

Name: Index No. Class:



Bukit Batok Secondary School

GCE O-LEVEL PRELIMINARY EXAMINATIONS 2024

SECONDARY 4 EXPRESS

CHEMISTRY

Paper 1 Multiple Choice

6092/01

20 AUGUST 2024

1105 - 1205

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

Write in soft pencil.

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 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 22.

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

- 1 A student transferred exactly 25.0 cm^3 of dilute hydrochloric acid into a conical flask. He added 2.50 g of solid calcium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need to carry out this experiment?

- A burette, pipette, thermometer
- B electronic balance, measuring cylinder, thermometer
- C electronic balance, pipette, stopwatch
- D electronic balance, pipette, thermometer

- 2 The rate of diffusion of ammonia and oxygen gases were compared at 20°C and 60°C .

Which would have the slowest rate of diffusion?

- A Ammonia gas at 60°C
- B Ammonia gas at 20°C
- C Oxygen gas at 60°C
- D Oxygen gas at 20°C

- 3 The melting and boiling points of four different substances are as shown.

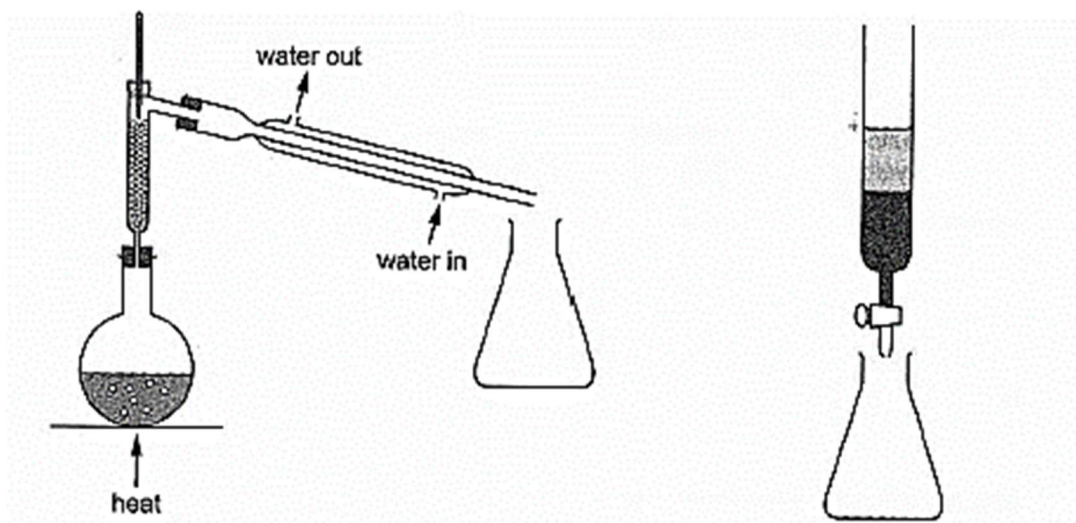
substance	melting point / $^\circ\text{C}$	boiling point / $^\circ\text{C}$
ethane	- 183	- 87
lead	328	1744
nitrogen	- 210	- 196
phosphorus	44	280

From the data given above, which of the following statements is correct?

- A Ethane is a volatile liquid at room temperature.
- B Lead has the greatest kinetic energy at 300°C .
- C Nitrogen has the weakest forces of attraction between its particles at -190°C .
- D Phosphorus is likely to be a gas at 276°C if it contains some impurities.

4 Liquids Y and Z are immiscible.

- Y has a lower boiling point than Z.
- Y has a lower density than Z.
- Y and Z can be separated from each other both by fractional distillation and using a separating funnel.



fractional distillation

separating funnel

Which row correctly gives the first liquid to be collected by fractional distillation and using separating funnel?

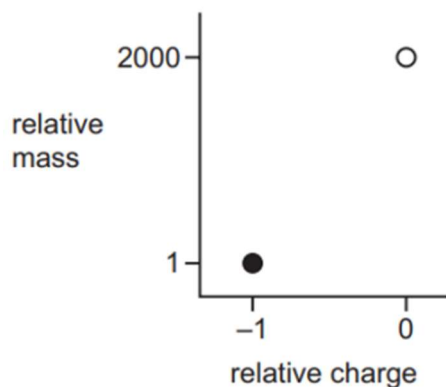
	first liquid collected by fractional distillation	first liquid collected using separating funnel
A	Y	Y
B	Y	Z
C	Z	Y
D	Z	Z

- 5 Two samples of a colourless solution are tested separately with aqueous sodium hydroxide, NaOH(aq), and aqueous ammonia, NH₃(aq), and the results are recorded.

