Name: Register Number: Class:

For Marker's Use

南僑中學

NAN CHIAU HIGH SCHOOL

PRELIMINARY EXAMINATION 2024
SECONDARY FOUR

CHEMISTRY **6092/01**

Paper 1 **27 August 2024, Thursday**

Additional Material – Multiple Choice Answer Sheet (OTAS) **1 hour**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.
Write in dark blue or black pen.
You may use a HB pencil for any diagrams or graphs.
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 **OTAS**.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on this paper.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.

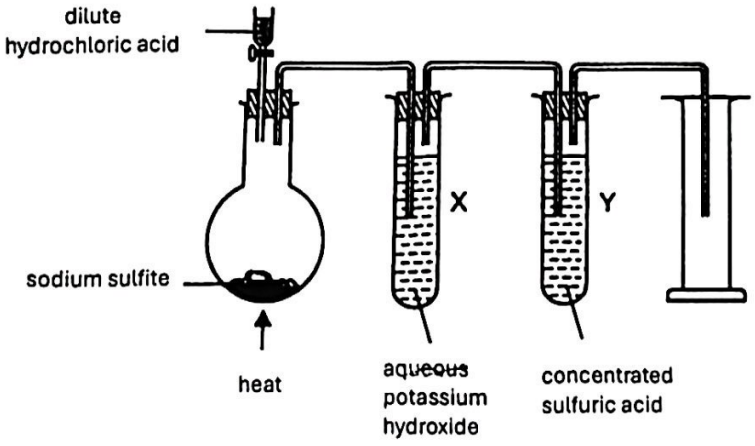
This paper consists of **18** printed pages including the cover page.

1. A flask contained a mixture of aqueous sodium hydroxide and aqueous sodium carbonate impurities.
Which procedure below could be used on its own to determine the volume of sodium carbonate added?

1 Adding hydrochloric acid in excess to the mixture in the flask and record the change in mass.
2 Adding hydrochloric acid to the mixture in the flask and record the change in volume of gas collected.
3 Titrate the mixture in the flask with hydrochloric acid and record the burette reading.

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

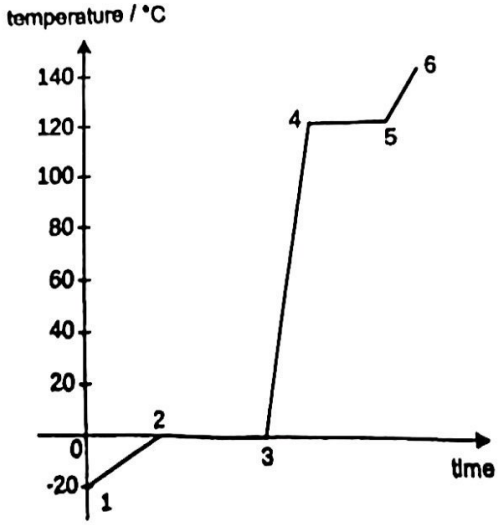
2. A student prepared the apparatus for collecting dry sulfur dioxide as shown below.



Which of the following changes is needed to ensure that the gas is obtained successfully?

A Remove test tube **X**.
B Remove test tube **Y**.
C Replace aqueous potassium hydroxide with water.
D Collect the gas using upward delivery.

3. The graph shows the change in temperature with time when a substance at -20°C is heated to 140°C



Which statement correctly describes the change taking place between the points?

A Energy is released from points 1 to 2
B The kinetic energy of the particles remains constant throughout from points 3 to 4.
C The volume of the vapour is increasing from points 3 to 4.
D The particles absorbs energy to break forces of attraction from points 4 to 5.

4. Particles with the same electronic structures are said to be isoelectronic.
Which of the following compounds contains particles which are isoelectronic?

A CaO
B KCl
C LiF
D Na_2S

5. An element R has 14 protons and 12 neutrons in its nucleus. Which row gives a possible correct number of protons, neutrons and electrons for a positive ion of an isotope of R?

	protons	Neutrons	electrons
A	12	13	13
B	12	12	15
C	14	13	13
D	14	11	15

6. In the liquid state, which substance conducts electricity using mobile electrons?

A hydrogen chloride
B ammonium chloride
C chromium(III) oxide
D chromium

7. Boron nitride is a man-made substance and exists in different crystalline forms. One form is known as c-BN. It is used as a lubricant for cutting purposes and high temperature equipment.

