UNITY SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2019
SECONDARY 4 CHEMISTRY

Paper 1

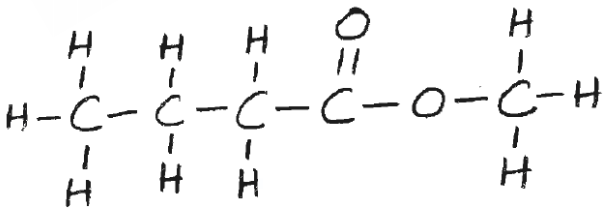
1	A	11	A	21	C	31	D
2	D	12	B	22	A	32	C
3	A	13	B	23	D	33	D
4	C	14	D	24	D	34	A
5	D	15	C	25	C	35	A
6	C	16	B	26	D	36	B
7	B	17	A	27	C	37	D
8	D	18	D	28	B	38	D
9	C	19	D	29	A	39	B
10	A	20	B	30	A	40	B

Paper 2

A1	ai	Br	1
	ii	P	1
	iii	N or H	1
	b	P – brown gas is seen	1
		Q – purple fumes/vapour seen	1
		R – purple-black solid condensed on surface of tube	1
	c	Arsenic acid being a weak acid ionises to form a few hydrogen ions only. At any time, there are only a few hydrogen ions colliding with the magnesium ribbon causing little reaction. Lesser number of colissions result in a lower proabability of effective colissions with magnesium. Thus rate of reaction is slow.	1 1
A2	a	49.2 g of calcium nitrate Number of mol = 49.2/164 = 0.3 0.3 mol of calcium nitrate produces 0.6 mol of NO_2 and 0.15 mol of O_2. Total volume of gases = (0.6 + 0.15) x 24 dm^3 = 18 **dm^3**	1 1
	b	+5	1

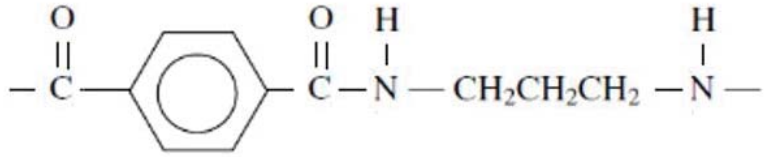
	c	Oxidation state of nitrogen in calcium nitrate (+5) decreased to +4 nitrogen dioxide; decrease in oxidation state; so reduced	1 1
A3	ai	Argon	1
	ii	1375 kJ/mol [Range: 1300 – 1400 kJ accepted]	1
	iii	The two valence electrons of magnesium is in the third shell that is further away from nucleus as compared to beryllium's valence electron in second shell which is nearer to the nucleus. Hence, attraction between the valence electron and the positively charged nucleus is **less strong in magnesium** and needs lesser ionization energy.	1 1
	b	Should be the same; as the difference between the two isotopes is only the number of neutrons. The number of protons is the same and hence the attractive force will be the same.	1
A4	a	Na_3PO_4	1
	b	H_3PO_4 + 3NaOH → Na_3PO_4 + $3H_2O$	1
	ci	Number of mol of H_3PO_4 = 0.05 x 1 = 0.05 mol 0.05 mol acid → 0.05 mol of sodium phosphate Mass of sodium phosphate = 0.05 x 164 = **8.2 g**	 1 1
	ii	Pour the solution into an evaporating dish and heat it till the saturation point. Let the hot saturated solution to cool for crystals to form. Filter to get the crystals, rinse with distilled water and dry by pressing between filter papers.	1 1 1
A5	a	y-axis : Volume of hydrogen gas/ cm^3	1
	b	The volume of hydrogen gas produced is double that of expt 1. Since zinc is the limiting reactant, they used double the mass of zinc; 0.52 g of zinc was used	1 1
	c		1

		Copper(II) sulfate could have acted as a catalyst; which makes the rate of reaction faster as indicated by a steeper gradient. Some zinc could have reacted with the copper(II) sulfate in displacement reaction; thus less zinc reacted with the acid. Hence the volume of hydrogen is lesser.	1
	d	Zinc being more reactive than iron, provides sacrificial protection to iron. It corrodes by reacting with the oxygen and protects the iron.	1
A6	ai	Electron flow from zinc to copper in the wire	1
	ii	$Zn\ (s) \rightarrow Zn^{2+}\ (aq) + 2e^-$ Zinc is more reactive than copper so it loses electrons easily to form zinc ions.	1 1
	bi	Ammeter will record a lower reading than that for zinc. This is because iron is closer to copper in the reactivity series as compared to zinc and copper.	1 1
	ii	The container will have a light green solution whereas it was colourless when zinc was used.	1
A7	a	Ethanol burns in oxygen to form carbon dioxide and water. In this combustion reaction, the energy needed to break the bonds (C-C, O-H, C-H,) in ethanol and oxygen molecules (O=O) is **much lower than** the energy released in forming the bonds (C=O) in carbon dioxide and (O-H) bonds in water; hence the enthalpy change is negative.	 1 1
	bi	From the table, 1 mol of ethanol gives out 1370 kJ of energy. 1370 kJ of energy from 1 mole 200 kJ of energy will come from = 1/1370 x 200 = 0.146 mol of ethanol No of mol of CO_2 produced = 0.146 x 2 =0.292 Volume of CO_2 = 0.292 x 24 dm^3 = **7.01 dm^3**	 1 1
	bii	 1 mol of octane gives out 5510 kJ of energy. 5510 kJ of energy from 1 mole	 1

