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中正中学

CHUNG CHENG HIGH SCHOOL (MAIN)

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Parent's Signature

**PRELIMINARY EXAMINATION 2023
SECONDARY 4**

CHEMISTRY

6092/01

Paper 1 Multiple Choice

September 2023

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and register number clearly in the spaces provided at the top of this page.

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

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

Read the instructions on the Answer Sheet 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 in this booklet.

A copy of the Periodic Table is printed on page 18.

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

- 1 A student accidentally mixed 50 cm³ of oil and 5 g of solid calcium nitrate.

Which sequence of separation would allow him to obtain pure samples of oil and solid calcium nitrate most easily?

- A Filtration followed by washing the residue with water.
- B Add water with stirring, use a separating funnel followed by crystallisation.
- C Simple distillation followed by crystallisation.
- D Use a separating funnel, chromatography followed by crystallisation.

- 2 The rate of diffusion of nitrogen and ammonia gases were compared at 50 °C and 25 °C.

Which would have the slowest rate of diffusion?

- A Nitrogen gas at 50 °C.
- B Nitrogen gas at 25 °C.
- C Ammonia gas at 50 °C.
- D Ammonia gas at 25 °C.

- 3 An aqueous solution containing two salts is found.

A series of tests is carried out to identify the ions present. The results are shown.

test	observations
Add dilute nitric acid followed by aqueous lead(II) nitrate.	No effervescence and white precipitate is observed.
Add aqueous sodium hydroxide followed by warming.	White precipitate is formed and dissolves in excess sodium hydroxide to form a colourless solution. No effervescence is observed.
Add aluminium foil followed by warming.	Effervescence is observed and gas turns moist red litmus paper blue.
Add aqueous ammonia.	White precipitate is formed. The mass of the white precipitate decreases by half when excess ammonia is added.

Which of the following salts are present in the aqueous solution?

- A zinc sulfate and aluminium nitrate
- B zinc sulfate and calcium nitrate
- C ammonium chloride and aluminium sulfate
- D calcium chloride and ammonium sulfate

- 4 Three particles and their nuclide notations are shown.

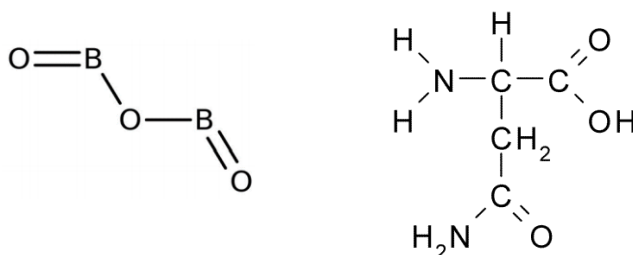
Particle	1	2	3
Nuclide notation	$^{40}_{19}\text{X}^{+}$	$^{39}_{19}\text{Y}$	$^{34}_{16}\text{Z}^{2-}$

Which of the following statements is correct about the particles?

- A Particle 1 and 2 have the same number of neutrons.
 - B Particle 1 and 3 have the same number of electrons.
 - C Particle 2 has fewer neutrons than particle 3.
 - D Particle 1 has more electrons than particle 3.
- 5 In which of the following substances are the particles farthest from one another at 25 °C?
- A dilute hydrochloric acid
 - B iron(II) oxide
 - C bromine
 - D methane

[Turn over

- 6 The structural formulae of boron oxide and asparagine are shown.



