4541/3 (PP)
Chemistry
Kertas 3
October
2020

MAKTAB RENDAH SAINS MARA

PEPERIKSAAN AKHIR SIJIL PENDIDIKAN MRSM 2020

CHEMISTRY

Kertas 3

Peraturan Pemarkahan

Untuk Kegunaan Pemeriksa Sahaja

Peraturan Pemarkahan ini mengandungi 17 halaman bercetak

MARKING GUIDELINES
SPMRSM
PAPER 3

Symbol		Meaning
//	-	replace the whole sentence
/	-	replace the previous word
[ ]	-	can be summarized from explanation
___ or bold	-	key word
adp	-	avoid double penalty
wcr	-	wrong cancel right
a.	-	accept
r.	-	reject
ecf	-	error carry forward

QUESTIONS	MARK SCHEME	MARK
1(a)	**Able to record all the temperature readings accurately with one decimal place** **Answer** Initial temperature of $CuSO_4$ solution : 27.0 Highest temperature of mixture : 40.0 Change in temperature : 13.0	3
	Able to record any 2 temperatures reading correctly All readings correctly but with two decimal places/without decimal place	2
	Able to record any 1 temperature reading correctly	1
	No response or wrong response	0

[*Lihat halaman sebelah*

<table>
<tr><th>QUESTIONS</th><th>MARK SCHEME</th><th>MARK</th></tr>
<tr><td rowspan="4">1(b)</td><td>Able to construct a table to record the data correctly
<u>Sample answer</u>
<table><tr><td rowspan="2">Temperature /°C</td><td colspan="2">Experiment</td></tr><tr><td>I</td><td>II</td></tr><tr><td>Initial temperature of $CuSO_4$ solution</td><td>27.0</td><td>T_1</td></tr><tr><td>Highest temperature of mixture</td><td>40.0</td><td>T_2</td></tr><tr><td>Change in temperature</td><td>13.0</td><td>T_3</td></tr></table></td><td>3</td></tr>
<tr><td>[Able to construct a table to record the data]
<u>Sample answer</u>
<table><tr><td rowspan="2">Temperature</td><td colspan="2">Experiment</td></tr><tr><td>I</td><td>II</td></tr><tr><td>Temperature of $CuSO_4$ solution</td><td>27</td><td>T_1</td></tr><tr><td>Temperature of mixture</td><td>40</td><td>T_2</td></tr><tr><td>Change in temperature</td><td>13</td><td>T_3</td></tr></table></td><td>2</td></tr>
<tr><td>[Able to give an idea to construct a table to record the data]
<u>Sample answer</u>
<table><tr><td rowspan="2">Temperature</td><td colspan="2">Experiment</td></tr><tr><td>I</td><td>II</td></tr><tr><td>Temperature of $CuSO_4$ solution</td><td>27</td><td>T_1</td></tr></table>
Minimum 2 data</td><td>1</td></tr>
<tr><td>No response or wrong response</td><td>0</td></tr>
</table>

QUESTION	MARK SCHEME	MARK
1(c)	**Able to state all three variables correctly]** Sample answer **Manipulated variable** Type of metals// Magnesium and zinc **Responding variable** Heat of displacement // Temperature change **Fixed variable** Volume and concentration of copper(II) sulphate solution // copper(II) sulphate solution	3
	[Able to state any 2 variables correctly or 1 variable correctly and idea of two variables]	2
	[Able to state any 1 variable correctly or idea of three variables]	1
	No response or wrong response	0

QUESTION	MARK SCHEME	MARK
1(d)	**[Able to state one hypothesis correctly]** Sample answer 1. If Zinc reacts with copper(II) sulphate solution, the heat of displacement is lower whereas when magnesium reacts with copper(II) sulphate solution, the heat of displacement is higher 2. When zinc reacts with copper(II) sulphate solution, the temperature change is lower than when magnesium reacts with copper(II) sulphate solution.	3
	[Able to state one hypothesis] Sample answer 1. Zinc reacts with $CuSO_4$, heat of displacement is lower 2. Heat of displacement of copper by magnesium is higher than zinc	2
	[Able to state an idea of the hypothesis] Sample answer 1. Different metal produce different heat 2. Type of metal affect/influence the heat of displacement	1
	No response given / wrong response	0

[Lihat halaman sebelah

QUESTION	MARK SCHEME	MARK
1(e)(i)	**[Able to state two observation for Experiment I correctly]** Sample answer 1. Brown solid produced / deposited 2. Zinc powder dissolved	3
	[Able to state one observation for Experiment I correctly] Brown precipitate // Zinc powder dissolved	2
	[Able to give an idea of the observation] Solid produced // powder disappear // colour change	1
	No response or wrong response	0
1(e)(ii)	**[Able to state the corresponding inference correctly]** Sample answer 1. Copper is formed 2. Zinc react /oxidized/ zinc atom release electron	3
	[Able to give the corresponding inference] Sample answer 1. Metal solid formed 2. Metal oxidized	2
	[Able to give an idea of an inference] Sample answer Solid formed // metal change // change in concentration // No copper(II) ion/ Cu^{2+} presence // All the Cu^{2+} has been reduced	1
	No response or wrong response	0