Which of the following best explains the properties of c-BN?

A It has a giant metallic structure with strong metallic bonds.
B It has a giant ionic structure with strong ionic bonds between ions.
C It has a giant molecular structure with strong covalent bonds between atoms.
D It has a giant molecular structure with weak intermolecular forces of attraction between different layers.

8. 100 cm^3 of methane is reacted with 150 cm^3 of oxygen. What could be the resulting mixture of gases when the products are cooled to room temperature?

A CO_2 and H_2
B CH_4, CO_2 and H_2O
C CH_4, CO_2 and CO
D O_2, CO_2 and CO

9. What is the percentage yield when 96 cm^3 of carbon dioxide is produced when 2.65 g sodium carbonate reacts with 100 cm^3 of 0.10 mol/dm^3 hydrochloric acid?

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + CO_2 + H_2O$$

A 16%
B 32%
C 48%
D 80%

10. Table 1 shows the pH ranges of an indicator, bromothymol blue.

colour of indictor	yellow	green	blue
pH range	4-5	6-7	8-9

Table 1

Table 2 shows the pH of four solutions.

solution	W	X	Y	Z
pH	3	5	7	9

Table 2

In a beaker with solution 1, a few drops of bromothymol blue is added.
Which row shows no colour change when solution 2 is added in excess to the beaker?

	solution 1 in the beaker	solution 2 added to the beaker until it is in excess
A	W	X
B	X	Y
C	Y	Z
D	Z	W

11. An unknown concentration of sodium hydroxide is titrated with 0.100 mol/dm^3 hydrochloric acid in the following sequence.

1 A pipette was rinsed with water and then some sodium hydroxide solution.
2 A burette was rinsed with water and then hydrochloric acid.
3 A conical flask was rinsed with some sodium hydroxide solution.
4 25.0 cm^3 of sodium hydroxide was added into the conical flask using the rinsed pipette. An indicator was then added.
5 Hydrochloric acid was added and the burette reading was recorded when the indicator changed colour at the end point.

Which statement is correct?

A The burette readings will be lower than expected.
B The calculated concentration of sodium hydroxide will be lower than expected.
C The calculated concentration of sodium hydroxide will be higher than expected.
D The calculated concentration of sodium hydroxide will be accurate.

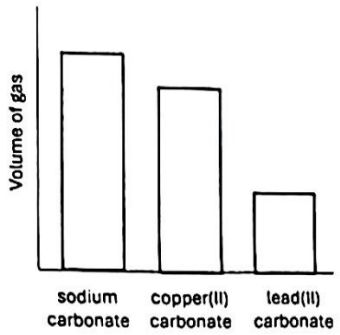
12. Different solids were added to separate portions of warm dilute hydrochloric acid.
For which solid is the observation correct?

	solid	observation
A	ammonium chloride	a gas produced which turns damn red litmus paper blue
B	copper	a gas produced which extinguished a lighted splint with a 'pop' sound
C	calcium oxide	solid dissolves to form a colourless solution
D	zinc carbonate	a gas produced which relights a glowing splint

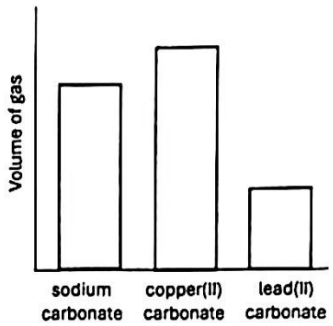
13. Excess dilute sulfuric acid were added to 1.0 g of copper(II) carbonate lead(II) carbonate and sodium carbonate separately in three test tubes.

Which graph shows the relative volumes of carbon dioxide obtained from each test tube?

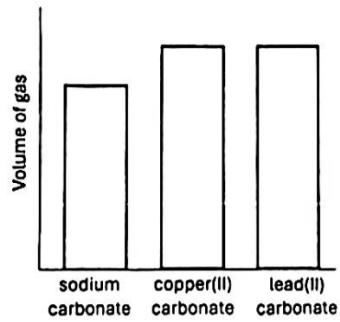
A



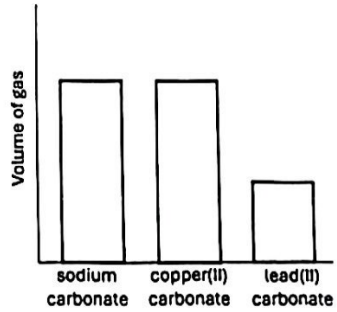
B



C



D



14. Elements **X**, **Y** and **Z** are in the same period in the Periodic Table.
The table below shows the reaction of their oxides with acid and alkali.

