



BEDOK SOUTH SECONDARY SCHOOL PRELIMINARY EXAMINATION 2022

4EXP

CANDIDATE
NAME

CLASS

REGISTER
NUMBER

CHEMISTRY

6092/01

31st August 2022

Additional Materials: Optical Mark Sheet (OMS)

1 hour

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on this paper with a blue or black pen.

Write your name, register number, class and subject on the Optical Mark Sheet (OMS) provided.

Write in soft pencil on the OMS.

Do not use staples, paper clips, glue, or correction fluid.

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OMS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this paper.

The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table is printed on page **13**.

For Examiner's Use	
Paper 1 (30%)	40

Setter: DL

- 1 An unknown white solid, X, melts between 161 °C and 163 °C. When chromatography is performed with water as the solvent, X produces only one spot on the chromatogram.

Which statement must be true about X?

- A X is pure.
- B X is impure.
- C X can sublime.
- D X is an ionic compound.

- 2 The boiling points of some substances found in air are given in the table.

Air is cooled to -190 °C so that some of the substances in it condense.

As the temperature is raised from -190 °C, which substance will undergo a change of physical state into a gas first?

	substance	boiling point / °C
A	argon	-186
B	oxygen	-183
C	nitrogen	-196
D	carbon dioxide	-78.5

- 3 Which statement correctly describes the rate and volume of hydrogen gas produced when 10 cm³ of 1.00 mol/dm³ of nitric acid and 10 cm³ of 1.00 mol/dm³ of ethanoic acid are reacted separately with excess magnesium until no visible reaction?

	volume of H ₂ produced	rate of reaction
A	the same volume of H ₂ would be obtained for both acids	The reaction with ethanoic acid would proceed at a slower rate
B	the volume of H ₂ would be more when nitric acid is used	The reaction with ethanoic acid would proceed at a slower rate
C	the same volume of H ₂ would be obtained for both acids	both reactions would proceed at the same rate
D	the volume of H ₂ would be more when nitric acid is used	both reactions would proceed at the same rate

- 4 The rate of diffusion of different gases is measured at the same temperature and pressure. Which two gases would diffuse at a different rate?

A N_2 and CO

B C_2H_4 and N_2

c CO_2 and C_3H_8

D C_3H_6 and CO

- 5** The R_f values for the dyes, J – M, in four different solvents are shown in the table.

	solvent			
	water	organic solvent 1	organic solvent 2	organic solvent 3
dye J	0.3	0.5	0.7	0.6
dye K	0.0	0.2	0.6	0.7
dye L	0.2	0.1	0.4	0.8
dye M	0.5	0.2	0.6	0.9

Which solvent could be used to separate a mixture of all four dyes, J, K, L and M?

A water

B organic solvent 1

C organic solvent 2

D organic solvent 3

- 6** An isotope of element X has 15 protons and 17 neutrons in its nucleus. Which chemical symbol best represents the ion of X?

A $^{15}_{32}\text{X}^{3+}$

B $^{15}_{32}\text{X}^{3-}$

c $^{32}_{15}\text{X}^{3+}$

D $^{32}_{15}\text{X}^{3-}$

7 Three different experiments that involve colour changes are carried out

- 1 Universal Indicator solution is bubbled with ammonia gas.
- 2 Sulfur dioxide is tested with acidified potassium manganate(VII) solution.
- 3 Chlorine gas is bubbled into litmus solution.

Which row correctly identifies the experiments that correspond to the colour changes?

	purple to colourless	green to blue	red to colourless
A	2	1	3
B	2	3	1
C	3	1	2
D	1	2	3

8 Which of the following represents the most likely structural formula for the compound S_2Cl_2 ?

- A $S - Cl - Cl - S$
B $S - Cl - S - Cl$
C $Cl - S - S - Cl$
D $Cl = S - S = Cl$

9 An imaginary element has two isotopes:

- The first isotope has 15 protons and a relative abundance of 80%
- The second isotope has 16 neutrons

If the relative atomic mass of the imaginary element is 30.2, determine the number of neutrons in the first isotope.

- A 15 B 16 C 17 D 18

10 A book recorded the formula of a sample of rust as ' $2Fe_2O_3 \cdot \frac{3}{2}H_2O$ '.

What is the percentage by mass of iron in this sample of rust?

- A 29.9% B 32.3% C 59.9% D 64.6%

11 What is the volume of carbon dioxide gas (at room temperature and pressure) produced when 2.65 g sodium carbonate reacts with 100 cm³ of 0.10 mol/dm³ hydrochloric acid?

