MAJLIS PEPERIKSAAN MALAYSIA

Malaysian Examinations Council

PELANGI

2024

LAPORAN PEPERIKSAAN STPM

Chemistry (962)

Chemistry

962/1

OVERALL PERFORMANCE

For Semester 1, 2 663 candidates sat for the examination for this subject and 63.61% of them obtained a full pass.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	6.07	7.80	11.41	10.76	11.11	9.42	7.04	4.21	7.49	3.77	20.92

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

Question number	Key	Question number	Key	Question number	Key
1	**A**	6	**C**	11	**A**
2	**C**	7	**D**	12	**B**
3	**D**	8	**A**	13	**B**
4	**C**	9	**B**	14	**D**
5	**C**	10	**D**	15	**C**

General comments

The performance of the candidates was good. All the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, good candidates managed to answer based on the questions asked. Excellent candidates provided organised solutions and explanation for the questions. They were able to plan and gave strategized steps when answering the questions. For numerical questions, the excellent candidates showed all the essential formula, correct substitution, correct significant figures and correct unit for the final answers. In writing chemical equation, candidates were able to write a balanced equation with correct physical states and use proper scientific terms to explain. Moderate candidates were able to present their answer well in the questions that they were familiar with. In solving numerical problems, moderate candidates were able to write formula and calculation correctly. However, they gave final answers with incorrect significant figures and or incorrect units. Weak candidates could only answer some straightforward questions or low cognitive level questions. They tend to write what they know without answering to the questions. Most candidates answered the questions in English.

Comments on the individual questions

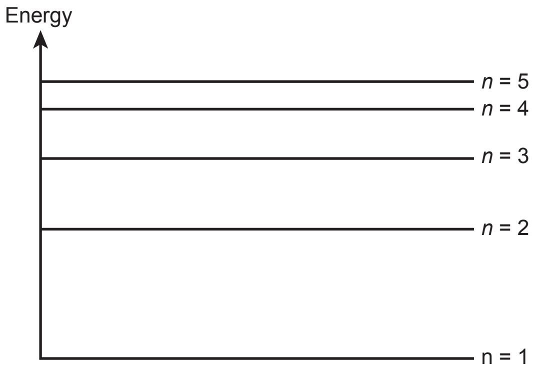
Question 16

The question tested the knowledge of candidates in emission spectrum of hydrogen atom. Candidates were required to name the series of emission spectrum and draw the energy level diagram based on the line spectrum given. However, candidates are required to write the valence electronic configuration and identify the position of the unknown element in Periodic Table based on the proton number.

In part (*a*)(i), most candidates were able to name the series of the emission spectrum. Some candidates stated incorrectly Lyman's series, lyman series or Lymen series or Lymaan series instead of Lyman Series and Bamer instead of Balmer series.

In part (*a*)(ii), some candidates were able to draw a labelled diagram to show how line *Q* is formed. Many candidates could not draw a labelled diagram of how line *Q* is formed. The common mistakes made by the candidates in this part were as follows:

- labelled y-axis as energy level instead of energy
- did not draw the energy levels n=1, n=2, n=3... converge as energy increases
- drew the energy levels n=1, n=2, n=3... touching to the energy axis as the diagram below



In part (*a*)(iii), only a few candidates were able to name the species that produce similar emission spectrum as hydrogen. The common mistakes made by the candidates were incorrectly naming the species as helium, He, atom or lithium, Li, atom instead of their corresponding ion (helium ion or He^+ or Li^{2+}). The reason given was either He has small atomic size or He atom has light mass. Some candidates explained generally that He^+ has the same number of electrons as hydrogen atom instead of He^+ has one electron as hydrogen atom.

In part (*b*)(i), most candidates were able to wrote the valence electronic configurations of an atom with atomic number 60. Most candidates failed to relate the proton number given to the position of element in the periodic table, thus unable to write the valence electronic configuration of given element with proton number 60 as $6s^2 5d^1 4f^3$ or $6s^2 4f^4$.

In part (*b*)(ii), almost all candidates were able to identify the period of the atom in the Periodic Table. Many candidates were unable to identify the correct group in the periodic table for an atom with atomic number 60. Most candidates stated as in Group 6, instead of Group 3. However, majority of the candidates were able to state Period 6 as their answer.

Question 17

The question tested about concepts involving chemical equilibrium in the Haber process. In this question, candidates were required to write the chemical equation involved for the formation of ammonia in Haber process and explained the reason for the chosen condition. Candidates are also required to calculate the equilibrium constant.