A √ indicates that a reaction took place.

metal oxide	reaction with acid	reaction with alkali
X oxide		√
Y oxide		
Z oxide		√

Arrange the elements **X**, **Y** and **Z** in increasing ease to lose electrons.

A Y, Z, X
B X, Z, Y
C X, Y, Z
D Y, X, Z

15. Hydrazine has the formula N_2H_4. It has similar properties to ammonia.
Which property will hydrazine have?

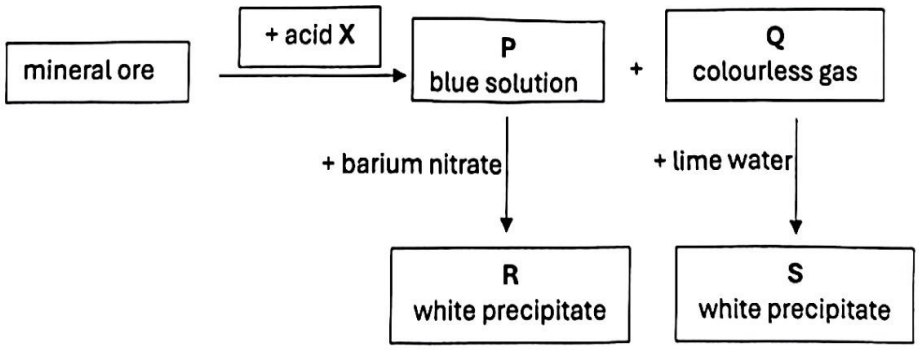
A It is an ionic compound.
B It reacts with alkalis to form salts.
C It dissolves in water to give hydrogen ions.
D It reacts with hydrogen chloride to form a compound with the formula $N_2H_6Cl_2$.

16. Two solutions were mixed in a test tube with no visible changes observed.
Aluminium foil was added to the resultant mixture and then warmed.
When a damp red litmus paper was placed at the mouth of the test tube, it turned blue.

What are the solutions?

A HNO_3 and Mg
B NH_4Cl and K_2CO_3
C KOH and HNO_3
D NH_4Cl and $ZnCl_2$

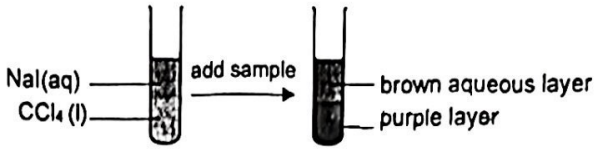
17. A chemist conducted a series of experiments to identify the ions present in a mineral ore. The diagram below shows the reaction scheme.



Which of the rows below is correct?

	mineral ore	P	Q	R
A	malachite $CuCO_3.Cu(OH)_2$	copper(II) sulfate	carbon dioxide	barium sulfate
B	haematite Fe_2O_3	iron(II) sulfate	carbon dioxide	barium sulfate
C	actamite $Cu_2Cl(OH)_3$	copper(II) chloride	carbon dioxide	barium chloride
D	siderite $FeCO_3$	iron(II) sulfate	hydrogen	barium sulfate

18. A student added an unknown sample to a colourless mixture containing sodium iodide, NaI and tetrachloromethane, CCl_4. The mixture turned from purple to brown and a purple layer formed in the tetrachloromethane, as shown below.



What was the unknown sample likely to be?

A sodium sulfate
B potassium manganate(VII)
C sodium chloride
D potassium iodide

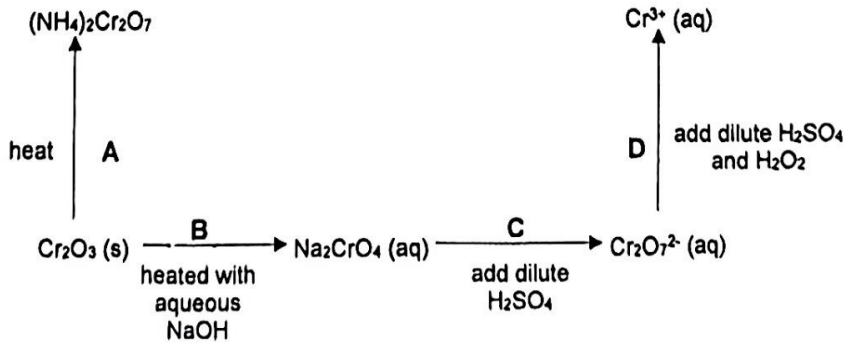
19. The table below shows three reactions which involve hydrogen peroxide.