- A** 120 cm³ **B** 240 cm³ **C** 600 cm³ **D** 1200 cm³

12 In an electrolysis experiment, the same amount of charge deposited 6 g of titanium and 16 g of copper. The charge on the copper ion was 2+. [Ar: Ti, 48; Cu, 64]

What was the charge on the titanium ion?

- A** 1+ **B** 2+ **C** 3+ **D** 4+

13 How many different ions are present in aqueous iron(II) sulfate?

- A** 2 **B** 3 **C** 4 **D** 5

14 Which statement about ammonia is correct?

- A** It reacts with alkalis to form salts.
B It dissolves in water to form an acidic solution.
C It is formed when ammonium salts are heated with sulfuric acid.
D It decomposes on heating to a high temperature to form nitrogen and hydrogen.

15 Solid ammonium chloride decomposes on heating in a test tube to produce two gases. Which change would be observed to a piece of moist red litmus paper?

- A** remains red
B turns blue and remains blue
C turns blue and then turns red
D turns blue and then bleached

16 Which reagent cannot be used to distinguish aluminium hydroxide from calcium hydroxide?

- | | | | |
|----------|------------------------------------|----------|-----------------------------------|
| A | $\text{H}_2\text{SO}_4(\text{aq})$ | B | $\text{HCl}(\text{aq})$ |
| C | $\text{NaOH}(\text{aq})$ | D | $\text{NH}_4\text{OH}(\text{aq})$ |

17 Salt X can be prepared by reacting together an acid and a metal or insoluble metal carbonate. A pure sample of salt X is then obtained by filtration, followed by crystallisation of the filtrate.

What is the identify of salt X?

- | | | | |
|----------|--------------------|----------|--------------------|
| A | lead(II) sulfate | B | sodium chloride |
| C | copper(II) sulfate | D | magnesium chloride |

18 Chlorine is reacted with aqueous potassium bromide and a brown solution is formed. Which statement about this reaction is correct?

- A** Bromide ions gain electrons.
- B** The oxidation state of chlorine decreases.
- C** Chlorine is reduced because it loses electrons.
- D** Bromine has a higher electron affinity than chlorine.

19 Lithium reacts with dilute nitric acid at a constant room temperature. Which statement about the rate of this reaction is correct?

- A** It increases as the reaction proceeds.
- B** It decreases as the reaction proceeds.
- C** It remains the same as the reaction proceeds.
- D** It increases then remains the same as the reaction proceeds.

20 An aqueous solution of sodium hydroxide has a pH of 10. Which substance could be added to the aqueous sodium hydroxide to increase the pH?

- | | | | |
|----------|--------------------|----------|--------------------------------|
| A | H^+ ions | B | OH^- ions |
| C | Na^+ ions | D | H_2O molecules |

21 For which does 10 g of the metal have the most electrons in its sea of electrons'?

- | | | | |
|----------|----------------|----------|----------------|
| A | aluminium (Al) | B | sodium (Na) |
| C | lithium (Li) | D | magnesium (Mg) |

- 22** Metal M can be obtained from its aqueous chloride by electrolysis and from its oxide by heating with carbon.

Which metal is M?

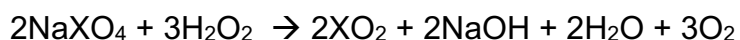
- | | | | |
|----------|--------|----------|--------|
| A | sodium | B | silver |
| C | lead | D | copper |

- 23** Potassium reacts with water to form solution R and gas S. When solution R reacts with dilute nitric acid, salt T is formed.

What are the formulae of R, S and T?

	solution R	gas S	salt T
A	KOH	H ₂	KNO ₃
B	KOH	CO ₂	K ₂ NO ₃
C	POH	H ₂	PNO ₃
D	POH	CO ₂	P ₂ NO ₃

- 24** A substance NaXO₄ undergo a chemical reaction with hydrogen peroxide, according to the following equation:



What is the role of hydrogen peroxide in the above reaction?

