



COMMONWEALTH SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2022

CHEMISTRY PAPER 1

Name: _____ () Class: _____

SECONDARY FOUR EXPRESS
6092/01

Thurs 15 Sep 2022
1h
0800 – 0900 h

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the question paper and the OTAS sheet.
Write in soft pencil.
An approved scientific calculator may be used.

There are **forty** questions in this section. Answer all questions. For each question, there are four possible answers, **A**, **B**, **C** or **D**. Choose the **one** you consider correct and record your choice in soft pencil on the OTAS sheet.

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 booklet.

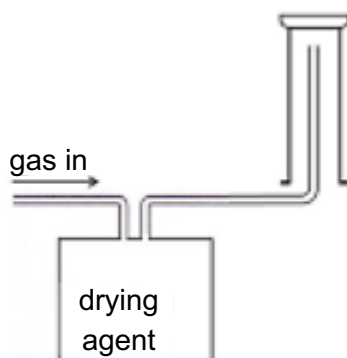
A copy of the Periodic Table is printed on page 19.

Name of setter: Ms Tian Yilin

This paper consists of **<19>** printed pages including the cover page.

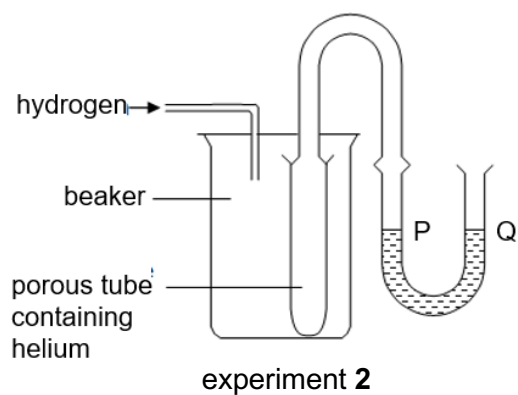
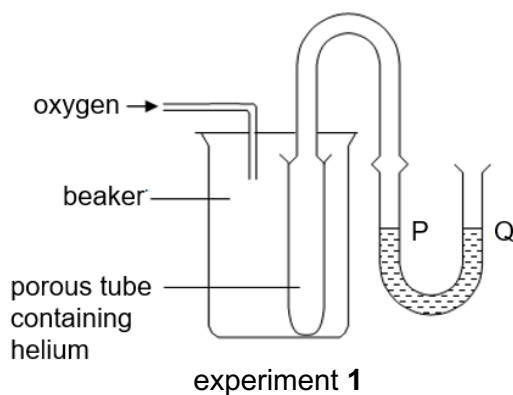
[Turn over

- 1 Which option shows the correct drying agent and the corresponding gas that can be collected by the method shown in the set up?



	drying agent	gas collected
A	anhydrous calcium oxide	carbon dioxide
B	anhydrous calcium oxide	hydrogen
C	concentrated sulfuric acid	ammonia
D	concentrated sulfuric acid	chlorine

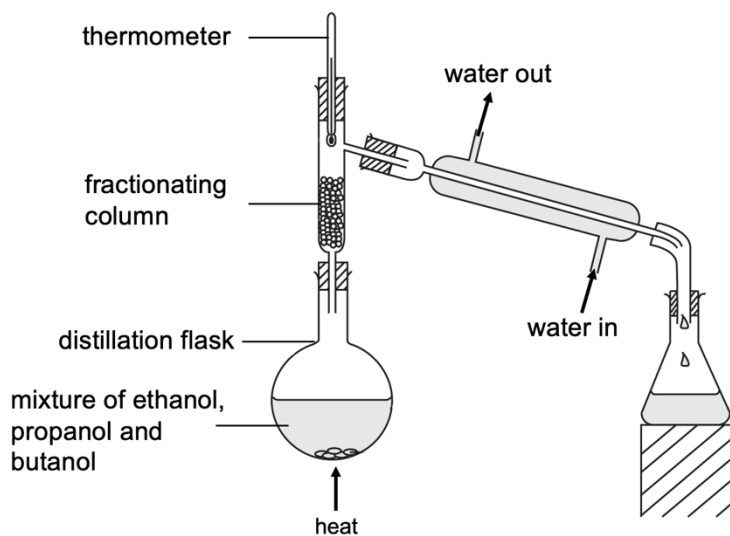
- 2 Two experiments, experiments 1 and 2, are set up to demonstrate the diffusion of gases.



