CONFIDENTIAL
4541/2
Chemistry
Paper 2
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SIJIL PENDIDIKAN
MAKTAB RENDAH SAINS MARA
2019

CHEMISTRY

Paper 2

MARKING SCHEME

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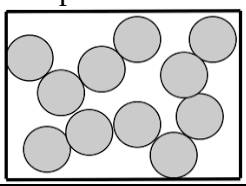
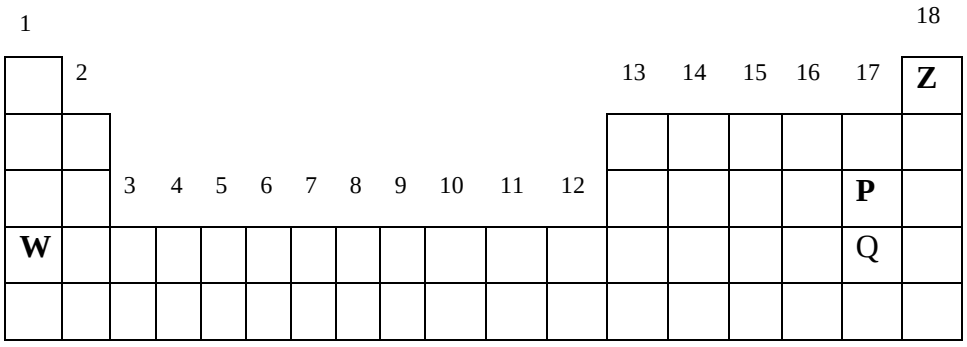
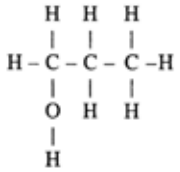
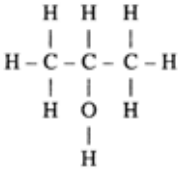
The marking scheme consists of 18 printed pages

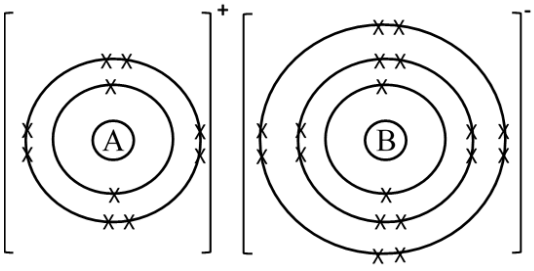
CHEMISTRY 4541/2
***Paper* 2**

Section A

No.			Mark Scheme	Sub Mark	Total Mark
1	(a)	(i)	**[Able to state particle in carbon dioxide correctly]** Answer: Molecule	1	1
		(ii)	**[Able to state the physical state of magnesium at 700^0C correctly]** Answer: Liquid	1	1
		(iii)	**[Able to draw the arrangement of liquid correctly]** Sample answer 	1	1
	(b)	(i)	**[Able to name the process occur correctly]** Answer: Diffusion	1	1
		(ii)	**[Able to state the factor and explain how the factor affect the rate]** Sample answer P1. Temperature P2. When the temperature is higher the kinetic energy of particles higher// move faster from higher concentration region to lower concentration <u>region</u>	1 1	2
	(c)	(i)	**[Able to state the position of W and Z correctly]** Answer 	1 1	2
		(ii)	**[Able to state the element correctly]** Answer: P	1	1
			TOTAL	**9**	