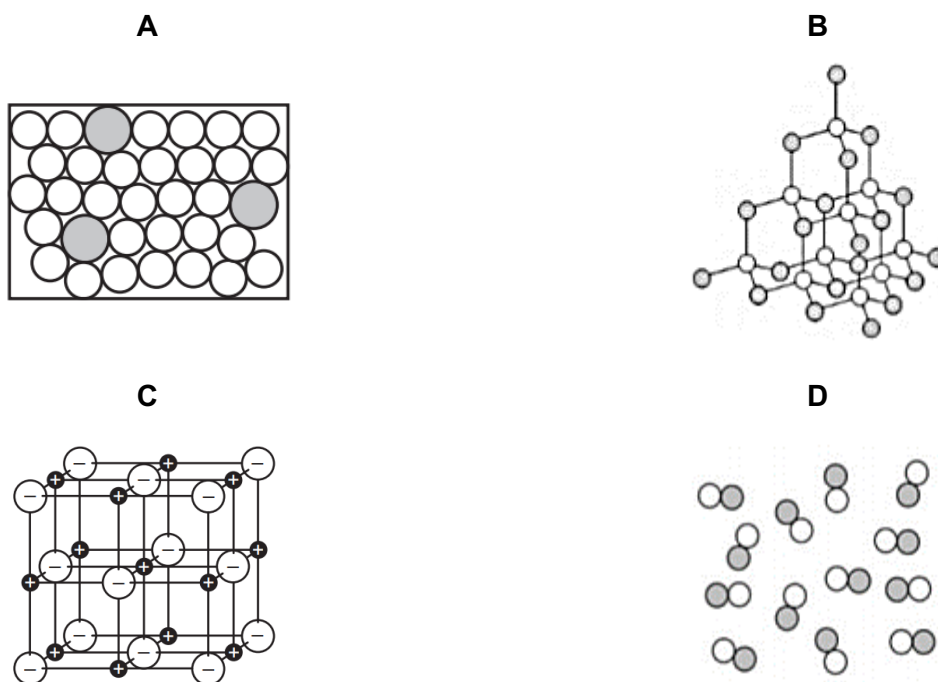
What is the total number of outer electrons not involved in bonding in boron oxide and asparagine?

	boron oxide	asparagine
A	12	12
B	12	16
C	14	12
D	14	16

- 7 The table below gives the number of subatomic particles of element **X** and **Y**.

subatomic particles	X	Y
protons	17	11
neutrons	20	12

Which diagram best represents the structure of the substance formed by **X** and **Y**?



- 8 Three elements W, X, Y, and Z have consecutive, increasing proton (atomic) numbers. Element Y exists as a colourless, monatomic gas at room temperature. Which will be the chemical formula of a compound formed between W and chlorine?

- A WCl
 B W_2Cl
 C WCl_2
 D W_2Cl_3

- 9 Compound G contains two elements, metal R and non-metal Q.

G consists of a lattice of positive ions and negative ions. Each positive ion is surrounded by four negative ions and each negative ion is surrounded by eight positive ions.

Which ions are present in, and what is the formula of, compound G?

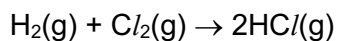
	ions present	formula
A	$R^+ Q^{2-}$	R_2Q
B	$R^{2+} Q^-$	RQ_2
C	$Q^+ R^{2-}$	Q_2R
D	$Q^{2+} R^-$	QR_2

- 10 Silver, graphite, silver nitrate and sulfur dioxide show different physical properties. Which statement is correct?

- A Silver and silver nitrate can conduct electricity in water due to their free moving ions.
 B Silver has high melting point due to the strong electrostatic forces of attraction between oppositely charged ions in its structure.
 C Graphite can conduct electricity within each layer in its structure due to free moving electrons.
 D Sulfur dioxide has a low boiling point as weak forces of attraction between its atoms are overcome during boiling.

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- 11 Hydrogen gas reacts with chlorine gas to form hydrogen chloride gas.



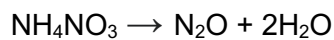
What is the final volume of the gas mixture when 20 dm³ of hydrogen is reacted with 30 dm³ of chlorine gas at 100 °C?

- A 40 dm³
 B 50 dm³
 C 60 dm³
 D 70 dm³

- 12 8 g of X₂O₃, an oxide of element X, contains 70 % of X.
 How many moles of X does 8 g X₂O₃ contain?

- A $\frac{8}{16} \times \frac{3}{2}$
 B $\frac{8}{16} \times \frac{2}{3}$
 C $\frac{2.4}{16} \times \frac{3}{2}$
 D $\frac{2.4}{16} \times \frac{2}{3}$

- 13 On heating, ammonium nitrate, NH₄NO₃, decomposes to form dinitrogen oxide and water.



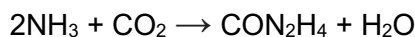
When 80 g of an impure sample of ammonium nitrate is heated, 27 g of water are formed.

What is the mass of ammonium nitrate in the impure sample?

[A_r: H, 1; O, 16; N, 14]

- A 20.0 g B 49.5 g C 60.0 g D 120 g

- 14 Ammonia and excess carbon dioxide can react to form urea and water in a reaction.