- | | | | |
|----------|-------------------------|----------|----------------------------|
| A | It acts as a catalyst. | B | It is an oxidising agent. |
| C | It is a reducing agent. | D | It is a dehydrating agent. |

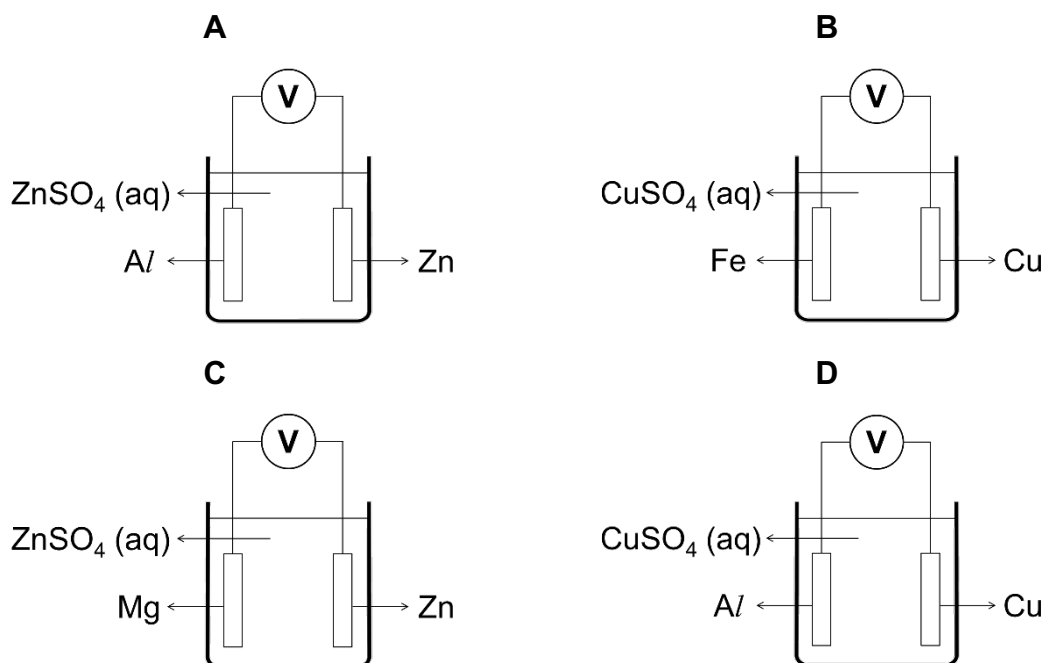
- 25** Metal M forms a chloride MCl.

M is below copper in the reactive series.

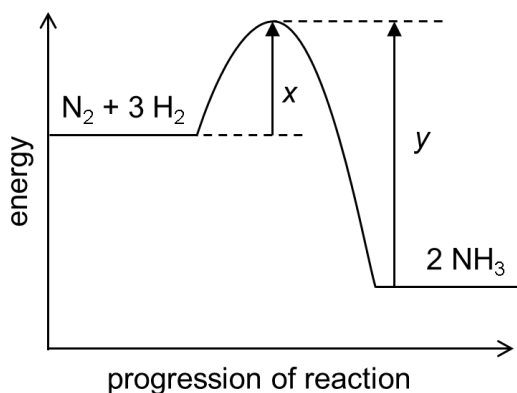
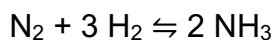
If a concentrated aqueous solution of MCl is electrolysed, which reaction will occur at the cathode and the anode?

	cathode (negative electrode)	anode (positive electrode)
A	$\text{M}^+ + \text{e}^- \rightarrow \text{M}$	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
B	$\text{M}^+ + \text{e}^- \rightarrow \text{M}$	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$
C	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$
D	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$

26 In which diagram would the voltage measured be the highest?



27 The equation and the energy profile for the reversible reaction in the Haber process are shown.



Which statement about bond breaking and forming is correct?

- A** The energy released in forming bonds is labelled x .
- B** The energy released in breaking bonds is equal to y .
- C** The energy released in breaking bonds is less than the energy absorbed in forming bonds.
- D** The energy released in forming bonds is more than the energy absorbed in breaking bonds.

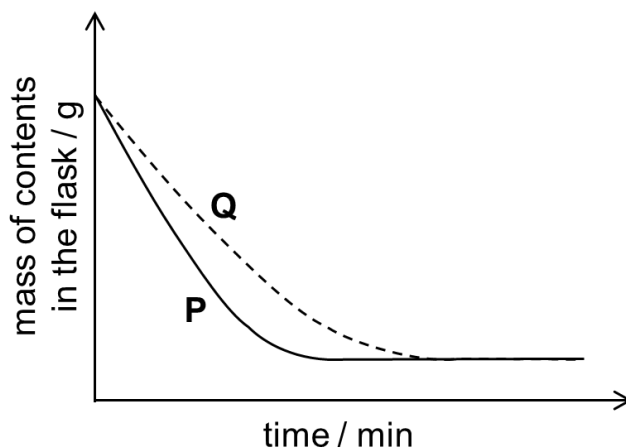
- 28** In experiment 1, one mole of ethane undergoes complete combustion to form carbon dioxide and water only. In experiment 2, one mole of propane is combusted completely instead.

