Singapore Chinese Girls' School
Science Department
Preliminary Examinations 2020
Chemistry (6092) - Answer Key

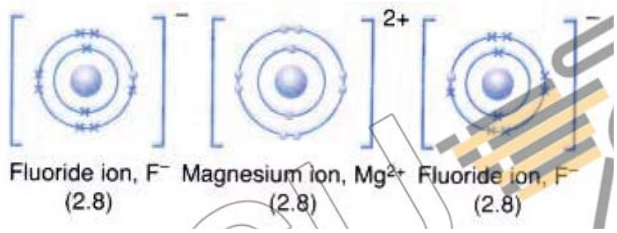
Paper 1

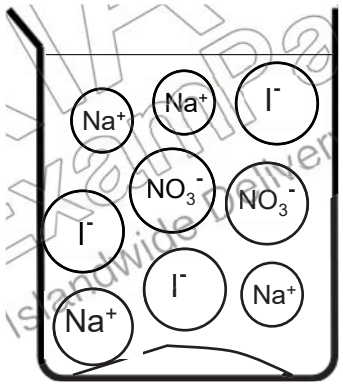
1.	D	**11.**	B	**21.**	A	**31.**	B
2.	A	**12.**	D	**22.**	C	**32.**	D
3.	A	**13.**	B	**23.**	B	**33.**	C
4.	C	**14.**	C	**24.**	C	**34.**	B
5.	C	**15.**	A	**25.**	B	**35.**	A
6.	D	**16.**	D	**26.**	B	**36.**	D
7.	B	**17.**	A	**27.**	D	**37.**	D
8.	C	**18.**	D	**28.**	B	**38.**	A
9.	B	**19.**	A	**29.**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

Singapore Chinese Girls' School
2020 Preliminary Exam
Secondary 4 OLP Chemistry

Section A [50 MARKS]

A1	(a) (b) (c) (d) (e)		Neutralisation Oxidation/Ionisation Decomposition Ionisation Reduction/Displacement	5
A2	(a)		Carry out **evaporation to dryness**. If dissolved salts are present **a residue/solid will be left behind**.	1
	(b)		Water molecules are small enough to pass through the membrane but the ions are too large. Or Neutral water molecules can pass through but not the charged ions.	1
	(c)	(i) (ii) (iii)	**Food colour B** is the least soluble in ethanol. Black food colouring contains 3 food colours – **food colours A and E** and **one unknown food colour**. R_f value of food colour C = **2.1/2.0 ÷ 5.0/5.1** = 0.39 - 0.41 **Food colour C could be Fast red.**	1 2 2
A3	(a)		1. HF has a low melting/boiling point 2. HF is a gas at room temperature. 3. Pure HF is a non-conductor/ (aqueous) HF conducts electricity in aqueous state 4. Soluble in organic solvents	2
	(b)	(i)	Hydrofluoric acid **partially ionises in water to form hydrogen ions** as its only positive ions $HF \rightleftharpoons H^+ + F^-$	2

		(ii)	$Mg + 2HF \rightarrow MgF_2 + H_2$ No. of moles of HF = 0.200 ÷ (1 + 19) = 0.01 No. of moles of H_2 = 0.01 ÷ 2 = 0.005 Volume of H_2 = 0.005 x 24 = 0.120 dm^3 or 120 cm^3	2
		(iii)	Magnesium fluoride has an **ionic structure/ionic crystal lattice structure** with **strong electrostatic forces of attraction between** the magnesium and fluoride (oppositely charged) **ions**. A **lot of energy is needed to break the forces** hence a high melting point.	2
		(iv)		2
A4	(a)		Colourless solution turns brown/yellow brown.	1
	(b)		Increasing the concentration of peroxodisulfate ions increases the relative rate of reaction. This can be seen in Expts 1, 2 and 3. While the concentration of peroxodisulfate ion increased from ….to …., relative rate of reaction increased from … to …. (concentration of iodide ions remained constant)	1
	(c)		The sulphur in the peroxodisulfate ion/peroxodisulfate ion is reduced as the oxidation state of sulfur decreased from +7 to +6. Iodine/iodide ion is oxidised as the oxidation state of iodine increased from -1 to 0. Since oxidation and reduction occurs, the reaction is a redox reaction.	2
	(d)		Catalyst increase rate of a reaction by **providing an alternative pathway with a lower activation energy.**	1
	(e)		Test: Add aqueous sodium hydroxide (until no further change/in excess) to the solution. Observation: Red-brown precipitate formed (precipitate insoluble in excess aqueous sodium hydroxide)	2

