

## CHEMISTRY

Paper 1 Multiple Choice

5070/12

May/June 2022

1 hour

You must answer on the multiple choice answer sheet.

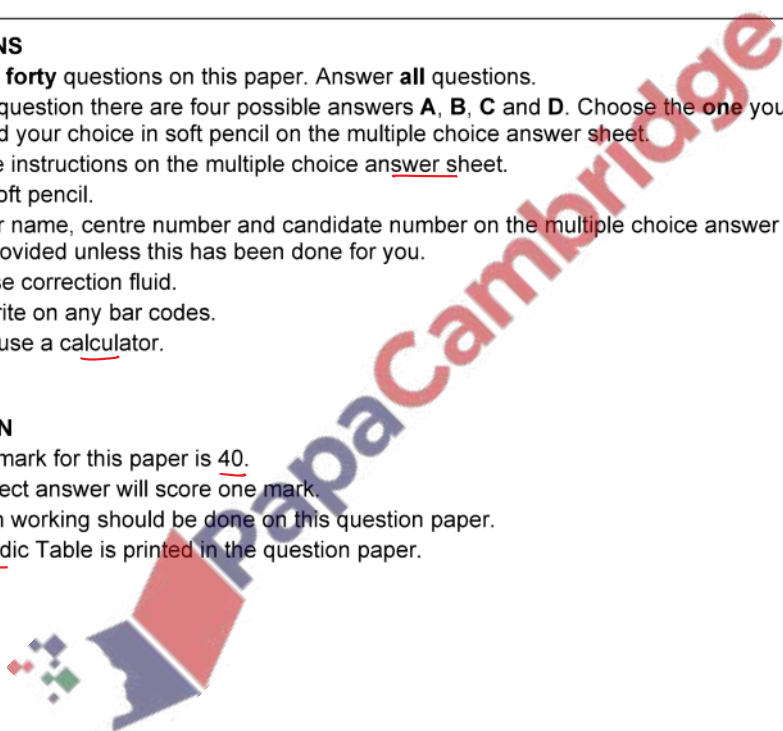
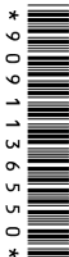
You will need: Multiple choice answer sheet  
Soft clean eraser  
Soft pencil (type B or HB is recommended)

## INSTRUCTIONS

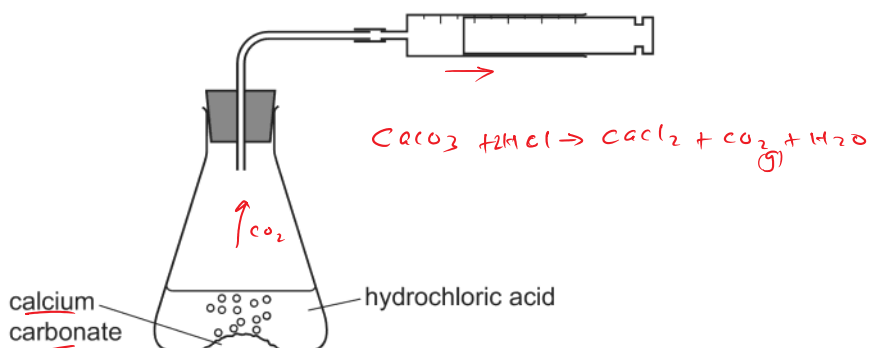
- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A, B, C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple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



- 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  $35^\circ\text{C}$  can be separated by distillation.
- B Locating agents are needed to identify the colours present in ink.   
 *↑ invisible substance* *↑ can seen.*
- C The desalination of sea water to produce pure water is achieved by fractional distillation.   
 *↑ by distillation* *↑ separating liquid of different boiling points*
- D The  $R_f$  value of a dye in a chromatogram can be calculated using the formula:

$$R_f = \frac{\text{distance moved by solvent}}{\text{distance moved by spot}} \quad \text{✗} = \frac{1}{R_f}$$

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

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.  $\uparrow \text{Al}^{3+}, \text{Ca}^{2+}, \text{Zn}^{2+}$
- When dilute nitric acid is added and the mixture is warmed, a gas is formed. The gas decolourises acidified potassium manganate(VII).  $\uparrow \text{SO}_2(\text{g})$
- When dilute nitric acid and aqueous barium nitrate are added, no visible reaction occurs.  $\uparrow \text{soluble}$

What can be deduced about the identity of X?