reaction 1:	$H_2O_2 + Ag_2O \rightarrow 2Ag + O_2 + 2H_2O$
reaction 2:	$H_2O_2 + 2KI + H_2SO_4 \rightarrow I_2 + K_2SO_4 + 2H_2O$
reaction 3:	$5H_2O_2 + 2KMnO_4 + 3H_2SO_4 \rightarrow 2MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O$

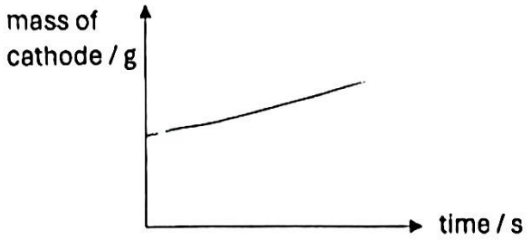
Which option correctly identifies the role of hydrogen peroxide in each reaction?

	reaction 1	reaction 2	reaction 3
A	oxidising agent	reducing agent	oxidising agent
B	oxidising agent	reducing agent	reducing agent
C	reducing agent	oxidising agent	reducing agent
D	reducing agent	oxidising agent	oxidising agent

20. The reaction scheme involving various compounds of chromium is shown below. Which of the following stages, A to D does not involve any change of oxidation state?



21. A coloured aqueous solution T is electrolysed. The mass of the negative electrode is taken at regular intervals as shown in the graph below.

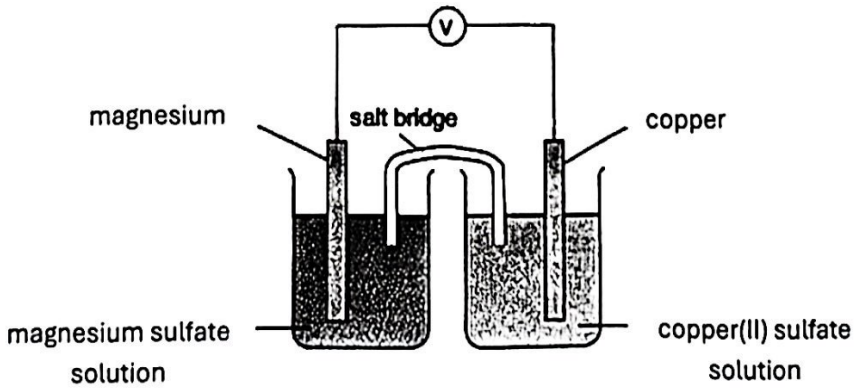


Solution T turns colourless as the electrolysis proceed.

Which of the following produce the changes in the above electrolysis?

	cathode	anode	solution T
A	graphite	graphite	dilute sulfuric acid
B	graphite	graphite	aqueous copper(II) nitrate
C	copper	copper	aqueous copper(II) nitrate
D	copper	silver	aqueous silver nitrate

22. A simple cell is shown below.



What will be observed after some time?

A Hydrogen gas is produced at the negative electrode.
B The positive electrode decreases in size.
C The negative electrode increases in size.
D The copper(II) sulfate solution decolourises.

23. The electrolysis of a molten **M** oxide yields 6 dm^3 of oxygen at the anode and 0.333 moles of metal **M** at the cathode. What could metal **M** be?

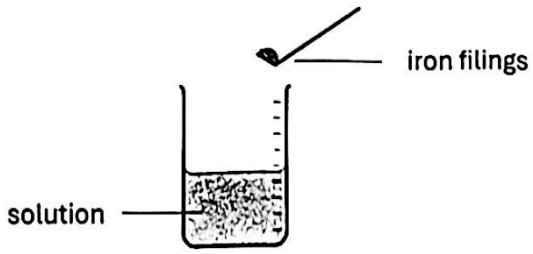
A sodium
B aluminium
C copper
D silver

24. Magnesium, calcium, strontium and barium are Group 2 elements.
Group 2 elements follow the same trends in reactivity as Group 1 elements.
Which statements about Group 2 elements are correct?