In part (*a*)(i), most candidates, were able to write the correct balanced equation of the Haber process. The common mistakes made by the candidates in this part were as follows:

- Did not use reversible sign, $\rightleftharpoons$ in the chemical equation.
- Did not put the gaseous physical phases for the reactants and the product.
- Some candidates were unable to give the correct chemical formula for gaseous nitrogen, hydrogen and ammonia. They wrote nitrogen as N or N^{3-}, hydrogen as H or H^+ and ammonia as NH_2 or NH_4^+.
- Some candidates write the equation as dissociation of ammonia, $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ instead of formation of ammonia $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$.

In part (*a*)(ii), majority of the candidates misunderstood the question. They explained about the reason to increase the product by using Le Chatelier's principle instead of explaining the needs of optimum temperature, 400 °C – 450 °C which is to increase the rate of reaction and optimum pressure, 200 atm is to minimise the cost or higher pressure will incur higher cost of production.

In part (*a*)(iii), many candidates were unable to state the correct answer because they only stated iron as the catalyst to increase the rate of reaction. The candidates should state the condition of the catalyst such as in powder form of iron or more finely divided iron. Almost all the candidates wrote add the catalyst.

In part (*b*)(i), majorities of the candidates were able to calculate the number of moles of ammonia in the equilibrium mixture.

In part (*b*)(ii), most candidates were able to calculate the value of K_c. Some candidates gave the number of moles of ammonia as 1.8 mol or 1.8 moles instead of 1.80 mol. The candidates lose marks by giving incorrect unit for the K_c as $mol^{-2}\ dm^6$ and incorrect significant figures.

Question 18

The question tested the knowledge of chemical bonding in substances. Candidates were required to explain the formation of coordinates bond in complex ion, $[Fe(NH_3)_6]^{2+}$ and the difference in melting point of two elements in Period 3 of the Periodic Table.

In part (*a*), many candidates were unable to explain the formation of coordinate bonds in $[Fe(NH_3)_6]^{2+}$. Some of the candidates were able to explain ammonia has a lone pair of electrons. The common mistakes made by the candidates in this part were as follows:

- Did not state the number of coordinate bond formed between NH_3 and Fe^{2+}.
  Example: candidate only explains the coordinate bond form between NH_3 and Fe^{2+} but did not state that there are 6 coordinate bonds.
- Candidate use single bond (—) instead of arrow (→) to show coordinate bond when draw the structure of the complex ion.
- Describe coordinate bond between NH_3 and Fe atom instead of Fe^{2+}.
- did not write valence electronic configuration of Fe^{2+}.
- Did not explain the use of empty 4*s*, 4*p* and 4*d* orbitals of Fe^{2+} to form coordinate bond.
- Explained NH_3 shared lone pair electrons to the empty orbitals of Fe^{2+} instead of donating the lone pair electrons to the empty orbitals of Fe^{2+}.

In part (*b*)(i), some candidates were able to write the correct answer that element *X* is sodium, Na, and element *Y* is sulphur, S. Some candidates give element *Y* is silicon which has higher melting point than element *X*.

In part (*b*)(ii), many candidates were unable to explain the reasons for the different in the melting points of elements *X* and *Y* because the wrong elements were given in (*b*)(i). They also were unable to explain the differences in the melting points of *X* and *Y* by using bonding and interparticle force. For element *X*, only few candidates explained the metallic bonding in sodium whereas for element *Y*, no candidate explained that due to the bigger size of *Y*, thus has a stronger van der Waals forces than metallic bond in *X*. The candidates only explained that van der Waals force in *Y* is stronger and *X*. Some candidates mistakenly wrote Van Der Waals instead of van der Waals.

Question 19

The question tested about the phase diagram of water and the applications of the phase diagram. This question required candidates to sketch phase diagram of water and explain the phase changes for isobaric heating and pressurised isothermally.

In part (*a*), most candidates were able to sketch the phase diagram correctly. Most of the candidates were able to label the axis, sketch the curve and state the phase correctly. The common mistakes made by the candidates in this part were as follows:

- Labelled the axes of pressure and temperature as P and T instead of pressure and temperature.
- Did not give the unit for the axes of pressure and temperature.
- Did not use the dotted line to show the values of the triple point and critical point.
- Did not label the triple point and critical point.
- Drew the solid-gas equilibrium curve begins from the origin.
- Drew the solid-gas equilibrium curve same size as the liquid-gas equilibrium curve.
- Drew the solid-gas equilibrium curve as a straight line.
- Labelled the states of solid, liquid and gas as s, l and g.

