



# Cambridge O Level

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## CHEMISTRY

5070/12

Paper 1 Multiple Choice

May/June 2022

1 hour

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

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### INSTRUCTIONS

- 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 multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

### INFORMATION

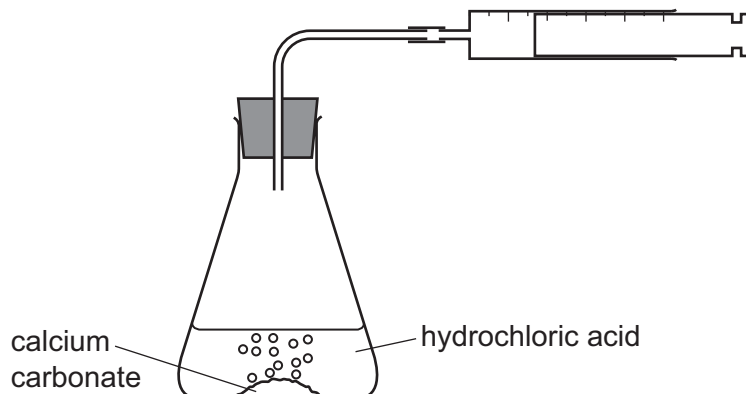
- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

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This document has **16** pages.



- 1 A student investigates the rate of reaction between calcium carbonate and hydrochloric acid.



The volume of gas in the syringe is recorded after one minute.

The experiment is repeated using different concentrations of hydrochloric acid.

Which additional pieces of apparatus are essential for the investigation?

- 1 balance
- 2 measuring cylinder
- 3 stop-clock

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

- 2 Which statement is correct?

- A** A mixture of liquids with boiling points which differ by 35 °C can be separated by distillation.
- B** Locating agents are needed to identify the colours present in ink.
- C** The desalination of sea water to produce pure water is achieved by fractional distillation.
- D** The  $R_f$  value of a dye in a chromatogram can be calculated using the formula:

$$R_f = \frac{\text{distance moved by solvent}}{\text{distance moved by spot}}$$

3 Some reactions of an aqueous solution of compound X are given.

- When a few drops of aqueous sodium hydroxide are added, a white precipitate is formed.
- When dilute nitric acid is added and the mixture is warmed, a gas is formed. The gas decolourises acidified potassium manganate(VII).
- When dilute nitric acid and aqueous barium nitrate are added, no visible reaction occurs.

What can be deduced about the identity of X?

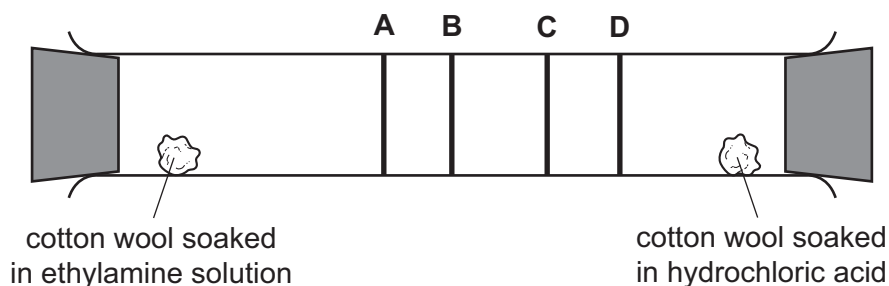
- A** X contains only aluminium sulfate,  $Al_2(SO_4)_3$ .
- B** X contains only calcium sulfite,  $CaSO_3$ .
- C** X must contain aluminium sulfite,  $Al_2(SO_3)_3$ , or zinc sulfite,  $ZnSO_3$ .
- D** X must contain aluminium sulfite,  $Al_2(SO_3)_3$ , calcium sulfite,  $CaSO_3$ , or zinc sulfite,  $ZnSO_3$ .

