Chemistry for University Study
[Final term]

2024

Examination Paper

Sample Assessment

Answer ALL questions in section A, section B and section C.

Time: 2 hours

The maximum mark for this paper is 100.

Any reference material brought into the examination room must be handed to the invigilator before the start of the examination.

Candidates are allowed to use a scientific calculator during this examination.

Section A – 25 MCQ Total 25 marks

Answer all the questions in this section – there is just ONE (1) correct answer for each multiple choice question unless stated otherwise.

Marks

Question 1 (AC 4.1.1)

Which of the following factors does NOT affect the rate of reaction? **1**

a. Temperature
b. Concentration of reactants
c. Surface area of the reactants
d. Molecular weight of products

Mark Scheme
d. Molecular weight of products

Question 2 (AC 5.1.1)

What trend describes the qualitative variation in atomic radius across a period in the periodic table? **1**

a. Increases from left to right
b. Decreases from left to right
c. Remains constant
d. Exhibits irregular patterns

Mark Scheme
b. Decreases from left to right

Question 3 (AC 5.2.1)

Which compound is formed when phosphorus reacts with oxygen? **1**

a. P_2O
b. P_4O_6
c. P_4O_8
d. P_4O_{10}

Mark Scheme
d. P4O10

		Marks
Question 4 (AC 5.2.4)		
Which of the following oxides is basic in nature?		**1**
a.	Na_2O	
b.	P_4O_{10}	
c.	SO_2	
d.	Al_2O_3	
	Mark Scheme ***a. Na_2O***	
Question 5 (AC 5.2.5)		
Which chloride is most likely to result in an acidic solution when dissolved in water?		**1**
a.	NaCl	
b.	$MgCl_2$	
c.	$AlCl_3$	
d.	$SiCl_4$	
	Mark Scheme ***c. AlCl3***	
Question 6 (AC 5.2.7)		
What type of bonding is most likely present in ionic chlorides like NaCl and MgCl2 based on their physical properties?		**1**
a.	Covalent bonding	
b.	Metallic bonding	
c.	Ionic bonding	
d.	Van der Waals forces	
	Mark Scheme ***c. Ionic bonding***	

		Marks
Question 7 (AC 5.3.1)		
What happens to the ionisation energy as you move down a group in the periodic table?		**1**
a.	Increases	
b.	Decreases	
c.	Remains constant	
d.	Fluctuates randomly	
	Mark Scheme ***b. Decreases***	
Question 8 (AC 5.4.1)		
What type of reaction is generally observed when elements react with sulfuric acid?		**1**
a.	Reduction	
b.	Oxidation	
c.	Displacement	
d.	Neutralisation	
	Mark Scheme ***c. Displacement***	
Question 9 (AC 5.4.4)		
In general, what happens to the melting points of metals as you move from left to right across a period in the periodic table?		**1**
a.	Increase	
b.	Decrease	
c.	Remain constant	
d.	Vary unpredictably	
	Mark Scheme ***a. Increase***	

		Marks Marks
Question 10 (AC 5.4.5)		
What is the trend in the solubility of Group 2 metal sulfates as you move down the group?		**1**
a.	Increases	
b.	Decreases	
c.	Remains constant	
d.	Varies unpredictably	
	Mark Scheme ***b. Decreases***	
Question 11 (AC 5.5.1)		
What is the typical colour of bromine in its liquid state at room temperature?		**1**
a.	Violet	
b.	Dark purple	
c.	Brown	
d.	Pale yellow-green	
	Mark Scheme ***c. Brown***	
Question 12 (AC 5.5.2)		
What is the trend in bond strength among halogen molecules moving down the halogen group?		**1**
a.	Bond strength increases	
b.	Bond strength decreases	
c.	Bond strength remains constant	
d.	Bond strength is unpredictable	
	Mark Scheme ***b. Bond strength decreases***	