In part (*b*)(i), most candidates were unable to describe the observation for isobaric heating from –10 °C to 300 °C at 1 atm. Most of the candidates just mentioned the phase changes from solid to gas without explaining changes at each phase, particularly for melting point at 0 °C and boiling point at 100 °C. Almost all candidates did not state the physical state at melting curve as solid-liquid equilibrium while at boiling curve as liquid-gas equilibrium. Candidates just mentioned water exist as solid at –10 °C. When temperature increased, water melts to become liquid and then gas. Instead, candidates should explain that at –10 °C, water exists as solid. When temperature increases, water exist as solid-liquid equilibrium and melts to become liquid at 0 °C. Further heating water boils at 100 °C and become liquid-gas equilibrium, and finally become gas.

In part (*b*)(ii), most candidates were unable to describe the observation for pressurised isothermally from 1 atm to 230 atm at 300 °C. Most candidates mentioned water remained as liquid for the entire process but some mentioned water changes from gas to liquid and finally becomes supercritical fluid due to the 230 atm and 300 °C is already over the critical point. Most candidates explained very general without referring to the temperature or pressure and phase equilibrium. Many candidates did not state the physical states at each important point such as at –10 °C and 1 atm. They also did not state water exists as a solid and at 300 °C and 1 atm, and water exists as a gas by referring to the phase diagram of water. The candidates did not mention the processes occur at 0 °C and 100 °C when temperature increases at 1 atm or when pressure increases at 300 °C.

In part (*c*), majorities of the candidates were unable to explain why a shorter time is needed to cook food using a pressure cooker. Candidates were unable to relate the theory to the application in cooking using pressure cooker i.e. candidates did not get marks because they could not apply about the effect of high pressure to the boiling point of water, and only explained high pressure increases the collisions of molecules which is not relevant to cook the food in a shorter time. Most candidates explained by using collision theory. For example, when pressure increases, frequency of collision increases, number of effective collisions increases. Some candidates explained that the pressure in the pressure cooker is higher but candidates did not explained the total pressure in the cooker is the sum of pressure of steam and atmospheric pressure. The candidates did not explain that the boiling point of water in the pressure cooker is higher than 100 °C.

Question 20

The question tested about the rate of reaction. This question tested candidates the knowledge on chemical kinetic. Candidates are required to determine the rate equation and rate constant, and ratio of rate constant at two different temperatures.

In part (*a*)(i), most candidates were able to determine the order of reaction with respect to I_3^- and $S_2O_3^{2-}$ correctly. Hence, the candidates were able to correctly deduce the rate equation for the reaction. Some candidates did not write the general rate equation for the reaction.

In part (*a*)(ii), most candidates were able to calculate the rate constant correctly. Some candidates gave incorrect unit or no unit for the rate constant. The common mistakes made by the candidates in this part were as follows:

- Substituted the concentration values using square bracket instead of normal bracket.
- Wrote the rate equation as rate equation = $k[I_3][S_2O_3^{2-}]$.
- Wrote the rate equation as rate = $k[I_3]^1[S_2O_3^{2-}]^1$.

In part (*b*)(i), most candidates did not apply the Arrhenius equation given correctly to calculate the ratio of the rate constants at different temperatures. The candidate also failed to convert energy unit from kilojoules, kJ, to Joules, J, 60.0 kJ mol^{-1} to 60.0×10^3 J mol^{-1} and convert temperature in Celsius to Kelvin when substituting in the equation. Most candidates could not expand the Arrhenius equation into

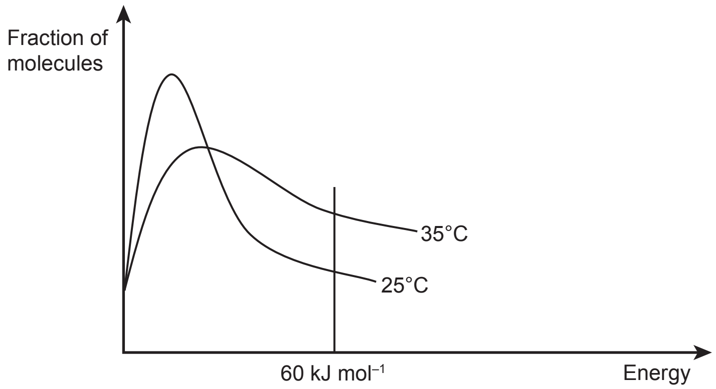
$$\ln k_1/k_2 = \frac{-E_a}{R}(1/T_2 - 1/T_1)$$ correctly.

