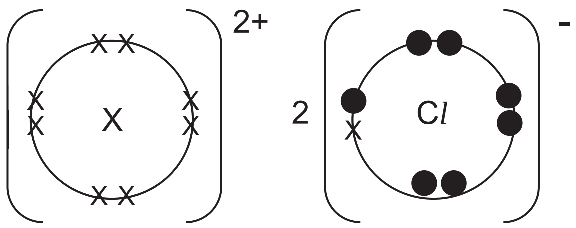
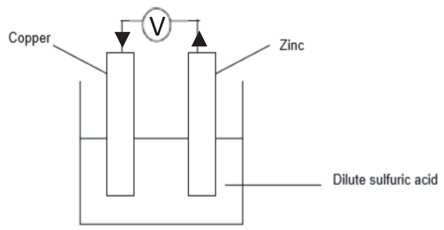
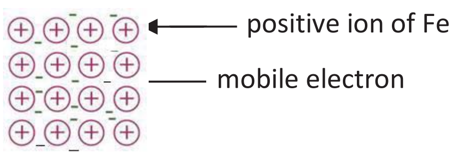
Geylang Methodist School (Secondary)
Prelim 2019
4Exp Chemistry 6092

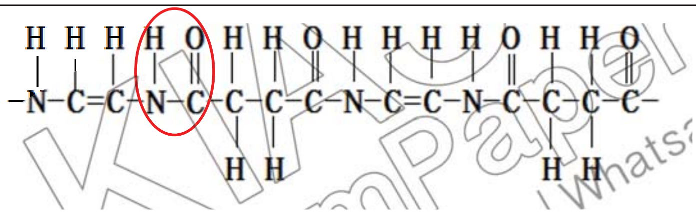
Paper 1

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

Paper 2

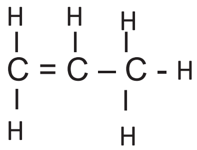
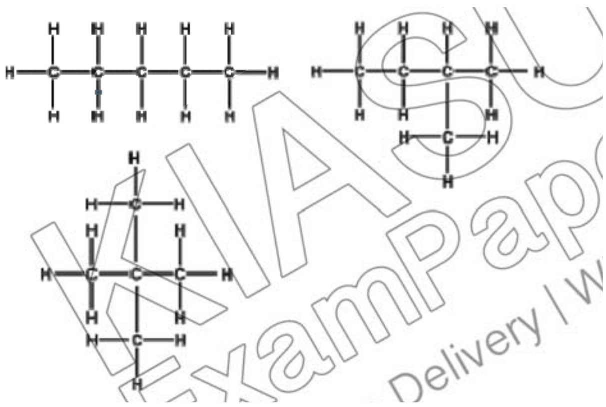
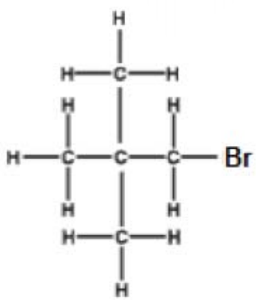
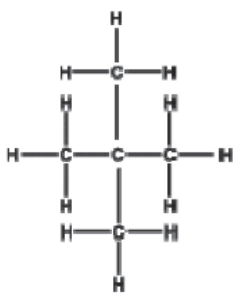
Section A (50 marks)		
A1		Marks allocation
(a)	B	1
(b)	C, D and E	3
(c)	A	1
(d)(i)	Blue precipitate forms. Blue precipitate dissolves in excess aqueous ammonia to form a dark blue solution.	1 1
(ii)	Y^{2+} (aq) + $2OH^-$ (aq) → $Y(OH)_2$ (s)	1 for correct ionic eqn 1 for correct state symbols
A2		
(a)(i)	C	1
(ii)	N	1
(iii)	K	1
(iv)	Ca	1