4 Which set of changes to the conditions increases the volume of a gas?

|          | pressure  | temperature |
|----------|-----------|-------------|
| <b>A</b> | decreases | increases   |
| <b>B</b> | increases | decreases   |
| <b>C</b> | increases | unchanged   |
| <b>D</b> | unchanged | decreases   |

5 Ethylamine gas,  $C_2H_5NH_2$ , and hydrogen chloride gas,  $HCl$ , react together to form a white solid, ethylamine hydrochloride.

At which position in the tube would a ring of solid white ethylamine hydrochloride form?



- 6 Element X can be represented by the symbol  ${}^{14}_6\text{X}$ .

Which statements about an atom of element X are correct?

- 1 It has 6 electrons.
- 2 It has 8 protons.
- 3 It is an isotope of carbon.
- 4 It is an isotope of nitrogen.

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

- 7 Two isotopes of chlorine are  ${}^{35}\text{Cl}$  and  ${}^{37}\text{Cl}$ .

Using these isotopes and  ${}^{12}\text{C}$  and  ${}^1\text{H}$ , how many different relative molecular masses are possible for the compound with molecular formula  $\text{C}_2\text{H}_3\text{Cl}_3$ ?

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

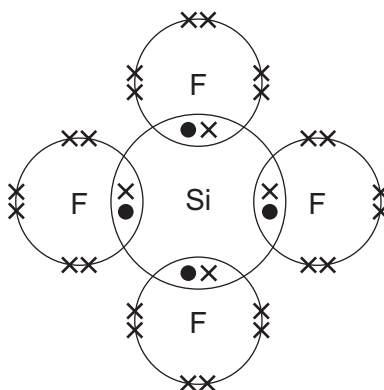
- 8 Which row is correct?

|          | elements       | compounds         | mixtures    |
|----------|----------------|-------------------|-------------|
| <b>A</b> | graphite, iron | methane, water    | air, copper |
| <b>B</b> | graphite, iron | sand, water       | air, brass  |
| <b>C</b> | iron, water    | methane, graphite | air, brass  |
| <b>D</b> | water, methane | air, graphite     | iron, brass |

- 9 Which statement about ionic compounds is correct?

- A** They are all solids at room temperature.
- B** They all conduct electricity at room temperature.
- C** They are all soluble in water.
- D** They all have strong intermolecular forces.

- 10 A molecule of tetrafluorosilane,  $\text{SiF}_4$ , is shown in the dot-and-cross diagram. Only the outer shell electrons are shown.



Which statement is correct?

- A** Each molecule of  $\text{SiF}_4$  has exactly 16 pairs of electrons.
- B** In  $\text{SiF}_4$  both the silicon and the fluorine have the same electronic configuration as neon.
- C** Molten  $\text{SiF}_4$  will conduct electricity.
- D**  $\text{SiF}_4$  has a low melting point.
- 11 The table describes two properties associated with metals.

Which row shows a correct reason for the stated property?

|          | property            | reason                                                |
|----------|---------------------|-------------------------------------------------------|
| <b>A</b> | malleable           | the layers of metal anions can slide over each other  |
| <b>B</b> | malleable           | the layers of metal cations can slide over each other |
| <b>C</b> | conduct electricity | metallic structures contain mobile anions             |
| <b>D</b> | conduct electricity | metallic structures contain mobile cations            |

- 12 Aqueous silver nitrate,  $\text{AgNO}_3$ , reacts with aqueous potassium chromate(VI),  $\text{K}_2\text{CrO}_4$ , to give a yellow precipitate.

What is the ionic equation for this reaction?