Some candidates failed to give answer in the correct significant figures.

In part (*b*)(ii), most candidates were able to sketch the Boltzmann distribution curves for decomposition of HI correctly. Some candidates did not draw the curves start from origin and did not label E_a or stated 60 kJ mol^{-1} on the x-axis. The common mistakes made by the candidates in this part were as follows:

- Label wrong axes, for example, x-axis as speed of molecules instead of energy or kinetic energy.
- Drew wrong curves shape.
- Did not draw the curve for 35 °C with lower peak and shifts to the right with a higher tail.
- Unable to label activation energy, E_a.

The correct diagram was as below:



Chemistry 962/2

OVERALL PERFORMANCE

For Semester 2, 2 485 candidates sat for the examination for this subject and 64.39% of them obtained a full pass.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	5.50	6.63	5.70	9.79	13.67	7.65	15.45	6.62	5.54	6.43	17.02

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

Question number	Key	Question number	Key	Question number	Key
1	**C**	6	**D**	11	**B**
2	**A**	7	**C**	12	**B**
3	**C**	8	**A**	13	**B**
4	**A**	9	**D**	14	**D**
5	**A**	10	**C**	15	**B**

General comments

The performance of the candidates was good. All the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, the performance of candidate is varied based on their ability to understand the fundamental of the topics tested. Most of the candidates could understand tasks required in the questions and expressed their ideas clearly. Most candidates could use the language quite well to explain observations and present their answers. Hence, most of their answer written in acceptable or understandable manner. The performance of the candidates is fairly good in questions 16, 18 and 19. Some candidates did not answer the question based on the question asked, but gave a general statement.

Comments on the individual questions

Question 16

The question tested about chemical energetics. The question tested the ability of candidates to use enthalpy of formations given to compare the stability of MgO with Mg_3N_2. The candidates also required to write thermochemical equation and calculate the enthalpy of combustion for Mg_3N_2.

In part (*a*), most candidates were able to define standard enthalpy of formation of magnesium nitride. Some of them were able to define but did not mention the phases of magnesium and nitrogen.

In part (*b*), most candidates were able to state MgO is more stable than Mg_3N_2 because its enthalpy of formation is more exothermic. Some candidates give the reason because of its enthalpy of formation is more negative, which is not accepted.

In part (*c*)(i), most candidates were able to write the correct chemical equation but unable to get mark because did not state value of ΔH. Some candidates multiply the equation as follows:

$$2Mg_3N_2(s) + 3O_2(g) \rightarrow 6MgO(s) + 2N_2(g)$$

In part (*c*)(ii), many candidates were able to calculate the standard enthalpy combustion of Mg_3N_2 by using several methods. For this question, candidates may use energy cycle, formula method, or thermochemical equation method. However, candidates lost mark due to not stated the phases of species when writing chemical equation. Some of them did not state the correct unit and significant figures for final answer.

Question 17

The question tested about Group 2 of the Periodic Table. The question tested the ability of candidates in arrangement of elements Group 2 in increasing order of proton number base on solubility in water. The candidates also need to state two factors that determine the solubility and explain the factors that play the main role in the solubility of Group 2 sulphates.

In part (*a*), most candidates were able to arrange *X*, *Y* and *Z* correctly but unable to explain the arrangement of the elements.

In part (*b*)(i), majorities of the candidates were able to state the factor influencing the solubility of the Group 2 sulphates. The correct factors are lattice energy and hydration energy.

In part (*b*)(ii), only a few of candidates recognize hydration energy as the major factor influencing solubility trends in Group 2 elements. Few candidates were able to compare the decrease in hydration energy with the lattice energy going down the group.

Question 18

The question tested about Period 3 of the Periodic Table. This question tested on the physical and chemical properties of Period 3 oxide. The candidates need to explain the differences in melting point of MgO and Al_2O_3 and they are required to describe the acid base properties by writing all chemical equations involved. They also need to state the solubility of the given oxides in water.

In part (a), most candidates were able to state MgO has higher melting point than Al_2O_3 but only a few of candidates managed to explain the differences between two oxides. Many candidates failed to compare the two ions involved accurately. The correct explanation requires stating that Al^{3+} has a higher charge density than Mg^{2+} resulting in greater polarizing power. Thus, the ionic bonds of Al_2O_3 have covalent character compared to MgO pure ionic bond. The ionic bond in MgO is stronger than Al_2O_3 leading to a higher melting point. Additionally, many candidates did not use superlative language to compare the two oxides effectively and incorrectly described the bonding as covalent or metallic, rather than ionic.

