MAKTAB RENDAH SAINS MARA

PEPERIKSAAN AKHIR SIJIL PENDIDIKAN MRSM 2022

KIMIA

Kertas 1

Peraturan Pemarkahan

Untuk kegunaan pemeriksa sahaja

Peraturan pemarkahan ini mengandungi 3 halaman bercetak

Table of Specification SPMRSM 2022

No.	Construct	Topic	Type Of Item	Key
1	Remembering	F 4 LA2	M. Choice	A
2	Remembering	F 4 LA3	M. Choice	B
3	Remembering	F 4 LA4	M. Choice	A
4	Remembering	F 4 LA6	M. Choice	A
5	Remembering	F 4 LA5	M. Choice	A
6	Remembering	F 4 LA7	M. Choice	B
7	Remembering	F 4 LA8	M. Choice	C
8	Remembering	F 5 LA9	M. Choice	D
9	Remembering	F 5 LA10	M. Choice	A
10	Remembering	F 5 LA9	M. Choice	B
11	Remembering	F 5 LA10	M. Choice	C
12	Remembering	F 5 LA11	M. Choice	D
13	Remembering	F 5 LA12	M. Choice	C
14	Remembering	F 5 LA13	M. Completion	A
15	Understanding	F 4 LA2	M. Choice	B
16	Understanding	F 4 LA2	M. Choice	C
17	Understanding	F 4 LA3	M. Choice	D
18	Understanding	F 4 LA4	M. Choice	C
19	Understanding	F 4 LA4	M. Choice	C
20	Understanding	F 4 LA5	M. Choice	B
21	Understanding	F 4 LA6	M. Choice	B
22	Understanding	F 4 LA7	M. Choice	D
23	Understanding	F 4 LA7	M. Choice	A
24	Understanding	F 5 LA14	M. Choice	D
25	Understanding	F 5 LA9	M. Choice	B
26	Understanding	F 5 LA10	M. Choice	D
27	Understanding	F 5 LA11	M. Completion	C
28	Understanding	F 5 LA12	M. Completion	D
29	Understanding	F 5 LA14	M. Choice	D
30	Applying	F 4 LA3	M. Choice	D
31	Applying	F 4 LA5	M. Choice	C
32	Applying	F 4 LA6	M. Choice	D
33	Applying	F 4 LA7	M. Choice	B
34	Applying	F 5 LA9	M. Choice	D
35	Applying	F5 LA9	M. Choice	D
36	Applying	F 5 LA11	M. Choice	A
37	Applying	F 5 LA10	M. Completion	B
38	Applying	F 4 LA6	M. Choice	B
39	Analyzing	F 5 LA9	M. Choice	A
40	Analyzing	F 5 LA 9	M. Choice	D

Key	No.
A	9
B	10
C	8
D	13
Total	**40**

Element	Code
Remembering	PK01
Understanding	KK01
Applying	KK02
Analyzing	KK03
Evaluating	KK04
Creating	KK05

END OF MARK SCHEME

MAKTAB RENDAH SAINS MARA

PEPERIKSAAN AKHIR SIJIL PENDIDIKAN MRSM 2022

KIMIA

Kertas 2

Peraturan Pemarkahan

Untuk Kegunaan Pemeriksa Sahaja

Peraturan Pemarkahan ini mengandungi 19 halaman bercetak

MARKING GUIDELINES

PAPER 2

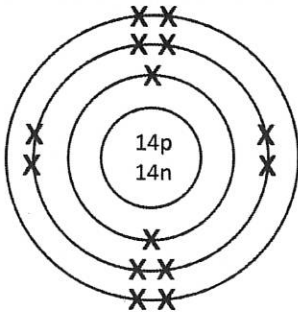| Symbol		Meaning
//	-	replace the whole sentence
/	-	replace the previous word
[ ]	-	can be summarized from explanation
___ or bold	-	key word
adp	-	avoid double penalty
wcr	-	wrong cancel right
a	-	accept
r	-	reject
ecf	-	error carry forward