- A**  $2\text{AgNO}_3(\text{aq}) + \text{K}_2\text{CrO}_4(\text{aq}) \rightarrow \text{Ag}_2\text{CrO}_4(\text{s}) + 2\text{KNO}_3(\text{aq})$
- B**  $2\text{Ag}^+(\text{aq}) + 2\text{NO}_3^-(\text{aq}) + 2\text{K}^+(\text{aq}) + \text{CrO}_4^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{CrO}_4(\text{s}) + 2\text{NO}_3^-(\text{aq}) + 2\text{K}^+(\text{aq})$
- C**  $2\text{Ag}^+(\text{aq}) + \text{CrO}_4^{2-}(\text{aq}) \rightarrow \text{Ag}_2\text{CrO}_4(\text{s})$
- D**  $\text{Ag}^+(\text{aq}) + \text{CrO}_4^{2-}(\text{aq}) \rightarrow \text{AgCrO}_4(\text{s})$

13 What is the relative formula mass of anhydrous sodium carbonate?

- A 51                      B 83                      C 106                      D 124

14 What contains the greatest mass of solute?

- A 100 cm<sup>3</sup> of 1.00 mol/dm<sup>3</sup> sodium hydroxide, NaOH  
 B 500 cm<sup>3</sup> of 0.05 mol/dm<sup>3</sup> sulfuric acid, H<sub>2</sub>SO<sub>4</sub>  
 C 1.00 dm<sup>3</sup> of 0.10 mol/dm<sup>3</sup> potassium hydroxide, KOH  
 D 2.00 dm<sup>3</sup> of 0.01 mol/dm<sup>3</sup> hydrochloric acid, HCl

15 How many tonnes of aluminium oxide, Al<sub>2</sub>O<sub>3</sub>, are required to produce 27 tonnes of aluminium?

- A 27                      B 51                      C 54                      D 102

16 Dilute sulfuric acid is electrolysed. Hydrogen gas and oxygen gas are produced.

Which row correctly describes what happens?

|   | oxygen produced at the | hydrogen produced at the | concentration of acid |
|---|------------------------|--------------------------|-----------------------|
| A | anode                  | cathode                  | decreases             |
| B | anode                  | cathode                  | increases             |
| C | cathode                | anode                    | decreases             |
| D | cathode                | anode                    | increases             |

17 Aluminium can be extracted by the electrolysis of aluminium oxide dissolved in molten cryolite.

Which reactions take place during the electrolysis?

|   | reaction at the anode              | reaction at the cathode            |
|---|------------------------------------|------------------------------------|
| A | $Al^{+} + e^{-} \rightarrow Al$    | $O^{2-} + 2e^{-} \rightarrow O$    |
| B | $Al^{3+} + 3e^{-} \rightarrow Al$  | $2O^{2-} + 4e^{-} \rightarrow O_2$ |
| C | $O^{2-} - 2e^{-} \rightarrow O$    | $3Al^{+} + 3e^{-} \rightarrow 3Al$ |
| D | $2O^{2-} - 4e^{-} \rightarrow O_2$ | $Al^{3+} + 3e^{-} \rightarrow Al$  |

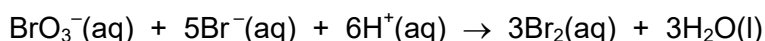
18 Which reaction is exothermic?

- A combustion of methane  
 B cracking of hydrocarbons  
 C decomposition of water into hydrogen and oxygen by electrolysis  
 D photosynthesis in plants

19 What is the correct balanced equation and enthalpy change,  $\Delta H$ , for the complete combustion of butanol,  $C_4H_9OH$ ?

- A  $C_4H_9OH(l) + 5O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$   $\Delta H = -2676 \text{ kJ/mol}$   
 B  $C_4H_9OH(l) + 5O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$   $\Delta H = +2676 \text{ kJ/mol}$   
 C  $C_4H_9OH(l) + 6O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$   $\Delta H = -2676 \text{ kJ/mol}$   
 D  $C_4H_9OH(l) + 6O_2(g) \rightarrow 4CO_2(g) + 5H_2O(g)$   $\Delta H = +2676 \text{ kJ/mol}$