- Gas evolved turn moist red litmus paper blue when NaOH(aq) is added and warmed.
- A white precipitate is formed with two drops of NH₃(aq) and dissolves in an excess of NH₃(aq).

What can be deduced from these results?

- A** The anion present is Cl⁻.
- B** The anion present is NO₃⁻.
- C** The cation present is Al³⁺.
- D** The cation present is Zn²⁺.
- 6 The diagram shows the relative mass and the relative charge of two sub-atomic particles, ● and ○, present in atoms and ions.



Which of these particles are present in a hydrogen atom, H, and a hydrogen ion, H⁺?

	hydrogen atom, H		hydrogen ion, H ⁺	
	●	○	●	○
A	yes	yes	yes	yes
B	yes	yes	no	no
C	yes	no	yes	no
D	yes	no	no	no

- 7 A piece of magnesium reacts with dilute hydrochloric acid.
The resulting solution is then evaporated leaving a solid white residue.

Which statement is correct?

- A A covalent solid is formed in this process.
- B Each chlorine atom gains one electron in this process.
- C Each magnesium atom loses only one electron in this process.
- D Molecules of an element are formed during the reaction.

- 8 The table shows the melting point of three hydrocarbons.

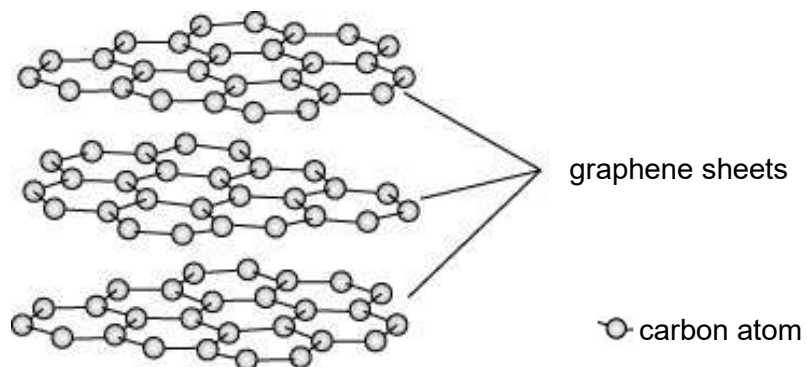
name of hydrocarbon	melting point/ °C
methane	– 182
pentane	– 130
poly(ethene)	92

What is responsible for the differences in melting points?

- A different number of bonds
 - B different relative molecular masses
 - C different structure
 - D stronger covalent bonds
- 9 Which pair of substances conducts electricity by respective mobile charged particles?

	conducts electricity by mobile electrons	conducts electricity by mobile ions
A	aqueous potassium chloride	copper
B	graphite	solid potassium chloride
C	graphite	aqueous potassium chloride
D	solid potassium chloride	copper

- 10** Graphene is an allotrope of carbon.
Graphene sheets are made up of carbon atoms which are linked in hexagonal shapes, as shown. Each carbon atom is covalently bonded to three other carbon atoms.



Which set of properties will graphene have?

- 1 It is hard.
 - 2 It has a high melting point.
 - 3 It has a giant covalent structure.
 - 4 It conducts electricity in the solid state.
- A** 1 and 2
B 2 and 3
C 1, 2 and 3
D 2, 3 and 4
- 11** Which contains the greatest number of molecules?
- A** 2.00 g of ammonia gas
B 4.00 g of liquid bromine
C 550 cm³ of hydrogen (measured at r.t.p.),
D 1.55 x 10²² molecules of water

- 12** 1.00 g of boron carbide completely oxidises to form 2.50 g of boron oxide, B_2O_3 , and 0.80 g of carbon dioxide.

What is the empirical formula of boron carbide?

- A** BC_2
- B** BC_4
- C** B_2C
- D** B_4C

- 13** An impure sample of calcium carbonate contains calcium sulfate as an impurity. When excess hydrochloric acid was added to 3 g of the sample, 0.6 dm^3 of gas was produced.

What is the percentage purity of the calcium carbonate sample?