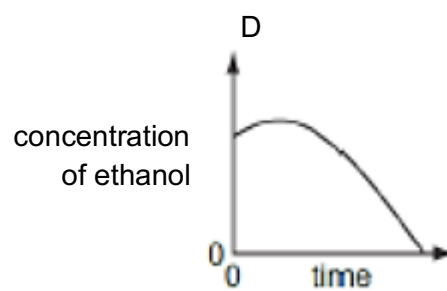
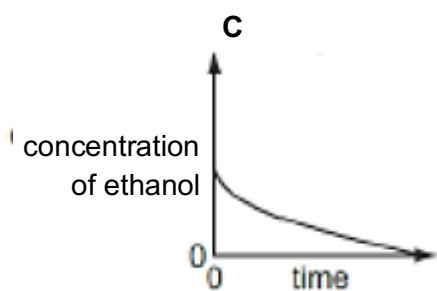
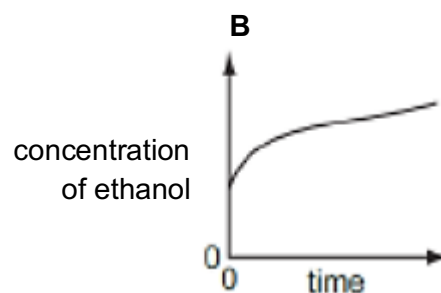
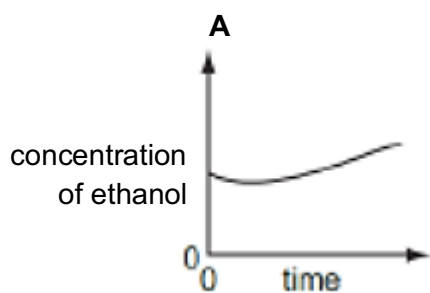
What would happen to the water levels at P and Q in both experiments?

	experiment 1	experiment 2
A	P is higher than Q	P and Q remain the same
B	P is higher than Q	P is lower than Q
C	P and Q remain the same	P and Q remain the same
D	P and Q remain the same	P is higher than Q

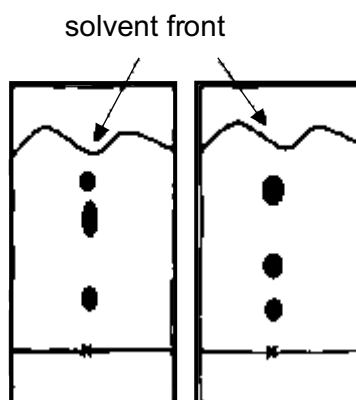
- 3 The apparatus is used to separate a mixture of ethanol (boiling point 78°C), propanol (boiling point 97°C) and butanol (boiling point 118°C).



Which graph shows the change in concentration of ethanol in the distillation flask as the distillation proceeds?



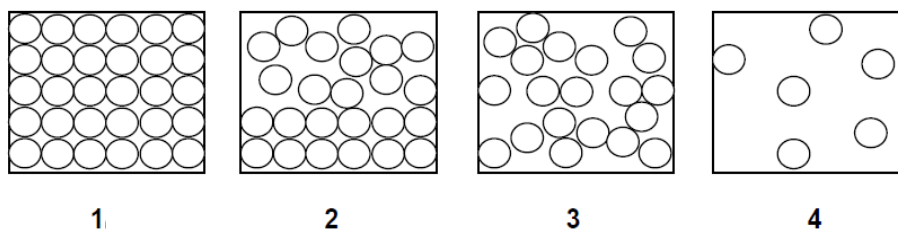
- 4 Two students carried out chromatography experiments to examine a urine sample. They used the same urine sample. The chromatograms obtained by the two students are shown in the diagrams.



Why are the chromatograms different?

- A One of the students used a larger amount of urine sample.
 B One of the students did not use enough solvent.
 C One of the students added another substance to the urine sample.
 D The two students used different solvents.
- 5 The melting and boiling points of carbon tetrachloride are -23°C and 76°C respectively.