20 Bromate, bromide and hydrogen ions react according to the equation shown.



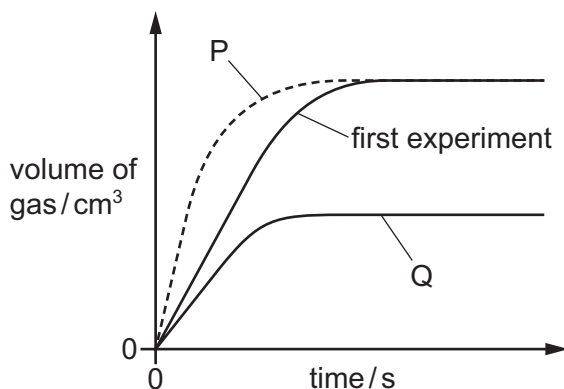
Some apparatus for measuring how the rate of this reaction varies over time is suggested.

- 1 gas syringe
- 2 balance
- 3 pH meter

Which apparatus is suitable to measure the rate of this reaction?

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

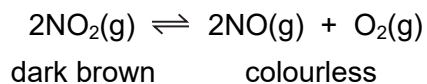
21  $25 \text{ cm}^3$  of  $1.0 \text{ mol/dm}^3$  hydrochloric acid reacts with  $10 \text{ g}$  of a solid to produce a gas. The solid is in excess. The graph labelled first experiment shows the volume of gas produced over time. Graphs P and Q show the volume of gas produced under different conditions.



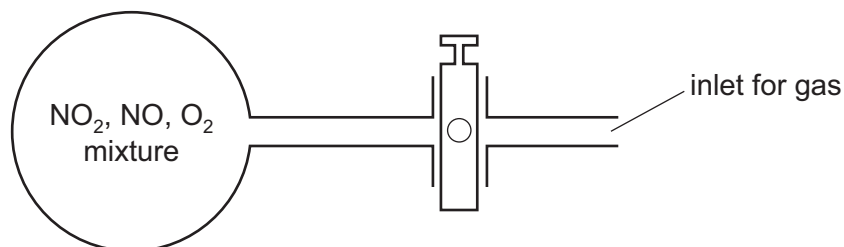
Which changes in conditions produce graphs P and Q, if all other conditions are kept the same?

- A P uses a catalyst and Q has a lower temperature.  
 B P uses  $25 \text{ cm}^3$  of more concentrated acid and Q uses smaller pieces of solid.  
 C P uses a higher temperature and Q uses  $25 \text{ cm}^3$  of more dilute acid.  
 D P uses smaller pieces of solid and Q uses larger pieces of solid.

- 22** Nitrogen dioxide,  $\text{NO}_2$ , is a dark brown gas that decomposes as shown in the equation.



The diagram shows a glass flask containing a mixture of the three gases. The mixture is pale brown.



More oxygen is forced into the flask.

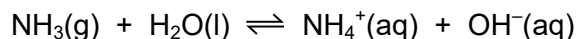
Which colour change is seen in the mixture?

- A** It becomes a darker brown.
- B** It becomes a paler brown.
- C** It turns colourless.
- D** There is no change.
- 23** What is an observation of an oxidation process?
- A** blue copper sulfate crystals turning to white powder when heated
- B** copper being deposited on the cathode during electrolysis
- C** green gas being produced at the anode when sodium chloride is electrolysed
- D** white precipitate forming when aqueous silver ions react with aqueous chloride ions
- 24** An excess of aqueous iodide ions is added to acidified aqueous potassium manganate(VII).

Which row is correct?

|          | iodide ions | colour of final solution |
|----------|-------------|--------------------------|
| <b>A</b> | oxidised    | colourless               |
| <b>B</b> | oxidised    | brown                    |
| <b>C</b> | reduced     | colourless               |
| <b>D</b> | reduced     | brown                    |

25 When ammonia gas is dissolved in water a reversible reaction takes place.



Which statements are correct?

- 1 Ammonia is an alkali because it produces hydroxide ions in solution.
- 2 The pH of this solution is 7.
- 3 Adding hydroxide ions to the mixture at equilibrium produces more ammonia.

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

26 Three dilute solutions of acid, each with a concentration of  $0.01 \text{ mol/dm}^3$ , are reacted separately with excess calcium carbonate until there is no further reaction. The same volume of acid is used each time.