How will the activation energy and enthalpy change of experiment 2 be different from experiment 1?

	activation energy	enthalpy change
A	unchanged	unchanged
B	increase	unchanged
C	unchanged	increase
D	increase	increase

- 29** Excess calcium carbonate powder was reacted with a fixed volume of dilute nitric acid in a conical flask placed on top of a mass balance. The mass of the contents in the flask was measured at regular time interval.

The data collected was used to plot graph P as shown below.



The experiment was modified in the following manner:

1. replacing the acid with ethanoic acid
2. use lumps of calcium carbonate
3. decrease the pressure on the system
4. increase the temperature of the acid

Which modification(s) will produce graph Q?

- A** 1 and 2 only **B** 3 and 4 only **C** 1, 2 and 3 **D** 2, 3 and 4

- 30** Which pair of gases are involved in the formation of acid rain?

- A** CO and CO₂ **B** CH₄ and NO₂
C NO₂ and CO **D** SO₂ and NO₂

31 Aqueous potassium iodide changes from colourless to brown when it is added to substance X.

What can be determined about substance X from this observation?

- A** Substance X is a reducing agent.
- B** Substance X is an oxidising agent.
- C** Substance X can only be aqueous bromine.
- D** Substance X contains Fe^{2+} ions which undergo oxidation.

32 Propene is used to make poly(propene).

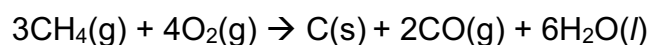
Which fraction from petroleum is the main feedstock for the manufacture of propene?

- | | | | |
|----------|------------------|----------|----------|
| A | lubricating oils | B | paraffin |
| C | bitumen | D | naphtha |

33 What is added to polyunsaturated vegetable oils to form solid margarine?

- A** steam
- B** ethene
- C** hydrogen
- D** aqueous bromine

34 A sample of methane gas reacts with oxygen gas as shown by the equation below.



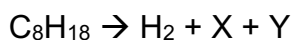
If 100 cm^3 of methane gas was mixed with 100 cm^3 of oxygen gas for this reaction, what is the volume of the resulting gaseous mixture at room temperature and pressure?

- A** 50 cm^3
- B** 75 cm^3
- C** 200 cm^3
- D** 225 cm^3

35 Which bond in a molecule of ethanoic acid is broken when it reacts with magnesium?

- A** the C-H bond
- B** the C-O bond
- C** the C=O bond
- D** the O-H bond

36 The equation for the cracking of an alkane is shown.



Compound X has three carbon atoms. Compound Y decolourises aqueous bromine.

What are the formulae of compounds X and Y?

	compound X	compound Y
A	C_3H_6	C_5H_{10}
B	C_3H_8	C_5H_{10}
C	C_3H_6	C_5H_{12}
D	C_3H_8	C_5H_{12}

37 X reacts with steam to form Y.

Y decolourises purple acidified potassium manganate(VII) to form Z.

If Z is butanoic acid, what is the formula of X?

A $\text{C}_4\text{H}_9\text{OH}$

B $\text{C}_3\text{H}_7\text{COOH}$

C C_4H_{10}

D C_4H_8

38 Eleostearic acid is a fatty acid present in bitter gourd oil.

It has a molecular formula of $\text{C}_{17}\text{H}_{29}\text{COOH}$.

How many carbon-carbon double bonds are present in one molecule of the acid?

A 2

B 3

C 4

D 5

39 Which alcohol cannot be oxidised to produce a carboxylic acid containing a CH_3 group?

A ethanol

B butanol

C propanol

D methanol

40 Which reaction can vinegar undergo but is not typically observed for a mineral acid?

A neutralisation with limewater

B combustion with oxygen

C reaction with sodium metal

D reaction with limestone

The Periodic Table of Elements

Group																	
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0
		Key proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9																
11 Na sodium 23	12 Mg magnesium 24																
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	89 – 103 actinoids	104 Rf Rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -	118 Og oganeson -	119 Ts tennessine -	120 Nh nihonium -	121 Lr lawrencium -

lanthanoids		57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids		89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	101 Md mendelevium -	102 No nobelium -	103 Lr lawrencium -

lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).