

4E Chemistry 6092 – Set II

Marking Scheme

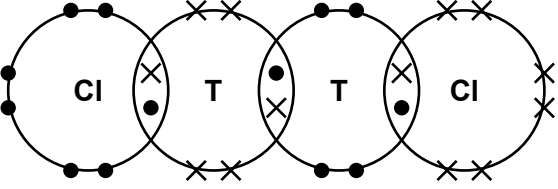
Paper 1

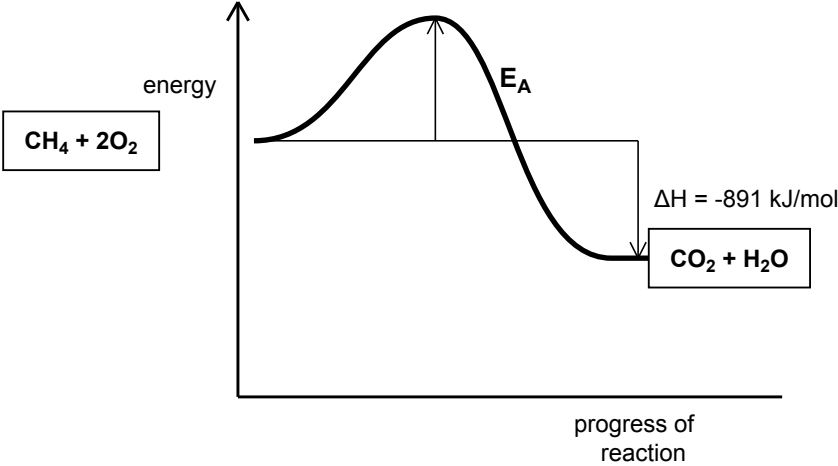
1	2	3	4	5	6	7	8	9	10
D	C	B	B	D	C	B	C	B	A
11	12	13	14	15	16	17	18	19	20
B	C	B	B	D	A	B	C	D	C
21	22	23	24	25	26	27	28	29	30
D	A	D	D	D	D	C	D	A	B
31	32	33	34	35	36	37	38	39	40
C	D	B	C	C	B	C	B	D	A

Paper 2

Section A

Question no	Answers	Marks
1 (a)	PbO	1
(b)	KI	1
(c)	SO ₂	1
(d)	CuCO ₃	1
(e)	PbBr ₂	1
		Total: 5
	Remarks/ common mistakes: - If students wrote 2 answers, only the first one will be marked. - For (b), many students wrote PbBr₂ which is incorrect as it is insoluble - For (e), many students wrote KI and it is incorrect as KI is a soluble salt and does not prepared using the precipitation method.	
2(a)	$76/100 \times 35 + 24/100 \times 37 = 35.5$ Accept: 35.48. No mark is penalised for wrong units.	1
(b)(i)	Simple (covalent) molecular structure./Simple covalent molecule/ simple covalent structure with small discrete molecules. It has a low melting and boiling point as it is made up of weak intermolecular forces of attraction between the molecules where little energy is required to overcome the forces of attraction. Reject: simple covalent bond/ simple covalent structure. Remarks: Most students unable to state the structure present. Some students confused with ionic bonding or giant covalent structure.	1 1