- A X contains only aluminium sulfate,  $\text{Al}_2(\text{SO}_4)_3$ .
- B X contains only calcium sulfite,  $\text{CaSO}_3$ .
- C X must contain aluminium sulfite,  $\text{Al}_2(\text{SO}_3)_3$ , or zinc sulfite,  $\text{ZnSO}_3$ .
- D** X must contain aluminium sulfite,  $\text{Al}_2(\text{SO}_3)_3$ , calcium sulfite,  $\text{CaSO}_3$ , or zinc sulfite,  $\text{ZnSO}_3$ .

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

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

$$p \propto \frac{1}{V} \uparrow$$

$$\frac{1}{T} \downarrow$$

5 Ethylamine gas,  $\text{C}_2\text{H}_5\text{NH}_2$ , and hydrogen chloride gas,  $\text{HCl}$ , react together to form a white solid, ethylamine hydrochloride.

diffusion - lighter gases diffuse faster.

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

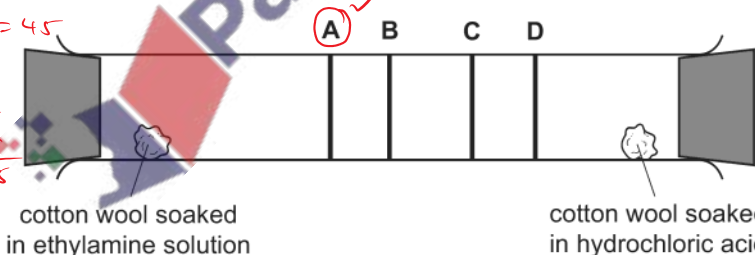
$$M_r \text{C}_2\text{H}_5\text{NH}_2 = 45$$

$$\text{C} - 12 \times 2 = 24$$

$$\text{H} - 1 \times 7 = 7$$

$$\text{N} - 14 \times 1 = 14$$

$$45$$



$$M_r \text{HCl} = 36.5$$

$$\text{H} = 1$$

$$\text{Cl} = 35.5$$

$$36.5$$

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

Proton = 6  
electron = 6  
neutrons =  $14 - 6 = 8$

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  ${}^{37}\text{Cl}$ .

Handwritten calculations for relative molecular masses of  $\text{C}_2\text{H}_3\text{Cl}_3$ :

Isotope Combination	Relative Molecular Mass
${}^{12}\text{C}_2 {}^1\text{H}_3 {}^{35}\text{Cl}_3$	132
${}^{12}\text{C}_2 {}^1\text{H}_3 {}^{35}\text{Cl}_2 {}^{37}\text{Cl}_1$	134
${}^{12}\text{C}_2 {}^1\text{H}_3 {}^{35}\text{Cl}_1 {}^{37}\text{Cl}_2$	136
${}^{12}\text{C}_2 {}^1\text{H}_3 {}^{37}\text{Cl}_3$	138

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

Handwritten calculations for relative molecular masses of  $\text{C}_2\text{H}_3\text{Cl}_3$ :

$\text{C} - 12 \times 2 = 24$      $\text{C} - 12 \times 2 = 24$      $\text{C} - 12 \times 2 = 24$      $\text{C} - 12 \times 2 = 24$

$\text{H} - 1 \times 3 = 3$      $\text{H} - 1 \times 3 = 3$      $\text{H} - 1 \times 3 = 3$      $\text{H} - 1 \times 3 = 3$

$\text{Cl} - (25 \times 1) + (37 \times 2) = 35 + 74 = 109$  ✓

$\text{Cl} - (25 \times 2) + (37 \times 1) = 50 + 37 = 87$  ✓

$\text{Cl} - (25 \times 3) = 75$  ✓

$\text{Cl} - (25 \times 3) = 75$  ✓

- 8 Which row is correct?