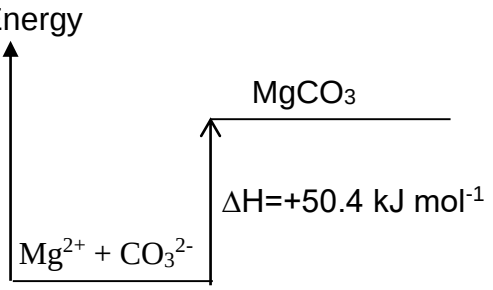
No.			Mark Scheme	Sub Mark	Total Mark
2	(a)		**[Able to state the homologous series correctly]** Answer: Alkene	1	1
	(b)	(i)	**[Able to state the name of the reaction correctly]** Answer: Hydrogenation/ addition of hydrogen	1	1
		(ii)	**[Able to write a chemical reaction for the reaction correctly]** Answer : $C_3H_6 + H_2 \longrightarrow C_3H_8$	1	1
	(c)	(i)	**[Able to state the condition of the reaction correctly]** Sample answer Temperature : 300°C// Pressure: 60atm// Catalyst: Phosphoric acid	1	1
		(ii)	**[Able to draw the structural formula for propanol correctly]** Sample answer  or 	1	1
	(d)	(i)	**[Able to state the chemical formula for the compound formed correctly]** Answer: $C_2H_5COOC_3H_7$	1	1
		(ii)	**[Able to state the physical properties of ester correctly]** Sample answer Sweet smell // less dense than water // insoluble in water	1	1
	(e)		**[Able to state the substance which is better fuel correctly]** Answer: P1. Butane **[Able to explain the reason correctly]** Sample answer P2. Because the percentage of carbon <u>by mass</u> in butane is lower // The fuel value of butane is higher **OR** % of C by mass in butane = 48/58 x 100 = 82.76% % of C by mass in kerosene = 144/170x100 = 84.71%	1 1	2
			TOTAL	**9**	

No.			Mark Scheme	Sub Mark	Total Mark
3	(a)	(i)	**[Able to state the name of the gas]** Answer: Carbon dioxide	1	1
		(ii)	**[Able to explain the differences in both observations]** Answer: P1. Acid ionise in water to produce hydrogen ion P2. Hydrogen ion react with carbonate ion // P3. Absence of water, acid remain as molecule.	 1 1 1	 3
		(iii)	**[Able to write ionic equation occurs]** Answer: $2H^+ + CO_3^{2-} \rightarrow CO_2 + H_2O$// $2H^+ + CaCO_3 \rightarrow Ca^{2+} + CO_2 + H_2O$ Correct formula of reactant and product Balance the equation	 1 1	 2
	(b)	(i)	**[Able to state the type of acid correctly]** Answer: Weak acid	1	1
		(ii)	**[Able to calculate the concentration of ethanoic acid correctly]** Sample answer P1. Average volume of NaOH = $\frac{23.40+23.60+23.50}{3}$ = 23.50 cm^3 P2. No of mole NaOH = 0.10 x 23.50 / 1000 = 0.00235mol P3. From equation 1 mol NaOH reacts with 1 mol CH_3COOH // :. 0.00235 mol NaOH reacts with 0.00235 mol CH_3COOH P4. Concentration CH_3COOH = 0.00235 x 1000 / 25 = 0.094 mol / dm^3 **OR** P2. $\frac{MaVa}{MbVb} = \frac{1}{1}$ P3. Ma = 1 x $\frac{0.10\ (23.50)}{25.00}$ P4. 0.094 mol /dm^3 (ecf P2 and P3 only)	 1 1 1 1	 Max 3
			TOTAL	**10**	

No.			Mark Scheme	Sub Mark	Total Mark
4	(a)	(i)	**[Able to state the meaning correctly]** Sample answer A chemical formula that shows the simplest whole number ratio of atom of each element in a compound	1	1
		(ii)	**[Able to determine the molecular formula correctly]** Answer [2(12) + 4(1) + 16] n = 88 44n = 88 n =2 molecular formula = $C_4H_8O_2$	1 1	2
	(b)		**[Able to state the empirical formula correctly]** Answer: $C_{10}H_{12}NO$	1	1
	(c)	(i)	**[Able to state two information correctly]** Answer: 2 mol of sodium azide / NaN_3 produced 2 mol sodium / Na and 3 mol Nitrogen / N2	1	1
		(ii)	**[Able to calculate the volume of gas correctly]** Answer : P1. No of mole NaN_3 = 19.5/65 = 0.30 mol P2. 0.3 mol of sodium azide react with 0.45 mol nitrogen P3. Volume N_2 = 0.45 x 24 = 10.8 dm^3 // 10800 cm^3	1 1 1	3
	(d)		**[Able to draw the compound correctly]** Sample answer  Correct nucleus and number of shells Correct number of electrons and charge	1 1	2
			TOTAL	**10**	