1 Calcium reacts faster than magnesium with water.
2 Barium reacts less vigorously than magnesium with dilute acid.
3 Strontium oxidises in air more slowly than barium.

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

25. Iron filings were added to a solution of **W** and **V** in two separate experiments.
Both solutions are added in excess.



The table shows the changes in mass of the solid present before and after the reactions.

Solution	Initial mass of solid / g	Final mass of solid / g
W	5.0	5.7
V	5.0	9.6

What are aqueous solutions **W** and **V**?

	W	V
A	copper(II) sulfate	silver nitrate
B	hydrochloric acid	sodium chloride
C	iron(II) chloride	calcium chloride
D	magnesium chloride	sulfuric acid

26. Some reactions of the metals **Q**, **R** and **S** are given below.

Metal	Heated with air	Reaction with water	Reaction with dilute hydrochloric acid
Q	solid burns quickly with a bright white flame	react very slowly with water	rapid reaction with effervescence observed
R	solid turns yellow when hot, white when cold	no visible change	moderately fast reaction with effervescence observed
S	solid turns red-brown	no visible change	slow reaction with effervescence observed

Which of the statements below is/are correct?

1 A piece of metal **R** attached to metal **Q** can protect metal **Q** from corrosion.
2 All three metals can be extracted by electrolysis of their molten metal oxide
3 Metal **R** can be thinly layered on metal **S** to prevent rusting.

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

27. The section of the reactivity series shown below includes a newly discovered metal, symbol **M**.

Mg
Fe
M
Cu

It forms only one oxide with the formula **MO**. Effervescence is observed when **M** is reacted with acid.

Which equation shows a reaction which occurs?

A $Cu(s) + 2M^{+}(aq) \rightarrow Cu^{2+}(aq) + 2M(s)$
B $Cu^{2+}(aq) + M(aq) \rightarrow Cu(s) + 2M^{+}(aq)$
C $Mg(s) + M^{2+}(aq) \rightarrow Mg^{2+}(aq) + M(s)$
D $Fe_2O_3(s) + 3M(s) \rightarrow 2Fe(s) + 3MO(s)$

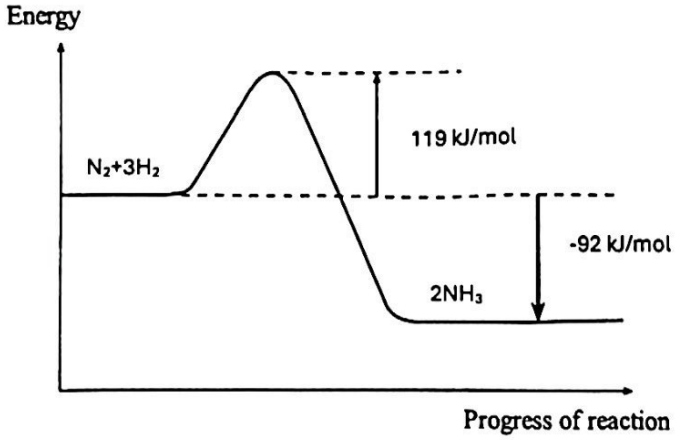
28. Which statement about exothermic and endothermic reactions is correct?

A In an endothermic reaction, the activation energy is greater than the energy absorbed when the bonds are formed.
B In an endothermic reaction, the activation energy is greater than the energy released when the bonds are broken.
C In an exothermic reaction, the activation energy is less than the energy absorbed when the bonds are formed.
D In an exothermic reaction, the activation energy is less than the energy released when the bonds are formed.

29. The Haber process can be represented in a reversible reaction,

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

The energy profile diagram for the formation of ammonia is shown below.

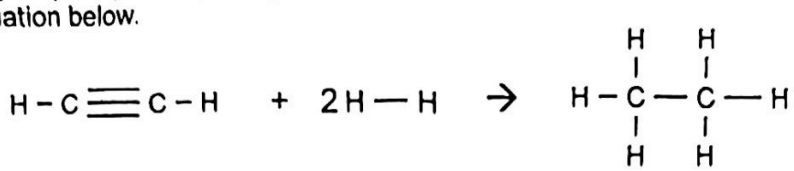


Which of the statements for the decomposition of ammonia is correct?

1 The enthalpy change is +119 kJ/mol.
2 The activation energy is +211 kJ/mol
3 The energy absorbed to decompose 1 mole of ammonia is 46 kJ.