(b)(ii)	 Remarks: Some students draw ionic bonding instead. Students did badly for this question,	2
		Total: 5
3(a)(i)	It indicates that chlorine has an oxidation state of +5. Badly done. Reject: Charge of chlorine is +5, valence electrons are 5, just state the (V) represent oxidation state but did not indicate value.	1
(a)(ii)	The statement is true. As the oxidation state of chlorine in NaClO_3 is decreased from +5 to -1 in NaCl, chlorine is being reduced. As the oxidation state of oxygen in NaClO_3 is increased from -2 to 0 in O_2, oxygen is being oxidised. As both reduction and oxidation is happening simultaneously, it is a redox reaction. Remarks: Many students compared the oxidation state of sodium instead of chlorine. Stated the oxidation state of oxygen as -6 instead of -2.	1 1
(a)(iii)	<u>Use a magnet to attract the iron</u> catalyst from the mixture and a pure and dry sample of sodium chloride will be obtained. Accept: using magnetic attraction /magnetic separation to separate iron form sodium chloride.	1
(b)	Sodium chlorate(V) will <u>decompose before its boiling point can be measured</u>. Reject: sodium chlorate (V) sublimes/temperature is too high to be measured.	1
(c)	Number of moles of $\text{O}_2 = 450 / 24000 = 0.01875\text{mol}$ From equation, $3 \text{ mol } \text{O}_2 : 2 \text{ mol } \text{NaClO}_3$ $0.01875 \text{ mol } \text{O}_2 : 0.0125 \text{ mol } \text{NaClO}_3$ M_r of $\text{NaClO}_3 = 106.5$ Mass of $\text{NaClO}_3 = 106.5 \times 0.0125 = 1.33\text{g}$ Percentage purity = $(1.33/5) \times 100 = 26.6\%$ (R: if round off to 1dp, A: 26.625%) Accept: No of moles of $\text{NaClO}_3 = 5/106.5 = 0.0469\text{mol}$ Volume of O_2 (theoretical) = $0.0469 / 2 \times 3 \times 24 = 1.69\text{dm}^3$ Percentage purity = $450/1690 \times 100 = 26.6\%$	1 1 1
		Total: 8
4(a)	Petrol is not a pure substance/mixture/ contains impurities OR it consists of a mixture of hydrocarbons. Hence, there is no fixed enthalpy change of combustion.	1
(b)(i)	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$	1

(ii)	As methane has a higher percentage of carbon than methanol , More energy is released in forming carbon dioxide and water vapour than energy absorbed in breaking the bonds in methane and oxygen	1 1
(iii)	 1 m for labelled reactant and product 1m for labelling of activation energy and ΔH 1m for correct energy diagram	3
(c)	Complete combustion of hydrogen produces only <u>water which is a non-pollutant/no negative impact to the environment</u> . However, combustion of methane produces <u>carbon dioxide which is a greenhouse gas that leads to global warming</u> .	1 1
(d)	The carbon monoxide produced is toxic as it binds to haemoglobin / <u>prevents the blood to transport oxygen around the body and leads to breathlessness and eventually death</u> . Or The methanol used is <u>toxic</u> as it can <u>lead to headache, dizziness or loss of consciousness</u> .	1
		Total: 10
5(a)	To ensure the piece of magnesium is fully reacted/ all Mg is fully used up. Reject: To ensure Mg is fully dissolved	1
(b)	Increase temperature – <u>particles move faster and have energy equal to or greater than the activation energy</u> / particles move faster, which increases the frequency of effective collisions . Higher concentration, <u>more particles present per unit volume</u> . Increased frequency of effective collision , higher rate of reaction. Note: 3 rd mark is only allocated if students wrote increased frequency of collision leads to increase in frequency of effective collisions for both factors	1 1 1*
(c)	Hydrogen gas produced pushes / carried up the metal to the surface from reacting acid and metal / The presence of effervescence / bubbles pushes / carried up the metal to the surface Remarks: A lot of students mentioned that magnesium is less dense than water which is incorrect.	1

