SOLUTION TO 5070/22/O/N/19

QUICK ACCESS GRID

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SECTION A: Q1		
	ANSWER	**NOTES**
a	O / S / Se	O / S /Se belong to group VI. They have 6 electrons in their outer shell. They tend to form ions of the type X^{2-} by gaining 2 electrons.
b	Cl	
c	I	I forms the I^- ion which reacts with aqueous Silver nitrate to form a precipitate of Silver iodide, AgI.
d	Al	Al is used to make food containers as it is resistant to corrosion.
e	N	

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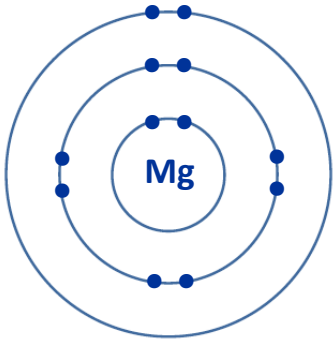
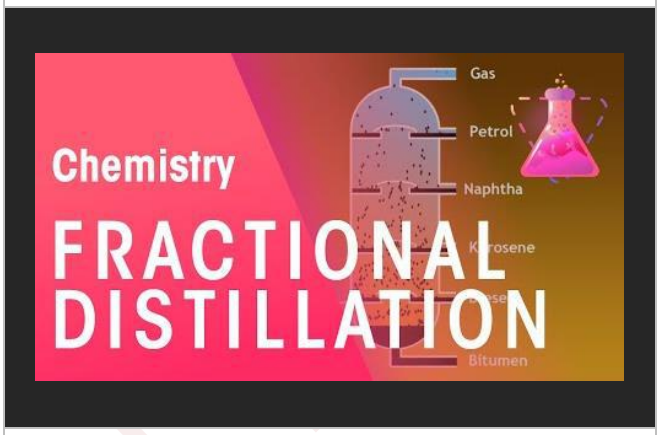
SECTION A: Q2

	ANSWER	NOTES
a	**Any two from:** • conducts electricity / conducts heat • malleable • ductile • shiny / lustrous	
b		
c (i)	Magnesium atom loses two electrons to form Magnesium ion, Mg^{2+}. Bromine atom gains an electron from Magnesium atom to form Bromide ion, Br^-. Magnesium ions and Bromide ions come close due to electrostatic attraction forming ionic bonds. One formula unit of Magnesium bromide consists of 1 Magnesium ion and 2 Bromide ions.	
		

SECTION A: Q2 continued from previous page		
	ANSWER	**NOTES**
c (ii)	high melting point / high boiling point **OR** does not conduct electricity when solid / conducts when molten / conducts in aqueous solution	Magnesium bromide is an ionic compound. Ionic compounds generally have high melting and boiling points. They do not conduct electricity in the solid state as the ions are not free to move. They can conduct electricity in molten state / aqueous solution as ions are free to move.
d	**product at anode:** Bromine (gas) **product at cathode:** Hydrogen (gas)	Magnesium is above Hydrogen on the reactivity series of metals. H^+ ions are therefore discharged at the cathode in preference to Mg^{2+} ions. Since concentrated aqueous Magnesium bromide is being used, bromide ions are discharged at the anode in preference to hydroxide ions.

SECTION A: Q2 continued from previous page		
	ANSWER	**NOTES**
e (i)	$2Br^- + Cl_2 \rightarrow 2Cl^- + Br_2$	$Cl_2\,(aq) + MgBr_2\,(aq)$ $\rightarrow MgCl_2\,(aq) + Br_2\,(aq)$ Ionic equation: $Cl_2 + Mg^{2+} + 2Br^- \rightarrow Mg^{2+} + 2Cl^- + Br_2$ Net ionic equation after eliminating the spectator ions (Mg^{2+}): $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$
(ii)	Chlorine is more reactive than Bromine.	A more reactive halogen can displace a less reactive halogen from its halide solution. Bromine is less reactive than Chlorine, hence no displacement reaction occurs.

