



TEMASEK SECONDARY SCHOOL
Preliminary Examination 2024
Secondary 4 Express

CHEMISTRY

6092/01

Paper 1 Multiple Choice

1 hour

Additional Material: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the Multiple Choice Answer Sheet.

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.

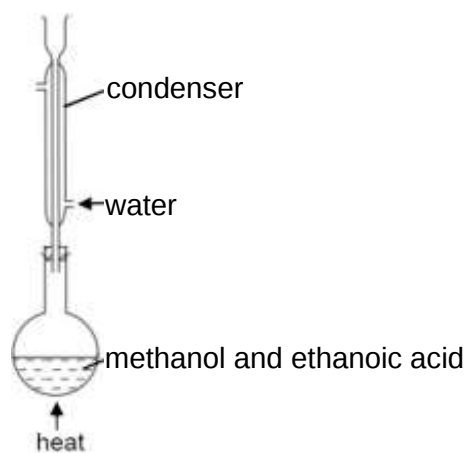
Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 17.

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

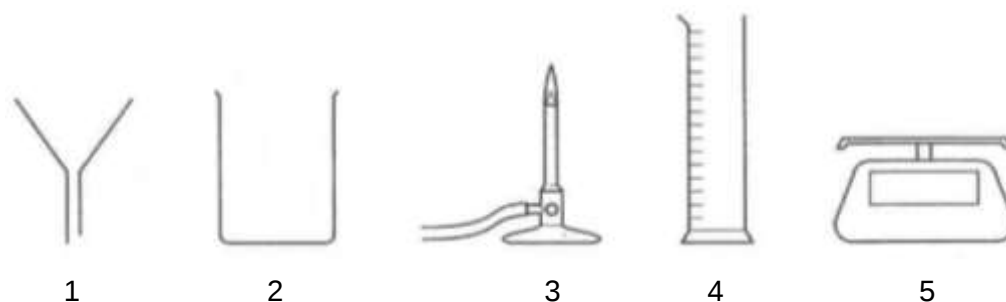
This document consists of **17** printed pages and **1** blank page.

- 1** Methanol and ethanoic acid can react to give methyl ethanoate using the set-up below.



What is the purpose of the condenser in this set-up?

- A** To prevent the methanol from reacting with the oxygen in the air.
- B** To prevent the methanol and ethanoic acid from escaping from the reaction mixture.
- C** To separate methyl ethanoate from the methanol and ethanoic acid.
- D** To lower the temperature to prevent decomposition of methyl ethanoate.
- 2** Calcium sulfate can be made by adding 20 cm³ of aqueous calcium nitrate to dilute sulfuric acid.



Which pieces of apparatus are needed to obtain calcium sulfate from aqueous calcium nitrate and dilute sulfuric acid?

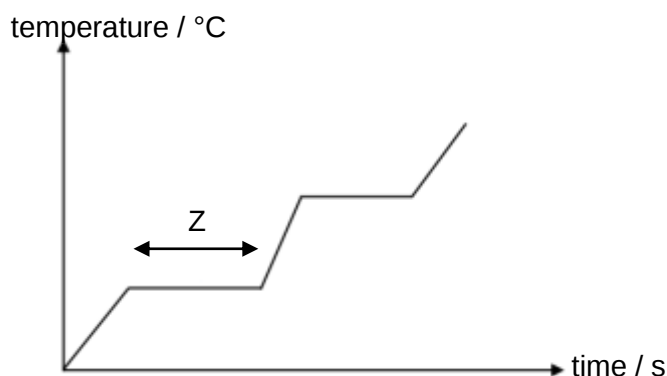
- A** 1, 2 and 4 **B** 1, 2 and 5
C 2, 3 and 4 **D** 2, 4 and 5

- 3 Four statements about a mixture containing X, Y and Z are given.

1	X and Y are miscible liquids.
2	Z is soluble in X but not in Y.
3	Y has a lower boiling point than X or Z.
4	Z will decompose upon heating.

Which row correctly lists the steps required to separate all three substances?