(d)(i)	Copper does not react with hydrochloric acid and no gas is produced. / zinc and iron react with acid to produce hydrogen gas . R: Should not just mention it is unreactive. Need to link the the experiment which is the reaction with acids.	1
(d)(ii)	The experiment with copper. Copper is acting as a catalyst in the experiment. Note: Copper is a transition metal which act as a catalyst in the reaction.	1
(d)(iii)	The gradient of the graph will be gentler / rate of reaction is slow than both graphs but with the <u>same amount of hydrogen gas produced</u> .	1
		Total: 8
6(a)	Electrode 2 is a <u>cathode</u> as (<u>zinc loses electrons</u>) as it is the more reactive metal and the electrons <u>flow to electrode 2/ flow from negative to positive terminal</u> . $2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$ R: If no state symbols are seen in half equation./ Move from more reactive to less reactive electrode.	1 1
(b)	Effervescence will be seen./bubbles will be seen/ greenish yellow gas is seen.	1
(c)	The colour of the electrolyte (universal indicator) changes from green to purple/blue . H⁺ and Cl⁻ are being discharged , leaving behind K ⁺ and OH ⁻ . This results in the formation of potassium hydroxide which is an alkali which turns universal indicator purple/blue. Accept: Concentration of hydrogen ions is less than concentration of hydroxide, thus universal indicator turns purple/blue R: The concentration of hydroxide ions will increase.	1 1
(d)	$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$	1
(e)	Replace zinc with a metal, magnesium which is further apart in the reactivity series than zinc and copper. (Do not accept reactive metals such as sodium, potassium and calcium) R: If no mentioned of the metal to be replace.	1
(f)	Bubbles of colourless gas would be observed at electrode 1 instead of 2 OR Pale greenish-yellow gas would be observed at electrode 2 instead of 1.	1
		Total: 8
7(a)	Both emission of unburnt hydrocarbons and carbon monoxide has similar trends. As the air: fuel increases, incomplete combustion of carbon-containing fuels decreases, this leads to lower emission of unburnt hydrocarbons. The amount of oxygen increases indicating lesser amount of carbon monoxide produced and more carbon dioxide produced . Remarks: If oxygen is not mentioned in the answer, max 1 for this Q.	1 1
(b)	High in air : fuel ratio results in complete combustion which will then result in large amount of energy to be released. More energy is given out/ higher temperature results in more nitrogen to react with the oxygen to form nitrogen oxides .	1 1
(c)	At air to fuel ratio of 13.8:1, although the emission of carbon monoxide and nitrogen oxide are the lowest, the emission of unburnt hydrocarbons is still high.	1

(c)(i)	$2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$	1
(c)(ii)	Carbon dioxide is produced during the conversion and nitrogen oxide is not completely removed which is a greenhouse gas. Error in question. All students awarded 1m	1
		Total: 7
8(a)	All ammonium iodide has <u>sublimed</u> , and no solid is left behind	1
(b)(i)	$2\text{NH}_4\text{I} + \text{X}_2 \rightarrow 2\text{NH}_4\text{X} + \text{I}_2$	1
(b)(ii)	Astatine is less reactive than iodine and will not be able to displace iodine from ammonium iodide.	1
(c)	In solid state, ammonium ions and iodide ions are held in fixed position by strong electrostatic forces of attraction, thus unable to act as charge carriers to conduct electricity. In aqueous state, ammonium ions and iodide ion are broken from its lattice structure and are free to move and act as charge carriers. Reject: if mentioned ionization of ammonium iodide in aqueous solution to explain electrical conductivity	1 1
(d)	Litmus paper for tube 1 will take a shorter time than litmus paper in tube 2 to change its colour. $M_r \text{ HCl}: 36.5 \quad M_r \text{ HI} = 128$ The rate of diffusion for HCl is faster than the rate of diffusion of HI, as the relative molecular mass of HCl is lower than the relative molecular mass of HI. Thus rate of diffusion is inversely proportional to relative molecular mass. Remarks: M_r value to be stated in the answers to obtain mark for the comparison on M_r .	1 1
9(a)(i)	Similarity: Both HDPE and LDPE contain carbon and hydrogen only./hydrocarbons/ contain carbon-carbon single bonds, carbon - hydrogen single bonds/ contains monomer ethene. Difference: LDPE contains side chains with different number of carbon atoms while HDPE does not contain any side chain/ LDPE is branched but HDPE is a straight chain. R: Different number of C atoms between LDPE and HDPE.	1 1
(a)(ii)	HDPE does not have any side chains resulting in a closer arrangement. This leads to higher mass/molecules per unit volume. Thus HDPE has a higher density than LDPE.	1 1
(b)(i)	 [the answer cell is blank in the original marking scheme]	1
(b)(ii)	Poly(lactic acid) is a homopolymer as it consists of only one repeating monomer	1