SECTION A: Q3

	ANSWER	NOTES
a	Petroleum (crude oil) can be separated into useful fractions by fractional distillation. It is vaporised by heating to a high temperature. The vaporised mixture is led into the fractionating column. The fractions have different boiling points. They start condensing at different levels as they rise up the column. The fractions with higher boiling points condense at the bottom while the ones with lower boiling points come off from the top of the column.	
b	**kerosene:** (fuel) for aircraft engines / (fuel) for heating / (fuel) for cooking **naphtha:** feedstock for chemical industry	
c (i)	Alkanes	
(ii)	C_nH_{2n+2}	
d (i)	CO is formed by the incomplete combustion of diesel (hydrocarbons) when burnt in limited oxygen or air supply.	
(ii)	CO is toxic and can cause poisoning in humans.	CO combines with haemoglobin in preference to Oxygen and lowers the Oxygen carrying capacity of blood.

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SECTION A: Q4		
	ANSWER	**NOTES**
a	The gas can be collected in a gas syringe. The volume of gas collected can be measured at regular time intervals to determine the reaction rate.	
b	The surface area of Calcium carbonate increases when smaller particles are used. The number of reacting particles per unit volume increases. More collisions occur per unit time resulting in faster reaction.	
c	The rate of a reaction increases when the temperature is increased. At a higher temperature, the reacting particles gain energy, start moving faster and collide more often. The collision rate increases. The proportion of reacting particles that collide with an energy ≥ activation energy also increases.	
d	Volume of CO_2 = 16.8 cm^3 = 0.0168 dm^3 n (CO_2) = $\frac{0.0168}{24}$ = 0.0007 **mole ratio** 1 $CaCO_3$: 1 CO_2 n ($CaCO_3$) = 0.0007 Mass of $CaCO_3$ = 0.0007 × 100 = 0.0700 g	1 dm^3 = 1000 cm^3 Molar gas volume at room temperature and pressure = 24 dm^3 Molar mass of $CaCO_3$ = 40 + 12 + 3 × 16 = 100 g

SECTION A: Q4 (continued from previous page)		
	ANSWER	**NOTES**
e	**Test:** bubble the gas through limewater **Result:** limewater turns milky	Limewater = aq. $Ca(OH)_2$ When CO_2 is bubbled through limewater, $CaCO_3$ gets precipitated turning the limewater milky.
f	Calcium hydroxide is alkaline / basic. It neutralises the acids present in soil making it less acidic.	

SECTION A: Q5		
	ANSWER	**NOTES**
a (i)	the melting point of sodium: 100°C the atomic radius of rubidium: 0.290 nm	**Acceptable range of values:** the melting point of sodium: values from 70°C to 170°C the atomic radius of rubidium: values from 0.240 nm to 0.320 nm
(ii)	No trend is seen in the values of relative thermal conductivity. The values increase and then decrease making it difficult to predict the relative thermal conductivity of Potassium.	
b (i)	$4Na + O_2 \rightarrow 2Na_2O$	
(ii)	**type of oxide:** basic oxide **reason:** Metal oxides are generally basic. Sodium is a metal.	
c	Copper does not form ions as easily as Sodium.	Sodium is more reactive than Copper. A more reactive metal loses electrons more readily than a less reactive metal.

SECTION A: Q5

(continued from previous page)

	ANSWER	NOTES
d	Relative molecular mass of $NaIO_3$ = 23 + 127 + 16 × 3 = 198 Mass of water in 288 g of hydrated Sodium iodate (V) = 288 – 198 = 90 g n (H_2O) = $\frac{90}{18}$ = 5 **mole ratio** 1 mol of $NaIO_3$: x mol of H_2O x = 5	Molar mass of water = 18 g

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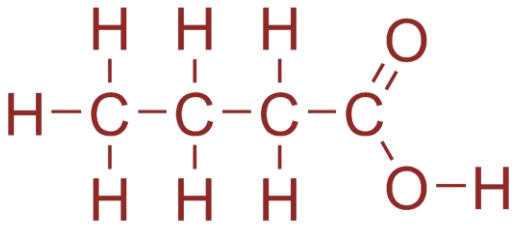
SECTION B: Q6