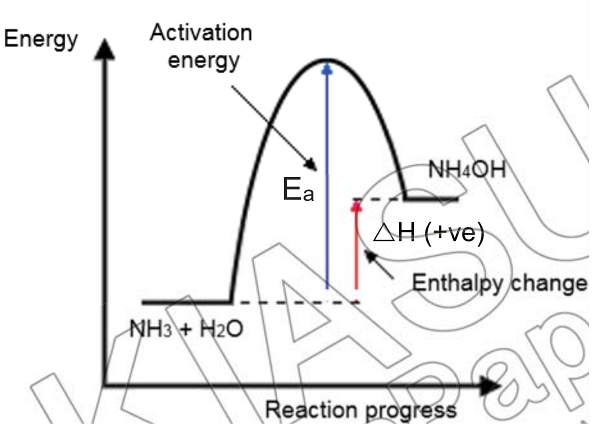
(b)	 Legends: X : electron for X atom ● : electron for Cl atom	1 for X^{2+} ion 1 for Cl^- ion
A3 **(i)**		1
(ii)	$Zn(s) \rightarrow Zn^{2+}(aq) + 2e$	1 for balanced ionic half equation 1 for correct state symbols
(b)(i)	The voltmeter reading will be **lower than that with zinc**. **Iron is below zinc** in the **reactivity series**. Hence, the **closer the metals are in the reactivity series**, the **smaller** the difference in voltage across the two electrodes.	1 1
(ii)	Colourless solution will turn pale green.	1
A4 **(a)**	Y, Z, X, W, V	1
(b)	**(i)** Electrolysis of molten ionic compound of Z. **(ii)** Calcium **(iii)** $Z + 2H_2O \rightarrow Z(OH)_2 + H_2$ or $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$	1 1 1
(c)		1 for diagram 1 for labelling of positive ions and electrons
A5 **(a)**	$BaCO_3 + 2HNO_3 \rightarrow Ba(NO_3)_2 + CO_2 + H_2O$ No. of moles of barium carbonate = 5 / (137+12+3x16) = 0.025381 mol No. of moles of dilute HNO_3 = (25/1000) x 0.4 = 0.01 mol Hence, HNO_3 is the limiting reactant.	 1 1 1
(b)	No. of moles of HNO_3 : no. of moles of $Ba(NO_3)_2$ = 2:1	

	No. of moles of $Ba(NO_3)_2$ = 0.01 / 2 = 0.005 mol Mass of theoretical barium nitrate = 0.005 x (137 + 14 x 2 + 16 x 6) = 1.305 g Percentage yield = 1 / 1.305 x 100% = 76.6 % (to 3 s.f.)	1 1 1
(c)	calcium nitrate solution / aqueous calcium nitrate and dilute sulfuric acid / any soluble sulfate	1 1
A6 (a)	$2CH_4$ (g) + $3O_2$ (g) → 2CO (g) + $4H_2O$ (g)	1 for correct eqn 1 for state symbols
(b)	Let bond energy in carbon monoxide by X. 8(+412)+3(+496)+8(-463)-2X = -1080 kJ X = 1080 kJ/mol	 1 1
(c)	The reaction is **exothermic** as the energy taken in to break bonds in the molecules of methane (8 C-H bonds) and oxygen (3 O=O bonds) is less than energy given out to form the bonds in the molecules of carbon monoxide (2 C≡O bonds) and water (8 O-H bonds).	1 for exothermic 2 for explanation
A7 (a)	Place a lighted splint at the mouth of the test tube. The lighted splint will extinguish with a pop sound.	1 1
(b)		1m for the two repeat units drawn 1m for circling the correct linkage
(d)	Reagent: Hydrogen Conditions: 200°C, nickel catalyst	1 1 1
(e)	The aqueous bromine will turn from reddish brown to colourless. Or The reddish-brown aqueous bromine will be decolourised.	1
B8		
(a)	Cl_2 (g) + $2Br^-$ (aq) → $2Cl^-$ (aq) + Br_2 (aq)	1
(b)	Absorbance increases with time. Bromide ions are slowly oxidised to bromine. Colour intensity is gradually increasing.	1 1

(c)	1st mark: Speed of reaction was **fast initially**. **Maximum/ high** concentration/amount of **bromide ions** and chlorine Very **high frequency of effective collision** between particles. 2nd mark: As reaction progresses, concentration/number of reacting particles **decreases, frequency of effective collision decreases**, **speed** of reaction **decreases**. 3rd mark: Absorbance is maximum/ no increase/ remains constant. Speed of reaction is **zero** as **all bromide ions are used up**.	1 1 1
(d) (i)	Experiment 2 [1]	
(ii)	Rate of reaction is **inversely** proportional to the time taken for the reaction to complete. OR The shorter the time taken for complete reaction, the faster the reaction rate.	
(iii)	Same absorbance reading at the end of the reaction was obtained because of the **same number of moles / concentration of bromide ions (limiting reactant) was reacted in both experiments**. A shorter time taken was taken (faster rate) for experiment **3** for reaction to finish because the **reaction was carried out at a higher temperature.** **OR** reverse argument	1 1
B9 (a)	Concentration of Na^+ and OH^- increases OR Concentration of sodium hydroxide increases. *Reject: concentration of electrolyte increases.*	1
(b)(i)	From the negative terminal to the positive terminal OR From left to right. *Reject: from anode to cathode unless student has identified which electrode is anode/cathode.*	1
(ii)	$2H_2$ (g) + $4OH^-$ (aq) → $4H_2O$(*l*) + $4e^-$ *State symbols are required.*	1 *(no state symbols = 0 m)*