		Marks Marks
Question 13 (AC 5.5.3)		
What type of intermolecular forces contribute significantly to the volatility of elements in the context of instantaneous dipole–induced dipole forces?		**1**
a.	Hydrogen bonding	
b.	Van der Waals forces	
c.	Ionic bonding	
d.	Covalent bonding	
	Mark Scheme ***b. Van der Waals forces***	
Question 14 (AC 5.6.1)		
Which Group 17 element is the most potent oxidising agent?		**1**
a.	Chlorine	
b.	Bromine	
c.	Fluorine	
d.	Iodine	
	Mark Scheme ***c. Fluorine***	
Question 15 (AC 5.8.1)		
What happens when chlorine reacts with cold aqueous sodium hydroxide?		**1**
a.	Chlorine is reduced	
b.	Chlorine is oxidised	
c.	Chlorine undergoes disproportionation	
d.	Sodium hydroxide is reduced	
	Mark Scheme ***c. Chlorine undergoes disproportionation***	

		Marks
Question 16 (AC 7.1)		
Which of the following reactions can be used to produce primary amines?		**1**
a.	Aldehyde + Ammonia	
b.	Carboxylic acid + Amine	
c.	Alkene + HCl	
d.	Halogenoalkane + NH_3 in ethanol under pressure	
	Mark Scheme ***d. Halogenoalkane + NH_3 in ethanol under pressure***	
Question 17 (AC 7.3.1)		
Poly(chloroethene), commonly known as PVC, is formed by the polymerization of:		**1**
a.	Chloroethane	
b.	Chloroethylene	
c.	Chloroethene	
d.	Chloromethane	
	Mark Scheme ***c. Chloroethene***	
Question 18 (AC 7.3.4)		
Why is the non-biodegradability of poly(alkenes) is a concern for their disposal?		**1**
a.	Biodegradable materials are easily recyclable	
b.	Non-biodegradable materials can accumulate in the environment	
c.	Non-biodegradable materials pose no environmental risks	
d.	Non-biodegradability enhances soil fertility	
	Mark Scheme ***b. Non-biodegradable materials can accumulate in the environment***	

		Marks
Question 19 (AC 7.6.1)		
What is the primary purpose of mass spectrometry?		**1**
a.	Measuring temperature	
b.	Identifying elements in a sample	
c.	Determining mass-to-charge ratios of ions	
d.	Analysing optical properties.	
	Mark Scheme ***c. Determining mass-to-charge ratios of ions***	
Question 20 (AC 7.6.3)		
What is the significance of the molecular ion peak's position in a mass spectrum?		**1**
a.	It indicates the charge state of the molecule	
b.	It determines the isotopic abundance	
c.	It reveals the molecular weight of the intact molecule	
d.	It represents the fragmentation pattern	
	Mark Scheme ***c. It reveals the molecular weight of the intact molecule***	
Question 21 (AC 6.4.1)		
In geometrical isomerism, what characterises cis/trans isomers?		**1**
a.	Different functional groups	
b.	Rotation around single bonds	
c.	Presence of chiral centres	
d.	Different spatial arrangements around a double bond	
	Mark Scheme ***d. Different spatial arrangements around a double bond***	

		Marks
Question 22 (AC 6.1.2)		
What is the defining characteristic of alkanes?		**1**
a.	Presence of a carbonyl group	
b.	Lack of functional groups	
c.	Aromaticity	
d.	Multiple double bonds	
	Mark Scheme ***b. Lack of functional groups***	
Question 23 (AC 6.7.1)		
What is/are the reagent(s) commonly used for the reduction of carboxylic acids to form primary alcohols?		**1**
a.	$LiAlH_4$	
b.	$NaBH_4$	
c.	PCC	
d.	$SOCl_2$	
	Mark Scheme ***a. LiAlH4***	
Question 24 (AC 6.7.5)		
What is the yellow precipitate formed during the reaction of an alcohol, ch3ch(oh)–r, with alkaline i2(aq)?		**1**
a.	Yellow precipitate of di-iodomethane (CH_2I_2)	
b.	Yellow precipitate of tri-iodomethane (CHI_3)	
c.	Yellow precipitate of iodine (I_2)	
d.	Yellow precipitate of methanol (CH_3OH)	
	Mark Scheme ***b. Yellow precipitate of tri-iodomethane (CHI_3)***	