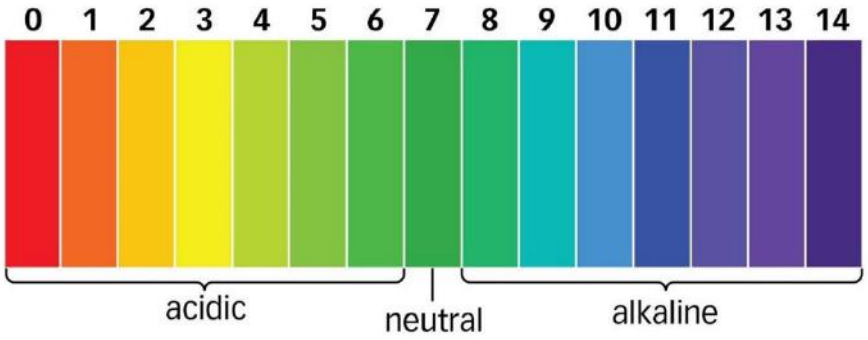
	ANSWER	NOTES
a		
b	**arrangement:** In liquid Butanoic acid, the particles are held closely, although in a disordered / random way. **movement:** The particles slide over each other.	
c	liquid 0°C is above the melting point and below the boiling point of Butanoic acid.	
d	V (Na_2CO_3) = 56.0 cm^3 = 0.056 dm^3 n (Na_2CO_3) = 0.056 × 0.500 = 0.028 Molar mass of Butanoic acid = 88 g n (C_3H_7COOH) = $\frac{5.28}{88}$ = 0.06 **mole ratio** 1 Na_2CO_3 : 2 C_3H_7COOH 0.028 Na_2CO_3 : 0.056 CH_3COOH 0.056 < 0.06 C_3H_7COOH is therefore in excess.	1 dm^3 = 1000 cm^3 Molar mass of Butanoic acid = 12 × 4 + 1 × 8 + 16 × 2 = 88 g

SECTION B: Q6

(continued from previous page)

	ANSWER	NOTES
e	$Mg + 2C_3H_7COOH \rightarrow (C_3H_7COO)_2Mg + H_2$	
f	The pH can be determined using a Universal indicator. The colour observed can be matched with a colour chart.	

UNIVERSAL INDICATOR COLOUR CHART



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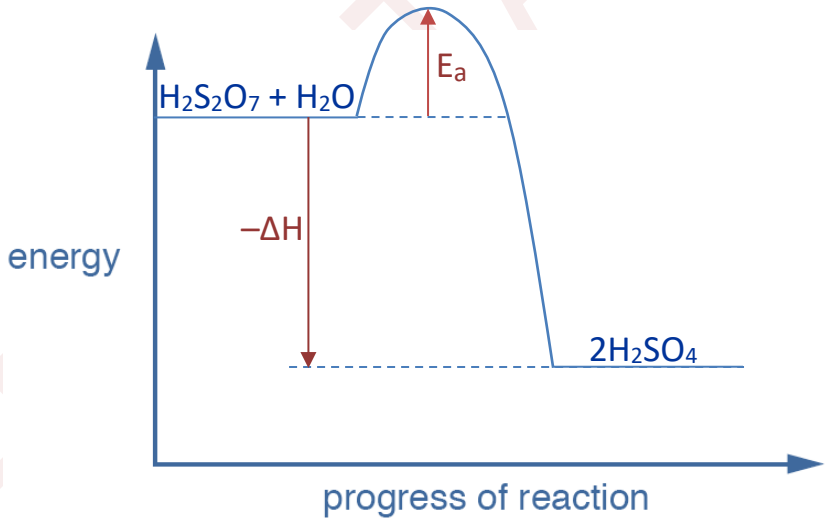
SECTION B: Q7

	ANSWER	NOTES
a	Vanadium(V) oxide	
b (i)	The equilibrium shifts to the left as the forward reaction is exothermic.	Increase in temperature favours the endothermic reaction (more than the exothermic reaction). In this case, the backward reaction is endothermic.
(ii)	Increase in pressure favours the side with fewer moles of gas. The equilibrium shifts to the right.	
c	↓	
		
d	Sulfur / Water	
e	(making) detergents / fertilisers / battery acids	

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SECTION B: Q8		
	ANSWER	**NOTES**
a (i)	number of electrons: 15 number of neutrons: 16 number of protons: 15	$^{31}_{15}P$ 31 → Nucleon number 15 → Proton number In an atom, number of protons = number of electrons Number of neutrons = nucleon number – proton number
(ii)	Isotopes are atoms of the same element with the same number of protons and different numbers of neutrons.	
b	$5KClO_3 + 6P \rightarrow 5KCl + 3P_2O_5$	
c	$H_5P_3O_{10}$	Simply count the number of atoms of each type to deduce the molecular formula.

