CHIJ SECONDARY

Sec 4 Preliminary Examination 20**24**

Chemistry 6092 **Mark Scheme**

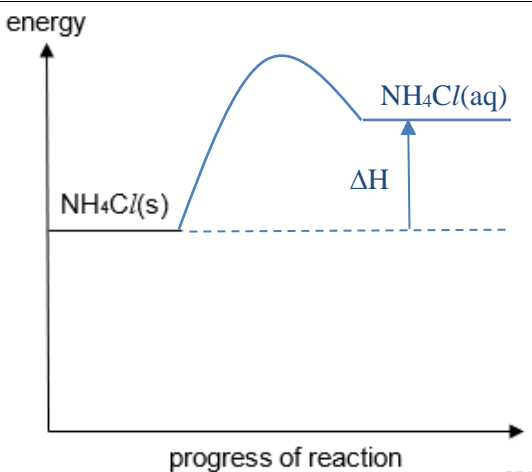Updated on 05/09/2024

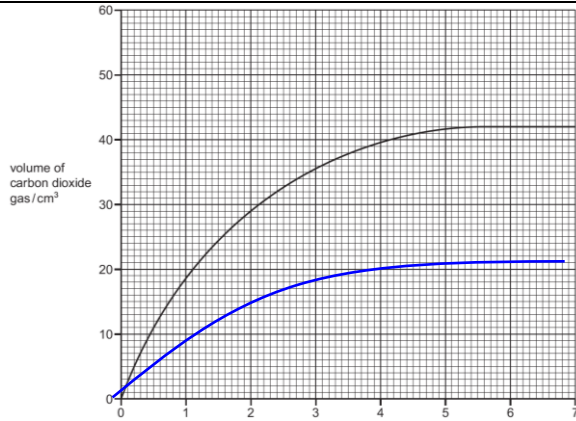## Paper 1 (40 marks)

No	Answer	No	Answer	No	Answer	No	Answer
1	D	11	D	21	D	31	C
2	D	12	B	22	B	32	C
3	C	13	B	23	B	33	D
4	A	14	B	24	C	34	D
5	C	15	D	25	A	35	D
6	C	16	D	26	B	36	C
7	B	17	C	27	D	37	B
8	D	18	C	28	B	38	B
9	C	19	A	29	C	39	D
10	B	20	C	30	A	40	D

Paper 2
Section A (70 marks)
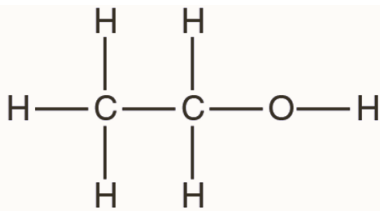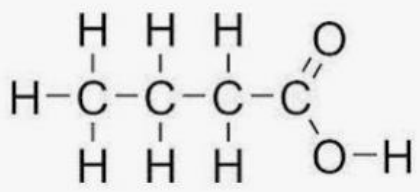
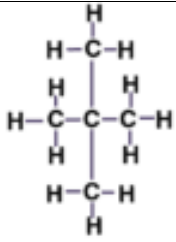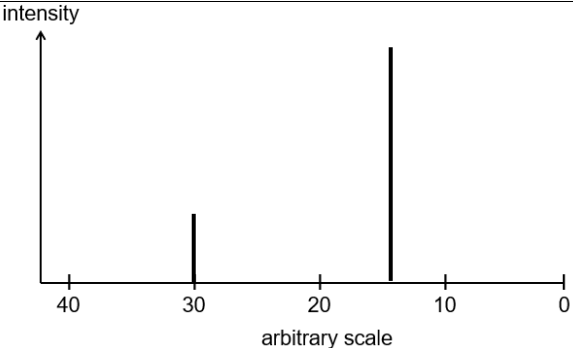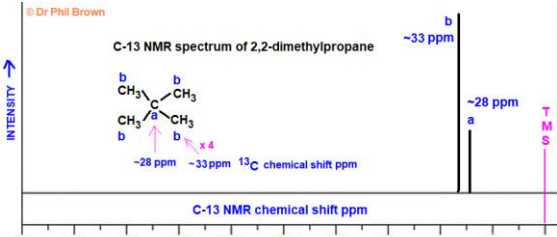| Question			Answers	Marks	Total
1	(a)		C	1	
	(b)		B	1	
	(c)		C	1	**5**
	(d)		A	1	
	(e)		D and E	1	
2	(a)		[1]: size [1]: composition	2	
	(b)	(i)	The iron and carbon atoms are physically combined / not chemically combined together.	1	
		(ii)	Steel has atoms of different sizes that disrupts the regular arrangement of the metal [1] causing the layers of atoms to slide over each other less easily. [1]	2	**8**
	(c)		There are free moving electrons to carry charge. Steel is made up of positive ions in a "sea of mobile(delocalised) electrons" 'Sea of delocalised 'electrons move to conduct electricity	1	

Question			Answers	Marks	Total
	(d)		Chromium is more reactive than iron [1] and corrodes/oxidises in place of iron. [1]	2	

3	**(a)**	**(i)**	Energy absorbed = 4C-Cl + 4O-H
			           = 4(340) + 4(460)
			           = 3200 kJ
				1	