- A** $\left(\frac{0.6}{3} \times 24\right) \div 3 \times 100\%$
- B** $\left(\frac{0.6}{9} \times 100\right) \div 3 \times 100\%$
- C** $\left(\frac{0.6}{24} \times 100\right) \div 3 \times 100\%$
- D** $\left(\frac{0.6}{44} \times 24\right) \div 3 \times 100\%$

- 14** An excess of dilute sulfuric acid was added separately to the following reagents.

reaction 1	1.2 g of magnesium
reaction 2	4.0 g of magnesium oxide, then warmed
reaction 3	8.2 g of magnesium carbonate

Each reaction produces 100% yield of products.

Which statement is correct?

- A** The number of moles of magnesium sulfate would be greatest in reaction 1.
- B** The number of moles of magnesium sulfate would be greatest in reaction 2.
- C** The number of moles of magnesium sulfate would be greatest in reaction 3.
- D** The number of moles of magnesium sulfate would be the same in all three reactions.

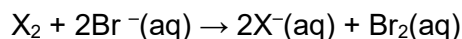
- 15** W, X, Y and Z have increasing proton numbers. They are all in Period 3 of the Periodic Table but not necessarily next to each other.

The following statements were made about properties about the elements.

- 1 W has the least number of valence electrons.
- 2 Z has the lowest relative atomic mass.
- 3 W and Y contain the same number of shells of electrons.
- 4 X and Z could be in the same group in the Periodic Table.

Which statement(s) is/are correct?

- A** 2 only
B 1 and 2 only
C 1 and 3 only
D 3 and 4 only
- 16** The equation shows a reaction between a halogen and a solution containing bromide ions.



Which row is true for the above reaction?

	identity of X_2	colour change observed
A	chlorine	orange to colourless
B	chlorine	colourless to orange
C	iodine	orange to colourless
D	iodine	colourless to orange

- 17** Which statement about transition elements and their compounds is correct?
- A** Copper(II) oxide catalyses the conversion of sulfuric acid to copper(II) sulfate.
B Iron allows hydrogen and nitrogen to react at a lower temperature.
C Nickel increases the rate of reaction between hydrogen and saturated hydrocarbons.
D Manganese forms compounds with variable oxidation states.

- 18** A **dilute** aqueous solution of a strong acid, HX, contains molecules of water and the ions, H^+ and X^- .

Which statement is correct?

- A** The solution also contains high concentration of HX molecules.
- B** The solution also contains OH^- ions.
- C** The solution also contains more OH^- ions than H^+ ions.
- D** The solutions contains more H^+ ions than water molecules.

- 19** Which method should be used to make a pure sample of potassium chloride?

- A** adding $\text{AgCl}(\text{s})$ to $\text{KNO}_3(\text{aq})$
- B** adding excess $\text{K}_2\text{CO}_3(\text{s})$ to $\text{HCl}(\text{aq})$
- C** mixing $\text{KNO}_3(\text{aq})$ with $\text{NaCl}(\text{aq})$
- D** titrating $\text{KOH}(\text{aq})$ with $\text{HCl}(\text{aq})$

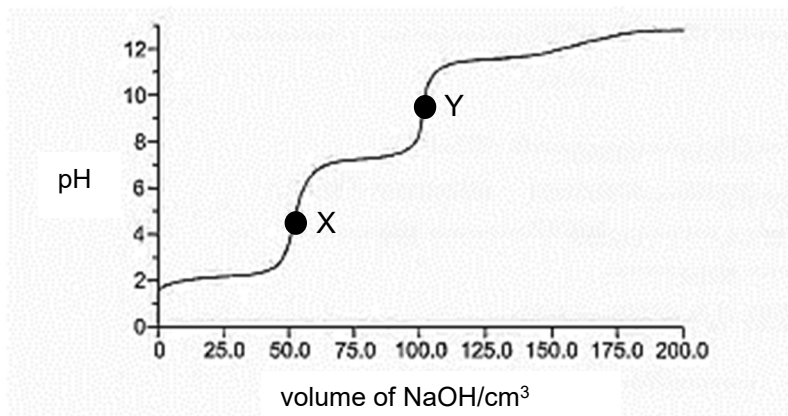
- 20** M, N and O are in the same period of the Periodic Table.