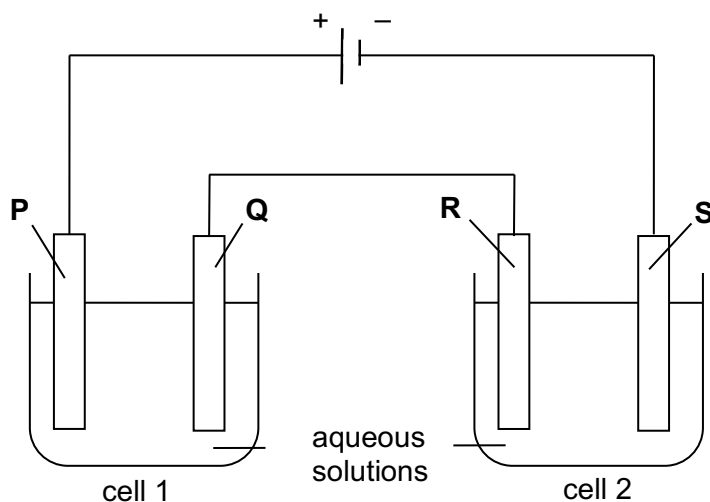
The percentage yield of this reaction is 80 %.

What is the mass of ammonia required for this reaction to obtain 60.0 g of urea?

[M_r : NH_3 , 17; CO_2 , 44; CON_2H_4 , 60; H_2O , 18]

- A** 10.6 g **B** 27.2 g **C** 34.0 g **D** 42.5 g

- 15 In the diagram below, each cell contains an aqueous solution of a single salt and all the four electrodes are platinum. Electrode **Q** and **S** increase in mass during the electrolysis and no gas is given off at **Q** or **S**.

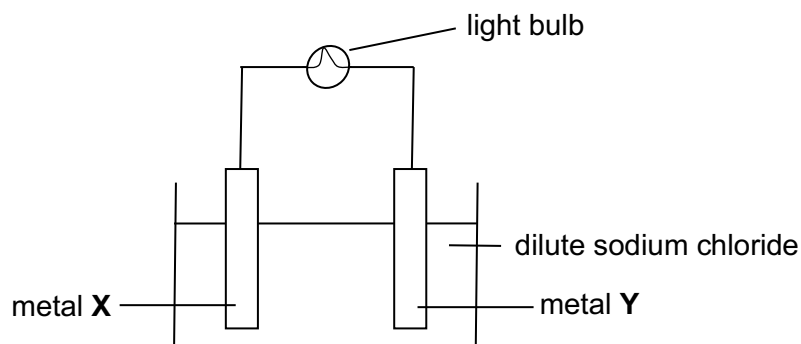


If the increase in mass of **Q** is greater than the increase in mass of **S** at the same time, which one of the following statements is necessarily true?

- A** The cation of the solution in cell 1 is different from the cation of the solution in cell 2.
B The anion of the solution in cell 1 is different from the anion of the solution in cell 2.
C The current flowing in cell 1 is greater than the current flowing in cell 2.
D The loss in mass of electrode **P** is less than the loss in mass of electrode **R**.

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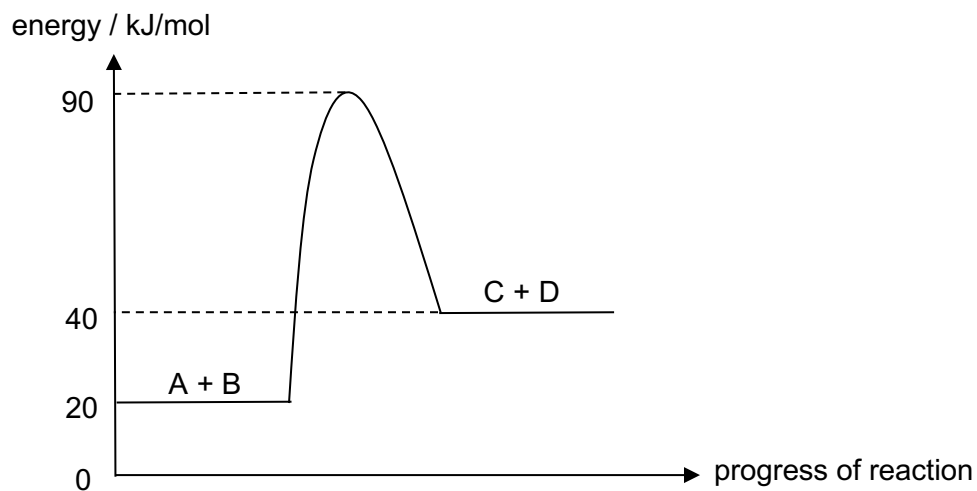
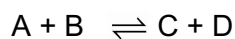
- 16 The apparatus was set up as shown.