		(ii)	ΔH = energy absorbed + energy released -130 = +3200 − [2C=O + 4H-Cl] -130 = +3200 − [2(805) + 4H-Cl] 4H-Cl = 1720 H-Cl = 430 kJ/mol	1	
	(b)		There is more energy released [1] in forming the C=O and H-Cl bonds / bonds in CO_2 and HCl [1] than energy taken in to break the C-Cl and O-H bonds / bonds in CCl_4 and H_2O. [1] OR Energy released/given out in forming the C=O and H-Cl bonds / bonds in CO_2 and HCl [1] is more[1] than energy taken in /absorbed to break the C-Cl and O-H bonds / bonds in CCl_4 and H_2O. [1]	3	5
4	**(a)**		Ammonium chloride: hydrochloric acid; ammonium carbonate/aqueous ammonia *[reject: ammonium hydroxide]* Calcium sulfate: sulfuric acid [1]: 1-2 correct, [2]: all 3 correct	2	
	(b)		An insoluble layer of calcium sulfate forms over the calcium carbonate, preventing further reaction.	1	
	(c)			3	6

Question			Answers	Marks	Total
			[1/2]: correct shape of each graph [1/2]: correct arrow direction with ΔH label for each graph [1/2]: correct formula and state symbol of each product		
5	**(a)**	**(i)**	Zn electrode: $Zn \rightarrow Zn^{2+} + 2e^-$ [1] Cu electrode: $Cu^{2+} + 2e^- \rightarrow Cu$ [1]	2	
		(ii)	Any 2: - The zinc electrode decreases in size - The copper electrode increases in size/ a reddish-brown solid forms on the copper electrode - The electrolyte/solution changes from blue to colourless	2	
	(b)		Any value between 1.20 to 1.40V [1] (actual: 1.36V) The difference in reactivity between zinc and silver is greater than the difference in reactivity between zinc and copper. [1]	2	
	(c)		Volume at O should be 8cm^3 [1] Every 2 points is 1 mark: P: $2H^+ + 2e^- \rightarrow H_2$ Q: $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$ [1] From the equations for every 4 moles of electrons that pass through electrolysis, 2 moles of hydrogen are produced at the cathode and 1 mole of oxygen is produced at the anode. [1] OR Overall reaction is $4OH^- + 4H^+ \rightarrow 2 H_2 + O_2 + 2H_2O$ Mole ratio of $H_2:O_2$ is 2:1, the volume ratio of $H_2:O_2$ is also 2:1 [1]	3	**9**

			Answers	Marks	Total
6	**(a)**		Volume of CO_2 = 42 cm^3	1	
	(b)		no. of moles of CO_2 = 42/1000 ÷ 24 = 0.00175 mol [1] no. of moles of HCl = 0.00175 × 2 = 0.0035 mol volume of HCl = 0.0035 ÷ 0.10 = 0.035 dm^3 = <u>35 cm^3</u> [1]	2	
	©	**(i)**		1	
		(ii)	$MgCO_3$ + $2CH_3COOH$ → $(CH_3COO)_2Mg$ + H_2O + CO_2	1	**11**
	(d)		In experiment 3, the higher temperature leads to the particles possessing <u>more kinetic energy</u> / <u>move faster</u> [1] frequency of collisions increases. Further more particles possess <u>energy greater than or equal to the activation energy</u>. [1] The <u>frequency of effective collisions</u> increases, [1] resulting in a <u>faster rate(or an increase in rate)</u> of reaction. [1]	4	
	(d)		Ethanoic acid is a weak acid, which only <u>partially ionises in water</u>, producing a <u>low concentration of hydrogen ions</u> than hydrochloric acid. [1] Hydrochloric acid is a strong acid which ionises completely in water to produce a high concentration of hydrogen ions[1]	2	

			Answers	Marks	Total
7	**(a)**		CO: <u>binds to haemoglobin</u> in blood, <u>preventing flow of oxygen</u> around the body, leading to breathing difficulties (or loss of consciousness and even death [1] OR CO <u>binds irreversibly with the haemogobin</u> in red blood cells. This <u>lowers the ability of the hemoglobin to transport oxygen</u> to the rest of the body. This can result <u>in loss of consciouness and death.</u> NO_2: cause acid rain, which can corrode limestone buildings/kill aquatic life/kill plants [1]	2	
	(b)		CO: Lean burn engines have <u>more air</u>, so the petrol tends to <u>undergo complete combustion</u> to form CO_2 instead of CO / less likely to undergo incomplete combustion to form CO [1] NO_2: Lean burn engines <u>have lower operating temperature</u>, so <u>nitrogen and oxygen in the air are less likely to react to form oxides of nitrogen</u> [1] OR NO2 is formed when nitrogen reacts with oxygen at high temperature.	2	8
	(c)	**(i)**	Catalysts provide an <u>alternate pathway of lower activation energy</u> allowing the reaction to proceed <u>faster</u>.	1	
		(ii)	<u>CO is oxidised</u> as the <u>oxidation state of C increases</u> from <u>+2 in CO to +4 in CO_2</u> [1] <u>NO_2 is reduced</u> as the <u>oxidation state of N decreases</u> from <u>+4 in NO_2 to 0 in N_2</u> [1] OR <u>Carbon in CO is oxidised</u> as the <u>oxidation state of C increases</u> from <u>+2 in CO to +4 in CO_2</u> [1] <u>Nitrogen in NO_2 is reduced</u> as the <u>oxidation state of N decreases</u> from <u>+4 in NO_2 to 0 in N_2</u> [1]	2	
		(iii)	The catalytic converter still <u>produces carbon dioxide</u>, which causes <u>global warming</u>.	1	