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

Handwritten notes: "compound" under "water, methane" in row D.

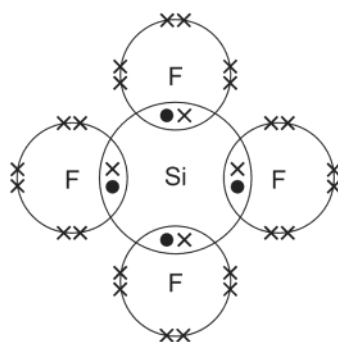
Handwritten note: "Not a mixture" next to "air, copper" in row A.

- 9 Which statement about ionic compounds is correct?

- A** They are all solids at room temperature. ✓
- B They all conduct electricity at room temperature. ✗ only conduct in molten form.
- C They are all soluble in water. ✗  $\text{BaSO}_4$ ,  $\text{PbCl}_2$  → not soluble though they are ionic compounds.
- D They all have strong intermolecular forces. ✗

Handwritten note: "Ionic compounds do not have molecules."

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



F - 9, 2, 7  
Si - 14, 2, 8, 4



Ne - 10, 2, 8

Si - 2, 8, 4

F - 2, 8, 8

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. ✗ This is a molecule, it does not have ions to conduct electricity. Argon  
D  $\text{SiF}_4$  has a low melting point. ✓ Intermolecular forces of attraction are weak, so they need only little energy to break, hence low m.p.

- 11 The table describes two properties associated with metals.

Which row shows a correct reason for the stated property?



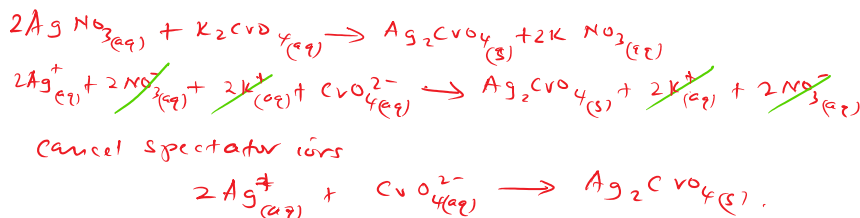
	property	reason
A	malleable ✓	the layers of metal <u>anions</u> can slide over each other ✗
B ✓	malleable	the layers of metal <u>cations</u> can slide over each other ✓
C	conduct electricity	metallic structures contain <u>mobile anions</u> ✗
D	conduct electricity	metallic structures contain <u>mobile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

↑ only mobile electrons

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

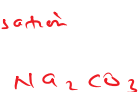
What is the ionic equation for this reaction?

- 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

$m = \text{mol} \times M_r$

$28 + 16 + 1 = 45$

$2 + 32 + (16 \times 4) = 98$

$39 + 16 + 1 = 56$

$16 + 1 = 17$

$2 \times 36.5 \times 0.01 = 0.73$

$1000 \text{ cm}^3 - 1 \text{ dm}^3 \rightarrow \frac{1000 \times 1}{1000} = 1.0$

$M_{\text{sol}} = 0.1 \times 40 = 4.0 \text{ g}$

$500 \times 0.05 = 0.025 \times 98 = 2.45 \text{ g}$

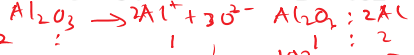
$M_{\text{sol}} \times 0.1 = 0.1 \times 56 = 5.6 \text{ g}$

$2000 \times 0.01 = 0.02 \times 36.5 = 0.73 \text{ g}$

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

$M_r \text{ of } \text{Al}_2\text{O}_3 = (27 \times 2) + (16 \times 3)$   
 $= 54 + 48 = 102$