		Marks
Question 25 (AC 6.10.2)		
During the hydrolysis of esters by dilute acid, what is the fate of the ester functional group?		**1**
a.	It is replaced by an alkali group	
b.	It is replaced by a hydroxyl group	
c.	It is replaced by a carboxyl group	
d.	It remains unchanged	
	Mark Scheme ***c. It is replaced by a carboxyl group***	

SECTION B – 20 questions Total 45 marks short answer questions
Answer ALL questions

Marks

Question 26 (AC 4.3.1)

How do catalysts affect the rate of a chemical reaction in terms of the frequency of effective collisions? **2**

Mark Scheme

Catalysts are substances that don't get used up in a reaction.

They provide an alternative pathway that allows the reaction to be completed with a lower activation energy. (1 mark)

This means that the more particles are above the activation energy, the more particles can react. So, the catalysis of a reaction increases reaction rate. (1 mark)

Question 27 (AC 5.2.2)

Explain the variation in oxidation numbers of sulfur in SO_2 and SO_3. **3**

Mark Scheme

In SO_2 (sulfur dioxide), sulfur has an oxidation number of +4, while in SO_3 (sulfur trioxide), sulfur has an oxidation number of +6 (1 mark). The variation in oxidation numbers is due to the number of oxygen atoms bonded to sulfur (1 mark). In SO_2, sulfur is bonded to two oxygen atoms, leading to a lower oxidation state, whereas in SO_3, sulfur is bonded to three oxygen atoms, resulting in a higher oxidation state (1 mark)

Question 28 (AC 5.2.5)

Write the equation for the reaction of $AlCl_3$ with water and discuss the pH of the solution. **2**

Mark Scheme

Aluminium chloride ($AlCl_3$) reacts with water and undergoes hydrolysis:

$AlCl_3+3H_2O \rightarrow Al(OH)_3+3HCl$ (1 mark)

The resulting solution is acidic due to the formation of hydrochloric acid from the hydrolysis of chloride ions. (1 mark)

Question 29 (AC 5.2.6)

Describe the variation in the nature of oxides across periods in the periodic table.	**3**
Mark Scheme ***The nature of oxides changes across periods. In the early periods, oxides of metals tend to be more basic, while non-metal oxides are acidic. (1 mark)*** ***As we move across the period, metal oxides become less basic, and non-metal oxides become more acidic. (1 mark)*** ***This trend is due to the changing nature of bonding, with ionic character decreasing for metal oxides and increasing for non-metal oxides. (1 mark)***	

Question 30 (AC 5.3.1)

How does the atomic radius change as you move from top to bottom within a group and why?	**2**
Mark Scheme ***The atomic radius increases from top to bottom within a group. (1 mark)*** ***This is because additional energy levels (shells) are added as you go down the group, resulting in larger atomic sizes. (1 mark)***	

Question 31 (AC 5.4.1)

Complete the balanced reactions of Group 2 metals (Magnesium, Calcium and Strontium) with oxygen.	**1**
Mark Scheme ***(1 mark for all THREE (3) correctly balanced equations)*** ***$2Mg + O_2$ à $2MgO$*** ***$2Ca + O_2$ à $2CaO$*** ***$2Sr + O_2$ à $2SrO$ <u>or</u> $Sr + O_2$ à SrO_2***	

Question 32 (AC 5.4.4)

Describe the trend in atomic radius across a period in the periodic table.	**2**
Mark Scheme ***The atomic radius generally decreases across a period (1 mark) due to increased effective nuclear charge, leading to a stronger attraction pulling the electrons closer to the nucleus. (1 mark)***	

Question 33 (AC 5.4.5)

Predict the solubility of strontium sulfate **and** justify your answer based on the trend in sulfate solubility.	**2**
Mark Scheme ***Strontium sulfate is less soluble compared to calcium sulfate but more soluble than barium sulfate.(1 mark)*** ***This is based on the trend of decreasing sulfate solubility down the Group 2 elements. (1mark)***	

Question 34 (AC 5.5.3 + more generalised)