8	(a)		Ethyl butanoate	1	
	(b)		Full structural formula of alcohol: [1] Full structural formula of carboxylic acid: [1]	2	8
	(c)		Test: Add reactive metal/carbonate [1] Outcome: If effervescence is observed, it is the acid. If there is no visible change, it is the alcohol. [1] OR Test: Add acidified $KMnO_4$ [1] Outcome: If it turns from purple to colourless, it is the alcohol. If there is no visible change, it is the acid. [1]	2	
	(d)	(i)	C [1] Ethyl butanoate is <u>insoluble in water</u>, while alcohols and carboxylic acids are soluble in water. [1]	2	
		(ii)	If the ethyl butanoate freezes or boils at a fixed temperature, it is pure.	1	
9	(a)		^{12}C and ^{13}C both have 6 protons (and 6 electrons), [1] but ^{12}C has 6 neutrons while ^{13}C has 7 neutrons. [1]	2	
	(b)		There are 2 carbon atoms of the same 'type' *d* compared to carbon atoms *a*, *b* and *c*, which only have 1 each. [1] Because both carbon atoms *d* are attached to a $-C_3H_7$ alkyl group. [1]	2	10
	(c)		The closer the carbon atom is to the end of the carbon chain, the lower its position on the arbitrary scale. [1] The terminal carbon, C_a, has the lowest value at 14 for isomer 1 and 12 for isomer 2. [1] The next carbon atom, C_b, has the second lowest value at 23 for isomer 1 and 25 for isomer 2 / the carbon atom in the centre of each molecule, C_c, has the highest value at 34 for isomer 1 and 32 for isomer 2. [1] OR	3	

			The more alkyl groups attached to the carbon atom, the higher its position on the arbitrary scale. [1] The terminal carbon, C_a, has the lowest value at 14 for isomer 1 and 12 for isomer 2. [1] Carbon atoms with two alkyl groups attached, C_b, have the next lowest values at 23 for isomer 1 and 25 for isomer 2 / the carbon atom, C_c in isomer 2, with three alkyl groups has the highest value at 32. [1]			
	(d)	**(i)**		1		
		(ii)	 arbitrary scale Every 2 correct features is 1 mark: • 2 peaks • 1 peak around 10-20 • 1 peak around 30-34 • 1 peak should be 4x the intensity of the other peak (does not matter which one) Actual: 	2		

Section B (10 marks)

			Answers	Marks	Total
10	**(a)**	**(i)**	Addition polymerisation occurs when unsaturated monomers/alkenes/many small molecules join together without losing any molecules.	1	
		(ii)		2	**10**

			Answers	Marks	Total
	(b)		Propene has a <u>simple molecular structure</u> while polypropene has a <u>macromolecular structure</u>. [1] Polypropene has <u>stronger intermolecular forces</u> of attraction between its molecules than propene, [1] that requires more <u>energy</u> to overcome, hence polypropene has a <u>higher melting point</u>. [1]	3	
	(c)		Polypropene can have a <u>range of relative molecular masses</u>, depending on how many monomers were used to make the polymer.	1	
	(d)	**(i)**	The plastics are <u>pulled</u> into long <u>thin strands</u>, then cut into <u>pellets</u> to make new products.	1	
		(ii)	Any 2: • Different plastics may have different costs incurred in the recycling process. • Some recycled plastics have lower market value and may not be worth recycling compared to others. • Some plastics may result in more toxic chemicals produced during recycling, so the wastewater needs to be treated.	2	
11	**(a)**	**(i)**	$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ [1] Every 2 underlined points is 1 mark: Glucose undergoes <u>fermentation</u> at <u>37°C</u>, with <u>yeast</u> as the catalyst, <u>in the absence of oxygen</u>, to form ethanol. [2]	3	
		(ii)	The carbon dioxide produced from the combustion of bioethanol [1] is offset by the carbon dioxide the biomass take in during photosynthesis. [1]	2	
	(b)	**(i)**	Advantages: • Biodiesel is produced at a lower temperature of 60°C compared to diesel at 600°C. [1] • Biodiesel can be obtained from recycled fat and oil, which is more sustainable than diesel, which is obtained from crude oil, a non-renewable resource. [1] Disadvantage: Diesel is obtained in a higher yield of 29% compared to biodiesel, with yield of only 11%. [1]	3	**10**
		(ii)	Add aqueous bromine to the biodiesel sample. [1] If it contains fats, there is no visible change. If it contains oils, the reddish-brown aqueous bromine decolourises. [1]	2	