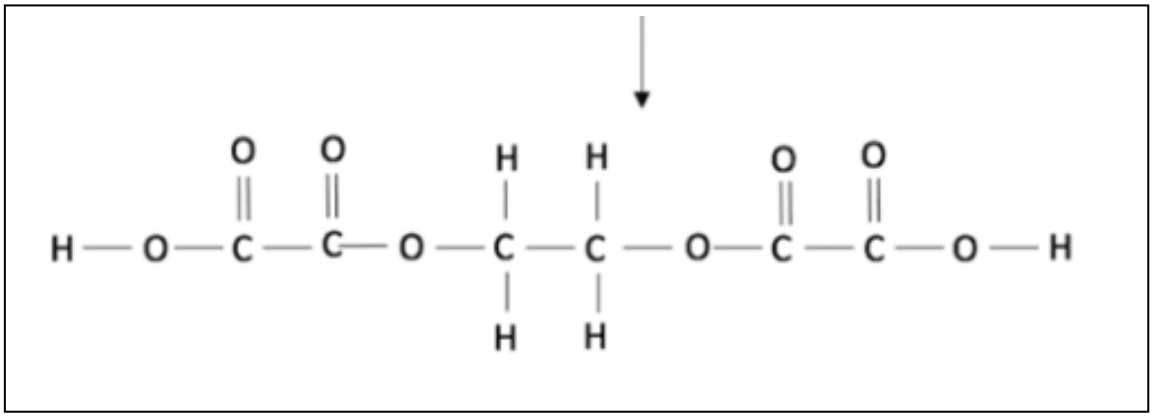
ii. What small molecule is expelled in the formation of the polymer?

_____

iii. Name the functional group present in the repeating unit of the polymer.

_____

Q3. Consider the polymer shown below.



a. Name the type of reaction that formed this polymer.

_____

b. Name each monomer. _____ _____