		200 kJ of energy will come from = 1/5510 x 200 = 0.0363 mol of octane No of mol of CO_2 produced = 0.0363 x 8 = 0.290 Volume of CO_2 = 0.290 x 24 dm^3 = **6.97 dm^3**	1
	c	Ethanol is **not necessarily a greener fuel** because it produces slightly more carbon dioxide than octane in combustion when the same amount of energy is released.	1
A8	ai	It refers to a group of organic compounds having similar chemical properties and the same functional group.	1
	ii	Ethanoyl chloride will have a higher boiling point than methanoyl chloride. This is because ethanoyl chloride is a bigger molecule and there are stronger forces of attraction between the molecules as compared to that in methanoyl chloride.(smaller molecule)	1 1
	iii		
	b	Name of ester: **methyl butanoate** Structure: 	

B9	ai	Silica / SiO_2 ;	1
	ii	Silica has a giant molecular structure where all the silicon and oxygen atoms are held together by a network of strong covalent bonds.; A lot of energy is required to overcome these bonds, hence, it can withstand high heat.;	1 1
	b	Potash is more thermally stable ; because K is a more reactive metal than Na and forms a more stable compound with oxygen.	1 1
	ci	Potassium salt is an ionic compound and ions are held by strong electrostatic forces of attraction. ; Only in the molten state will the ions be free to move / mobile. ; hence the temperature is high	1 1
	ii	The potassium ions have a larger ionic radii of 142 x 10^{-12} m while the sodium ions only have an ionic radii of 116 x 10^{-12} m. ; potassium ions fills up the structure and prevents the atoms (and ions) in the glass from moving/sliding easily, hence increasing its strength. ; Accept: - K^+ ions were larger / larger ionic radii than Na^+ ions - Reduces the empty spaces between particles / limits movement between particles.	1 1
	iii	Silicon dioxide is the main component in the Gorilla glass and is an acidic oxide that reacts with an alkali. ;	1
B10	ai	Anode: $2Cl^-$ (aq) → Cl_2 (g) + $2e^-$ Cathode: $2H^+$ (aq) + $2e^-$ → H_2 (g)	1 1
	ii	Bubbles of gases (yellow-green) will be seen at anode	1 1

		This is because although both chloride and hydroxide ions are attracted to the anode, it is the chloride ions that are preferentially discharged due to its higher concentration Bubbles of gas (colourless) also formed at cathode This is because although hydrogen ions and sodium ions are attracted to the cathode, due to the ease of discharge, hydrogen ions are preferentially discharged.	1 1
	bi	Number of mol of oxygen gas = 6/24 = 0.25 mol $4OH^-$ (aq) → $2H_2O$ + O_2 + $4e^-$ When 1 mol of oxygen is formed at anode, 4 mol of e are lost. Since only ¼ mol of oxygen is formed, only 1 mol of e are lost. Cu^{2+} (aq) + $2e^-$ → Cu (s) From this, 1 mol of e can only produce ½ mol of Cu Mass of copper formed = ½ x 64 g = 32 g Ag^+ (aq) + e^- → Ag (s) 1 mol of e can produce 1 mol of silver Mass of silver formed = 108 g	1 1
	ii	The blue solution turned colourless when all the copper ions had been discharged from the solution. Or Reddish-brown solid is formed at cathode as copper ions are being discharged to form copper metal.	1 1
B11		**Either**	
	a	The compound X is methanol. Concentrated sulfuric acid is needed as a catalyst and the mixture must be heated.	1 1
	bi	Monomer D	1
	ii	Monomer B which has C=C bonds in it. It undergoes addition polymerisation where atoms are not lost.	1
	ci	Monomer A and C	

			1
	ii	It has amide group in it with nitrogen atoms; on burning it may form the harmful gases, nitrogen monoxide and nitrogen dioxide. These nitrogen oxides may give rise to the formation of acid rain that corrodes buildings and affects vegetation.	1 1
	d	Adding some **bromine solution** separately into all the four solutions. Only **monomer B, having the C=C bond, will decolourise** the red-brown iodine solution. Add **acidified potassium manganite(VII)** solution to the three remaining solutions and heat. **Monomer D**, having the hydroxyl group, will get oxidised and there will be a colour change in the solution. **Purple solution will turn colourless**. In the remaining two solutions, add a piece of **magnesium ribbon**. The one which **produces bubbles of gas** will be **monomer A** as it is an acid. The monomer which does not react in all the three reactions above is monomer C.	1 1 1
B11		**OR**	
	a	Coke is essential in the blast furnace for the following two reactions. Firstly, coke is needed to burn in oxygen to form carbon dioxide. $C + O_2 \rightarrow CO_2$ Secondly, it is needed to reduce carbon dioxide to carbon monoxide. $CO_2 + C \rightarrow 2CO$ We need this carbon monoxide because, carbon monoxide will reduce the iron(III) oxide in haematite to produce iron. $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$	 1 1 1 1
	b	Order of reactivity: lead, iron, metal X (least reactive to most reactive) In beaker 1, iron displaces lead; iron is more reactive. In beaker 3, X displaces iron, metal X is more reactive than iron.	1 1 1

		In beaker 2, lead cannot displace X; as X is most reactive	
	ci	Fe^{2+} (aq) + $2OH^-$ (aq) → $Fe(OH)_2$ (s)	1
	ii	The brown solid is iron(III) hydroxide. It is formed when green iron(II) hydroxide gets oxidised to brown iron(III) hydroxide by the atmospheric oxygen.	1 1