Describe the relationship between molecular size **and** the ability to induce instantaneous dipoles, and how it affects volatility.	**3**
Mark Scheme ***Larger molecules have more electrons and a greater electron cloud, making them more polarisable. (1 mark)*** ***This increased polarizability enhances the ability to induce instantaneous dipoles in neighbouring molecules. (1 mark)*** ***As a result, larger molecules experience stronger van der Waals forces, leading to higher volatility compared to smaller molecules. (1 mark)***	

Question 35 (AC 5.7.1)

Explain the trend in thermal stability among hydrogen halides **and** what factor primarily influences the thermal stability of hydrogen halides? **2**

Mark Scheme

The trend in thermal stability follows the order HF > HCl > HBr > HI. (1 mark)
The strength of the hydrogen-halogen bond is the key factor influencing thermal stability. (1 mark)

Question 36 (AC 5.7.2)

Give a balanced equation for the reaction of each of the hydrogen halides (Chlorine, bromine, and Iodine) with concentrated sulfuric acid. **3**

Mark Scheme

(1 mark for each correctly balanced equation)

Halide Ion	Reaction with Concentrated Sulfuric Acid
$Cl^-(aq)$	$H_2SO_4(l) + NaCl(s) \longrightarrow HCl(g) + NaHSO_4(s)$
$Br^-(aq)$	$H_2SO_4(l) + NaBr(s) \longrightarrow HBr(g) + NaHSO_4(s)$ $H_2SO_4(l) + 2HBr(s) \longrightarrow Br_2(g) + SO_2(g) + 2H_2O(l)$
$I^-(aq)$	$H_2SO_4(l) + NaI(s) \longrightarrow HI(g) + NaHSO_4(s)$ $2HI(g) + H_2SO_4(l) \longrightarrow I_2(g) + SO_2(g) + 2H_2O(l)$ $6HI(g) + H_2SO_4(l) \longrightarrow 3I_2(g) + S(s) + 4H_2O(l)$ $8HI(g) + H_2SO_4(l) \longrightarrow 4I_2(g) + H_2S(s) + 4H_2O(l)$

Question 37 (AC 5.8.2)

What is the primary purpose of using chlorine in water purification **and** write the equation for the dissociation of chlorine in water? **2**

Mark Scheme

Chlorine is used to disinfect water by killing bacteria and other harmful microorganisms. (1 mark)

The equation for the dissociation of chlorine in water is-

$$Cl_2 + H_2O \rightarrow HClO + H^+ + Cl^- \quad \textit{(1 mark)}$$

Question 38 (AC 7.2.2)

Describe the TWO (2) -step process in the nucleophilic addition of hydrogen cyanide to carbonyl compounds? **2**

Mark Scheme

The nucleophilic addition of hydrogen cyanide to carbonyl compounds is a TWO (2) -step process, where:

- ***In step 1 called the nucleophilic attack, where the cyanide ion attacks the carbonyl carbon forming a negatively charged intermediate. (1 mark)***
- ***In step 2 which is the protonation, where the negatively charged oxygen atom in the reactive intermediate immediately reacts with aqueous H+ to form a 2-hydroxynitrile. The aqueous H+ can be either from HCN, water or dilute acids. (1 mark)***

Question 39 (AC 7.3.2)

How can the repeat unit of an addition polymer be deduced from the monomer structure? **2**

Mark Scheme

(1 mark for correctly stating TWO (2) points from the below, and 2 marks for correctly stating FOUR (4) points):

- ***To draw a repeat unit, the double bond in the monomer is changed to a single bond in the repeat unit.***
- ***This is followed by the addition of a bond to each side of the repeat unit.***
- ***The bonds on either side of the polymer extends outside the bracket.***
- ***The small subscript n is written on the bottom right-hand side to indicate many repeat units.***

Question 40 (AC 7.4.1)

a)	Identify the organic functional groups present in the molecule CH_3CH_2COOH using reactions in the syllabus.	**1**
	Mark Scheme ***The organic functional groups present in CH3CH2COOH are-*** ***alkane (CH3CH2-), alkene (C=C) and carboxylic acid (-COOH). (1 mark for stating all THREE (3) functional groups correctly)***	
b)	Predict ONE (1) property associated with the carboxylic acid functional group.	**1**
	Mark Scheme ***One property associated with the carboxylic acid functional group is acidity, leading to the ability to donate a proton (H+). (1 mark)***	