For which pair of metals would effervescence be seen only at metal Y?

	metal X	metal Y
A	copper	zinc
B	iron	copper
C	lead	iron
D	iron	zinc

- 17 The energy profile diagram of a reversible reaction is shown below.

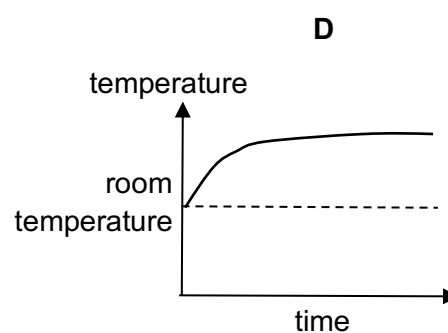
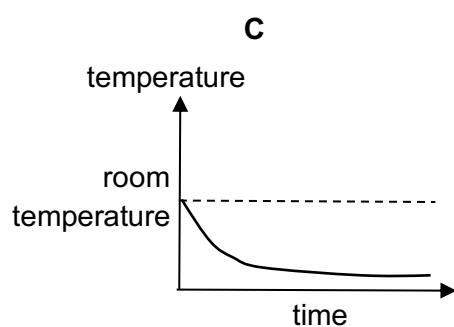
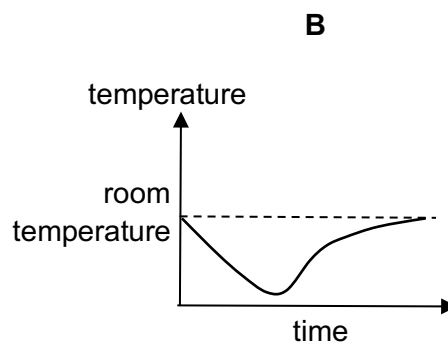
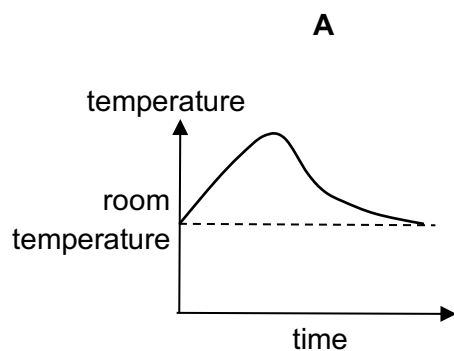


What is the value of the activation energy for the backward reaction?

- A** 90 kJ/mol **B** 70 kJ/mol **C** 50 kJ/mol **D** 20 kJ/mol

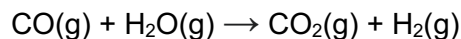
- 18 Dissolving anhydrous copper(II) sulfate in water is exothermic.

Which graph shows how the temperature changes as the anhydrous copper(II) sulfate is added to water and then is left to stand for some time?

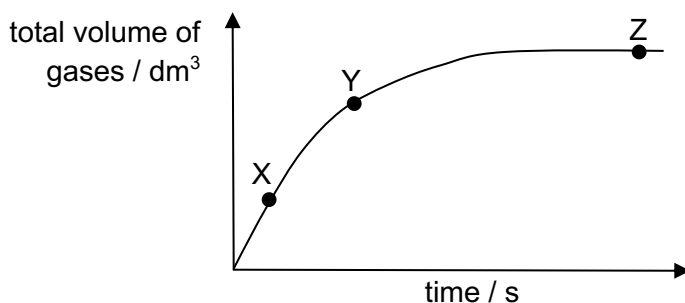


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- 19 In a water gas shift reaction, excess carbon monoxide can react with 1.5 dm^3 of steam in a fixed volume reactor to produce the hydrogen required for Haber process.

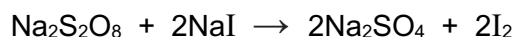


The graph shows the total volume of gases evolved plotted against time.



Which of the following statements about the reaction and graph is correct?

- A** The speed of reaction decreases from point X to point Y and then first reaches completion at point Z.
- B** The total volume of gases evolved at point Z increases if a catalyst is added.
- C** The time taken to reach completion increases if the pressure of the reaction is increased.
- D** The total volume of gases evolved is greater if a larger volume of steam is used.
- 20 The reaction between sodium persulfate and sodium iodide is shown.



Which element has been reduced?