SECTION A

No.			Mark Scheme	Sub Mark	Total Mark
1	(a)		[Able to state the physical state of fats at room temperature correctly]		
			Answer: Solid	1	1
	(b)		[Able to name the reaction for the conversion of saturated fats into unsaturated fats correctly]		
			Answer: Hydrogenation // Addition of hydrogen	1	1
	(c)		[Able to state the type of food additives and function of citric acid in the cake correctly]		
			P1. Type of food additives	1	
			P2. Function of citric acid	1	2
			Answer:		
			P1. Antioxidants		
			P2. Slow down the oxidation of fats in food // Prevent oily or greasy food from becoming rancid.		
	(d)		[Able to state one other example of food additives in the cake correctly]		
			Sample answer:		
			Preservatives // flavourings // stabilisers // emulsifiers// dyes	1	1
			Total		**5**

No.			Mark Scheme	Sub Mark	Total Mark
2	(a)	(i)	**[Able to state the meaning of molecular formula correctly]** Answer: Chemical formula that shows the actual number of atoms of each element in a molecule/compound	1	1
		(ii)	**[Able to write the molecular formula of aspirin correctly]** Answer: $C_9H_8O_4$	1	1
		(iii)	**[Able to state the type of particle of aspirin correctly]** Answer: Molecule	1	1
	(b)		**[Able to give two information that can be interpreted from the chemical equation correctly]** P1. Identify reactants and product P2. Mole ratio//quantity ratio of reactant and product Sample answer: 4 mol of aluminium reacts with 3 mol of oxygen to produce 2 mol of aluminium oxide // 4 aluminium atoms react with 3 oxygen molecules to produce 2 units of aluminium oxide	1 1	2
				Total	5

No.			Mark Scheme	Sub Mark	Total Mark
3	(a)		**[Able to state the meaning of isotopes correctly]** Sample answer: <u>Atoms</u> of the same element with the <u>same proton number</u> but <u>different nucleon number</u> // <u>Atoms</u> of the same element with the <u>same number of protons</u> but <u>different number of neutrons</u>	1	1
	(b)		**[Able to draw the atomic structure of Si-28 correctly]** P1. Nucleus is shown and correct number of shell P2. Correct number of electron and label proton and neutron in the nucleus Sample answer:	1 1	2
	(c)		**[Able to calculate the relative atomic mass of Si correctly]** P1. Calculation P2. Correct answer Sample answer: RAM of Si $= \dfrac{[92 \times 28] + [5 \times 29] + [3 \times 30]}{100}$ $= 28$	1 1	2
	(d)		**[Able to state one example of isotopes used in medicine field correctly]** Sample answer: Cobalt-60 // Iodine-131 *Accept any suitable isotopes	1	1
				Total	**6**

No.			Mark Scheme	Sub Mark	Total Mark
4	(a)		[Able to write the electron arrangement of ion T correctly] Answer: 2.8.8	1	1
	(b)		[Able to state the position of element S in the Periodic Table of Elements correctly] Answer: Period 2, Group 16	1	1
	(c)		[Able to arrange the atomic size of the elements in descending order correctly] Answer : Q,T,U,P,R,S	1	1
	(d)	(i)	[Able to state the element that exists as monoatomic gas correctly] Answer: U	1	1
		(ii)	[Able to explain answer in d(i) correctly] Sample answer: <u>Atom</u> has achieved stable octet electron arrangement	1	1
	(e)		[Able to explain the difference in reactivity between the two elements correctly] Sample answer: P1. Size of Q atom is bigger than P atom// [Atomic size] P2. Attraction forces between nucleus and the valence electron in Q atom is weaker than P atom // Q atom is easier to lose electron than P atom	1 1	2
				Total	7