No.			Mark Scheme	Sub Mark	Total Mark
5	(a)	(i)	**[Able to state the cathodes correctly]** Answer: Q and R	1	1
		(ii)	**[Able to state the formula of ions correctly]** Answer: Pb^{2+} , I^-	1	1
		(iii)	**[Able to state the observation correctly]** Answer: Purple gas is released	1	1
		(iv)	**[Able to write the ionic equation correctly]** Answer: $Pb^{2+} + 2e \longrightarrow Pb$	1	1
	(b)	(i)	**[Able to state product at Y]** Answer: Chlorine // Cl_2	1	1
		(ii)	**[Able to write chemical equation]** Answer: $Cl_2 + H_2O \longrightarrow HCl + HOCl$	1	1
		(iii)	**[Able to explain the change of concentration of electrolyte in Cell Y and the reason correctly]** Answer: P1. Decreases. P2. H^+ ion discharged at cathode and Cl^- ion discharged at anode. P3. The concentration of H^+ ion and Cl^- ion in the electrolyte decreases // The number of H+ ion and chloride ion <u>per unit volume</u> decreases.	 1 1 1	3
	(c)		**[Able to justify the uses of batteries to sustain a green environment correctly]** Sample answer P1. No P2. Improper disposal will release poisonous / toxic gas **OR** P1. Yes P2. These batteries can be reused / recycle // proper disposal	 1 1 1 1	2
			TOTAL	**11**	

No.			Mark Scheme	Sub Mark	Total Mark
6	(a)		**[Able to state the meaning of heat of precipitation correctly]** Sample answer: Heat change when 1 mol of precipitate is formed from its ion in the solution// Heat released when 1 mol of silver chloride formed from silver ion and chloride ion in the solution// Heat absorb when 1 mol of magnesium carbonate formed from magnesium ion and carbonate ion in the solution	1	1
	(b)		**[Able to state one observation]** Answer: White precipitate r: container feel warm/ cold	1	1
	(c)		**[Able to write ionic equation correctly]** Sample answer: $Ag^+ + Cl^- \longrightarrow AgCl$// $Mg^{2+} + CO_3^{2-} \longrightarrow MgCO_3$	1	1
	(d)		**[Able to compare and explain the difference in temperature change of the experiment correctly]** Sample answer P1. Temperature change in set I is increase and in set II is decrease P2. Set I is exothermic reaction set II is endothermic reaction // Set 1 release heat set II absorb heat	1 1	2
	(e)		**[Able to calculate the heat of precipitation for Set II correctly]** Sample answer P1. $Q = mc\theta = (20 + 20) \times 4.2 \times 3 = 504J$ P2. no of mol = 0.5 x 20 /1000 = 0.01mol P3. Precipitation of 0.01mol of $MgCO_3$ absorbs 504J // :. Precipitation of 1 mol absorbs 504/0.01 = 50400J P4. $\Delta H = +\frac{504}{0.01} = +50400$ J / mol // ΔH = + 50.4kJ / mol	1 1 1 1	max3

No.			Mark Scheme	Sub Mark	Total Mark
	(f)		**[Able to draw the energy level diagram for Set II correctly]** Sample answer  P1. Energy level of reactants and products, axis with label energy P2. Chemical / ionic equation and ΔH	 1 1	 2
	(g)		**[Able to write what should be done to reduce heat loss to the surrounding correctly]** Sample answer Cover the polystyrene cup with lid // pour the solution quickly // double the polystyrene cup // wrap the polystyrene cup with cloth	 1	 1
			TOTAL		**11**

Section B:

No.			Mark Scheme	Sub Mark	Total Mark
Q7	(a)		***[Able to determine the molecular and empirical formula for the compound]*** ***[Able to state the information from the molecular formula]***		
			P1. Molecular formula: $C_4H_6O_6$	1	
			P2. Empirical formula: $C_2H_3O_3$	1	
			P3. The compound consists of carbon, hydrogen and oxygen	1	
			P4. There are 4 carbon atoms, 6 hydrogen atoms and 6 oxygen atoms in the molecule// There are 4 mol carbon, 6 mol hydrogen and 6 mol oxygen.	1	4
			(Remark: P3 can be obtain from P4)		
	(b)	(i)	**[*Able to write chemical equation for the reaction]***		
			$4Fe + 3 O_2 \rightarrow 2 Fe_2O_3$		
			P1. Correct formulae of reactants and product	1	
			P2. Balanced equation	1	2
			[Able to calculate the volume of O_2]		
		(ii)	P1. Mass of iron = 2.0 g	1	
			P2. Number of mole of Fe = $\frac{2}{56}$ = 0.0357 mol	1	
			P3. 4 mol of Fe react with 3 mol of O_2 // 0.0357 mol of Fe react with $\frac{3}{4}$ x 0.0357 = 0.268 mol of O_2	1	
			P4. Volume of O_2 = 0.268 x 24 = 0.643 dm^3 // 643 cm^3	1	4