- The oxide of M reacts with water to form a solution with a pH less than 7.
- The oxide of N reacts with water to form a solution that turns damp red litmus paper blue.
- The oxide of O is soluble in both hydrochloric acid and aqueous sodium hydroxide.

What is the order of increasing proton number for elements M, N and O?

- A** M, N, O
- B** M, O, N
- C** N, O, M
- D** O, N, M

- 21 The graph is obtained for the titration of 50.0 cm^3 of 0.10 mol/dm^3 phosphoric acid, H_3PO_4 , against 0.10 mol/dm^3 sodium hydroxide, NaOH , is shown.



The table shows the pH range of colour changes of some acid-base indicators.

indicator	pH range of colour changes
thymol blue	1.2 – 2.8 and 8.0 – 9.6
naphthyl red	3.7 – 5.0
neutral red	6.8 – 8.0

Which indicators should be used to show the end-points at X and Y respectively?

	X	Y
A	thymol blue	thymol blue
B	naphthyl red	thymol blue
C	thymol blue	neutral red
D	naphthyl red	neutral red

- 22** The carbonates of metals X and Y are heated in air.
The carbonate of metal X changed colour from green to black when heated and carbon dioxide is given off.
The carbonate of metal Y did not decompose.

Which statements are correct?

- 1 Metal X is more reactive than metal Y.
- 2 Both metal carbonates would react with dilute nitric acid to form carbon dioxide.
- 3 Metal X could be a transition element.

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

- 23** A large volume of copper(II) sulfate solution is left in an iron container overnight.

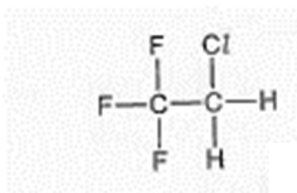
Which statement describes what happens?

- A** Atmospheric oxygen reacts with copper(II) sulfate to give copper(II) oxide.
- B** Some fine iron particles are formed in the solution.
- C** The part of the container in contact with the solution is coated with copper.
- D** The solution evaporates completely and some copper(II) sulfate crystals are left behind.

- 24** Which statement about the metals iron, lead and copper is correct?

- A** They react with warm, dilute hydrochloric acid with the evolution of hydrogen.
- B** Their sulfates are soluble in water.
- C** All their compounds are coloured.
- D** Their oxides can be reduced to the metal by heating with carbon.

- 25** In the past, CFC compounds were used as aerosol propellants. The structure of one CFC compound is shown.



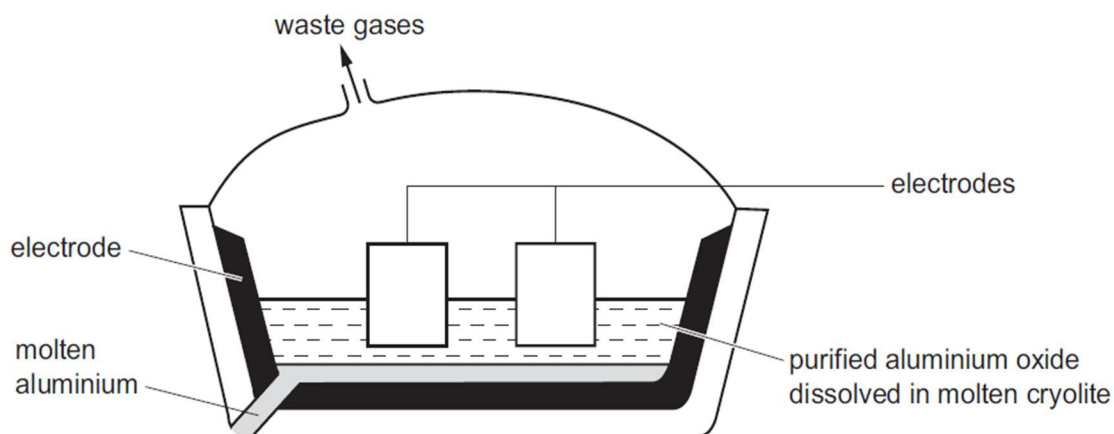
Which element in this compound can cause a depletion of ozone?

- A** carbon
B chlorine
C fluorine
D hydrogen
- 26** The following are statements about air pollutants.
- 1 Carbon monoxide is responsible for the formation of acid rain.
 - 2 Oxides of nitrogen can be produced during volcanic eruptions.
 - 3 Sulfur dioxide can be produced by combustion of fossil fuels.
 - 4 Methane contributes to global warming.