	(f)		$S_2O_8^{2-} + 2Fe^{2+} \rightarrow 2Fe^{3+} + 2SO_4^{2-}$	1
A5	(a)		$Pb(NO_3)_2 + 2NaI \rightarrow PbI_2 + 2NaNO_3$	1
	(b)		No of moles of $Pb(NO_3)_2$ = 1.50 ÷ (207 + 28 + 96) = 0.0045317 No of moles of NaI = (125 ÷ 1000) x 0.1 = 0.0125 From equation, 2 moles NaI reacts with 1 mole of $Pb(NO_3)_2$. Therefore 0.0125 mol of NaI reacts with 0.00625 mol of $Pb(NO_3)_2$ but there are only 0.0045317 mol of $Pb(NO_3)_2$. Therefore $Pb(NO_3)_2$ is the limiting reactant.	2
	(c)		No of moles of nitrate ions in 125 cm^3 = 2 x 0.0045317 = 0.0090634 Therefore concentration of nitrate ions (no of moles in 1 dm3) = 0.0090634 ÷ (125 ÷ 1000) = 0.0725072 = **0.0725 mol/dm^3 (3 sf)**	2
	(d)			1
	(e)		**Excess lead(II) oxide is added to nitric acid.** **Filter** the mixture to obtain the **filtrate**. **Heat filtrate to saturated** and **allow to cool**. **Collect/filter to obtain crystals** and **dry crystals between filter paper.**	3

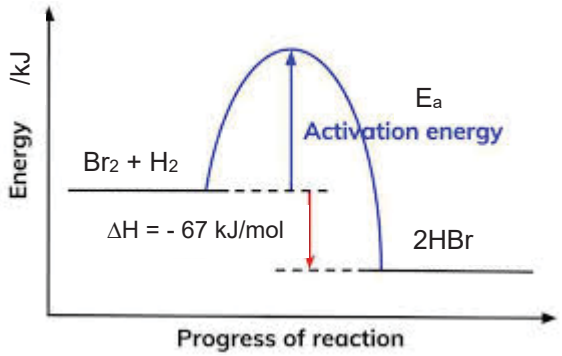
<table>
<tr><td>A6</td><td>(a)</td><td></td><td>Graphite has a giant covalent/macromolecular structure where each carbon atom is bonded to three other carbon atoms
So one valence electron per atom is not utilised in bonding/ only three out of the four electrons per carbon atom are used in bonding. Mobile electrons present to conduct electricity.</td><td>2</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Solution X is sodium hydroxide

At the cathode, hydrogen ions are preferentially discharged as they are less stable/gain electrons more readily than sodium ions.

At the anode, chloride ions are preferentially discharged as they are present in much greater concentration than hydroxide ions.
Since the hydrogen and chloride ions are discharged, hydroxide and sodium ions are left in the electrolyte. (OWTTE)</td><td>3</td></tr>
<tr><td>A7</td><td>(a)</td><td></td><td><table><tr><td></td><td>Potassium iodide</td><td>Calcium nitrate</td><td>Ammonium sulfate</td></tr><tr><td>Test with acidified silver nitrate</td><td>(Pale) Yellow precipitate formed</td><td>No change observed</td><td>No change observed</td></tr><tr><td>Test with acidified barium chloride</td><td>No change observed (1m for both)</td><td>No change observed (1)</td><td>White precipitate formed (1)</td></tr></table></td><td>3</td></tr>
<tr><td></td><td>(b)</td><td></td><td>Yes I agree.
<table><tr><td></td><td>Potassium iodide</td><td>Calcium nitrate</td><td>Ammonium sulfate</td></tr><tr><td>Test with aqueous NaOH</td><td>No change observed/No visible reaction/No precipitate formed (1)</td><td>White precipitate formed. (1)</td><td>No precipitate formed. On warming, (colourless, pungent) gas evolved turns moist red litmus blue (1) (ammonia gas evolved)</td></tr></table></td><td>3</td></tr>
</table>

Section B [30 MARKS]