<table>
<tr><th colspan="3">No.</th><th>Mark Scheme</th><th>Sub Mark</th><th>Total Mark</th></tr>
<tr><td></td><td>(c)</td><td>(i)</td><td>[Able to explain all the observations correctly]
<table><tr><td>Oxide of P</td><td>P1. React with nitric acid to form salt and water// reaction occur
P2. Shows basic properties</td></tr><tr><td>Oxide of Q</td><td>P3. React with sodium hydroxide solution to form salt and water// reaction occur
P4. Shows acidic properties</td></tr><tr><td>Oxide of R</td><td>P5. React with both nitric acid and sodium hydroxide solution to form salt and water// reaction occur
P6. Shows amphoteric properties</td></tr></table></td><td>1
1
1
1
1
1</td><td>6</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>[Able to suggest the name of metal P, Q and R]
[Able to arrange metal P, Q and R in an increasing order of proton number]
P1. P: sodium / magnesium
P2. Q: silicon / sulphur
P3. R: Aluminium
[r: formula]

P4. P R Q →
Increasing order</td><td>

1
1
1

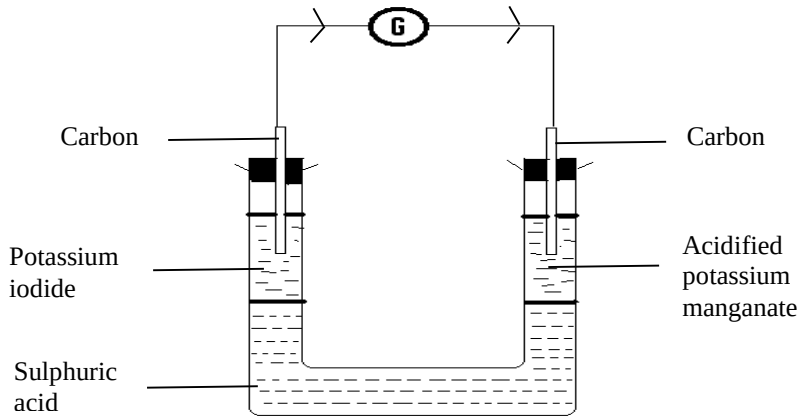
1</td><td>

4</td></tr>
<tr><td></td><td></td><td></td><td>TOTAL</td><td>20</td></tr>
</table>

<table>
<tr><th colspan="3">No.</th><th>Mark Scheme</th><th>Sub Mark</th><th>Total Mark</th></tr>
<tr><td>Q8</td><td></td><td>(a)</td><td>[Able to state type of cell and compare contrast between cell P and Q]
P1. Cell P: Chemical cell/ voltaic cell
Cell Q: Electrolytic cell
<table><tr><th>Characteristic</th><th>Cell P</th><th>Cell Q</th></tr><tr><td>P2. Energy change</td><td>Chemical energy to electrical energy</td><td>Electrical energy to chemical energy</td></tr><tr><td>P3. Positive terminal of the cell</td><td>Silver</td><td>Silver</td></tr><tr><td>Half equation at anode</td><td>P4. $Zn \rightarrow Zn^{2+} + 2e$</td><td>P5. $Ag \rightarrow Ag^{+} + e$</td></tr><tr><td>Observation at cathode</td><td>P6. Gas Bubbles</td><td>P7. Shiny grey solid deposited</td></tr></table>Notes: if cell is reversed, award mark for P3, P4 and P5 only</td><td>1