Which of the statements are correct?

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

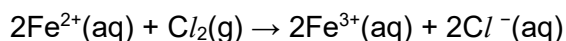
- 27 Aluminium is obtained from the electrolysis of molten aluminium oxide.



Which row shows the electrode at which aluminium is formed and the correct equation for its formation?

	electrode	equation
A	anode	$Al^{3+} + 3e^{-} \rightarrow Al$
B	anode	$Al^{3+} - 3e^{-} \rightarrow Al$
C	cathode	$Al^{3+} + 3e^{-} \rightarrow Al$
D	cathode	$Al^{3+} - 3e^{-} \rightarrow Al$

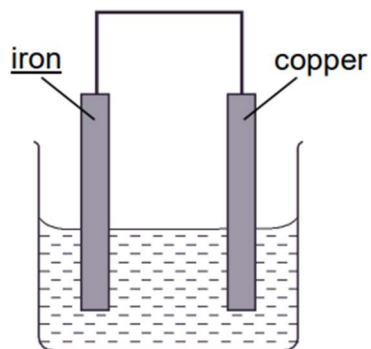
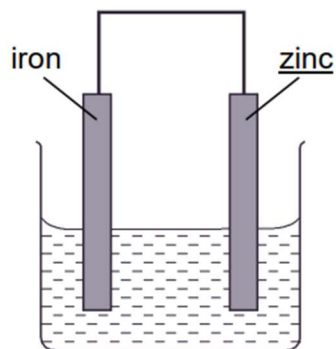
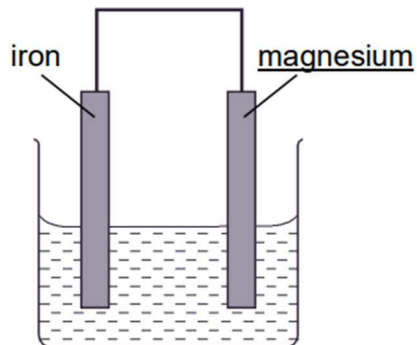
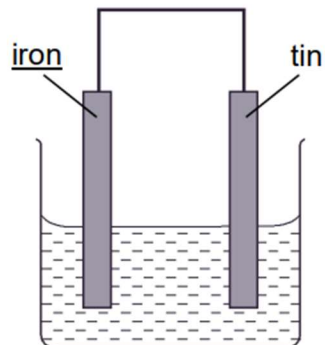
- 28 Iron(II) ions react with chlorine.



Which statement about this reaction is correct?

- A** Chlorine is reduced by iron(II) ions.
- B** Chlorine is the reducing agent.
- C** Iron(II) ions are reduced by chlorine.
- D** Iron(II) ions are the oxidising agent.

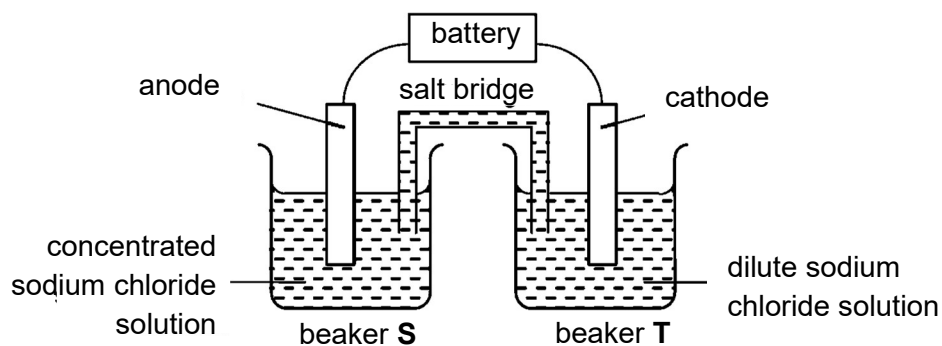
- 29 A student sets up the four cells using aqueous sodium chloride as the electrolyte to determine the order of reactivity of the metals. In each cell, the electrode that dissolved is underlined.