$102 \rightarrow 54 \text{ tonnes}$

$? \rightarrow 27$

$\frac{102 \times 27}{54} = 51$

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

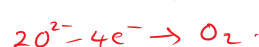
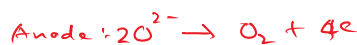
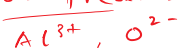


17 Aluminium can be extracted by the electrolysis of aluminium oxide dissolved in molten cryolite.

Which reactions take place during the electrolysis?

	reaction at the anode	reaction at the cathode
A	$\text{Al}^+ + \text{e}^- \rightarrow \text{Al}$	$\text{O}^{2-} + 2\text{e}^- \rightarrow \text{O}$
B	$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$	$2\text{O}^{2-} + 4\text{e}^- \rightarrow \text{O}_2$
C	$\text{O}^{2-} - 2\text{e}^- \rightarrow \text{O}$	$3\text{Al}^+ + 3\text{e}^- \rightarrow 3\text{Al}$
D	$2\text{O}^{2-} - 4\text{e}^- \rightarrow \text{O}_2$ ✓	$\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$ ✓

ions present



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

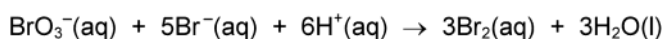


- 19 What is the correct balanced equation and enthalpy change,  $\Delta H$ , for the complete combustion of butanol,  $C_4H_9OH$ ?  *$C_4H_9OH + 6O_2 \rightarrow 4CO_2 + 5H_2O$*

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

*↑  
exothermic  
 $\Delta H = -ve$*

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



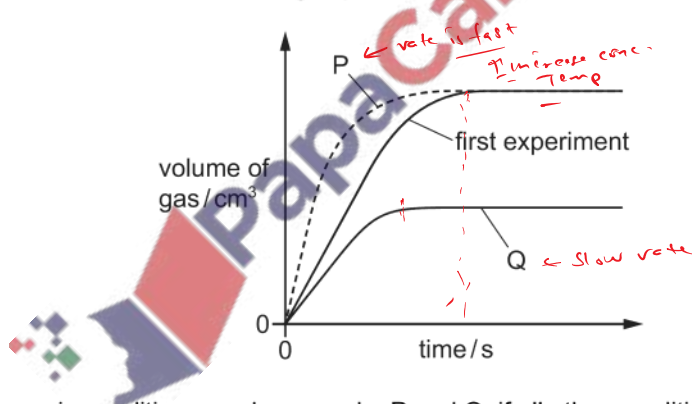
Some apparatus for measuring how the rate of this reaction varies over time is suggested.

- 1 gas syringe *→ No gas*  
 2 balance *→ No mass to measure*  
 3 pH meter ✓ *→ Measure the concentration of  $H^+$  ions*

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.

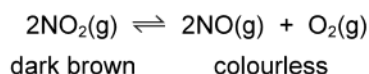


*Rate of reaction depends on*  
 - concentration  
 - Temperature  
 - Surface area  
 - catalyst

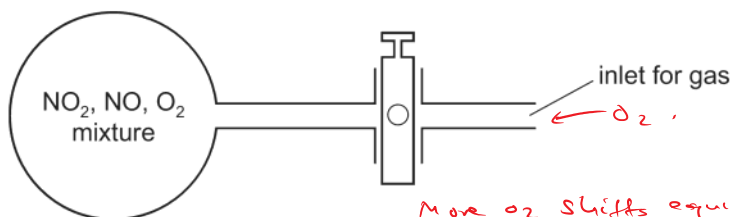
Which changes in conditions produce graphs P and Q, if all other conditions are kept the same?

- 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.

More  $\text{O}_2$  shifts equilibrium to the left  
 - So more  $\text{NO}_2(\text{g})$  is produced.  
 - So mixture becomes more dark brown.

- 23 What is an observation of an oxidation process?

- A blue copper sulfate crystals turning to white powder when heated → loss of water crystallisation  
 B copper being deposited on the cathode during electrolysis →  $\text{Cu}^{2+} + 2\text{e}^- \rightarrow \text{Cu}$  reduction  
☒ C green gas being produced at the anode when sodium chloride is electrolysed →  $2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$  oxidation  
 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).