No.			Mark Scheme	Sub Mark	Total Mark
5	(a)		**[Able to state the meaning of the polymer correctly]** Answer: A <u>long chain molecule</u> that is made from a combination of many repeating <u>basic units/monomers</u>.	1	1
	(b)	(i)	**[Able to draw the structural formula of the monomer correctly]** Answer:	1	1
		(ii)	**[Able to state the type of polymerisation reaction in the production of the polymer correctly]** Answer : Addition polymerisation	1	1
		(iii)	**[Able to state one of the uses of the polymer correctly]** Sample answer: Food container // Plastic bottles // Ropes // Twine *Accept any suitable answer	1	1
	(c)	(i)	**[Able to choose and justify the use of natural rubber or synthetic rubber in the making of this sport shoe sole correctly]** P1. Choose the type of rubber P2 & P3. Justification Sample answer: P1. Natural rubber P2. Soft (which makes foot is more comfortable) P3. Low heat resistance (This will make the sole become sticky and less slippery. This makes the sole can grip the flooring better.) **OR** P1. Synthetic rubber P2. More elastic. (It can retain its shape longer. The shoe can be wear longer) P3. More/High heat resistant.(The shoe sole is not easily worn)	1 1+1	3
		(ii)	**[Able to suggest one way to overcome the issue correctly]** Sample answer: Recycle // Reuse // Reduce	1	1
				Total	**8**

No.			Mark Scheme	Sub Mark	Total Mark
6	(a)	(i)	**[Able to write the electron arrangement of atom X correctly]** Answer: 2.8.2	1	1
		(ii)	**[Able to state the type of forces of attraction correctly]** Answer: <u>Electrostatic attraction</u> forces // <u>Electrostatic</u> forces of attraction	1	1
		(iii)	**[Able to write the chemical equation for the formation of the compound correctly]** P1. Correct formula of reactant and product P2. Balanced chemical equation Answer: $2X + Y_2 \rightarrow 2XY$ // $2Mg + O_2 \rightarrow 2MgO$	1 1	2
		(iv)	**[Able to calculate the mass of XY produced when 0.1 mol of X react with Y in excess correctly]** P1. Mole ratio P2. Mass of XY with correct unit Sample answer: P1. 2 mol X produce 2 mol XY // 0.1 mol X produce 0.1 mol XY P2. Mass of XY = 0.1 x (24+16) = 4 g Note: Apply ecf P1 from 6(a)(iii)	1 1	2

	(b)		**[Able to identify the type of compound and explain the two properties of white solid correctly]**
			
			P1. Covalent compound// Covalent
			    r : covalent bond
			P2. Consists of neutral molecule //
			    no free moving ion present
			P3. <u>Weak</u> attraction forces between molecules//
			    <u>Weak</u> intermolecular forces of attraction//
			    <u>Weak</u> Van der Waals force between molecules
				1
				
				1
				
				1
					3

				Total	**9**

No.			Mark Scheme	Sub Mark	Total Mark
7	(a)	(i)	**[Able to state the meaning of heat of precipitation correctly]** Answer: Heat change when 1 mole of precipitate is formed from their ions in aqueous solutions. a: specific definition	1	1
		(ii)	**[Able to state one information that can be obtained from the energy level diagram correctly]** Sample answer: Precipitation of barium sulphate is an exothermic reaction // 1473.2 kJ heat is released when 1 mol of barium sulphate is formed // Total energy content of reactants is higher than total energy content of products	1	1
		(iii)	**[Able to name solution X correctly]** Answer: Barium chloride // Barium nitrate r: Formula	1	1
		(iv)	**[Able to write ionic equation correctly]** Answer: $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$	1	1
	(b)	(i)	**[Able to calculate the increase in temperature with unit correctly]** P1. Number of mole of $Pb(NO_3)_2$/ Na_2SO_4 P2. Heat released, Q P3. Temperature change, θ with unit Answer: P1. Number of mole of $Pb(NO_3)_2$ = MV /1000 $\qquad\qquad\qquad\qquad$ = 1 x 25 /1000 $\qquad\qquad\qquad\qquad$ = 0.025 mol // $\quad$ Number of mole of Na_2SO_4 = 1 x 25 /1000 $\qquad\qquad\qquad\qquad$ = 0.025 mol P2. 1 mol of $PbSO_4$ released 50.4 kJ $\quad$ 0.025 mol of $PbSO_4$ released 1.26 kJ // $Q = \Delta H (n) = 50400 (0.025) = 1260$ J	1 1 1	3