In part (*b*), majorities of the candidates were able to describe acid-base properties of the oxides. They correctly identified the acid-base behaviors of MgO, Al_2O_3 and SiO_2, supporting their answers with balanced equations. Few candidates were unable to write the correct equations for the reaction of Al_2O_3 and SiO_2 with bases.

In part (*c*), most candidates were able to state solubility of the oxides with water. They correctly identified the solubility of the oxides and a few used incorrect terms such as dissolves, unsoluble, and less soluble.

Question 19

The question tested about physical properties and chemical properties of halides of Group 17 of the Periodic Table. The candidates need to explain the relative thermal stabilities of hydrides and the acidity of hydrides. The candidates also need to state the observation and write the chemical equation for chemical test of halides ion.

In part (*a*), most candidates were able to explain the thermal stabilities of the hydrides of Group 17 correctly. Some candidates mention molecular size such as Cl_2, Br_2, and I_2 instead of atomic size of halogen atom. Most candidates failed to relate the increase in atomic size will decrease in electronegativity of halogen towards hydrogen but manage to relate to the bond length of H-X and the bond strength of H-X. However, majorities of the candidates lost mark because they did not mention the ΔH for H-X become more endothermic.

In part (*b*), most candidates were able to arrange the in the descending order of their acidity. Most candidates stated the correct order as shown HI > HBr > HCl > HF. However, only few candidates explained the arrangement based on the relationship between bond length, bond strength, and the degree of dissociation. Many candidates overlooked the relationship between acidity and the concentration of H^+ in solution. Some candidates did not explained the trend from HI, HBr, HCl to HF, but only explained the selected halides such as HI and HF only.

In part (*c*), most candidates were able to state the observation when HCl is added to aqueous $AgNO_3$ followed by excess ammonia solution. The candidates were able to write correct equations for the formation of white precipitate of AgCl. However, most candidates were unable to write the correct formula of the products thus unable to write balanced equation for the reaction between AgCl with NH_3. For the reaction between HI with aqueous $AgNO_3$ followed by excess NH_3, many candidates were able to describe the colour of the precipitate formed which is yellow precipitate. The candidates also were able to write the balanced equation correctly for the formation of AgI. However, some candidates unable to state the correct observation when aqueous NH_3 is added. Some candidates state that yellow precipitate is insoluble in dilute NH_3 but soluble in concentrated NH_3.

Question 20

The question tested about the chemical properties of transition elements. The candidates need to describe the relative stabilities of Co and Fe ions in aqueous solution separately by using standard reduction potential given in the questions. The candidates need to choose the metal ions which is colourless in aqueous solution and explained the observation when blue colour solution turns green.

In part (*a*), most candidates were able to state Co^{2+} is more stable than Co^{3+} and Fe^{3+} is more stable than Fe^{2+}. However, candidates were unable to justify the answers by comparing with the standard reduction potential of Co^{3+} and Fe^{3+} with O_2. Some candidates were able to write the overall equation and calculate the cell potential correctly. However, candidates did not give further explanation based on the E°_{cell} value.

In part (*b*), some candidates were able to state Cu^+ is colourless. However, candidates are unable to give an explanation due to 3*d* orbital are fully filled and no *d-d* electronic transition.

In part (*c*), majorities of the candidates were unable to explain the observation. They were unable to explain the colour of the solution and ligand exchange, whereby Cl^- displaced H_2O from $[Cu(H_2O)_6]^{2+}$. All candidates wrote the incorrect chemical equation.

For example, $2HCl + CuSO_4 \rightarrow CuCl_2 + H_2SO_4$ instead of $[Cu(H_2O)_6]^{2+} + 4Cl^- \rightleftharpoons [CuCl_4]^{2-} + 6H_2O$.

Chemistry 962/3

OVERALL PERFORMANCE

For Semester 3, 2 469 candidates sat for the examination for this subject and 48.44% of them obtained a full pass.