The carbon dioxide produced is collected and its volume measured. All measurements are at room temperature and pressure.

| acid | pH  | volume of carbon dioxide formed / $\text{cm}^3$ |
|------|-----|-------------------------------------------------|
| 1    | 2.0 | 20                                              |
| 2    | 1.7 | 40                                              |
| 3    | 3.4 | 20                                              |

What are the possible identities of the acids?

|          | acid 1       | acid 2       | acid 3       |
|----------|--------------|--------------|--------------|
| <b>A</b> | hydrochloric | sulfuric     | ethanoic     |
| <b>B</b> | hydrochloric | nitric       | ethanoic     |
| <b>C</b> | nitric       | sulfuric     | hydrochloric |
| <b>D</b> | sulfuric     | hydrochloric | nitric       |

**27** The steps for the preparation of a pure sample of sodium nitrate are listed.

- 1 Titrate with dilute nitric acid until the end-point is seen.
- 2 Evaporate to concentrate the solution.
- 3 Rinse out the conical flask.
- 4 Add indicator.
- 5 Pipette a known volume of aqueous sodium hydroxide into a conical flask.
- 6 Cool and filter to remove crystals.
- 7 Repeat using the same volumes of aqueous sodium hydroxide and dilute nitric acid but no indicator.

Which order of steps is correct?

- A** 1 → 7 → 5 → 4 → 2 → 6 → 3
- B** 3 → 5 → 7 → 1 → 2 → 4 → 6
- C** 4 → 1 → 3 → 5 → 2 → 6 → 7
- D** 5 → 4 → 1 → 3 → 7 → 2 → 6

**28** A white compound is insoluble in water.

Which cations and anions could be present in the compound?

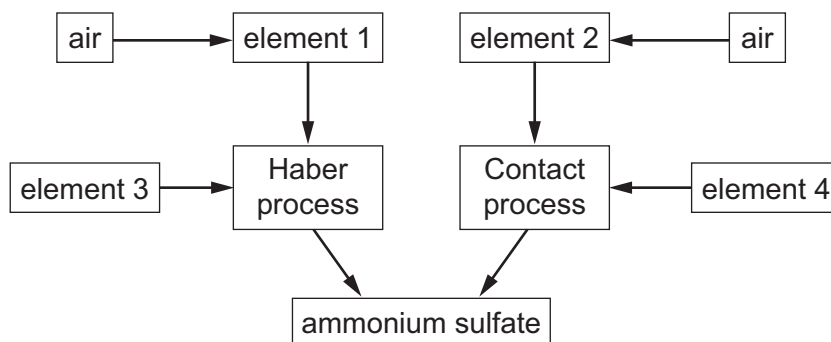
|          | sodium | calcium | carbonate | nitrate |
|----------|--------|---------|-----------|---------|
| <b>A</b> | ✓      | ✓       | x         | ✓       |
| <b>B</b> | ✓      | x       | ✓         | x       |
| <b>C</b> | x      | ✓       | ✓         | x       |
| <b>D</b> | x      | ✓       | ✓         | ✓       |

key

✓ = present

x = absent

29 The flow chart describes the preparation of ammonium sulfate.



What are elements 1–4?

|          | 1        | 2        | 3        | 4        |
|----------|----------|----------|----------|----------|
| <b>A</b> | nitrogen | oxygen   | hydrogen | sulfur   |
| <b>B</b> | nitrogen | oxygen   | hydrogen | oxygen   |
| <b>C</b> | oxygen   | nitrogen | hydrogen | sulfur   |
| <b>D</b> | oxygen   | nitrogen | sulfur   | hydrogen |

30 Which row correctly shows the possible uses of sulfur dioxide and sulfuric acid?

|          | sulfur dioxide           | sulfuric acid      |
|----------|--------------------------|--------------------|
| <b>A</b> | as a bleach              | as battery acid    |
| <b>B</b> | killing bacteria in food | as a bleach        |
| <b>C</b> | making detergents        | as battery acid    |
| <b>D</b> | making fertilisers       | making fertilisers |