Question 41 (AC 7.5)

What is Infrared Spectroscopy and how does it work?	**2**
Mark Scheme ***Infrared spectroscopy is a technique to measure the interaction of infrared light with matter by absorption, emission, and reflection. It is used to identify chemical compounds and functional groups in solids, liquids, and gaseous form. (1 mark)*** ***Infrared spectroscopy works by exposing a sample to infrared radiation. Molecules absorb specific frequencies of infrared light, causing vibrational transitions. The resulting spectrum reveals characteristic absorption peaks. (1 mark)***	

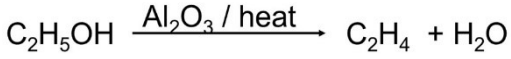
Question 42 (AC 7.6.1)

In THREE (3) key points, state how you can analyse mass spectra in terms of isotopic abundances.	**3**
Mark Scheme ***Isotopic abundances in a mass spectrum can be analysed by observing peaks corresponding to different isotopes of an element. (1 mark)*** ***Isotopes exhibit peaks at slightly different m/e values due to their varying masses. (1 mark)*** ***The relative intensities of these peaks reveal the isotopic distribution and abundance in the sample. (1 mark)***	

Question 43 (AC 6.3.3)

In molecules with sp3 hybridised atoms, how are σ and π bonds arranged?	**2**
Mark Scheme ***Molecules with sp3 hybridised atoms have sigma (σ) bonds formed by the head-on overlap of sp3 hybrid orbitals. (1 mark)*** ***There are no π bonds as all three p orbitals are used for hybridisation, leaving no unhybridised p orbitals for lateral π bonding. (1 mark)***	

Question 44 (AC 6.7.2)

Explain the dehydration of alcohols to form alkenes, particularly focusing on the role of a heated catalyst such as Al_2O_3 or a concentrated acid. Provide the balanced chemical equation for the reaction.	**2**
Mark Scheme ***Dehydration of alcohols involves the removal of water to form an alkene. A general example using ethanol is:***  ***(1 mark)*** ***The heated catalyst (Al_2O_3) promotes the elimination of water from the alcohol, leading to the formation of the corresponding alkene. (1 mark)***	

Question 45 (AC 6.7.3)

Define alcohols as primary, secondary, and tertiary alcohols, **and** include ONE (1) example of each.	**3**
Mark Scheme ***(1 mark for each correctly stated definition-example pair):*** ***Alcohols can be classified as primary, secondary and tertiary alcohols.*** • ***Primary alcohols are alcohols in which the carbon atom bonded to the –OH group is attached to one other carbon atom.*** ***Example: Ethanol (CH_3CH_2-OH)*** • ***Secondary alcohols are those in which the carbon atom bonded to the –OH group is attached to two other carbon atoms.*** ***Example: Isopropanol (CH_3-CHOH-CH_3)*** • ***Tertiary alcohols are those in which the carbon bonded to the –OH group is attached to three other carbon atoms.*** ***Example: 2-Methyl-2-propanol (CH_3-C(CH_3)(OH)CH_3)***	

SECTION B – 6 questions Total 30 marks short answer questions
Answer ALL questions