Which diagrams best represent the arrangement of carbon tetrachloride particles as a sample of it is cooled from 80°C to -20°C ?



	arrangement at 80°C	arrangement at -20°C
A	1	2
B	4	4
C	3	3
D	4	3

6 Which of the following contains an element, a mixture and a compound?

- A ozone, air, sulfur trioxide
- B helium, distilled water, chromium
- C diamond, limewater, carbon dioxide
- D calcium carbonate, magnesium, oxygen

7 A scientist wants to carry out a series of tests on three test-tubes of different colourless solutions which are labelled **X**, **Y** and **Z**. To a portion of each solution, he adds silver nitrate solution followed by dilute nitric acid. His observations are shown below.

test-tube	X	Y	Z
add silver nitrate solution	no change observed	white ppt formed	white ppt formed
add dilute nitric acid	no change observed	effervescence	white ppt remained

Based on his observations, what are the possible identities of the anions present in each of the three test-tubes?

	test-tube X	test-tube Y	test-tube Z
A	NO_3^-	Br^-	Cl^-
B	NO_3^-	CO_3^{2-}	Cl^-
C	NO_3^-	CO_3^{2-}	SO_4^{2-}
D	NH_4^+	Br^-	SO_4^{2-}

8 An ion contains 8 protons, 7 neutrons and 9 electrons. What is its nucleon number?

- A 8
- B 15
- C 17
- D 24

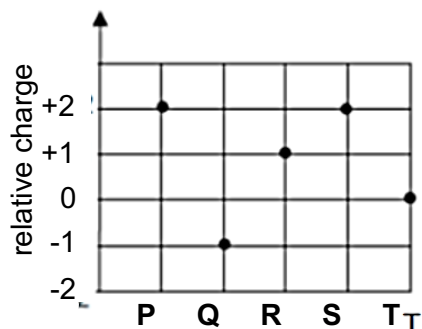
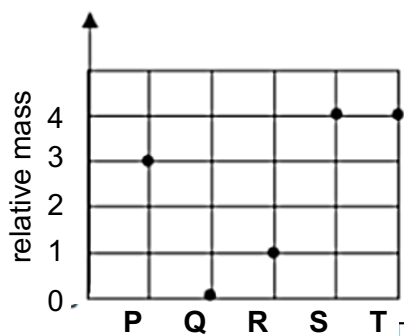
9 An imaginary element has two isotopes:

- 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** 8
B 15
C 17
D 24

10 The relative mass and relative charge of particles **P**, **Q**, **R**, **S** and **T** are shown in two diagrams.



Which statement(s) is/are correct?

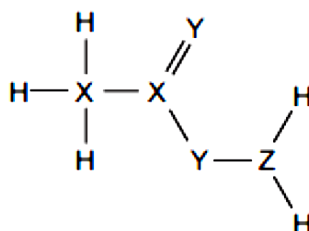
- 1 **Q** represents an electron.
- 2 **R** represents a hydrogen ion.
- 3 **T** represents the nucleus of a helium atom.
- 4 **P** and **S** represent the nuclei of isotopes.

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

11 Which substance contains both ionic and covalent bonds?

- A** ammonium chloride
B hydrogen chloride
C iron(III) oxide
D phosphorus trichloride

- 12 The diagram shows the structure of a covalent compound containing the element hydrogen, H, and the unknown elements X, Y and Z.



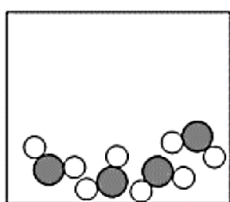
How many valence electrons do each of the three elements, X, Y and Z possess?

	X	Y	Z
A	4	5	6
B	4	6	5
C	4	5	1
D	5	1	4

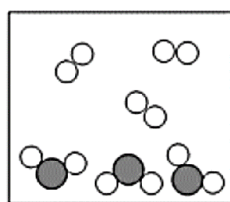
- 13 24 cm³ of hydrogen burns in 10 cm³ of oxygen.

Which one of the following diagrams represents the molecules that remain in the reaction vessel?

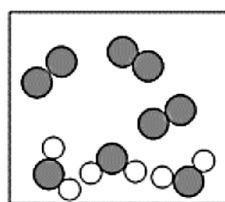
(All volumes are measured at room temperature and pressure. The number of particles do not represent the actual amounts.)



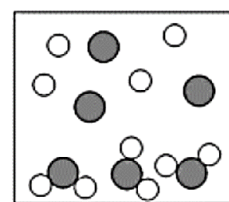
A



B



C



D

- 14 The extraction of iron in the blast furnace yields pig iron, impure iron. A student dissolves a 3.8 g sample of pig iron with an excess of sulfuric acid. 1.58 dm³ of hydrogen gas was obtained at r.t.p.

Which calculation shows the percentage purity of iron in pig iron?