31 Selenium is in Group VI and gallium is in Group III.

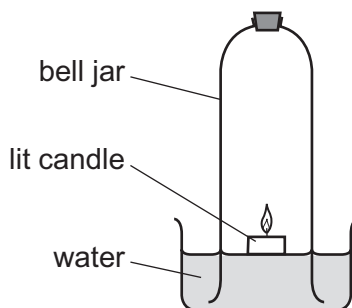
Which prediction can be made from this information?

- A** A gallium atom has three more protons than a selenium atom.
- B** Gallium is more likely to form negative ions than selenium.
- C** Selenium atoms have fewer valence electrons than gallium atoms.
- D** Selenium has more non-metallic character than gallium.

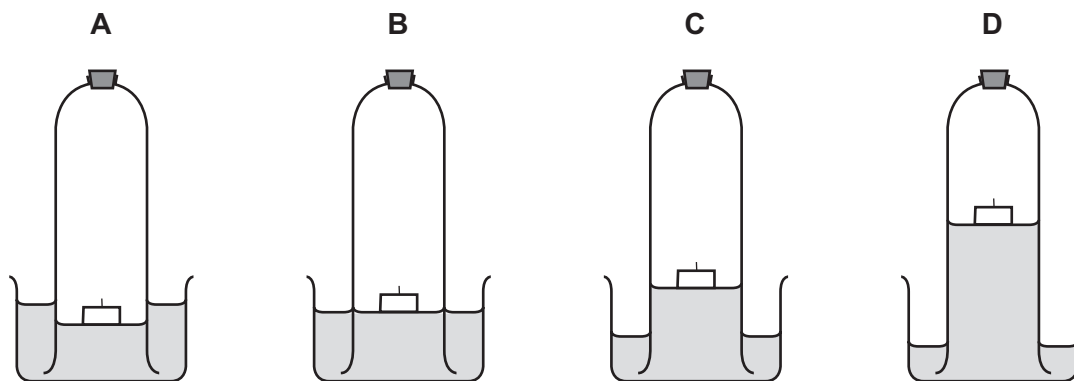
32 Which statement about some metals and their compounds is correct?

- A Calcium reacts with cold water but not with steam.
- B Lead carbonate decomposes at a higher temperature than zinc carbonate.
- C Magnesium can be extracted from its oxide by heating strongly with carbon.
- D Pure aluminium reacts with cold, dilute hydrochloric acid.

33 The diagram shows an experiment to determine the percentage of oxygen in air.



Which diagram shows the correct level of water after the candle stops burning?

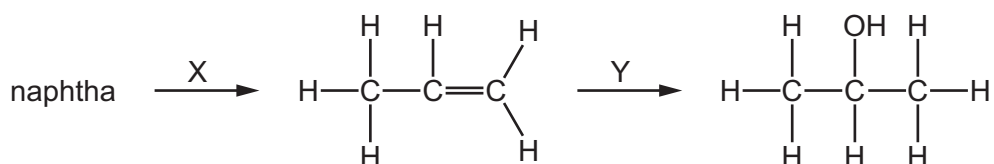


34 The addition reaction between a hydrocarbon X and bromine forms only one product.

Which compound is X?

- A  $\text{CH}_4$
- B  $\text{C}_2\text{H}_4$
- C  $\text{C}_2\text{H}_6$
- D  $\text{CH}_3\text{OH}$