- A** Na **B** I **C** O **D** S
- 21 Which of the following statements about an acid is **not** correct?

- A** When an acid reacts with a reactive metal, the reactive metal loses electrons.
- B** A weak acid can have the same pH as a strong acid.
- C** pH is a measure of the acid concentration in a solution.
- D** An acid reacts with a soluble base to form a salt and water only.

- 22 Which pair of compounds could be used in the preparation of barium sulfate?
- A barium carbonate and dilute sulfuric acid
 - B barium chloride and ammonium sulfate
 - C barium carbonate and sodium sulfate
 - D barium nitrate and calcium sulfate
- 23 Which statement about the industrial production of ammonia is correct?
- A The production of ammonia is an exothermic reaction.
 - B The hydrogen used is obtained from the fractional distillation of liquefied air.
 - C 1 mole of hydrogen reacts with 3 moles of nitrogen to give 2 moles of ammonia.
 - D Adding iron will provide an alternative pathway with higher activation energy.
- 24 Element Z is in Period 3 of the Periodic Table. The following four statements describe the properties of element Z and its compounds.
- Three statements are correct descriptions. One of the statements is not correct because it does not fit with the other three.
- Which statement is **not** correct?
- A The oxide Z_2O_3 reacts with water to give a solution with pH less than 7.
 - B Element Z forms an oxide, Z_2O_3 , which can react with hot aqueous sodium hydroxide.
 - C Element Z is a solid at room temperature which conducts electricity.
 - D A chloride salt containing Z and water are formed when hot dilute hydrochloric acid is added to the oxide Z_2O_3 .

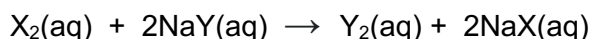
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- 25** The elements W, X, Y and Z have increasing proton numbers. They are all in Period 3 of the Periodic Table but are not necessarily next to each other.

Which statement is correct?

- A** W and Z react with oxygen to form basic oxides.
- B** X has more non-metallic character than Z.
- C** Z forms bonds by sharing electrons with chlorine.
- D** Y has greater number of electron shells than W.

- 26** In the equation shown, X and Y represents elements in Group VII of the Periodic Table.



Which pair of elements could be X and Y?

	X	Y
1	iodine	chlorine
2	bromine	iodine
3	chlorine	bromine
4	bromine	chlorine

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

- 27** Which of the following statements regarding caesium are correct?

- 1 It reacts with water to form a metal oxide and hydrogen gas.
- 2 It reacts with dilute acid to release more heat than potassium.
- 3 It has a lower density than sodium.
- 4 It has a lower melting point than lithium.

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

- 28 Q, R and S are metals.

Q and R can occur naturally as an element or in their respective ores containing their oxides or carbonates. S only occurs naturally as an element.

The time taken for metal carbonate QCO_3 to undergo complete thermal decomposition is longer than that for metal carbonate RCO_3 .

Which statement is correct?

- A Only Q can be extracted from its ore by electrolysis.
- B Metal oxide RO can react with Q with heating.
- C S can react with concentrated acid more vigorously than R.
- D The aqueous ions of Q can be displaced by R.

- 29 Scrap iron is often recycled.

Which reason for recycling is **not** correct?

- A It saves natural resources.
- B It reduces the amount of pollution at the site of the ore extraction.
- C It reduces the amount of waste taken to the landfill sites.
- D It reduces the need to collect scrap iron.

- 30 Steel is an alloy of iron with a very small percentage of carbon.

Which statement is correct?

- A A decrease in the percentage of carbon makes the steel harder.
- B Iron atoms are smaller than the carbon atoms.
- C An increase in the percentage of carbon makes the steel more brittle.
- D Iron atoms disrupt the giant structure of carbon.

[Turn over

31 Which of the following statements about the gases are correct?

- 1 Methane and carbon dioxide can cause global warming.
- 2 Complete combustion of fossil fuels produces pollutant gases such as carbon monoxide and water.
- 3 Sulfur dioxide, nitrogen dioxide and carbon monoxide can cause limestone buildings to corrode.
- 4 The oxides of nitrogen are formed by lightning activities.

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

32 Which atmospheric pollutants, emitted by internal combustion engines, are reacted together to convert them to less harmful products?

- A** Carbon monoxide and nitrogen dioxide
B Carbon monoxide and unburnt hydrocarbons
C Nitrogen dioxide and sulfur dioxide
D Sulfur dioxide and unburnt hydrocarbons

33 When crude oil is fractionally distilled, which list best describes the mixture of compounds collected at the bottom of the fractionating column?