1
1
1+1
1+1</td><td>7</td></tr>
<tr><td></td><td></td><td>(b)</td><td>[Able to calculate the mass of silver]
P1. Number of mole of silver ion:
$\frac{1.0 \times 50}{1000}$ // 0.05 mol
P2. Number of mole of silver
1 mol of Ag^{+} produce 1 mol of Ag //
0.05 mol of Ag^{+} produce $\frac{1}{1} \times 0.05$
= 0.05 mol of Ag
P3. Mass of silver = 0.05 x 108g = 5.4 g</td><td>1

1
1</td><td>3</td></tr>
</table>

No.			Mark Scheme	Sub Mark	Total Mark
	(c)	(i)	***[Able to explain the similar observations in Set I and Set II in terms of oxidation number]***		
			Set I:		
			P1. bromine is more <u>electronegative</u> than iodine	1	
			P2. bromine displaces iodine from potassium iodide solution	1	
			P3. oxidation number of iodine increases from -1 to 0	1	
			P4. iodide ion is oxidised to iodine// $2I^- \rightarrow I_2 + 2e$	1	
			P5. reaction occur	1	
			Set II:		
			P6. iodine is less <u>electronegative</u> than bromine	1	
			P7. iodine cannot displace bromine from potassium bromide	1	
			P8. reaction does not occur	1	8
		(ii)	***[Able to draw labelled diagram to show apparatus set up to investigate electron transfer at a distance]***		
					
			P1. Apparatus set up and label	1	
			P2. Label electron flow in the diagram	1	2
			TOTAL		**20**

No.			Mark Scheme	Sub Mark	Total Mark
Q9	(*a*)		***[Able to suggest a suitable material to replace vinegar and explain the reason]*** P1. Hydrochloric acid / Nitric acid / Sulphuric acid P2. Hydrochloric acid / Nitric acid / Sulphuric acid is a strong acid/ ionized completely in water P3. Produced higher concentration of H^+ P4. React faster to produce <u>more</u> carbon dioxide gas	1 1 1 1	4
	(*b*)	(i)	***[Able to suggest a suitable concentration for acids in Set I and II]*** Set I: 0.1 mol dm^{-3} // 0.5 mol dm^{-3} // 1.0 mol dm^{-3} Set II: 0.2 mol dm^{-3} // 1.0 mol dm^{-3} // 2.0 mol dm^{-3} [** Concentration of acid used in set II is double of set I]	1	
		(ii)	***[Able to explain the difference in the rate of reaction in Set I and II]*** P1. Rate of reaction in Set II is <u>higher</u> than Set I. P2. Concentration of hydrochloric acid in Set II is higher/ double than that of Set I. P3. The number of hydrogen ions per unit volume is higher / double. P4. Frequency of collision between hydrogen ions and zinc atoms is higher. P5. Frequency of effective collision is higher.	1 1 1 1 1	6

No.			Mark Scheme	Sub Mark	Total Mark
	(*c*)		***[Able to describe an experiment to investigate the effect of temperature on the rate of reaction]*** Temperature factor <u>*Procedure*</u>: P1. [25 – 100] cm^3 of [0.1 – 2.0] mol dm^{-3} sodium thiosulphate solution is poured into conical flask. P2. The initial temperature of the solution is recorded. P3. The conical flask is placed on top of white paper with mark 'X' P4. [5 - 20] cm^3 of 0.2 mol dm^{-3} hydrochloric acid is poured into conical flask. P5. The stopwatch is started immediately. P6. The conical flask is swirled P7. The stopwatch is stopped once the mark 'X'disappeared from sight and the time is recorded. P8. The experiment is repeated using [25 – 100] cm^3 of [0.1 – 2.0] mol dm^{-3} sodium thiosulphate solution using different temperature <u>*Chemical equation*</u>: $2\ HCl + Na_2S_2O_3 \rightarrow 2\ NaCl + SO_2 + S + H_2O$ P9. Correct formulae of reactant and product P10. Balanced equation	1 1 1 1 1 1 1 1 1 1	10
				TOTAL	**20**