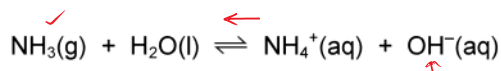
Which row is correct?

	iodide ions	colour of final solution
A	oxidised ✓	colourless ✓
<input checked="" type="radio"/> B	oxidised ✓	brown ✓
C	reduced	colourless
D	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. ← pH of water or neutral solution
- 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	hydrochloric ✓	nitric	ethanoic
C	nitric	sulfuric ✓	hydrochloric
D	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. 6
- 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. ← No  $\text{Na}^+$  and  $\text{NO}_3^-$

Which cations and anions could be present in the compound? ← metal ions

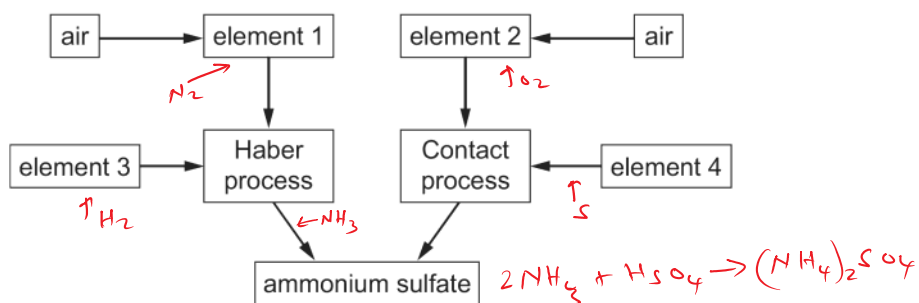
	sodium	calcium	carbonate	nitrate
<b>A</b>	✓ x	✓	x	✓ x
<b>B</b>	✓ x	x	✓ ✓	x ✓
<b>C</b> ✓	x ✓	✓ ✓	✓ ✓	x ✓
<b>D</b>	x ✓	✓ ✓	✓ ✓	✓ x

key  
 ✓ = present  
 x = absent

— All nitrate salts are soluble

— All Sodium Salts are Soluble

- 29 The flow chart describes the preparation of ammonium sulfate.  $(\text{NH}_4)_2\text{SO}_4$



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?

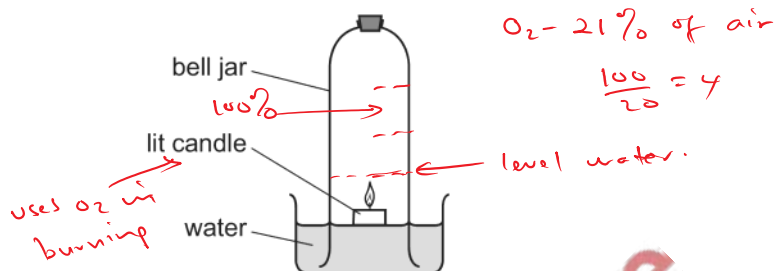
- A Calcium reacts with cold water but not with steam. x  
 B Lead carbonate decomposes at a higher temperature than zinc carbonate. x  
 C Magnesium can be extracted from its oxide by heating strongly with carbon. x

(D) ✓ Pure aluminium reacts with cold, dilute hydrochloric acid.

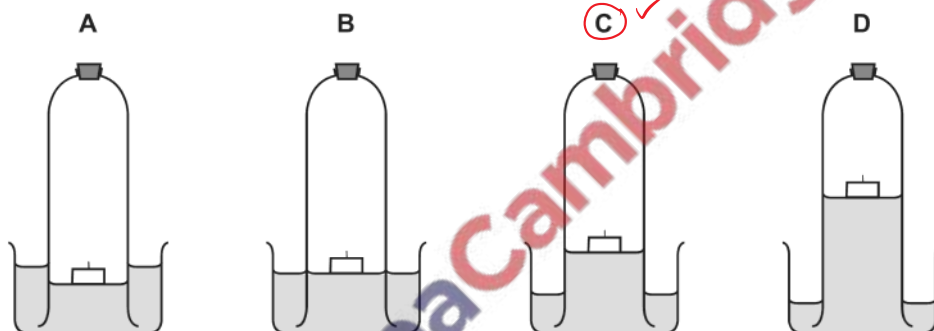


↑ cannot reduce Magnesium.  
 $\text{MgO} + \text{C} \rightarrow \text{no reaction}$