The achievement of the candidates for this subject according to grades is as follows:

Grade	A	A–	B+	B	B–	C+	C	C–	D+	D	F
Percentage	9.07	5.43	4.17	5.02	9.40	7.09	8.26	5.26	5.43	6.28	34.59

RESPONSES OF CANDIDATES

SECTION A: *Multiple-Choice Questions*

Answer keys

Question number	Key	Question number	Key	Question number	Key
1	**C**	6	**C**	11	**A**
2	**D**	7	**B**	12	**B**
3	**D**	8	**B**	13	**A**
4	**C**	9	**A**	14	**C**
5	**D**	10	**A**	15	**B**

General comments

The performance of the candidates was good. All the questions were in the medium range with 30% to 70% of the candidates obtaining the correct answers.

SECTIONS B AND C: *Structured and Essay Questions*

General comments

In general, the quality of answers was satisfactory. Candidates did fairly well in question 16 and question 17. Candidates had difficulty in answering question 19, as they did not use the information given in the question to deduce the structural formulae of the compounds. In term of presentation, the presentation of answers was quite systematically organised. Some of the candidates were able to plan their answers coherently and systematically.

Comments on the individual questions

Question 16

The question tested about isomerism of organic compounds.

In part (*a*), most candidates were able to state the types of isomerism which are optical, geometrical and chain isomerisms.

In part (*b*), most candidates were able to state the molecular formula of C_4H_8 as the first alkene that exhibits both types of isomerism. Some candidates stated the wrong molecular formula with more than four carbon atoms.

In part (*c*), many candidates were unable to draw all isomers for alkene with molecular C_4H_8. Many candidates draw cis and trans isomers, and some of them repeatedly drew the same structure, simply bending the C-C bonds in different directions.

In part (*d*), majorities of the candidates were able to name the isomers that yields the same product upon catalytic hydrogenation. They give 1-butene and 2-butene as the answer.

Question 17

The question tested about polymers. In the question, candidates need to identify monomers, draw the structural formulae of monomers, types of polymerisations and suggest the reagent and conditions to prepare one of the monomers.

In part (*a*), some of the candidates were able to define a copolymer correctly. Few candidates incorrectly stated that a copolymer consists of only two or more type of monomer, rather than two or more different monomers.

Common mistakes in defining copolymer as follows:

- A copolymer is formed from two polymers
- A copolymer consists of only two or more type of monomer
- A copolymer is formed from monomer with different functional groups
- Copolymer is formed from different monomer

In part (*b*), majorities of the candidates were able to draw the structural formula of the third monomer correctly. They also were able to write the IUPAC name for *Q* and third monomer. Almost all of the candidates were able to state the type of polymerisation correctly as addition polymerisation.

In part (*c*), most candidates were able to state the reagent and reaction conditions for the synthesis of *P* from benzene. The candidates gave CH_3CH_2Cl or chloropropane as the reagent and $AlCl_3$ as the reaction condition in Step 1. Most candidates gave ethanolic KOH or ethanolic NaOH or ethanol in KOH, as the reagent and heat as the reaction condition. It should be KOH is the reagent, and ethanol and heat as the reaction condition.

Question 18

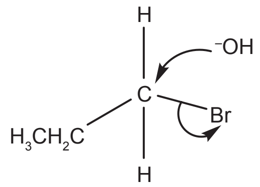
The question required candidates to identify structural formulae of compounds based on the reaction of haloalkane with potassium hydroxide before undergo oxidation. Candidates also need to write reaction mechanism, distinguish compound by chemical test and synthesise butanoic acid.

In part (*a*), most candidates were able to draw all structural formulae of *P*, *Q*, *R*, *S*, *T* and *U*. Common mistakes made by the candidates were drew the structural formulae of *P* as 1-bromopropane and *Q* as 2-bromopropane. Few candidates incorrectly identified *U* as propanal instead of propanoic acid. This is because the candidates were unable to identify the product of an oxidation reaction using a strong oxidising agent, such as acidified potassium dichromate(VI), which oxidises primary alcohols to carboxylic acids.

In part (*b*), only a few of the candidates were able to write the S_N2 mechanism correctly.

The common mistakes made by the candidates in this part were as follows:

- The nucleophile attacked was on the same side as Br or a frontside attack instead of the backside attack of the carbon bearing a leaving group



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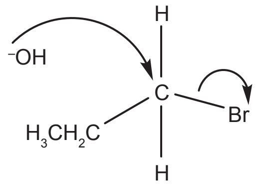
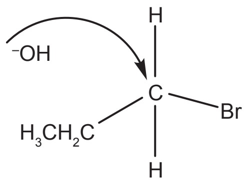


- The attack was not occurred simultaneously, so that drew two separate steps instead of a single concerted step or missed one of the steps entirely