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

30. Ethyne (C_2H_2) undergoes hydrogenation to form ethane as shown in the structural equation below.



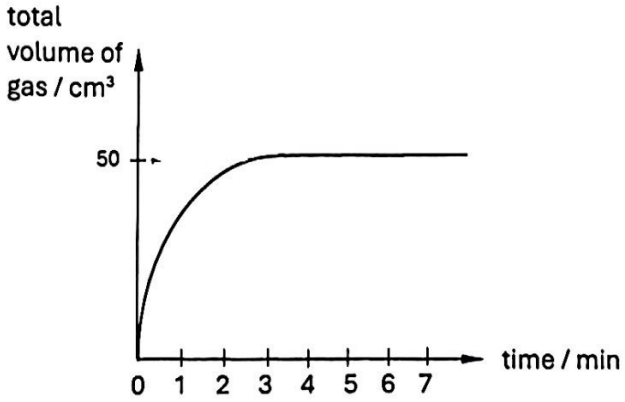
The bond energies in the substances involved are shown in the table below.

Bond	Bond energy (kJ/mol)
C – H	413
C – C	347
C = C	612
C ≡ C	839
H – H	432

What is the enthalpy change for this reaction?

A -176 kJ/mol
B 296 kJ/mol
C +296 kJ/mol
D +176 kJ/mol

31. The graph below shows the volume of gas collected every minute for the reaction between a known mass of a metal and 0.5 mol/dm³ hydrochloric acid.



The experiment was repeated with the same mass of metal and 1.0 mol/dm³ of hydrochloric acid. In both experiments, there was no solid observed at the end of the reactions.

Which of the rows below is correct for the second experiment?

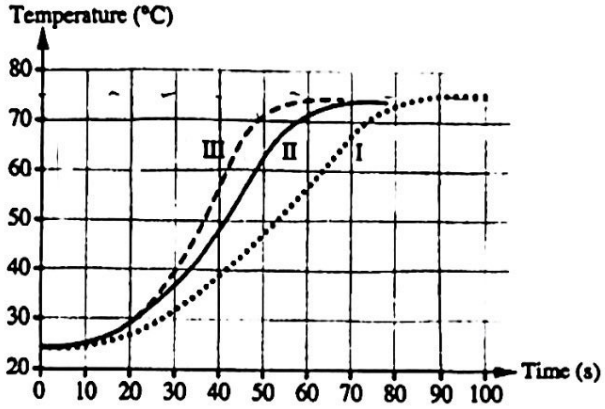
	maximum volume of gas collected	time taken for reaction to complete
A	50 cm³	less than 3 minutes
B	50 cm³	more than 3 minutes
C	100 cm³	more than 3 minutes
D	100 cm³	less than 3 minutes

32. In the 'Elephant Toothpaste' experiment, the rate of decomposition of hydrogen peroxide can be catalysed by potassium iodide. This reaction releases heat.

Three different experiments were conducted using different solutions of aqueous potassium iodide.

Experiment	Concentration of potassium iodide (mol/dm^3)
I	0.20
II	0.30
III	0.40

The graph below shows the changes in temperature of the reaction mixtures with time.



Which conclusion can be drawn from the results shown in the graph?

A The concentration of catalyst has no effect on the rate of reaction.
B The rate of reaction is the fastest at the beginning of each experiment.
C Potassium iodide is the limiting reactant.
D The higher the concentration of the catalyst, the faster is the reaction.

33. Biofuels, such as bioethanol derived from corn, are an important alternative renewable energy source.
Which of the following is not the reason why the use of biofuels are increasingly important?

A They help reduce greenhouse gas emissions compared to fossil fuels.
B They can decrease the reliance on non-renewable fossil fuels.
C They contribute to increased air pollution.
D They support agricultural development and rural economies.

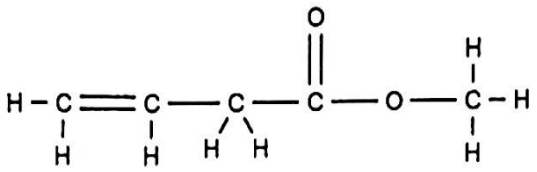
34. One mole of a hydrocarbon compound **X** is completely burned in excess oxygen. The reaction produces 17 moles of water.
In another experiment, the compound **X** does not decolourise aqueous bromine.