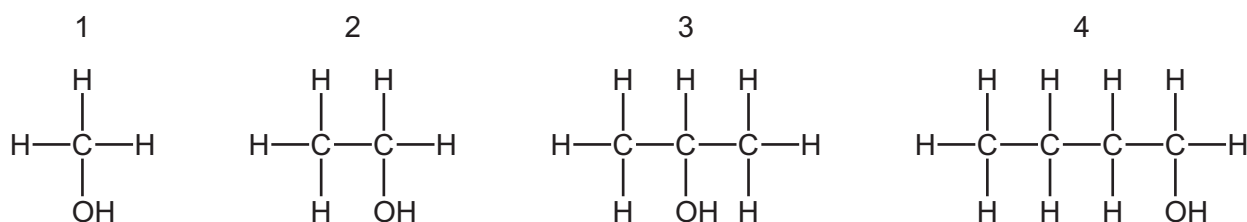
- 35 A series of reactions producing propanol from the naphtha fraction of petroleum (crude oil) is shown.



What are processes X and Y?

|          | X                       | Y                   |
|----------|-------------------------|---------------------|
| <b>A</b> | cracking                | reaction with steam |
| <b>B</b> | cracking                | fermentation        |
| <b>C</b> | fractional distillation | reaction with steam |
| <b>D</b> | fractional distillation | fermentation        |

- 36 The structures of four alcohols are shown.



Which statement is correct?

- A** Alcohol 1 can be made by the addition of steam to an alkene.  
**B** Alcohol 2 can be made from glucose.  
**C** Alcohol 3 is a renewable energy source.  
**D** Alcohol 4 has only one other isomer.
- 37 Which compounds have the molecular formula  $\text{C}_3\text{H}_6\text{O}_2$ ?
- 1 methyl ethanoate  
 2 ethyl methanoate  
 3 propanoic acid
- A** 1 and 2 only    **B** 1 and 3 only    **C** 2 and 3 only    **D** 1, 2 and 3

38 An organic compound has the empirical formula  $\text{CH}_2\text{O}$ .

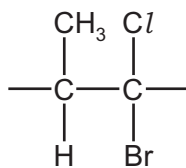
Which row shows a possible correct name and structure for this compound?

|          | name           | structure                                                                                                                                    |
|----------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A</b> | methanol       | $\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C}-\text{H} \end{array}$                                                           |
| <b>B</b> | methanoic acid | $\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C} \\ \diagdown \\ \text{O}-\text{H} \end{array}$                                  |
| <b>C</b> | ethanol        | $\begin{array}{c} \text{H} \quad \text{O} \\   \quad \parallel \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \\ \text{H} \end{array}$ |
| <b>D</b> | ethanoic acid  | $\begin{array}{c} \text{H} \quad \text{O} \\   \quad \parallel \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \\ \text{H} \end{array}$ |

39 Which statement is correct?

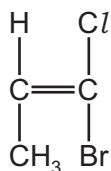
- A** Complex carbohydrates, such as starch, are hydrolysed to give simple sugars.
- B** Fats have the same amide linkages as *Terylene*.
- C** Proteins and nylon are polymers formed from the same monomers but with different linkages.
- D** Proteins are natural polymers and are also called polysaccharides.

40 The repeat unit of a polymer is shown.

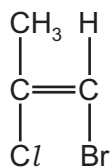


Which monomer would produce this polymer?

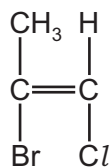
**A**



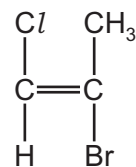
**B**



**C**



**D**



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## Group

|    |    |           |     |    |    |         |     |    |    |              |     |    |    |           |     |    |    |            |   |    |    |           |     |    |    |           |     |    |    |            |     |    |    |           |     |    |    |             |     |    |    |             |     |     |    |         |     |     |    |             |     |     |    |           |     |     |    |            |     |
|----|----|-----------|-----|----|----|---------|-----|----|----|--------------|-----|----|----|-----------|-----|----|----|------------|---|----|----|-----------|-----|----|----|-----------|-----|----|----|------------|-----|----|----|-----------|-----|----|----|-------------|-----|----|----|-------------|-----|-----|----|---------|-----|-----|----|-------------|-----|-----|----|-----------|-----|-----|----|------------|-----|
| 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 | euporium  | 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 |
| 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 | —   |

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