SECTION B: Q8

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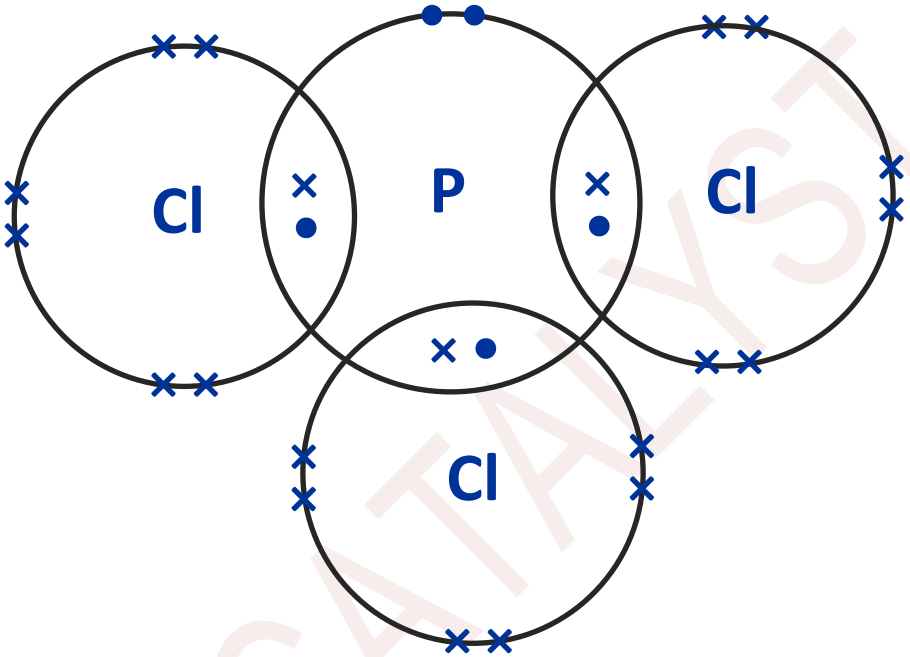
	ANSWER	NOTES
d	↓	
		
e	**oxidising agent:** Cu^{2+} **explanation:** It gets reduced to Cu by gaining electrons	An oxidising agent brings about oxidation of other chemical species but itself gets reduced.

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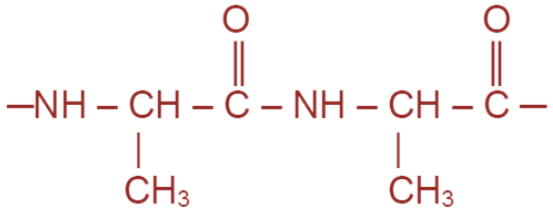
SECTION B: Q9		
	ANSWER	**NOTES**
a	Complex carbohydrates / fats	
b	Proteins can be hydrolysed to carboxylic acids by heating strongly under reflux with dilute Hydrochloric acid.	
c		
d	**linkage:** ester **explanation:** an ester linkage is formed by condensation reaction between –OH and –COOH groups. A water molecule is eliminated per linkage formed.	–OH + –COOH → –COO– + H_2O
e (i)	Ink will dissolve in the solvent used and undergo chromatographic separation unlike the pencil which is insoluble in the solvent.	
(ii)	A locating agent is needed to locate the colourless spots by producing a colour.	Amino acids are colourless. A locating agent is needed to make the spots visible. It reacts with the separated amino acids and produces a colour.

SECTION B: Q9

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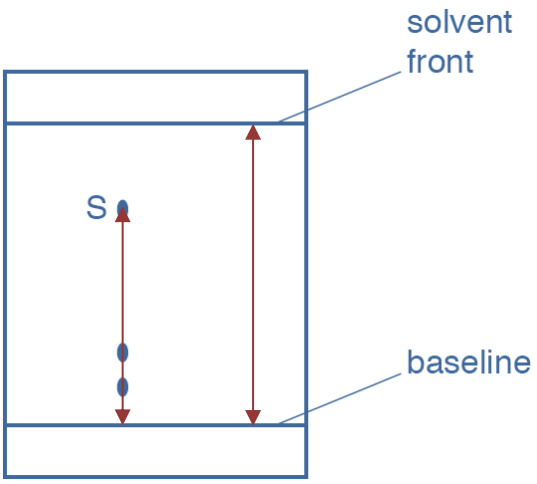
	ANSWER	NOTES
e (iii)	R_f value = 0.71 **NOTE:** The measured distances may differ in printed copies of the script. The ratio would remain unaffected.	 Distance travelled by solvent = 4 cm Distance travelled by solute = 2.9 cm R_f value = 4 ÷ 2.9 = 0.725

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