No.			Mark Scheme	Sub Mark	Total Mark
			P3. $\theta = Q / mc = \dfrac{1260}{(25+25)\ (4.2)}$ $= 6\ ^\circ C$		
	(ii)		**[Able to suggest how to obtain the result correctly]** Answer: Use 0.5 mol dm^{-3} lead(II) nitrate solution and 0.5 mol dm^{-3} sodium sulphate solution	1	1
	(c)		**[Able to choose the best fuel for cooking and justify your choice correctly]** P1. Fuel chosen P2. Justification Sample answer: P1. Methane P2. Cheaper OR P1. Octane P2. The fuel value is higher // Easier to handle // Safer	1 1	2
				Total	**10**

No.			Mark Scheme	Sub Mark	Total Mark
8	(a)	(i)	**[Able to state all anions present in NaCl solution correctly]**		
			Sample answer:	1	1
			Chloride and hydroxide ions // Cl^- & OH^-		
		(ii)	**[Able to name the product formed at electrode P correctly]**		
			Answer:		
			Chlorine	1	1
			r: formula		
		(iii)	**[Able to explain the selection of ions to be discharged at electrode P correctly]**		
			Answer:	1	1
			Concentration of chloride ions/Cl^- is higher than hydroxide ions/OH^-		
		(iv)	**[Able to describe a chemical test to verify the product formed at electrode P]**		
			P1. Method and reagent	1	
			P2. Observation	1	2
			Sample answer:		
			P1. Place a damp blue litmus paper into a test tube containing the product formed		
			P2. Blue litmus paper turns to red and then <u>bleached</u>		
	(b)		**[Able to write the half equation correctly]**		
			Answer:		
			$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$	1	1
	(c)	(i)	**[Able to compare and explain the difference in the observations correctly]**		
			Sample answer:		
			P1. Inference based on observation in Test tube I and II	1	
			P2. Reason for observation in Test tube I	1	
			P3. Reason for observation in Test tube II	1	3
			P1. Test tube I : Lead metal formed Test tube II: No reaction occurs		
			P2. Test tube I : Lead(II) ion receives/gains electron to form lead atom // Lead is displaced from lead(II) nitrate solution by iron //		

No.			Mark Scheme	Sub Mark	Total Mark
			Iron is more electropositive than lead // E^0 value of iron is more negative than E^0 value of lead		
			P3. Test tube II : Copper cannot displace lead from lead(II) nitrate solution// Copper less electropositive than lead // E^0 value of copper is more positive than E^0 value of lead		
		(ii)	**[Able to suggest an action to be taken to ensure reaction occurs in test tube II correctly]** Sample answer: Change copper wire with a more electropositive metal // Change copper wire with a metal with more negative E^0 value. // Change lead(II) nitrate solution with silver nitrate solution	1	1
			Total		10

SECTION B

No.			Mark Scheme	Sub Mark	Total Mark
9	(a)	(i)	[**Able to choose and explain the method to relieve the stomach pain faster**] P1. Method P2. & P3. Explanation Sample answer: P1. Chew the antacid tablet P2. Chewing will break the tablet into smaller size P3. Larger total surface area of tablet exposed / react with acid	1 1+1	3
		(ii)	[**Able to calculate the average rate of reaction for Set I and Set II with unit correctly**] Answer: P1. Set I : 48.00/2 = 24 $cm^3\,min^{-1}$ P2. Set II: 72.00/4 = 18 $cm^3\,min^{-1}$	1 1	2

		(iii)	[**Able to write a balanced chemical equation and calculate the mass of calcium carbonate correctly**]
			P1. Correct formulae of reactants and products
			P2. Balanced equation
			P3. Number of mole of CO_2
			P4. Mole ratio
			P5. Mass calcium carbonate with correct unit
			
			Answer:
			
			P1&P2. $2HCl + CaCO_3 \longrightarrow CaCl_2 + CO_2 + H_2O$
			
			Sample answer:
			P3. Number of mole carbon dioxide;
			  n = Volume /molar volume
			   = 72 /24000
			   = 0.003 mol
			
			P4. 1 mol of CO_2 produced by 1 mol of $CaCO_3$
			 0.003 mol of CO_2 produced by 0.003 mol $CaCO_3$
			