- A $\frac{1.58}{24} \div \frac{3.8}{56} \times 100$
- B $1.58 \times 24 \div \frac{3.8}{56} \times 100$
- C $\frac{3.8}{56} \div (1.58 \times 24) \times 100$
- D $\frac{3.8}{56} \div \frac{1.58}{24} \times 100$

- 15 0.10 mol of a compound contains 4.8 g of oxygen, 1.6 g of hydrogen and 9.6 g of carbon. What is the molecular formula of the compound?

A $\text{C}_7\text{H}_{12}\text{O}_4$
B $\text{C}_8\text{H}_{16}\text{O}_3$
C $\text{C}_{14}\text{H}_{24}\text{O}_8$
D $\text{C}_{16}\text{H}_{32}\text{O}_6$

- 16 What is the volume of 1.0 mol/dm^3 of hydrochloric acid that is required to react completely with 1.25 g of zinc carbonate?

A 10 cm^3
B 20 cm^3
C 100 cm^3
D 200 cm^3

- 17 Ethanoic acid (CH_3COOH) is an acid commonly found in vinegar. It reacts with sodium hydroxide to form the soluble salt sodium ethanoate (CH_3COONa) and water.

What is the ionic equation for this reaction?

A $\text{H}^+ (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{H}_2\text{O} (\text{l})$
B $\text{CH}_3\text{COO}^- (\text{aq}) + \text{Na}^+ (\text{aq}) \rightarrow \text{CH}_3\text{COONa} (\text{aq})$
C $\text{CH}_3\text{COOH} (\text{aq}) + \text{OH}^- (\text{aq}) \rightarrow \text{CH}_3\text{COO}^- (\text{aq}) + \text{H}_2\text{O} (\text{l})$
D $\text{CH}_3\text{COOH} (\text{aq}) + \text{NaOH} (\text{aq}) \rightarrow \text{CH}_3\text{COONa} (\text{aq}) + \text{H}_2\text{O} (\text{l})$

- 18 Which statement(s) is/are true about dilute ethanoic acid and dilute hydrochloric acid?

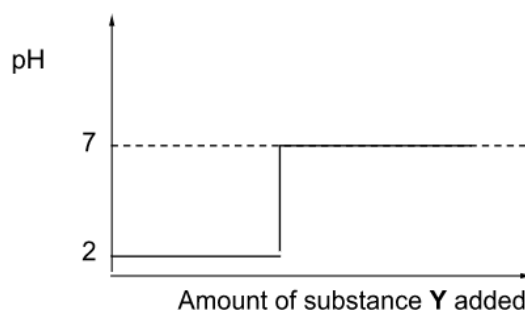
- 1 Pure ethanoic acid is a stronger acid than 0.1 mol/dm^3 ethanoic acid.
- 2 1.0 mol/dm^3 ethanoic acid is a stronger acid than 0.1 mol/dm^3 ethanoic acid.
- 3 0.1 mol/dm^3 hydrochloric acid is a stronger acid than 0.1 mol/dm^3 ethanoic acid.
- 4 0.1 mol/dm^3 hydrochloric acid is a stronger acid than 1.0 mol/dm^3 ethanoic acid.

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

19 Which equation suggests that the underlined oxide has amphoteric properties?

- A $\underline{\text{K}_2\text{O}} + \text{H}_2\text{O} \rightarrow 2\text{KOH}$
 B $\underline{\text{P}_2\text{O}_5} + 6\text{NaOH} \rightarrow 2\text{Na}_3\text{PO}_4 + 3\text{H}_2\text{O}$
 C $\underline{\text{Cl}_2\text{O}} + 2\text{LiOH} \rightarrow 2\text{LiClO} + \text{H}_2\text{O}$
 D $\underline{\text{Ga}_2\text{O}_3} + 2\text{KOH} \rightarrow 2\text{KGaO}_2 + \text{H}_2\text{O}$

20 An excess of substance **Y** was added bit by bit, with stirring to aqueous solution **Z**. The changes in the pH of the mixture is shown in the graph.