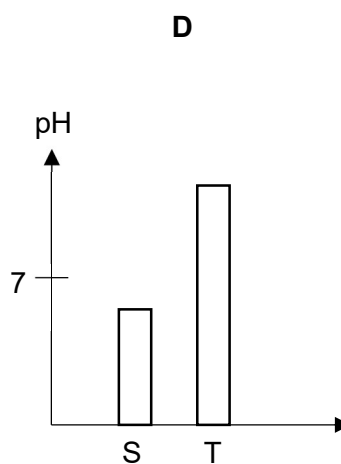
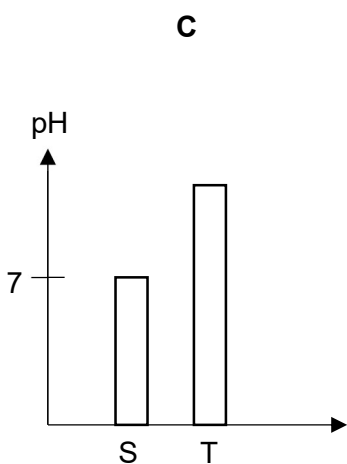
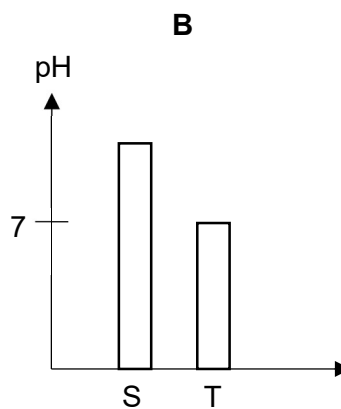
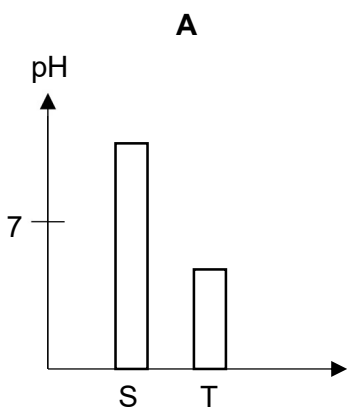
Which two other cells are needed in addition to the four cells above?

	electrodes in the first cell	electrodes in the second cell
A	copper / tin	magnesium / zinc
B	iron / iron	iron / zinc
C	magnesium / tin	copper / zinc
D	tin / zinc	magnesium / copper

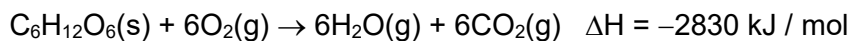
30 The following apparatus was set up as shown.



If graphite electrodes are used, which of the following diagrams show the pH of the solution in each beaker at the end of the experiment?



- 31** An equation for respiration is shown.



What can be deduced from the equation?

- A** ΔH for photosynthesis is +2830 kJ / mol.
 - B** Energy from sunlight is needed for this reaction.
 - C** The energy level of the reactants is lower than the energy level of the products.
 - D** More energy is absorbed to break the bonds in glucose and oxygen than energy released to form bonds in water and carbon dioxide.
- 32** Sulfur dioxide reacts with oxygen in the air.

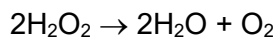


The reaction is very slow if no catalyst is present.

Which statement explains this?

- A** Air contains only 21% oxygen so there is not enough oxygen for all the sulfur dioxide to react.
- B** Only a small proportion of the sulfur dioxide and oxygen molecules have enough energy to react, even at high temperatures.
- C** The reaction is exothermic and so at high temperatures, more heat is released producing only a small proportion of sulfur trioxide.
- D** The reaction is reversible and so products turn back to reactants; this happens more quickly at high temperatures.

- 33 Hydrogen peroxide slowly decomposes at room temperature.

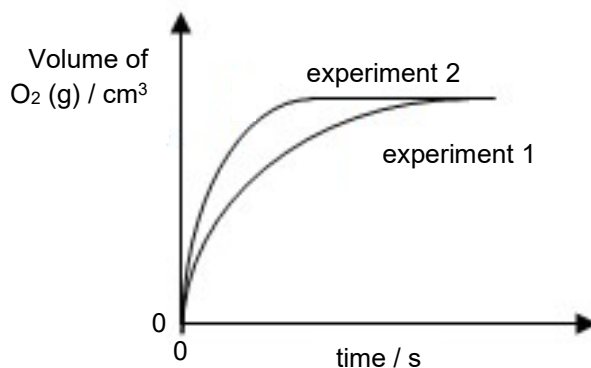


Two experiments were performed to study the effects of adding lead(IV) oxide on the decomposition of 1.5 mol / dm^3 hydrogen peroxide at constant temperature.