QUESTION	MARK SCHEME	MARK
1(f)	**[Able to state the correct operational definition of heat of displacement in this experiment with the following criteria]** 1. What should be done [metal added into solution to displace 1 mol of copper] 2. What should be observed [raise in temperature] Sample answer 1. Raises/ increases in temperature when metal/Mg/ Zn powder is added into $CuSO_4$ solution to displace / form 1 mol of Cu 2. When Mg/ Zn powder is added into $CuSO_4$ solution to displace 1 mol of Cu, the temperature raises/increases	3
	[Able to state the correct operational definition for the heat of displacement in this experiment with the following aspects] 1. What must be done [metal added into solution when 1 mol of copper displaced] **OR** 2. What is observed [raise in temperature] Sample answer Raises/ increases in temperature // when metal/Mg/ Zn powder is added into $CuSO_4$ solution to displace / form 1 mol of Cu //[Theoretical definition]	2
	[Able to give an idea of the operational definition] Sample answer Heat release // Heat change	1
	No response or wrong response	0

[*Lihat halaman sebelah*

QUESTION	MARK SCHEME	MARK
1(g)	**[Able to calculate the mass of Cu formed that fulfil the following criteria]** 1. Correct no. of mole of Cu^{2+} 2. Correct mole ratio of Cu^{2+}: Cu 3. Correct answer with correct unit Sample answer P1. No. of mole Cu^{2+} /copper(II) sulphate = [MV/1000] $= \frac{0.5 \times 50}{1000}$ $= 0.025$ mol P2. 1 mol Cu^{2+} produce 1 mol Cu // 0.025 mol Cu^{2+} produce 0.025 mol Cu // Cu^{2+} : Cu 1 : 1 0.025 : 0.025 P3. Mass of Cu = 0.025 X 64 = 1.6 g	3
	[Able to fulfil any two of the criteria]	2
	[Able to fulfil any one of the criteria]	1
	No response or wrong response	0

QUESTIONS	MARK SCHEME	MARK
1(h)	**[Able to predict temperature after adding silver powder correctly]** Answer: 28.0	3
	[Able to predict temperature after adding silver powder] Sample answer 28	2
	[Able to give an idea to predict temperature] Sample answer 27// no change in temperature	1
	No response or wrong response	0

QUESTIONS	MARK SCHEME	MARK

1(i)	**[Able to state the relationship between the colour of copper(II) sulphate solution with time correctly]**
	
	Sample answer:
	The intensity of blue colour decreases with time
	// The intensity of blue colour decreases as time increases
	// vice versa
		3

	[Able to state the relationship between the colour of copper(II) sulphate with time]
	
	Sample answer:
	Intensity of blue colour decreases
	// Intensity of blue colour directly proportional with time
	// Blue colour of $CuSO_4$ changes to colourless when time increases
		2

	[Able to give an idea of the relationship between the colour of copper(II) sulphate with time] Sample answer: The intensity of the colour changes	1
	No response or wrong response Sample answer: Intensity of the blue colour decreases as time decreases	0

[*Lihat halaman sebelah*

<table>
<tr><th>QUESTIONS</th><th>MARK SCHEME</th><th>MARK</th></tr>
<tr><td>1(j)</td><td>[Able to classify all the metals correctly]

<u>Answer:</u>

<table><tr><th>More electropositive</th><th>Less electropositive</th></tr><tr><td>Magnesium, Aluminium, Zinc, Lead</td><td>Silver, Gold</td></tr></table>
*Score 1 if reverse</td><td>3</td></tr>
<tr><td></td><td>[Able to classify any four or five metals correctly]</td><td>2</td></tr>
<tr><td></td><td>[Able to classify any three metals correctly]</td><td>1</td></tr>
<tr><td></td><td>No response or wrong response</td><td>0</td></tr>
</table>

QUESTION	MARK SCHEME	MARK
2 (a)	**[Able to give the problem statement correctly]** Sample answer: 1.Does the concentration of potassium chloride solution /electrolyte affect the product of electrolysis at the anode? 2.How does the concentration of electrolyte affect the product formed of electrolysis at anode? 3.Does concentrated KCl solution produce chlorine gas at anode and diluted KCl solution produce oxygen gas at anode during electrolysis?	3
	[Able to give the problem statement] Sample answer: 1.Does the concentration of electrolyte affect the product of electrolysis? 2. How does the concentration of electrolyte affect the product formed? 3. Does concentrated KCl solution produce chlorine gas at anode? 4. Does diluted KCl solution produce oxygen gas at anode?	2
	[Able to state an idea of problem statement] Sample answer: 1.Concentration affect /influence products 2. electrolyte affects the product of electrolysis 3.Different concentration give different products	1
	No response or wrong response	0