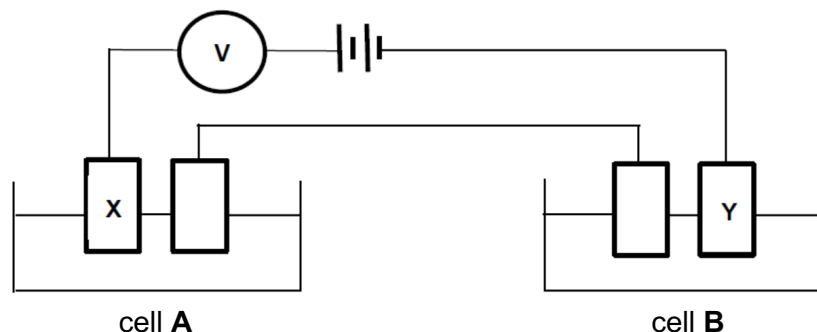
What could substance **Y** and **Z** be?

	substance Y	substance Z
A	potassium oxide	sulfuric acid
B	magnesium oxide	ethanoic acid
C	calcium oxide	ethanoic acid
D	zinc oxide	sulfuric acid

21 Which statement describes what happens in a hydrogen fuel cell?

- A Electricity is used to produce water.
 B Electricity and water are produced.
 C Hydrogen is burnt to form steam.
 D Oxygen is produced.

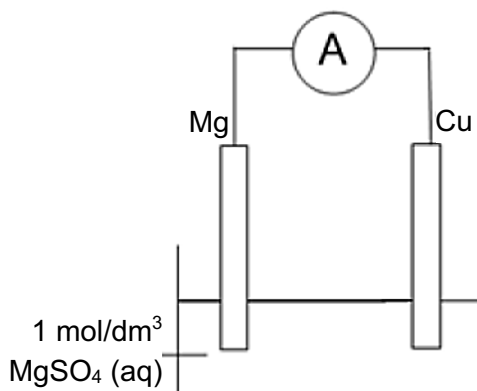
- 22 A student carried out an experiment involving the electrolysis of concentrated copper(II) chloride in cell **A** and concentrated sodium chloride in cell **B** using inert electrodes.



What are the ionic equations that occurred at electrode **X** and **Y** at the start of the electrolysis?

	at electrode X	at electrode Y
A	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
B	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2$
C	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	$\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$
D	$4\text{OH}^- \rightarrow 2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^-$	$\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$

- 23 The following is a simple cell set-up.

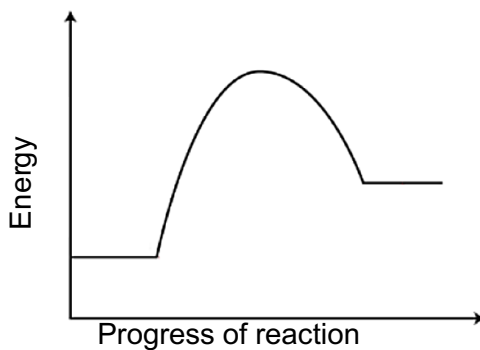


Which statements are correct?

- Electrons flow from the copper electrode to the magnesium electrode.
- The mass of the magnesium electrode decreases.
- A deposit of magnesium will appear on the copper electrode.
- Chemical energy is converted into electrical energy.

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

- 24 The energy profile diagram of a reaction is given.



Which reaction **cannot** be represented by this diagram?

- A** $\text{H}_2\text{O}(\text{g}) \rightarrow 2\text{H}(\text{g}) + \text{O}(\text{g})$
B $6\text{CO}_2(\text{g}) + 6\text{H}_2\text{O}(\text{l}) \rightarrow \text{C}_6\text{H}_{12}\text{O}_6(\text{s}) + 6\text{O}_2(\text{g})$
C $\text{N}(\text{g}) + 3\text{H}(\text{g}) \rightarrow \text{NH}_3(\text{g})$
D $\text{CuCO}_3(\text{s}) \rightarrow \text{CuO}(\text{s}) + \text{CO}_2(\text{g})$
- 25 The enthalpy changes for the complete combustion of three fuels are as shown:

Reaction	Enthalpy change/kJ per mole of fuel
$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$	-100
$\text{C}_2\text{H}_5\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$	-75
$2\text{C}_3\text{H}_6 + 9\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$	-170

What is the correct arrangement for the fuels from the least energy per gram of fuel to the most energy per gram of fuel?

	least	→	most
A	CH_4	C_3H_6	$\text{C}_2\text{H}_5\text{OH}$
B	C_3H_6	CH_4	$\text{C}_2\text{H}_5\text{OH}$
C	$\text{C}_2\text{H}_5\text{OH}$	CH_4	C_3H_6
D	$\text{C}_2\text{H}_5\text{OH}$	C_3H_6	CH_4

- 26 Which formulae contains nitrogen with an oxidation state of +5?