(c)(i)	Formation of **carbon dioxide** due to complete combustion. [1] A **greenhouse** gas that can cause global warming, resulting in rising sea levels + melting ice caps [1] **OR** Formation of **carbon monoxide** due to incomplete combustion. [1] A **poisonous** gas as it combines irreversibly with haemoglobin in blood to form carboxyhaemoglobin which reduces ability of haemoglobin to carry oxygen to different parts of the body, resulting in breathing difficulties and eventually death [1] **OR** Unburnt hydrocarbons may be released due to incomplete combustion. [1] Formation of photochemical smog when present with other polluting gases [1] **OR** Formation of **nitrogen oxides** due to high temperatures in engine. Nitrogen oxides results in **acid rain** which increases acidity of lakes and rivers harming aquatic life / corrode metal and limestone structures / increases acidity of soil hindering plant growth.	2 *Reject: production of sulfur dioxide*
(ii)	To obtain hydrogen, we require **cracking of longer-chain hydrocarbons** [1] which requires **large amount of heat** [1] OR To obtain hydrogen, **electrolysis of water** must be carried out [1] which requires **large amount of electricity** [1] OR Hydrogen is **difficult to store as it is a gas / flammable / explosive**[1], hence it is expensive to construct special containers/equipment [1] to store it.	} 1 1
(iii)	**Nitrogen reacts with oxygen in air to form nitrogen oxides** [1] Both types of engines work / function at **high temperatures**. [1] *Reject: both engines are at comparable temperatures.*	
(iv)	In a hydrogen fuel cell powered engine, there is **absence of carbon monoxide to function as a reducing agent** in the catalytic converter. **OR** For a catalytic converter to remove NO, the following must happen: $\mathbf{2CO + 2NO \rightarrow 2CO_2 + N_2}$ However, there is **no carbon monoxide present** in the engine powered by the fuel cell. **OR** NO is **soluble in water** present in the fuel cell, and **will not reach the catalytic converter** for reaction to occur.	Any one. 1

B10 E		
(a)	aluminium oxide / silicon dioxide and high temperature at 600°C OR High temperature / catalyst	1
(b)		1
(c)	Mixture of hydrocarbons C, D and E is <u>heated</u> [1] and the <u>vaopur [1] is passed into the fractionating coloumn</u>. The hydrocarbon with the <u>lowest boiling point</u> [1] will be <u>distilled and collected at the higher outlet in the fractionating column</u> while hydrocarbon with the next higher b.p. will be distilled and collected at the lower outlet in the column. *Acceptable: methods which describe small scale fractional distillation*	1 1 1
(d) (i)	Isomerism is the existence of two or more compounds with the same molecular formula but with different structural formulae.	1
(ii)		2 m for all 3 correct isomers. 1 m for any 2 correct isomers. 0 m for only 1 correct isomer
(e)	Structure **F**:  Structure of the alkane used: 	

OR B10		
(a)	$CO(NH_2)_2$ (aq) + H_2O (*l*) → $2NH_3$ (g) + CO_2 (g)	[1] correct equation [1] state symbols
(b)	400°C to 450°C 200 - 250 atm Iron catalyst	[1] for all 3 conditions correct
(c)(i)	It is a redox reaction. The oxidation state of N increases from **–3 in NH_3 to 0 in N_2.** [1] The oxidation state of O decreases from **0 in O_2 to –2 in H_2O.** [1]	
(c) (ii)	Ammonia	[1]
(c) (iii)	By volume ratio, volume of O_2 needed = 20 cm^3 Hence, volume of air needed = $20 \times \frac{100}{21} = 95.2$ cm^3 (3 s.f.)	[1]
(d)		Correct axes [1] Correct shape [1] Correct label [1]