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  $\text{CH}_4$

↑  
methane  
alkane

(B)  $\text{C}_2\text{H}_4$

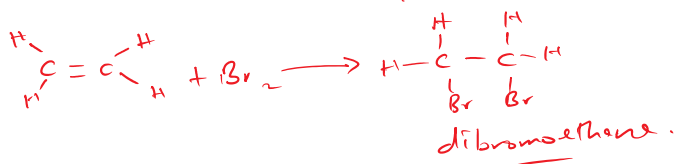
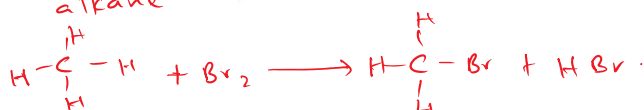
↑  
ethene

C  $\text{C}_2\text{H}_6$

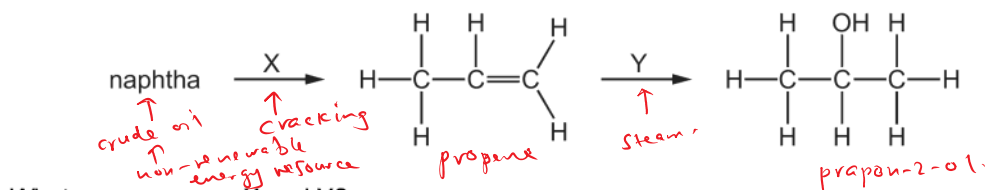
ethane

D  $\text{CH}_3\text{OH}$

methanol



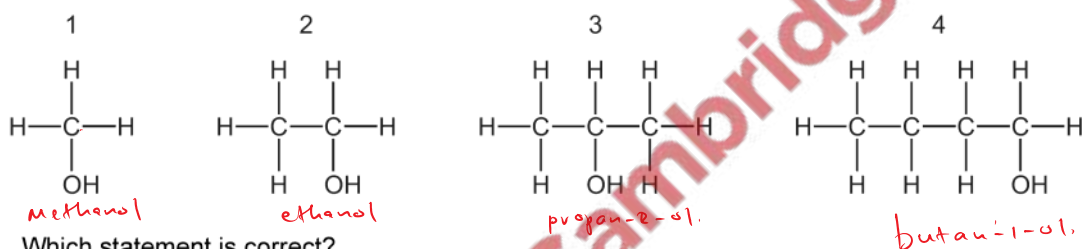
- 35 A series of reactions producing propanol from the naphtha fraction of petroleum (crude oil) is shown.



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. x  $\text{C}=\text{C}$   
**B** ✓ Alcohol 2 can be made from glucose. → *glucose fermentation gives ethanol*  
**C** Alcohol 3 is a renewable energy source. x  
**D** Alcohol 4 has only one other isomer. x *butan-2-ol*

- 37 Which compounds have the molecular formula  $\text{C}_3\text{H}_6\text{O}_2$ ?

- 1 methyl ethanoate ✓  $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_3$   $\text{C}_3\text{H}_6\text{O}_2$   
 2 ethyl methanoate ✓  $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{CH}_2-\text{CH}_3$   $\text{C}_3\text{H}_6\text{O}_2$   
 3 propanoic acid ✓  $\text{H}-\underset{\text{H}}{\underset{|}{\text{C}}}-\underset{\text{H}}{\underset{|}{\text{C}}}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$   $\text{C}_3\text{H}_6\text{O}_2$