			Note: Apply ecf P4 from P1 & P2
			
			P5. Mass of $CaCO_3$ = 0.003 x molar mass
			    = 0.003 x 80
			    = 0.24g
				1
				1
				1
				1
				1
					5

No.			Mark Scheme	Sub Mark	Total Mark
	(b)		**[Able to suggest the change that can be done to Set I and explain the changes based on collision theory correctly]** P1. Changes to obtain Set II P2-P5. Explanation using collision theory P6. Changes to obtain Set III P7-P10. Explanation using collision theory Sample answer:		
			To obtain Set II		
			P1. Use zinc granules // Use bigger size of zinc	1	
			Explanation:		
			P2. Zinc granules have smaller total surface area exposed to collision	1	
			P3. Frequency of collision between H^+ ions and Zn atoms is lower	1	
			P4. Frequency of effective collision between H^+ ions and Zn atoms is lower	1	
			P5. Rate of reaction will be lower	1	
			To obtain Set III		
			P6. Add copper(II) sulphate (solution)	1	
			Explanation:		
			P7. The presence of copper(II) sulphate as catalyst provide alternative pathway with lower activation energy	1	
			P8. More colliding particles able to achieve the lower activation energy	1	
			P9. Frequency of effective collision between H^+ ions and Zn atoms is higher	1	
			P10. Rate of reaction will be higher	1	10
			Note: -reject decreases for P3, P4 and P5 *-reject increases for P9 and P10*		
				Total	**20**

No.			Mark Scheme	Sub Mark	Total Mark
10	(a)	(i)	[Able to state the method and physical properties involved in the separation process of crude oil correctly] Answer P1. <u>Fractional</u> distillation P2. Boiling point	 1 1	 2
		(ii)	[Able to draw the structural formulae for both distillates correctly] P1. Structural formula of 2,2,4-trimethylpentane P2. Structural formula of butane Answer 	 1 1	 2
	(b)		[Able to write the chemical equation for the combustion of hexane and calculate volume of carbon dioxide gas correctly] P1. Correct formulae of reactants and products P2. Balanced equation P3. No. of mole of hexane P4. Mole ratio P5.Volume of carbon dioxide gas with correct unit Sample answer: P1&P2. $C_6H_{14} + 19/2\ O_2 \rightarrow 6CO_2 + 7H_2O$ P3. No of mole C_6H_{14} = 258 / (12(6)+14(1)) = 3 mol P4. 1 mol C_6H_{14} produce 6 mol CO_2 3 mol C_6H_{14} produce 18 mol CO_2 Note: Apply ecf P4 from P1 & P2 P5. Volume of CO_2 gas = 18 x 24 = 432 dm^3	 1+1 1 1 1	 5

No.			Mark Scheme	Sub Mark	Total Mark
(c)	(i)		**[Able to suggest the name of alcohol P, write the molecular formula of compound Q, state the homologous series of compound R and name of Reaction III correctly]**		
			Answer:		
			P1. Ethanol // propanol	1	
			P2. C_2H_4 // C_3H_6	1	
			P3. Alkane	1	
			P4. Oxidation	1	4
	(ii)		**[Able to compare the sootiness of the flame correctly]**		
			P1. Calculate % of C by mass in compound Q		
			P2. Calculate % of C by mass in compound R		
			P3. Compare the % of C by mass between both compounds		
			P4. Compare the sootiness of the flame		
			Sample answer:		
			P1. % of C by mass in compound Q / C_2H_4 $$= \frac{(12 \times 2)}{(2(12) + 4(1))} \times 100 = 85.71\%$$	1	
			P2. % of C by mass in compound R / C_2H_6 $$= \frac{(12 \times 2)}{(2(12) + 6(1))} \times 100 = 80\%$$	1	
			P3. % of C by mass in compound Q / C_2H_4 is higher than compound R / C_2H_6	1	
			P4. compound Q / C_2H_4 produces more soot / higher sootiness than compound R / C_2H_6	1	4
			OR		
			P1. % of C by mass in compound Q / C_3H_6 $$= \frac{(12 \times 3)}{(3(12) + 6(1))} \times 100 = 85.71\%$$		
			P2. % of C by mass in compound R / C_3H_8 $$= \frac{(12 \times 3)}{(3(12) + 8(1))} \times 100 = 81.81\%$$		
			P3. % of C by mass in compound Q / C_3H_6 is higher than compound R / C_3H_8		
			P4. compound Q / C_3H_6 produces more soot / higher sootiness than compound R / C_3H_8		