What could compound **X** be?

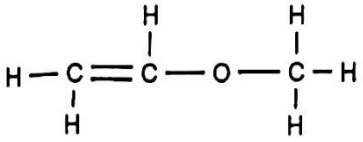
A $C_{16}H_{32}$
B $C_{16}H_{34}$
C $C_{17}H_{36}$
D $C_{18}H_{38}$

35. A compound **Y** can undergo addition polymerisation and is miscible with water.
When reacted with ethanoic acid, it produces a sweet-smelling product.
Which of the following structures represents **Y**?

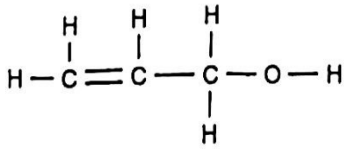
A



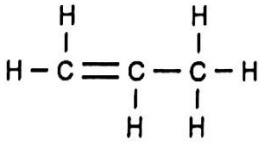
B



C



D

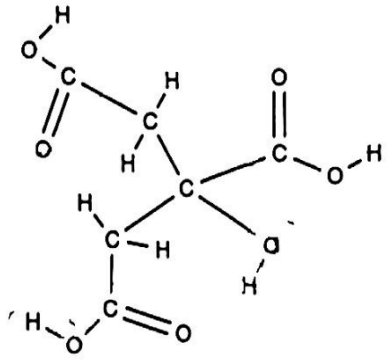


36. Which substances have the same number of carbon atoms?

1 ethyl methanoate
2 ethanoic acid
3 methyl propanoate
4 butanol

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

37. The diagram below shows the structural formula of citric acid.



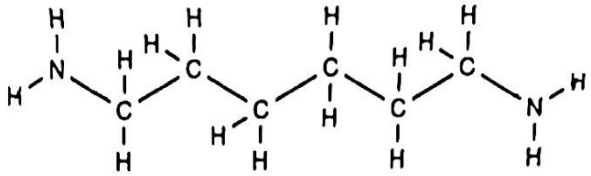
If 1 mole of citric acid is reacted with 5 moles of sodium hydroxide (NaOH) in an aqueous solution, how many moles of NaOH will remain unreacted?

A 1 mole
B 2 moles
C 3 moles
D 4 moles

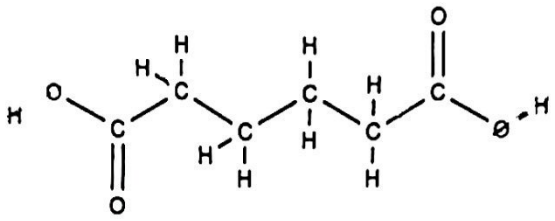
38. Similar amounts of some fats and oils are dissolved in an organic solvent. A few drops of aqueous bromine are added and each mixture is shaken.
Which fat or oil is the most polyunsaturated?

	fat or oil	colour of mixture after shaking
A	butter	dark orange
B	lard	orange
C	margarine	yellow
D	sunflower oil	colourless

39. Nylon is a type of polymer that is formed through condensation polymerisation. The structure of the monomers are given below.



Hexamethylenediamine



Adipic acid

What is the repeating unit of the nylon polymer formed from these monomers, and which small molecule is released during the reaction?

	repeating unit	small molecule
A	$\left(\text{NH-(CH}_2\text{)}_6\text{-NH-CO-(CH}_2\text{)}_4\text{-CO}\right)$	water
B	$\left(\text{NH-(CH}_2\text{)}_4\text{-NH-CO-(CH}_2\text{)}_6\text{-CO}\right)$	water
C	$\left(\text{NH-(CH}_2\text{)}_4\text{-NH-CO-(CH}_2\text{)}_6\text{-CO}\right)$	ammonia
D	$\left(\text{NH-(CH}_2\text{)}_4\text{-NH-CO-(CH}_2\text{)}_4\text{-CO}\right)$	carbon dioxide

40. In what way do chlorofluorocarbons, unburnt hydrocarbons and sulfur dioxide affect the atmosphere and the environment?

	chlorofluorocarbons	unburnt hydrocarbons	sulfur dioxide
A	acid rain	depletion of the ozone layer	global warming
B	depletion of the ozone layer	acid rain	global warming
C	depletion of the ozone layer	global warming	acid rain
D	global warming	depletion of the ozone layer	acid rain

~End of paper~