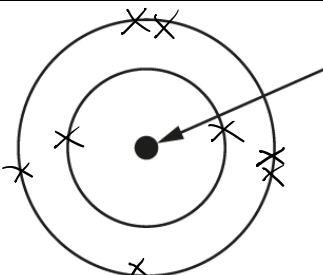


Chemistry 6092
TKSS Sec 4 Preliminary Examination 2026 Mark Scheme

Qn	Ans	marks
1	allow chemical formulae	
(a)	zinc	[1]
(b)	nickel	[1]
(c)	chlorine	[1]
(d)	hydrogen	[1]
(e)	zinc	[1]
2(a)	In lightbulbs / in the manufacture of steel <i>Accept: to provide an inert atmosphere for reactions to take place in</i> <i>Reject: to store ... / to replace nitrogen / to fill balloons</i>	[1]
(b)	Argon has a fully-filled <u>outermost electron shell</u> / has 8 electrons in the outer shell / has a stable electronic structure/arrangement Chlorine <u>gains</u> one <u>electron</u> (to give a full (outer) shell) <i>reject chlorine loses or gains electrons</i> <i>IGNORE argon does not gain/lose electrons IGNORE chlorine has 7 electrons in the outer shell alone / chlorine does not have a full outer shell / is missing an electron</i>	[1] [1]
(c)(i)	True False True False	[1] for every 2 correct
(ii)	Any 1 from: sodium / potassium / rubidium / caesium / francium <i>reject formulae</i>	[1]
3 a)	Particle X= cation / positive ion / copper ion / metal ion	[1] for both
i)	Particle Y = electrons	
ii)	X does not move AND Y moves	[1]
b) i)	The total percentage of elements does not add up to 100% (idea of calculation of all being less than 100%)	[1]
ii)	Wrong ratio (show calculations) Or Size of copper atoms is bigger than zinc in the diagram but from the table copper should be smaller	[1]
iii)	<u>Different sizes</u> ion/atoms disrupt the orderly arrangement of (copper) atoms.	[1]

Qn	Ans	marks
	<u>Layers</u> of atom/ions cannot easily slide over	[1]
(c)	zinc is more reactive than copper, zinc displaces copper from solution (forming orange coating)	[1]
	copper(II) ions decreasing / used up / reacted (causing paler blue solution)	[1]
	$\text{Zn} + \text{Cu}^{2+} \rightarrow \text{Cu} + \text{Zn}^{2+}$	[1]
(d)	Copper(II) <u>ion</u> is lower than hydrogen <u>ion</u> in the electrochemical series (thus preferentially discharged)	[1]
	Zinc ion higher than hydrogen ion in the electrochemical series	
	Reject zinc ion higher than copper(II) ion	
	Allow explanation in terms of reactivity of atom or tendency for ion to gain electron	
4 a)	They have same number of protons.	[1]
i)		
ii)	 nucleus containing: 8..... protons 10 neutrons	[1] correct protons and neutrons [1] electron arrangement
b)	Magnesium loses/transfers electrons to oxygen, forming magnesium ion and oxide ion. Ionic bond is formed due to strong electrostatic forces of attraction between the ions.	[1]
	Carbon shares electron with oxygen forming covalent bonds.	[1]
c i)	Graph intersects origin (0,0) AND Graph gradient is constant ($y = 2x$) OR When moles of oxygen doubled (1 to 2), the moles of element also doubles (2 to 4).	[1] for proving constant gradient or proportional

Qn	Ans	marks
		[1] quoting values from graph
ii)	0.9 mol of oxygen needed Mass of oxygen = $0.9 \times 32 = 28.8$ g	[1]
iii)	Beth. 1 mole of oxygen gas reacts with 2 moles of element.	[1]
5 a) i)	Propanoyl chloride , C_2H_5COCl $ \begin{array}{ccccccc} & H & & H & & O & \\ & & & & & & \\ H & -C & - & C & - & C & - Cl \\ & & & & & & \\ & H & & H & & & \end{array} $	[1] 2 correct [2] for all 3 correct
ii)	Each successive member differ by $-CH_2$ group / All have the same general formula of $C_nH_{2n+1}COCl$ / Same functional group, $COCl$	[1]
iii)	$C_8H_{17}COCl$	
b i)	Ethyl ethanoate	[1]
ii)	HCl Reject name	[1]
c) i)	C-O and O-H	[1]
ii)	The same number AND type of bonds are broken and formed. Energy <u>absorbed to break</u> bonds is <u>equal</u> to the <u>energy released to form</u> bonds	[1] [1] [1]
6 a) i)	Ester linkage	[1]
ii)	Water is formed / more than 1 product formed / monomer contains functional group at both ends.	[1]

Qn	Ans	marks																
b)	<table><tr><td></td><td>C</td><td>F</td><td>Br</td></tr><tr><td>Mass in 100g sample/g</td><td>10.8</td><td>17.1</td><td>72.1</td></tr><tr><td>No of moles</td><td>10.8/12 =0.9</td><td>17.1/19 = 0.9</td><td>72.1/80 =0.9013</td></tr><tr><td>Divide by smallest number</td><td>0.9/0.9 = 1</td><td>0.9/0.9 = 1</td><td>0.9013/0.9 =1.001</td></tr></table> Empirical formula = CBrF (any order)		C	F	Br	Mass in 100g sample/g	10.8	17.1	72.1	No of moles	10.8/12 =0.9	17.1/19 = 0.9	72.1/80 =0.9013	Divide by smallest number	0.9/0.9 = 1	0.9/0.9 = 1	0.9013/0.9 =1.001	[1] [1] [1]
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c i)	$n \begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ \text{C} = \text{C} \\ \quad \\ \text{H} \quad \text{CH}_3 \end{array} \rightarrow \left(\begin{array}{c} \text{CH}_3 \quad \text{H} \\ \quad \\ \text{C} - \text{C} \\ \quad \\ \text{H} \quad \text{CH}_3 \end{array} \right)_n$	[1] for equation [1] for correct polymer drawn																
b) i)	Both needs only 1 type of monomer. Any 2 from: In addition polymerisation, there is only 1 product while in condensation polymerisation there is more than 1 (or 2 products) In addition polymerisation, monomer contains C=C while in condensation polymerisation monomer has functional group at both ends. In addition polymerisation, the polymer has C-C linkage while in condensation polymerisation the polymer has ester linkage.	[1] [2]																
7a) i)	C/O⁻: +1 Cl⁻: -1	[1] [1]																
ii)	Colourless potassium iodide turns yellow/brown	[1]																
b)i)	There are more than 8 (valence) electrons around phosphorus atom	[1]																
ii)																		