- A** Short chain molecules, low viscosity, high flammability
B Short chain molecules, low boiling point, low flammability
C Long chain molecules, high flammability, high boiling point
D Long chain molecules, high viscosity, high boiling point

- 34 One mole of hydrocarbon $C_{12}H_{26}$ obtained from petroleum can undergo cracking to give three moles of C_2H_4 , one mole of C_3H_6 and one mole of hydrocarbon **Q**.

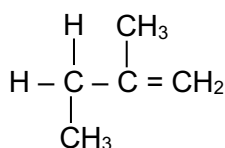
Which row best describes the molecules in hydrocarbon **Q** and the effect of **Q** on aqueous bromine?

	number of carbon atoms in Q molecule	effect of Q on aqueous bromine
A	3	decolourises
B	3	no effect
C	7	decolourises
D	7	no effect

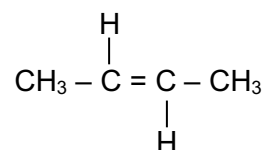
- 35 Addition of hydrogen to an unknown alkene gives the alkane $CH_3CH_2CH(CH_3)_2$.

Which is the unknown alkene?

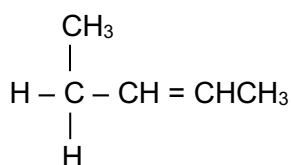
A



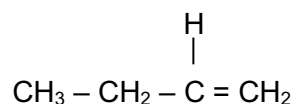
B



C



D



- 36 An organic compound **X** has the molecular formula $C_{36}H_{62}O_2$ that contains a number of carbon-carbon double bonds.

Compound **X** turns moist blue litmus paper red.

What is the minimum number of moles of aqueous bromine needed to completely remove all the carbon-carbon double bonds in one mole of compound **X**?

A 4

B 5

C 6

D 10

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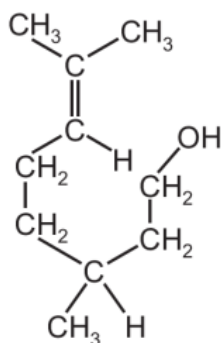
- 37 An alcohol was fully oxidised to a carboxylic acid.

Complete neutralisation of the carboxylic acid with sodium carbonate gave a salt of formula $\text{NaO}_2\text{CCH}_2\text{CO}_2\text{Na}$.

What was the formula of the alcohol?

- A $\text{CH}_3\text{CH}_2\text{OH}$
B $\text{HOCH}_2\text{CH}_2\text{OH}$
C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
D $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$
- 38 Citronellol is found in rose oil.

The structure of citronellol is shown.



Which statement about citronellol is correct?

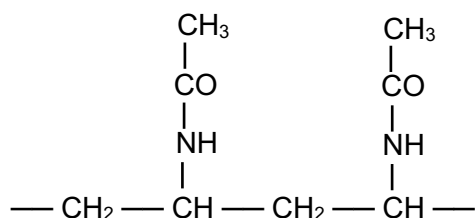
- A Citronellol dissolves in water to give an alkaline solution.
B Citronellol reacts with zinc at room temperature to give a salt and a colourless gas.
C Citronellol reacts with hydrogen in the presence of a catalyst to give an unsaturated compound.
D Citronellol forms a polymer with the same empirical formula as the monomer.

39 Which of the compounds below are isomers of one another?

- 1 propyl methanoate
- 2 propanoic acid
- 3 butanoic acid
- 4 ethyl ethanoate
- 5 butanol

A 1, 2 and 4 **B** 1, 3 and 5 **C** 1, 3 and 4 **D** 2, 4 and 5

40 The diagram shows a part of a polymer structure.



Which of the following could be used to make this polymer?

- A** $\text{CH}_3 - \text{NH} - \text{CO} - \text{CH} = \text{CH}_2$
- B** $\text{CH}_3\text{CO}_2\text{H}$ and $\text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \text{NH}_2$
- C** $\text{CH}_3\text{CO}_2\text{H}$ and $\text{NH}_2 - \text{CH} = \text{CH}_2$
- D** $\text{CH}_3\text{CO}_2\text{CH}_3$ and $\text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \text{NH}_2$

[Turn over

[illegible]

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	yterbium	173	71	Lu	lutetium	175
89	Ac	actinium	227	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	-

actinoids

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