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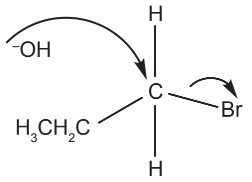
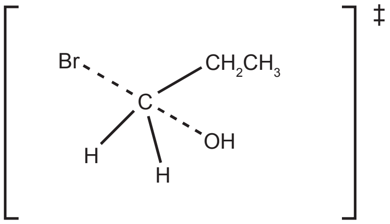


- Use a solid line instead of dotted line for the bond forming between C-OH and bond breaking C-Br in the transition state structure



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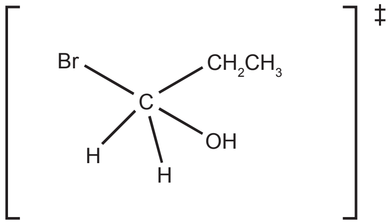
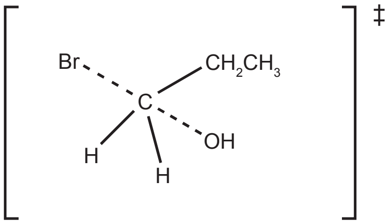


- The position bond breaking and bond forming in the transition state is not 180° from each other



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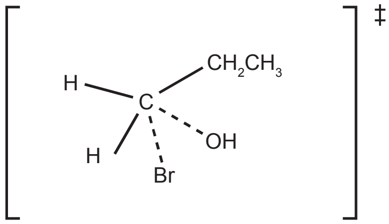


- Write the S_N1 mechanism instead of S_N2 mechanism.

In part (*c*), most candidates were able to suggest a chemical test to distinguish between compound *R* and compound *S*. They also able to state the observation and write the chemical equation involved correctly. Few candidates gave a bromine water as the test. By writing the chemical equations, some candidates made errors such as placing the negative charge of oxygen at *H*, by writing OH^- instead of ^-OH. The common mistakes are as follows:

- Lucas test: Incorrectly write zinc chloride as ZnCl instead of $ZnCl_2$, place the HCl above the arrow instead of $ZnCl_2$ in the reaction equation and state the correct time taken for the cloudiness to appear
- Iodoform test: placing the negative charge on the wrong atom, OH^- instead of ^-OH
- Stating no reaction as the observation for compound *S* instead of no observable change

In part (*d*), most candidates were able to write the synthetic pathway for preparation of butanoic acid from compound *Q*, 1-bromopropane. They also able to write the correct reagents and conditions for the synthesis. The common mistakes are as follows:

- Writing the synthetic pathway in the form of several reaction equations
- Use KCN(aq) with ethanol instead of ethanolic KCN in the first step of the synthesis
- Did not write reflux or heat in the synthetic pathway as the reaction condition

Question 19

In this question, candidates need to deduce structural formulae and write chemical equation based on reaction and observation given.

In part (*a*), most candidates were able to draw the structural formulae of *X* and *Y*. However, 80% of the candidates did not use the observation given in the question to deduce the structural formulae of *X* and *Y*. Many candidates lose mark to explain how the positive results lead to identifying *X* and

Y. Regarding to ozonolysis, most candidates did not adequately convey the concept, often neglecting to mention that symmetrical alkenes formed 2 moles of *X*. The common mistakes were as follows:

- Did not explicitly state the observations that led to the deduction of the structural formulae *X* and *Y*
- Did not show that the ozonolysis reaction is a two steps reaction, first with O_3 followed by Zn/H_3O^+
- Wrote the chemical equations for ozonolysis as, (i) O_3, (ii) ZnCl, H_2O
- Wrote the wrong species in Tollens' reagents as $[Ag(NH_3)]^+$ or $[Ag(NH_3)]^{2+}$ or OH^- instead of $[Ag(NH_3)_2]^+$ and ^-OH

In part (*b*), almost all of the candidates were able to draw structural formula of *Z* and write the chemical equation for the Lucas test. Many of them could not differentiate between reagents and reaction conditions. Most candidates wrote the observations of Lucas test as a cloudy solution that appeared after 5 minutes, between 1 to 5 minutes and a few minutes instead of the cloudy solution forms between 3-5 minutes. The common mistakes were as follows:

- stating the reducing agent as $LiAlH_4$ in dry ether and heat
- stating the reaction condition as acidic hydrolysis instead of H_3O^+ with heat
- for Lucas test, incorrectly write zinc chloride as ZnCl instead of $ZnCl_2$ and place the HCl above the arrow instead of $ZnCl_2$ in the reaction equation

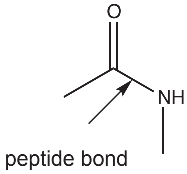
Question 20

In this question, candidates need to provide structural formulae for three isomers from molecular formula and observation given. The candidates need to draw the structural formulae of zwitterion of 2-aminopropanoic acid and a dipeptide, and label the peptide bond.