B8	(a)		**Reacts moderately/slowly in sunlight**. (Does not react in the dark)		1
	(b)		Reaction is slow so **platinum is added as a catalyst.**		1
	(c)		As the **bond length of the hydrogen halide increases** the **bond energy decreases.** **Since the bond length of the HI bond is the longest, the bond energy is the lowest/bond strength is the weakest so HI is the least stable/decomposes most readily**.		2
	(d)		**With HCl there will be no visible change.** **With HI, a purple vapour will be seen.** (HCl does not decompose easily on heating but HI does to form iodine vapour)		2
	(e)	(i)	$H_2 + Br_2 \rightarrow 2HBr$ Energy absorbed to break bonds = 432 + 193 = 625 kJ Energy released to form bonds = 2 x 346 = 692 kJ Enthalpy change = 625 – 692 = - 67 kJ/mol		2
		(ii)	The **reaction is exothermic** as the enthalpy change is negative. **Energy released when bonds of hydrogen bromide are formed is greater than energy absorbed when bonds of hydrogen and bromine are broken.** So excess energy is released as heat.		2

		(iii)			2
B9	(a)		Energy released = (1 ÷ 1.2) x 24.36 = 20.3 kJ		1
	(b)		**Heat is lost to the surroundings** will cause the **temperatures recorded to be lower than the actual temperatures/ calculated energy released lower than actual.**		1
	(c)	(i)	**Incomplete combustion of the fuels produces soot/carbon.**		1
		(ii)	**Lower percentage of carbon** in hexane compared to hexene.		1
	(d)		1. **Highest amount of energy released per gram** 2. **Least smoky flame**		2
	(e)		Advantage: Hydrogen **burns to produce only water which is a non-pollutant** while (incomplete) combustion of petrol produces carbon monoxide which is a pollutant. Or Combustion of petrol **produces carbon dioxide and water and therefore produces more greenhouse gases and contributes more to global warming than hydrogen which produces only water when burned.** Or Hydrogen **produces more energy per gram than petrol.** Or **Hydrogen is obtained from water which is a renewable resource while petrol is obtained from crude oil, a finite/non-renewable resource.** Disadvantage: **Hydrogen is a gas at room temperature** so takes up a lot of space. **Needs to be pressurised and so special conditions/containers**		2

			needed to store/ transport the fuel. **Petrol is a liquid** and can be easily transport/stored.		
B10E	(a)		The **mass of iron decreases/ graph shows a decreasing trend** as the **iron reacts with the bromine solution to form soluble/aqueous iron bromide** The **gradient of the curve becomes gentler/less steep as the rate of reaction decrease** as **the reactants are used up/concentration of bromine and mass/surface area of Fe decrease.** The **gradient becomes zero/graph plateaus/ becomes horizontal** as **the reaction stops when the aqueous bromine is used up/all reacted.**		3
	(b)		**The rate would increase**. A sheet of iron metal provides a **greater surface area of iron** for reaction with the bromine.		2
	(c)		A **higher concentration** of 0.1 mol/dm^3 means the solution contains a **greater number of particles per unit volume** (than the 0.05 mol/dm^3 solution). Particles are closer together so **frequency of collisions increases and frequency of effective collisions increases.** So **rate of reaction increases** and there is a greater loss in mass in one minute.		2
	(d)		Loss in mass of iron = 1 – 9 mg **Rate of reaction would be slower** as **iodine is less reactive than bromine**.		1
	(e)		**No of moles of bromine gas = 1200 ÷ 24000** **= 0.05** $2Fe + 3Br_2 \rightarrow 2FeBr_3$ **No of moles of iron** = (**0.05 ÷ 3) x 2** **= 0.03333** Mass of Fe reacted = **0.03333 x 56** **= 1.87g** (3sf)		2
B10 O	(a)		Ethanol **evaporates more easily/faster** than water.		1

	(b)		Cu (s) - 2e → Cu^{2+} (aq)		2
	(c)	(i)	**Copper(II) ions are preferentially discharged as copper(II) ions are less stable/gain electrons more readily than hydrogen ions.** **Copper is deposited on the cathode** so electrode B increases in mass.		1
		(ii)	Increase in mass at electrode B = 8.25 – 7.95 = 0.30g Theoretical value x = 8.78 – 0.30 = **8.48**		1
		(iii)	Electrode A was **impure/contained impurities**. (Mass lost was higher than expected because impurities fell to the bottom of the container)		1
	(d)		Half equation at electrode B: **Cu^{2+} + 2e → Cu** **64 g of Cu is produced by 2 mole of electrons** 0.3 g of Cu produced by (0.3 ÷ 64) x 2 = 0.00938 moles of electrons = 0.00938 F		2
	(e)		When a graphite anode is used, **the anode shows no decrease in mass/size. Instead effervescence is seen at the anode**. Explanation: **Anode is made of inert material and will not ionise but instead hydroxide ions are preferentially discharged as the ions are less stable than the sulfate ions and oxygen is produced**		2