Experiment 1: 20 cm^3 of hydrogen peroxide

Experiment 2: 20 cm^3 of hydrogen peroxide and 1.0 g of lead(IV) oxide

At the end of experiment 2, the mixture was filtered, and 1.0 g of lead(IV) oxide was recovered.



Which row is correct?

	frequency of effective collisions	activation energy
A	higher in experiment 1	higher in experiment 1
B	higher in experiment 2	higher in experiment 2
C	higher in experiment 2	higher in experiment 1
D	higher in experiment 1	higher in experiment 2

- 34** To preserve the world's fossil fuel resources, scientists and engineers work to develop alternative fuels. The table listed some common fossil fuel alternatives, and their heat of combustion, ΔH .

type of fuel	$\Delta H / \text{kJmol}^{-1}$
ethanol	– 1370
hydrogen	– 286
methanol	– 882
propanol	– 2010

Which of the above fuel will produce the highest amount of energy when 1 g of the fuel is completely burned?

- A** ethanol
B hydrogen
C methanol
D propanol
- 35** Octane number is a measure of the tendency of a fuel to auto-ignite. The table shows the octane number of several hydrocarbons.

number of carbon atoms	octane number	
	alkane	alkene
4	94	98
5	62	93
6	25	85
7	0	75

Statement 1: The shorter the carbon chain, the better the hydrocarbon burns.

Statement 2: The octane number of an alkane is lower than that of an alkene with the same number of carbon atoms.

Based on the data above, which of the following is correct?

- A** Both statements are correct and statement 2 explains statement 1.
B Both statements are correct but statement 2 does not explain statement 1.
C Statement 1 is correct but statement 2 is incorrect.
D Statement 2 is correct but statement 1 is incorrect.

36 The structural formulae of four hydrocarbons are shown.

P	Q	R	S
<pre> H H H - C - H H - C - H H H </pre>	<pre> H H H - C - H H - C - H H H </pre>	<pre> H H H H H H - C - C - C - C - C - H H H H H H </pre>	<pre> H H-C-H H H H - C - C - C - H H H H H-C-H H </pre>

Which of the following are isomers?

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

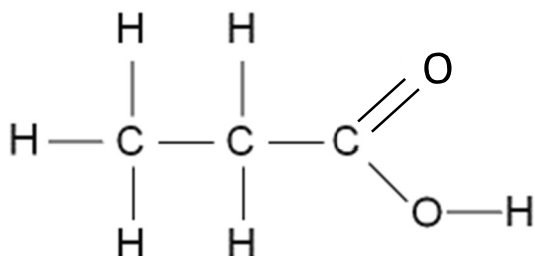
37 Some information about a hydrocarbon is given.

- Its relative molecular mass is 82.
- It decolourises aqueous bromine rapidly under room conditions.
- 0.10 g of the hydrocarbon absorbs 58.6 cm^3 (at r.t.p.) of hydrogen.

How many **double** bonds are there in one molecule of the hydrocarbon?

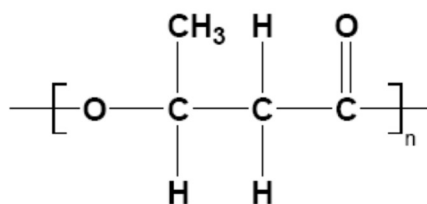
- A** 1
B 2
C 3
D 4

- 38 The full structural formula of an organic compound is as shown.