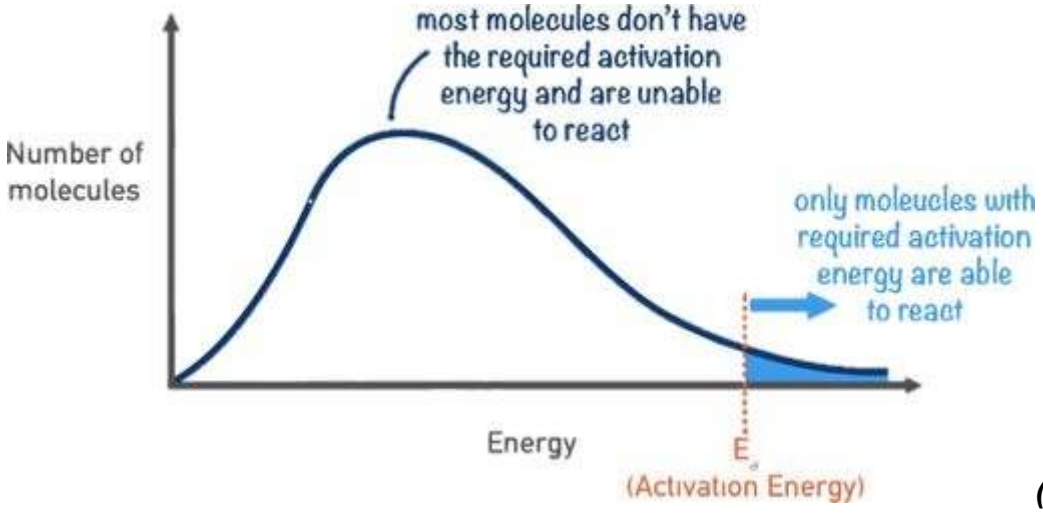
Marks

Question 46 (AC 4.2.2)

Sketch **and** use the Boltzmann distribution to explain the significance of activation energy in chemical reactions. **4**

Mark Scheme

The Boltzmann distribution illustrates the distribution of kinetic energies among a group of particles at a specific temperature. When applied to chemical reactions, it helps us understand the significance of activation energy.



(1 mark)

In the Boltzmann distribution, the x-axis represents the speed (kinetic energy), and the y-axis represents the number of particles with that energy. The curve shows that most particles have energies near the average, but there is a range of energies present due to thermal motion.

The activation energy (EA) is the minimum energy required for a successful collision leading to a reaction. Only particles with energy equal to or greater than the activation energy can overcome the energy barrier and proceed to react. (1 mark)

In the Boltzmann distribution, particles with energy less than the activation energy contribute to the area under the curve to the left of the activation energy. These particles represent non-effective collisions, as they lack the energy required to initiate the reaction. (1 mark)

Particles with energy equal to or greater than the activation energy contribute to the area under the curve to the right of the activation energy. These particles represent effective collisions capable of overcoming the energy barrier and leading to a reaction. (1 mark)

Question 47 (AC 5.2.3)

Explain the acid/base behaviour of SO_2, SO_3, MgO and NaOH, stating the reaction equation of each.	**6**

Mark Scheme

<u>Acid/base behaviour of SO_2 and SO_3:</u>

- ***SO_2 (sulfur dioxide) is an acidic oxide. It dissolves in water to form sulfurous acid (H_2SO_3).***
  $SO_2+H_2O \rightarrow H_2SO_3$ (1 mark)
- ***SO_3 (sulfur trioxide) is also an acidic oxide. It reacts with water to form sulfuric acid (H_2SO_4).***
  $SO_3+H_2O \rightarrow H_2SO_4$ (1 mark)

<u>Acid/base behaviour of MgO:</u>

Magnesium oxide (MgO) is a basic oxide. It reacts with water to form magnesium hydroxide (Mg(OH)2), which is a weak base.

$MgO+H_2O \rightarrow Mg(OH)_2$ (1 mark)

<u>Acid/base behaviour of NaOH:</u>

Sodium hydroxide (NaOH) is a strong base.

It dissociates in water to produce hydroxide ions (OH-) and sodium ions (Na+).

$NaOH \rightarrow Na^+ + OH^-$ (1 mark)

It reacts with acids to form water and the corresponding salt:

$NaOH + HCl \rightarrow NaCl + H_2O$ (1 mark)

NaOH also reacts with certain metal oxides, such as aluminium oxide (Al2O3), exhibiting amphoteric behaviour:

$2Al(OH)_3 + 6NaOH \rightarrow 2Na[Al(OH)_4]_3$ (1 mark)

Question 48 (AC 5.4.2)

Write the balanced equation for the reaction of Group 2 hydroxides (Mg, Ca, Sr, and Ba) with dilute HCl and dilute H_2SO_4. **8**

Mark Scheme

(1 mark for each correctly stated balanced equation up to 8 marks):