- A** NO_2
B N_2O_4
C NH_4^+
D HNO_3

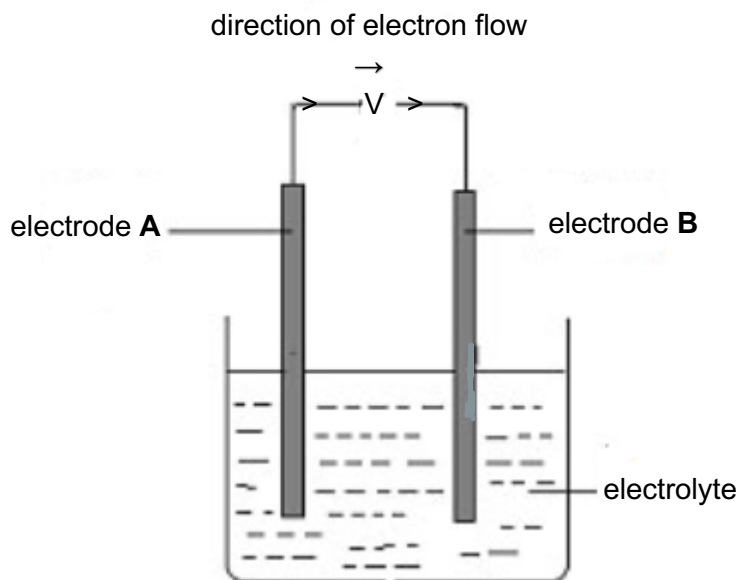
27 Which one of the following processes is **not** a redox reaction?

- A rusting of iron nails
- B combustion of methane
- C decomposition of hydrogen peroxide into water and oxygen
- D neutralisation of dilute hydrochloric acid by aqueous sodium hydroxide

28 Experiments were carried out to determine the positions of metals **X**, **Y** and **Z** in the reactivity series. The table shows the results.

Test	Metal X	Metal Y	Metal Z
Reaction between metal and hydrochloric acid	Effervescence	Effervescence	No visible observation
Heating the metal oxide with carbon	Metal oxide reduced	Metal oxide not reduced	Metal oxide reduced

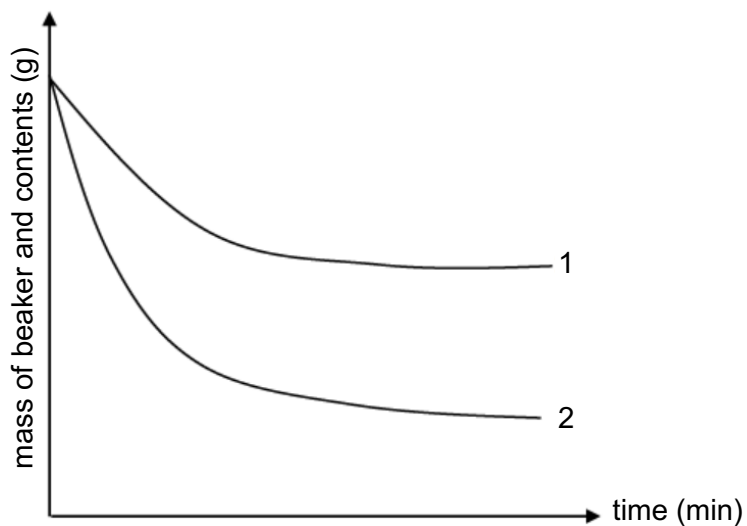
Two of these metals were used to form a simple cell as shown in the diagram.



Which pairs of metals used at electrodes **A** and **B** would produce the largest voltage in the direction of electron flow?

	electrode A	electrode B
A	metal X	metal Z
B	metal Y	metal Z
C	metal Z	metal X
D	metal Z	metal Y