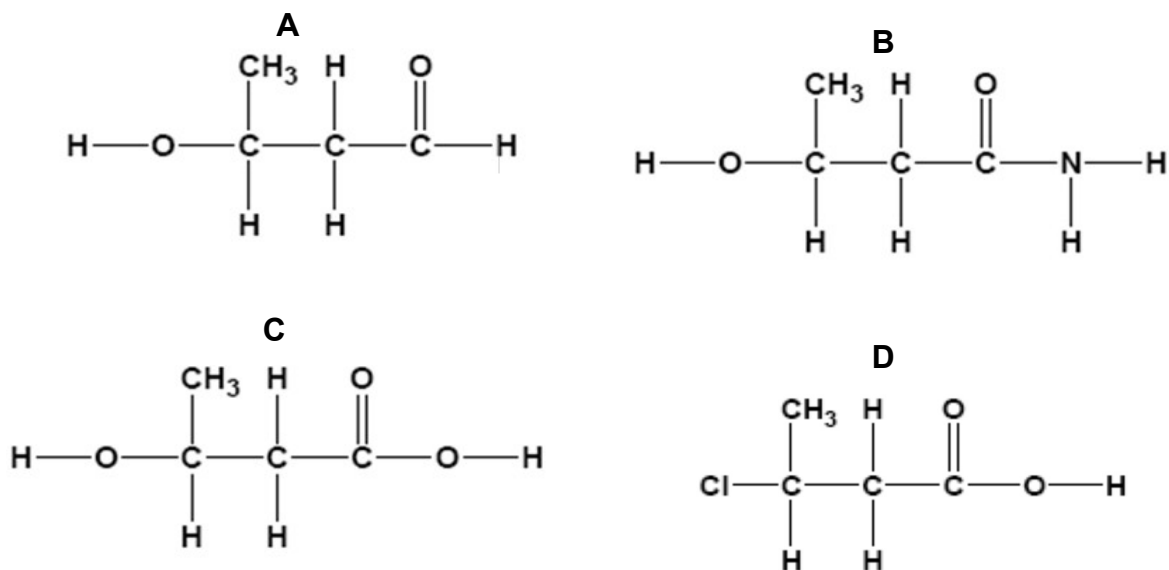


Which statement about the compound shown is correct?

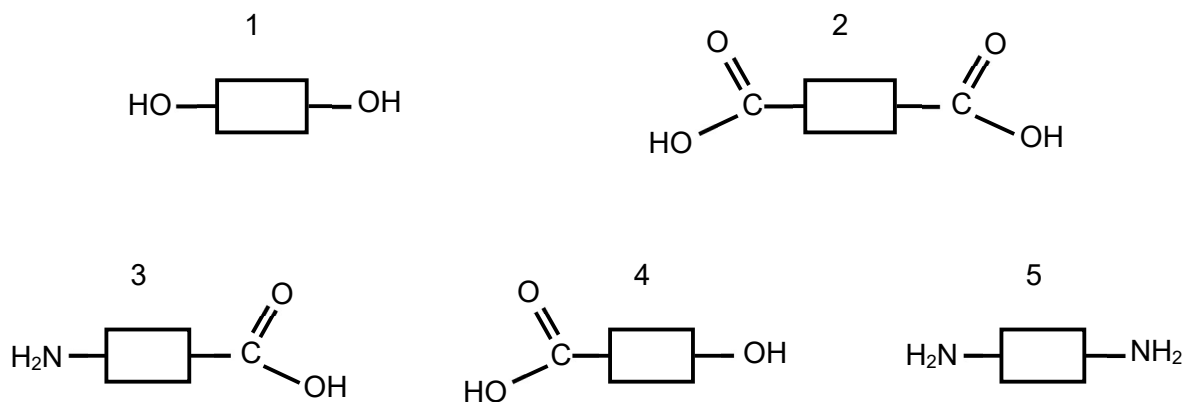
- A** It does not react with ammonia.
B It does not react with sodium carbonate.
C It is ethanoic acid.
D It is formed by the oxidation of propanol.
- 39 Polyhydroxyalkanoates are biodegradable plastics.
 The structure of one type of these plastics is shown.



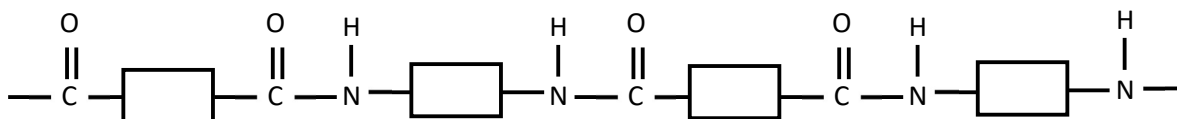
Which of the following molecules could be its monomer?



40 The structures of five monomers are shown.



Which pair of monomers will form a polymer with the following structure?



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

End of Paper

The Periodic Table of Elements

Group																									
1	2											13	14	15	16	17	18								
Key proton (atomic) number atomic symbol name relative atomic mass							1 H hydrogen 1															2 He helium 4			
								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	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
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 –	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 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –								

lanthanoids	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 europium 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
actinoids	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 24dm³ at room temperature and pressure (r.t.p).
The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$.