No.		Mark Scheme	Sub Mark	Total Mark
(d)		**[Able to justify the use of artificial ethene for fruit ripening process correctly]**		
		P1. Agree/Disagree P2&P3. Justification	1 1+1	3
		Sample answer:		
		P1. Yes // it can be used. P2. It induces fruit ripening. P3. The ripening process of the fruits becomes faster / takes shorter time.		
		OR		
		P1. No // it shouldn't be used. P2. It decrease the fruit shelf-life//Fruit easily become over-ripe. P3. Cause vomiting / diarrhoea / sore throat / shortness of breath		
		Note: accept any suitable answers		
			Total	**20**

SECTION C

No.			Mark Scheme	Sub Mark	Total Mark
11	(a)	(i)	[Able to state the basicity of ethanoic acid and explain correctly] Sample answer: P1. Monoprotic P2. 1 mol of ethanoic acid ionise in water to produce 1 mol of H^+ ion. // 1 molecule of ethanoic acid ionise in water to produce 1 H^+ ion.	1 1	2
		(ii)	[Able to state and explain the differences in the observation between experiment I and II correctly] P1. Observation of experiment I and II P2. Inference of experiment I and II P3. Explanation of experiment I and II Sample answer:	1 1 1	3

	Experiment I	Experiment II
P1.	Balloon does not inflate// No change	Balloon inflate
P2.	No carbon dioxide gas release//No reaction occur	Carbon dioxide gas released//Reaction occurs
P3.	Exist as molecule // no H^+ present	Presence of H^+

(sub marks for the above table: 1, 1, 1)

No.			Mark Scheme	Sub Mark	Total Mark
	(b)	(i)	[Able to identify solid salt X, black solid Y, brown gas Z and name substance P correctly] Answer: P1. Salt X: Copper(II) nitrate P2. Solid Y: Copper(II) oxide P3. Gas Z: Nitrogen dioxide P4. Substance P: Nitric acid *a: formula for P1, P2 & P3 r: formula for P4	1 1 1 1	4

No.			Mark Scheme	Sub Mark	Total Mark
		(ii)	**[Able to write a balanced chemical equation and calculate the volume of gas Z correctly]**		
			P1. Correct formula of reactant and products	1	
			P2. Balanced chemical equation	1	
			P3. No. of mole of salt X	1	
			P4. Mole ratio	1	
			P5.Volume of gas Z with correct unit	1	5
			Answer:		
			P1 & P2. $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$		
			P3. No. of mole of X = 9.4/(64+2(14)+6(16)) = 0.05 mol		
			P4. 2 mol $Cu(NO_3)_2$ produce 4 mol NO_2		
			0.05 mol $Cu(NO_3)_2$ produce 0.1 mol NO_2		
			Note: Apply ecf P4 from P1 & P2		
			P5. Volume of gas Z = 0.1 x 24 = 2.4 dm^3		
	(c)		**[Able to suggest chemical substance used to treat the waste, name the reaction and describe confirmatory test correctly]**		
			P1. Suggested chemical substance	1	
			P2. Name of reaction	1	
			P3. Ionic equation	1	
			P4,P5&P6. Confirmatory test	1+1+1	6
			Sample answer:		
			P1. Calcium oxide // calcium hydroxide // calcium carbonate *a: formula		
			P2. Neutralisation		
			P3. $H^+ + OH^- \rightarrow H_2O$		
			P4. Pour 2 cm^3 of the waste water into a test tube.		
			P5. Add **(a named metal carbonate / metal)** into the test tube.		
			P6. No effervescence occur // No gas bubbles		
				Total	**20**

PERATURAN PEMARKAHAN TAMAT