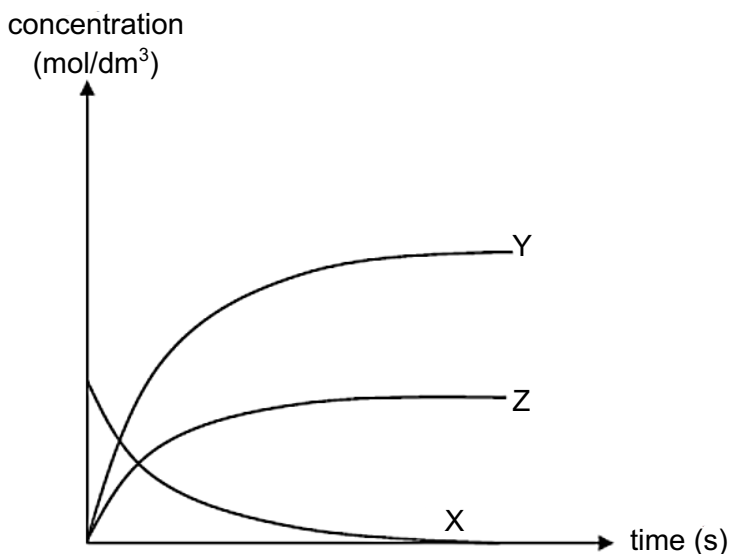
- 29 Excess zinc was added to a beaker of dilute hydrochloric acid on a balance. A graph of the mass of the beaker and contents was plotted against time (curve 1).



Which of the following changes to the experiment could give curve 2?

- | | |
|---|--|
| 1 | The same volume of a more concentrated solution of hydrochloric acid |
| 2 | An increase in pressure |
| 3 | The same mass of zinc but in smaller pieces |
-
- | | |
|----------|--------------|
| A | 1 only |
| B | 2 only |
| C | 1 and 3 only |
| D | 1, 2 and 3 |

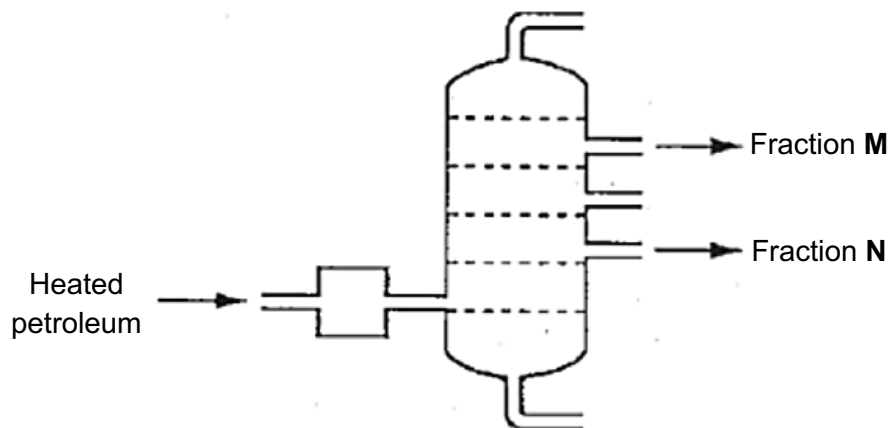
- 30 The following graph shows the change in reactant and product concentrations with time during a chemical reaction.



Which equation represents the reaction?

- A $X \rightarrow 2Y + Z$
B $X \rightarrow Y + 2Z$
C $Y + Z \rightarrow X$
D $2Y + Z \rightarrow X$
- 31 Which statement about transition elements is correct?
- A All catalysts are transition elements or their compounds.
B All coloured compounds contain transition elements.
C Transition elements conduct electricity because they have variable oxidation states.
D Transition elements have high melting points due to strong attraction between positive ions and a 'sea of electrons'.
- 32 A newly discovered element, gistatine, is placed in Group VII of the Periodic Table. It has a relative atomic mass of 370. What property is gistatine likely to have?
- A It forms a black compound with sodium.
B It is a dark green gas at room temperature.
C It is displaced by fluorine from potassium gistatide.
D It reacts with aqueous potassium iodide.

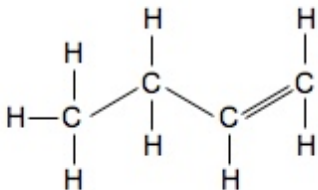
- 33 Which statement about groups in the Periodic Table is correct?
- A All groups contain acidic and basic oxides.
 - B In Group VII, all the elements form halides with most metals.
 - C In Group I, all the elements form covalent compounds with hydrogen.
 - D All groups form either positively charged ions or negatively charged ions.
- 34 The diagram shows the fractional distillation of petroleum.



Which row about fractions **M** and **N** are correct?