No.			Mark Scheme	Sub Mark	Total Mark
Q10	(*a*)		***[Able to suggest solvent Y, identify salt X and describe chemical test to verify anion in salt X]***		
			Sample answer: P1. Solvent Y is water P2. Salt X is iron(II) nitrate Confirmatory test for nitrate ion P3. Pour salt solution X into a test tube/ boiling tube P4. Add/ drop dilute sulphuric acid and iron(II) sulphate <u>solution</u> and shake P5. Add concentrated sulphuric acid slowly/ carefully/ drop by drop/ slanted test tube/ along the wall of test tube P6. Brown ring is formed	1 1 1 1 1 1	6
	(*b*)	(*i*)	***[Able to explain the use of barium sulphate]***		
			P1. Barium Sulphate is an insoluble salt P2. It does not dissolve in the fluid of digestive system	1 1	2
		(ii)	***[Able to suggest solution T and name the reaction]***		
			P1. Sodium Sulphate solution / Potassium Sulphate solution/ sulphuric acid [a: any soluble sulphate salt] P2. Double decomposition reaction / Precipitation reaction	1 1	2

No.			Mark Scheme	Sub Mark	Total Mark
		(iii)	***[Able to describe an experiment to prepare barium sulphate and calculate the maximum mass of salt formed]***		
			Procedure:		
			P1. Measure and pour 100 cm^3 of 0.2 mol dm^{-3} barium nitrate solution into a beaker.	1	
			P2. Add 50 cm^3 of 0.5 mol dm^{-3} sodium sulphate solution / solution T into the beaker.	1	
			P3. Stir the mixture.	1	
			P4. Filter the mixture using filter paper.	1	
			P5. Rinse the residue/salt using distilled water.	1	
			P6. Dry the salt by pressing it between sheets of filter papers	1	
			Chemical equation: $Ba(NO_3)_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaNO_3$	1	
			P7. Correct formulae of reactant and product	1	
			P8. Balanced equation		
			P9. Number of mole of Na_2SO_4 = 0.2 (100) / 1000 = 0.02 mol	1	
			P10. 1 mol of Na_2SO_4 react with 1 mol of $BaSO_4$ // 0.02 mol of Na_2SO_4 react with 0.02 mol of $BaSO_4$	1	
			P11. Mass of $BaSO_4$ = 0.02 X 233 = 4.66g	1	11 Max 10
				TOTAL	**20**

PERATURAN PEMARKAHAN TAMAT

[Lihat halaman sebelah

TEST SPECIFICATION TABLE
SIJIL PENDIDIKAN MRSM
CHEMISTRY PAPER 2, 2019

JSU Peperiksaan Akhir SPMRSM Kimia – Kertas 2

Section	Question No.	PK01	KK01	KK02	KK03	KK04	KK05	KK06
A	1 Structure atom	a(i)1 a(ii)1 a(iii)1 b(i)1	b(ii)2 c(i)2 c(ii)1					
	2 Carbon compound	a1 b(i)1 c(i)1	d(ii)1	b(ii)1 c(ii)1 d(i)1 e2				
	3 Acid base	a(i)1 b(i)1	a(ii)3	a(iii)2 b(ii)3 c(iii)3				
	4 Chemical formula and equation	a(i)1 b1	c(i)1 d2	a(ii)2 c(ii)3				
	5 Electro chemistry	a(i)1	a(ii)1 a(iii)1 b(i)1	a(iv)1 b(ii)1	b(iii)3	c2		
	6 Thermochemistry	a1	b1	c1 e3 f2	d2	g1		

Section	Question Number (Topic)	Construct of Elements Evaluated				
		KK 01 Knowledge	**KK 01** Comprehension	**CS 02** Application	**KK 03** Analysis	**KK 04** Synthesis
B	Q7 CHEMICAL FORMULAE & PERIODIC TABLE OF ELEMENTS		**4**	**6**	**3**	
			7a [4m]	7b (i) [2m] 7b (ii) [4m]	7c (i) [6m] 7c (ii) [4m]	
	Q8 ELECTROCHEMISTRY & REDOX		**4**	**6**	**10**	
				8b [3m] 8c(ii) [2m]	8a [7m] 8c(i) [8m]	
C	Q9 RATE OF REACTION			**4**	**7**	**10**
				9a [4m]	9b (i)(ii) [6m]	9b(iii)[10 m]
	Q10 ACID AND BASE SALT			**4**	**6**	**10**
				10b(i)[2m] 10b(ii)[2m]	10a(i)[6m]	10b(iii) [10m]