Group 2 Hydroxide	Reaction with dilute HCl	Reaction with dilute H_2SO_4
MgOH	$Mg(OH)_2(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + 2H_2O(l)$	$Mg(OH)_2(s) + H_2SO_4(aq) \longrightarrow MgSO_4(aq) + 2H_2O(l)$
CaOH	$Ca(OH)_2(s) + 2HCl(aq) \longrightarrow CaCl_2(aq) + 2H_2O(l)$	$Ca(OH)_2(s) + H_2SO_4(aq) \longrightarrow CaSO_4(s) + 2H_2O(l)$
SrOH	$Sr(OH)_2(s) + 2HCl(aq) \longrightarrow SrCl_2(aq) + 2H_2O(l)$	$Sr(OH)_2(s) + H_2SO_4(aq) \longrightarrow SrSO_4(s) + 2H_2O(l)$
BaOH	$Ba(OH)_2(s) + 2HCl(aq) \longrightarrow BaCl_2(aq) + 2H_2O(l)$	$Ba(OH)_2(s) + H_2SO_4(aq) \longrightarrow BaSO_4(s) + 2H_2O(l)$

Question 49 (AC 7.2.3)

Define hydroxynitriles then describe the hydrolysis of nitriles with dilute acid or dilute alkali followed by acidification to produce a carboxylic acid.	**4**

Mark Scheme

Hydroxynitriles are compounds which has both hydroxy (-OH) and cyanide (-CN) functional groups. (1 mark)

The reaction below shows the hydrolysis of nitriles by either dilute acid or dilute alkali, followed by acidification to form a carboxylic acid.

<u>Hydrolysis of Nitriles with Dilute Acid</u>: (1 mark)

Reaction with Dilute Acid: Nitriles are treated with a dilute acid (usually hydrochloric acid or sulfuric acid). The general reaction can be represented as follows:

$$\xrightarrow{} RCN + H_2O \quad Dilute\ Acid \quad RCOOH + NH_3$$

In this reaction, the nitrile undergoes hydrolysis to form a carboxylic acid (RCOOH) and ammonia (NH_3).

<u>Hydrolysis of Nitriles with Dilute Alkali with Acidification</u>: (1 mark)

Reaction with Dilute Alkali: Alternatively, nitriles can be hydrolysed using dilute alkali (usually sodium hydroxide, NaOH). The general reaction is as follows:

$$\xrightarrow{} RCN + H_2O \quad Dilute\ Alkali \quad RCOONa$$

In this case, a salt called a sodium salt of the carboxylic acid is formed.

<u>Acidification:</u> (1 mark)

The sodium salt obtained in the previous step is then acidified, usually with dilute acid, to convert it into the corresponding carboxylic acid:

$$\xrightarrow{} RCOONa + HCl \quad Acidification \quad RCOOH + NaCl$$

The carboxylic acid (RCOOH) is produced along with the formation of a salt (NaCl in this example).

Question 50 (AC 6.5.4)

Suggest how cracking can be used to obtain more useful alkanes **and** alkenes of lower molecular weight from heavier crude oil fractions.	**4**

Mark Scheme

- ***In many cases, shorter hydrocarbons are more useful than longer hydrocarbons, for fuels etc. So, there is a higher demand for shorter hydrocarbons and a smaller demand for larger hydrocarbons.***
- ***Hence, the industry uses a method called cracking to break down the larger hydrocarbons into smaller, more useful, hydrocarbons by breaking the carbon chain. (2 marks)***

Mechanisms of cracking are a) Catalytic cracking & b) Thermal cracking.

a) Catalytic cracking: (1 mark)

Catalytic cracking involves using a solid catalyst often used called zeolite (hydrated aluminosilicate) at a slight pressure and a temperature of 500 °C, which facilitates the cleavage of carbon-carbon bonds.

b) Thermal cracking: (1 mark)

Thermal cracking involves heating the hydrocarbons at an extremely high temperature and pressure (around 1000°C and a pressure of up to 70 atm) to facilitate the cleavage of large hydrocarbon molecules.