	M burns more easily than N	M has a higher boiling point than N	M is more viscous than N
A	true	false	false
B	true	true	false
C	false	true	true
D	false	false	true

- 35 The diagram shows how the structural formula of butene can be simplified:

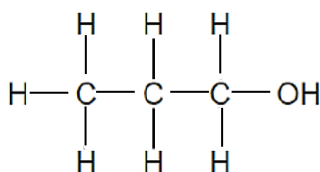
Usual structural formula of butene	Simplified version
	

The simplified structural formula of benzene is shown:

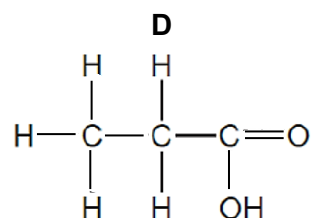
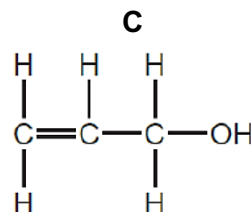
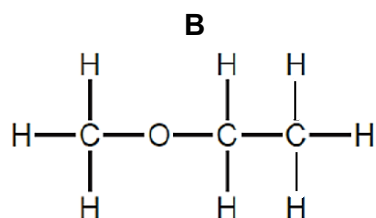
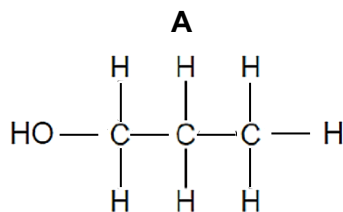


What is the empirical formula of benzene?

- A** CH
B CH₂
C CH₃
D CH₄
- 36 The following shows the structural formula of propan-1-ol.

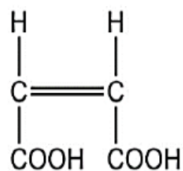
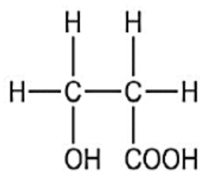
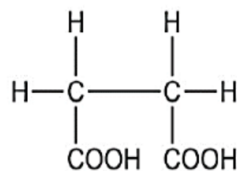
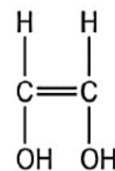


Which of the following is an isomer of propan-1-ol?



- 37 A student experiments with the properties of compounds **W**, **X**, **Y** and **Z**.

The compound reacts with steam to form a compound that further reacts with an alcohol to form a sweet-smelling compound.

**W****X****Y****Z**

Which compound will give these reactions?

- A** **W**
B **X**
C **Y**
D **Z**
- 38 A student investigated the reactions of four vegetable oils **P**, **Q**, **R** and **S** with hydrogen gas. 100 cm³ of hydrogen gas was passed through 1 g samples of each of the four vegetable oils in the presence of a suitable catalyst.

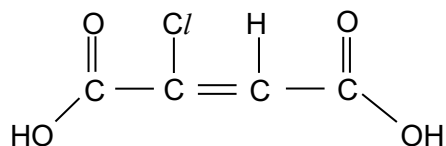
The volume of hydrogen remaining after each reaction was recorded.

vegetable oil	volume of hydrogen gas remaining/cm ³
P	0
Q	87
R	100
S	64

Which vegetable oil(s) is/are saturated?

- A** **P** only
B **R** only
C **P**, **Q** and **S**
D **Q**, **R** and **S**

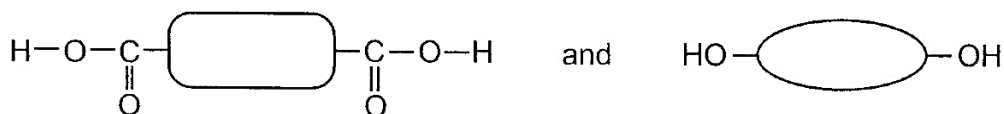
- 39 The diagram shows the structural formula of chloromaleic acid.



Which of the following statements about chloromaleic acid is/are true?

- I It decolourises bromine solution in the absence of sunlight.
- II It reacts with calcium carbonate with one of its products having the chemical formula $\text{Ca}_2\text{C}_2\text{HO}_4\text{Cl}$.
- III One mole of chloromaleic acid reacts with excess sodium metal to produce one mole of hydrogen gas.

- A I only
 - B I and II only
 - C I and III only
 - D II and III only
- 40 A synthetic polymer is made by condensation polymerisation of the two monomers shown.



In the polymerisation of the two monomers to form the polymer, which of the following set correctly shows the changes in properties?

	boiling point	percentage composition by mass
A	change	no change
B	change	change
C	no change	change
D	no change	no change

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).