(c)(i)	M_r of ONE repeat unit = $100000/962 = 103.95$		1	
		C	H	1
	percentage / %	92.3	7.7	1
	no. of moles	$92.3/12 = 7.691$	$7.7/1 = 7.7$	
	ratio	$7.691/7.691 = 1$	$7.7/7.691 = 1.0011$	
	Empirical formula = CH M_r of CH = $12 + 1 = 13$ Let the molecular formula of one repeat unit of poly(styrene) be (CH) _n . $n = (\text{relative molecular mass})/(M_r \text{ of empirical formula})$ $= 103.95/13 = 7.99 = 8$ (round off to whole no.) Molecular formula of one repeat unit = C ₈ H ₈ From Table 8.2, Therefore, formula of R in poly(styrene) = C ₈ H ₈ – 2C – 3H = C ₆ H ₅			
(d)	Based on the information provided, both mechanical recycling and depolymerisation can be used to recycle RIC 1- PET which is a co-polymer. Thus, the statement is not true. Accept: any logical reasoning with relation to the information provided in Q		1	
(e)(i)	When PVC is heated, the presence of chlorine will allow the release of corrosive hydrogen chloride gas that are toxic to humans.		1	
(e)(ii)	It is used as plastic pipes which can last for a long time and is not so disposable compared to other plastics./ durable and can last for a long time		1	
			Total: 12	

Section B – answer one question

B10(a)(i)	Any set of test and results.	1
	-Measure the pH of both acids. For both acids, the readings should show a pH 0-2.	1
	-Add universal indicator to both acids. For both acids, universal indicator should turn red.	
(a)(ii)	For a fair comparison, both acids must have same concentration of H^+ as sulfuric acid is dibasic , hexanesulfonic is monobasic , with the difference in concentration, they will produce same concentration of H^+ /1 mol of H_2SO_4 produces 2 mol of H^+ ions, whereas 1 mol of hexanesulfonic produces 1 mol of H^+ ions	1
(b)(i)	$2CH_3NH_2 + H_2SO_4 \rightarrow (CH_3NH_3)_2SO_4$	1
(b)(ii)	When methylamine is added to aqueous iron(II) sulfate, a green precipitate is formed.	1
	When left to stand in air, the green precipitate is oxidised to brown precipitate.	1
(c)(i)	$C_nH_{2n+1}NH_2$	1
(c)(ii)	$78^\circ C$ Accept $76-88^\circ C$	1
(c)(iii)	$C_3H_7OH + CH_3COOH \rightarrow CH_3COOC_3H_7 + H_2O$	1
(c)(iv)	$ \begin{array}{ccccccc} & H & & O & & H & H & H \\ & & & & & & & \\ H & - C & - & C & - O & - C & - C & - C - H \\ & & & & & & & \\ & H & & & & H & H & H \end{array} $	1
		Total: 10

B11(a)(i)	General formula : C_nH_{2n-2}	1
	Functional group : $C\equiv C$ triple bond or carbon-carbon triple bond	1
(a)(ii)	Alkynes consists of carbon-carbon triple bonds . Accept: unsaturated	1
(a)(iii)	Structural formula of product	1
	[the structure is blank in the original marking scheme] Observation: reddish brown/brown bromine turns colourless.	1
(a)(iv)	Compound X is not an isomer of pentyne as it has a different molecular formula, C_6H_8 from pentyne, C_5H_8 .	1
	Compound Y is an isomer of pentyne as it has the same molecular formula as pentyne but different structural formula . Note: If never state molecular formula but state number of C and H, award 1m	1
(b)(i)	$2CH_3COOH + Mg \rightarrow (CH_3COO)_2Mg + H_2$	1
(b)(ii)	Add ethanoic acid in excess OR until no more effervescence is observed.	1
	Filter the mixture to obtain copper as the residue. Wash the residue with deionised water to obtain pure copper.	1
		Total: 10