Question 51 (AC 6.8.1)

Define what aldehydes and ketones are and describe the reactions, including reagents **and** conditions, by which aldehydes and ketones can be synthesised.	**4**

Mark Scheme

Aldehydes and ketones are carbonyl compounds having the C=O group (1 mark)

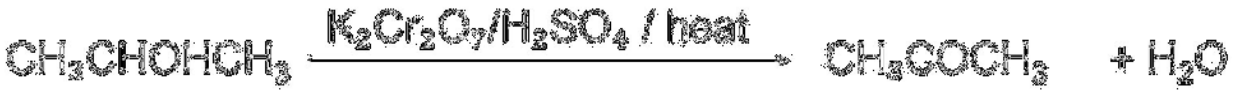
<u>Reagents: Oxidising agents</u>

The oxidising agents used to produce aldehydes and ketones from alcohols are acidified potassium dichromate (orange colour reduced to green) and acidified potassium manganate (purple colour reduced to colourless). (1 mark)

Aldehyde are synthesised by oxidation of primary alcohols as the equation below-

(1 mark)

Ketones are synthesised by oxidation of secondary alcohols as the equation below-



(1 mark)

End of paper

Learning Outcomes matrix

Question	Learning Outcomes / Assessment Criteria assessed	Marker can differentiate between varying levels of achievement
Section A		
1	4.1.1	Yes
2	5.1.1	Yes
3	5.2.1	Yes
4	5.2.4	Yes
5	5.2.5	Yes
6	5.2.7	Yes
7	5.3.1	Yes
8	5.4.1	Yes
9	5.4.4	Yes
10	5.4.5	Yes
11	5.5.1	Yes
12	5.5.2	Yes
13	5.5.3	Yes
14	5.6.1	Yes
15	5.8.1	Yes
16	7.1	Yes
17	7.3.1	Yes
18	7.3.4	Yes
19	7.6.1	Yes
20	7.6.3	Yes
21	6.4.1	Yes
22	6.1.2	Yes
23	6.7.1	Yes
24	6.7.5	Yes
25	6.10.2	Yes
Section B		
26	4.3.1	Yes
27	5.2.2	Yes
28	5.2.5	Yes
29	5.2.6	Yes
30	5.3.1	Yes
31	5.4.1	Yes
32	5.4.4	Yes
33	5.4.5	Yes
34	5.5.3	Yes
35	5.7.1	Yes
36	5.7.2	Yes
37	5.8.2	Yes
38	7.2.2	Yes
39	7.3.2	Yes
40	7.4.1	Yes
41	7.5	Yes

42	7.6.1	Yes
43	6.3.3	Yes
44	6.7.2	Yes
45	6.7.3	Yes
Section C		
46	4.2.2	Yes
47	5.2.3	Yes
48	5.4.2	Yes
49	7.2.3	Yes
50	6.5.4	Yes
51	6.8.1	Yes

Learning Outcome	Pass (40-59%)	Merit (60-69%)	Distinction (70-100%)
1.Be able to define, analyse and discuss the atom and its particles as well as isotopes, electrons, energy levels, atomic orbitals and ionisation energy.	Demonstrates an adequate awareness and understanding of concepts, terminology and processes with a reasonable discussion and application of principles and satisfactory reference to theory and science.	Demonstrates a consistent and accurate awareness and understanding of concepts, terminology and processes with a detailed discussion and application of principles and precise reference to theory and science.	Demonstrates an outstanding awareness and understanding of concepts, terminology and processes with a highly comprehensive and sophisticated discussion and application of principles and critical and meticulous reference to theory and science.
2.Be able to define, analyse and discuss atoms, molecules, stoichiometry and chemical bonding.			
3.Be able to define, analyse and discuss states of matter, energy changes in chemistry as well as electrochemistry and chemical equilibria.			
4.Be able to define, analyse and discuss the kinetics of reactions.			
5.Be able to recognise, analyse and discuss the Periodic Table and chemical periodicity with focus on Group 2 and Group 17 elements.			
6.Be able to recognise, analyse and discuss Hydrocarbons, compounds (Halogen, Hydroxy, Carbonyl), Esters,			

Carboxylic acids and their derivatives.			
7.Be able to recognise, analyse and discuss nitrogen compounds, polymerisation, organic synthesis and analytical techniques.			