QUESTION	MARK SCHEME	MARK
2 (b)	**[Able to state all the variable correctly]** Sample answer **Manipulated Variable** Concentration of electrolyte/potassium chloride solutions/chloride ion **Responding Variable** Product formed/ion discharged at anode **Fixed Variable** Type of electrode/carbon electrode//Type of electrolyte/Potassium chloride solution	3
	[Able to state any two variables correctly or one variable correctly or idea of two variables] Sample answer **Manipulated Variable** Concentration **Responding Variable** Product formed/ion discharged **Fixed Variable** Type of electrode/carbon electrode// Type of electrolyte/Potassium chloride	2
	[Able to state any one variable correctly or idea of three variables] Sample answer **Manipulated Variable** Concentration /solution /electrolyte **Responding Variable** Product formed **Fixed Variable** Electrode	1
	No response given or wrong response	0

QUESTION	MARK SCHEME	MARK
2 (c)	**[Able to state the hypothesis correctly]** Sample answer 1.If concentrated/higher concentration potassium chloride solution is electrolysed/used, product at the anode is chlorine gas and if the dilute potassium chloride solution/lower concentration is electrolysed/used, the product at the anode is oxygen gas // 2.If concentrated KCl solution is used, chlorine gas produce at anode and if diluted KCl solution is used, oxygen gas produce at anode. [a: high concentration: 0.1-2.0 mol dm^{-3}, diluted: $x \leq 0.0001$ mol dm^{-3}]	3
	[Able to state the hypothesis] Sample answer: 1.If concentrated potassium chloride solution used, product at anode is chlorine gas // 2.If dilute potassium chloride solution used, the product at anode is oxygen gas.// 3.Chlorine gas produce at anode if concentrated KCl solution is used, and oxygen gas produce at anode if diluted KCl solution is used	2
	[Able to state an idea of the hypothesis] Sample answer: 1.Concentration of electrolyte affects/influence/ different the product at the anode 2.Different concentration different product	1
	No response given or wrong response	0

QUESTION	MARK SCHEME	MARK
2 (d)	**[Able to list all the apparatus and materials]** Materials 1. [0.0001] mol dm^{-3} / dilute potassium chloride solution, 2. [0.1 - 2.0] mol dm^{-3} / concentrated potassium chloride solution Apparatus 1. carbon electrodes, 2. electrolytic cell 3. connecting wire 4. battery / dry cell/ power supply 5. test tube 6. ammeter / voltmeter 7. wooden splinter 8. blue litmus paper	3
	[Able to list apparatus and materials] **Materials** [0.0001] mol dm^{-3} / diluted potassium chloride solution // [0.1 – 2.0] mol dm^{-3} / concentrated potassium chloride solution **Apparatus** Electrolytic cell, carbon electrodes, connecting wire, battery	2
	[Able to give idea of materials and apparatus] Material [Any electrolyte] Apparatus [Container], electrodes, battery,wire	1
	No response or wrong response	0

QUESTION	MARK SCHEME	MARK
2 (e)	**[Able to state all steps of the procedure correctly]** 1. Fill/ Pour half full / [20 – 200]cm^3 of [0.0001] mol dm^{-3} / diluted potassium chloride solution into an electrolytic cell. 2. Dip the carbon electrodes into the electrolyte 3. Pour the solution into two test tubes and place the test tube inversely to both electrodes 4. Connect both electrodes to the battery with connecting wires // Complete the circuit. 5. Record all observation. 6. Repeat step 1 to 4 by using concentrated / [0.1 - 2.0] mol dm^{-3} potassium chloride solution .	3
	[Able to state the steps 1, 4, 5 and 6]	2
	[Able to state steps 1, 4 and 5]	1
	No response or wrong response	0

<table>
<tr><th>QUESTION</th><th>MARK SCHEME</th><th>MARK</th></tr>
<tr><td rowspan="3">2 (f)</td><td>[Able to construct a table that consist of:]

1. Heading for manipulated and responding variable

2. State the name of two different concentration of electrolyte

<table>
<tr><th>Concentration of electrolyte, (mol dm^{-3})</th><th>Observation // Product at anode</th></tr>
<tr><td>0.0001 / diluted potassium chloride solutions</td><td></td></tr>
<tr><td>[0.1 -2.0] / concentrated diluted potassium chloride solutions</td><td></td></tr>
</table></td><td>2</td></tr>
<tr><td>[Able to construct a table that consist of:]

1. Heading for manipulated and responding variable
2. No unit

<table>
<tr><th>Concentration / electrolyte</th><th>Observation</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
</table></td><td>1</td></tr>
<tr><td>No response or wrong response</td><td>0</td></tr>
</table>