- 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
A	methanol $\times$	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C}-\text{H} \end{array}$
B	methanoic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}-\text{C} \\   \\ \text{O}-\text{H} \end{array}$
C	ethanol $\times$	$\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \quad \parallel \\ \text{H} \quad \text{O} \end{array}$
D	ethanoic acid	$\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\   \quad \parallel \\ \text{H} \quad \text{O} \end{array}$

$\text{CH}_2\text{O}$  methanal (aldehyde).  
-OH

$\text{C}_2\text{H}_4\text{O}_2$

ethanoic acid

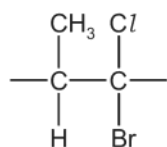
$\text{C}_2\text{H}_4\text{O}_2$   
 $\text{CH}_2\text{O}$

39 Which statement is correct?

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



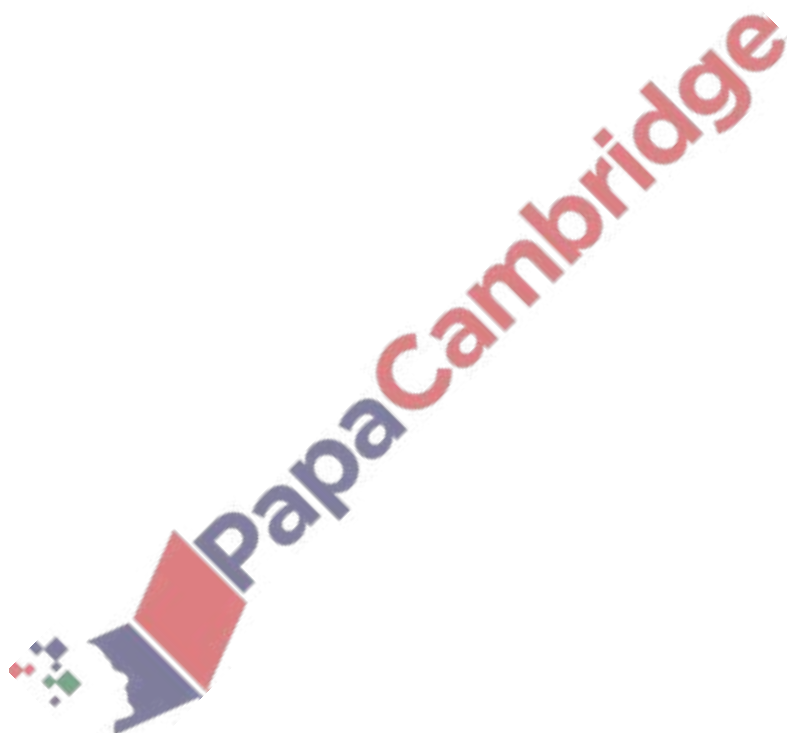
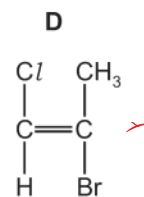
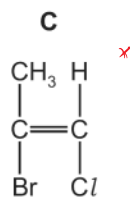
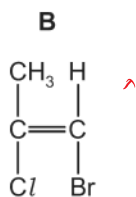
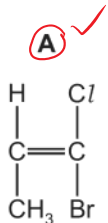
40 The repeat unit of a polymer is shown.



Introduce a double bond between c-c atoms

$$\begin{array}{c} \text{CH}_3 \quad \text{Cl} \\ | \quad | \\ \text{C}=\text{C} \\ | \quad | \\ \text{H} \quad \text{Br} \end{array}$$

Which monomer would produce this polymer?



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The Periodic Table of Elements

Group																	
I	II	<div><div><div>1</div><div>H</div><div>hydrogen</div><div>1</div></div><div><div><div>Key</div><div>atomic number</div><div>atomic symbol</div><div>name</div><div>relative atomic mass</div></div></div></div>										III	IV	V	VI	VII	VIII
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
	11 Na sodium 23											12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5
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 101	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 —	113 Nh nihonium —	114 Fl flerovium —	115 Lv livermorium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganeson —

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 dm<sup>3</sup> at room temperature and pressure (r.t.p.).