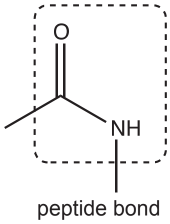
In part (*a*), most candidates were able to draw the structural formulae of compounds *J*, *K*, *L* and *M*. Majority of the candidates were able to write the synthetic pathway for the formation of methylaniline from benzene. Few candidates were unable to draw the structural formula of compound *L*, thus they could not write the synthetic pathway for the formation of compound *L*. Some candidates lost marks because they attempted to convert aniline to 2-methylaniline using Friedel-Crafts alkylation. Friedel-Crafts alkylation of aniline does not take place due to formation of complex with $AlCl_3$. The common mistakes were as follows:

- The structural formula of compound *J* is secondary amine
- The structural formula of compound *L* is primary amine

In part (*b*), majority of the candidates were able to draw the structural formula of zwitterion but a few of them were able to describe the amphoteric properties of the amino acid. Some of candidates failed to indicate positive sign on the nitrogen atom in the structure of zwitterion such as $^+NH_3$. Majority of the candidates also were able to draw the structural formula of the self-condensation product of 2-aminopropanoic acid and label peptide bond correctly. Some candidates did not indicate the peptide bond by circle or place a square around the entire peptide bond. They only circle the C-N bond insteads of HN-C=O.



The correct answer is



PAPER 962/5 (WRITTEN PRACTICAL TEST)

General comments

In general, the performance of the candidates was satisfactory. Knowledge of mole concept is crucial in problem solving of titrimetric as tested in question 1. For question 2, the electrolysis experiment was not fully answered by the candidates. For question 3, strong fundamentals and concepts of organic chemistry are required to be applied based on the observations.

Comments on individual questions

Question 1

In part (*a*), most candidates were unable to calculate the concentration of $Na_2S_2O_3$ solution from the burette reading and the average titre.

In part (*b*), some candidates stated the wrong species involved in the chemical reaction between I_2 and $S_2O_3^{2-}$.

In part (*c*), by using the formula, $\frac{M_aV_a}{M_bV_b} = \frac{1}{2}$; Therefore, $2M_aV_a = M_bV_b$.

Most candidates were unable to calculate the volume of I_2 that did not react with SO_3^{2-} because they also unable to write a balanced ionic equation in (*b*).

In part (*d*) and (*e*), most candidates were unable to calculate the concentration of SO_3^{2-} even though the chemical reactions were given in the question. Therefore, the percentage purity of $Na_2S_2O_3$ were incorrectly calculated.

Question 2

In part (*a*), most candidates were able to state the function of rheostat.

In part (*b*), some candidates were able to give correct answer which is indicating the purpose of rinsing of electrode to dry the negative electrode.

In part (*c*), most candidates were able to state that the concentration of Cu^{2+} remained unchanged. The Cu^{2+} undergoes reduction process and deposited as Cu at the negative electrode, whereas Cu from the positive electrode released Cu^{2+} in the solution. Both oxidation and reduction reactions occurred simultaneously.

In part (*d*), majority of the candidates wrongly wrote the half-equation for the reaction at negative electrode.

In part (*e*), some candidates were able to give the mass of copper deposited at the negative electrode.

In part (*f*) and (*g*), majority of the candidates were unable to determine the percentage purity of copper because the quantity of charge, *Q*, is wrongly calculated.

In part (*h*), some candidates were able to mention the effect on the mass copper deposited at the negative electrode which is doubled if the time taken for the electrolysis is doubled.

Question 3

In part (*a*), most candidates were unable to give the reason why the mixture was stirred thoroughly after the addition of 2 mol dm^{-3} HCl into the 2-aminobenzoic acid in stage I.

In part (*b*), most candidates were unable to mention the purpose of using ice-water bath and name the reaction involved.

In part (*c*), the candidates were unable to give the reason why phenol was dissolved in the aqueous NaOH.

In part (*d*) and (*e*), most candidates were unable to answer correctly because they did not completely understand the fundamental of organic chemistry related to the preparation of azo dye.

In part (*f*), most of candidates were unable to calculate the percentage of 2-(4-hydroxyphenylazo) benzoic acid produced in the experiment.

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