Qn	Ans			marks
		structure	bonding	[2]: one column /row correct [3]: two columns /rows correct [4]: all three columns /rows correct
	NaCl/	giant ionic lattice	a lot of energy is needed to overcome strong electrostatic forces of attraction/ ionic bonds between ions	
	PCl ₅	simple covalent	little energy is needed to overcome weak intermolecular forces of attraction (between PCl ₅ molecules)	
	PVC	macro - molecular	little energy is needed to overcome weak intermolecular forces of attraction (between PVC molecules) OR intermolecular forces of attraction are stronger due to larger Mr OR melts over a range due to different chain lengths	
8 a)	As the particle radius increases, the time taken for dissolution increases. As particle radius increases, exposed surface area for collision decreases. Hence the frequency of effective collision is lowered, (so the rate of reaction is lowered/time taken for reaction to complete increases).			[1] [1]
b)	Acidity decreases AND Carbonic acid (formed from carbon dioxide and water) is reacted with mineral olivine			[1]
c)	SiO ₄ ⁴⁻			[1]

Qn	Ans	marks
d)	Energy level of product lower than reactant Downward single-headed arrow of enthalpy change approx. same length (both diagrams R and P level must be the same) Upward single-headed arrow of activation energy (smaller for reaction with enzyme) reaction without enzyme reaction with enzyme	[1] [1] ECF [1] ECF
e)	$\text{Mg}_2\text{SiO}_4(\text{s}) + 4\text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow 2\text{Mg}^{2+}(\text{aq}) + 4\text{HCO}_3^-(\text{aq}) + \text{SiO}_2(\text{s})$ Moles of CO_2 $= 48000 / 24$ $= 2000 \text{ mol}$ $\text{CO}_2 : \text{Mg}_2\text{SiO}_4$ $4 : 1$ $2000 \text{ mol} : 500 \text{ mol}$ Mass of $= 500 \times [2(24) + 28 + 4(16)]$ $= 500 \times 140$ $= 70\,000\text{g or } 70 \text{ kg}$	[1] [1] ECF [1] ECF
f i)	More particles have energy equal to or greater than the activation energy (so the frequency of effective collision increases)	[1]
ii)	Enzymes denatured / deformed	[1]

Qn	Ans	marks
9 a)	There is a <u>range</u> of boiling point Reject: does not have fixed mp/bp, data shows a range, also should not give negative response	[1]
b)	Crude oil is <u>boiled/ vaporised</u> Any 1 from: -Fractionating column is cooler at the top. -The fractions condense when temperature is lower than the boiling point. Any 1 from: - <u>Heavier</u> fractions/molecules with <u>higher</u> boiling point <u>condense</u> /collected at the <u>bottom</u> -Lighter fraction/molecules with lower boiling point condense/collected at the top.	[1] [1] [1]
c)	Hydrogen is a gas while diesel is a liquid. OR Particles in hydrogen are far apart while particles in diesel liquid are closely packed. For the same mass 1g, hydrogen occupies volume of 0.09 cm ³ while diesel occupies larger volume of 0.85cm ³	[1] [1]
d) i)	$2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$	[1]
ii)	State at least 1 advantage and 1 disadvantage: Any 3 from: Advantage of hydrogen over diesel: -obtained from water which is <u>renewable</u> resource while petrol comes from <u>limited</u> resource, crude oil. -only formed water which is <u>non-pollutant</u> while petrol form carbon dioxide which is <u>greenhouse gas</u> . Disadvantage of hydrogen over diesel: - occupies a large volume so large tank is required/not feasible -dangerous as hydrogen is highly flammable	[3]
10 a)	Cathode for both experiment:	[1] for each correct

Qn	Ans	marks
	$\text{Ag}^+ (\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$ Anode for experiment 1: $4\text{OH}^- (\text{aq}) \rightarrow \text{O}_2 (\text{g}) + 2\text{H}_2\text{O} (\text{l}) + 4\text{e}^-$ Anode for experiment 2: $\text{Ag}(\text{s}) \rightarrow \text{Ag}^+ (\text{aq}) + \text{e}^-$	equation (total 3m for 3 equations) [1] for state symbols for all equations
b i)	<u>White precipitate</u> formed, as <u>silver chloride / AgCl</u> formed is <u>insoluble</u>. $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}$ Or $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$	[1] [1]
ii)	Non-inert/ reactive <u>silver anode</u> in experiment 2 <u>oxidises</u> to form more silver ions or <u>replenishes silver ions</u>. AND <u>Inert carbon anode does not oxidise</u> to produce silver ions If no white ppt is formed, all the silver ions has been deposited / for expt 1 AND If white ppt is formed, silver ions still present in solution / for expt 2.	[1] [1]
c i)	Flow of electrons from zinc to silver direction	[1]
ii)	Magnesium / calcium / aluminium Reject group I metals	[1]