- A fractional distillation → crystallisation
 B fractional distillation → evaporation to dryness
 C simple distillation → crystallisation
 D simple distillation → evaporation to dryness
- 4 The graph below shows a heating curve as a substance change from the solid to the gaseous state.

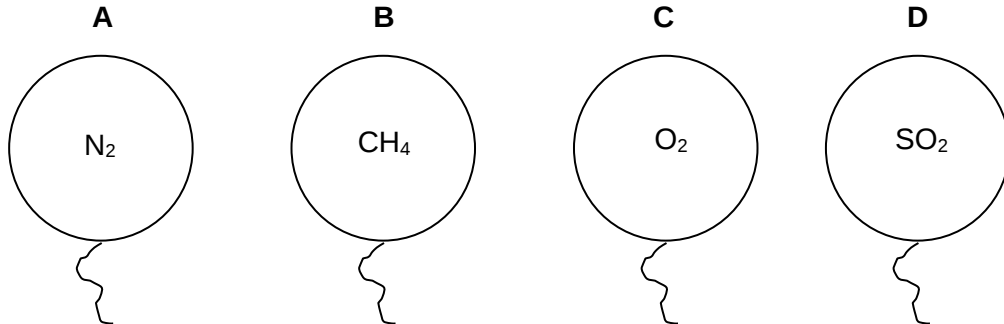


What is/are the state(s) of the substance in region Z of the graph?

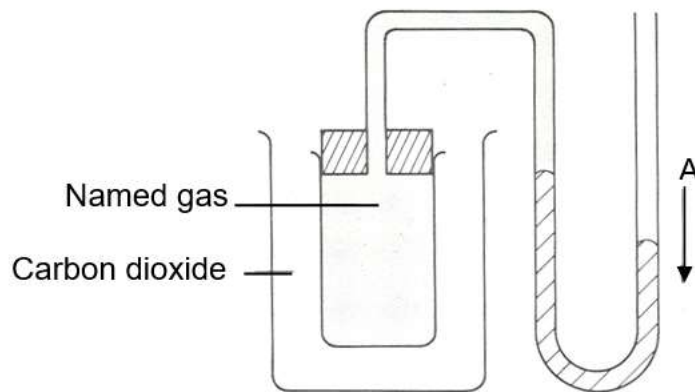
- A solid only
 B gaseous only
 C solid and liquid
 D gaseous and liquid
- 5 What happens to the molecules when steam condenses to form water?
- A The molecules gain energy and move faster.
 B The molecules lose energy and become smaller.
 C The molecules lose energy and move closer together.
 D The molecules gain energy and break up to form atoms.

- 6 Four balloons are filled with equal volume of different gases at the same temperature and pressure.

Which balloon will shrink the fastest?



- 7 The following set-up shows a manometer.



Which of the following gas(es) will cause the liquid level in column **A** to fall?

- 1 ethane
- 2 sulfur dioxide
- 3 carbon monoxide

- A** 2 only
B 1 and 2 only
C 1 and 3 only
D All the above

- 8 Lithium has a relative atomic mass of 7. It has two stable isotopes with relative masses of 6 and 7 respectively.

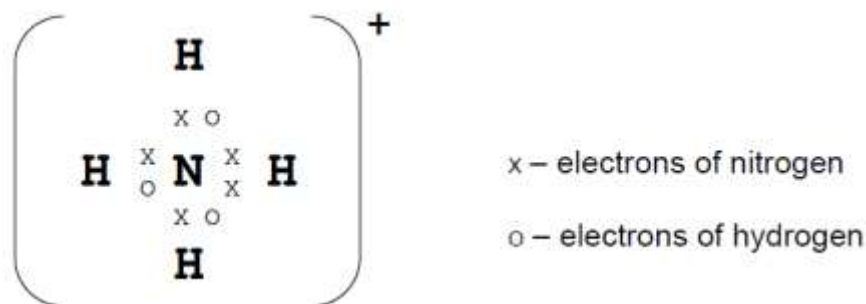
What can be concluded from these information?

- A Lithium-6 is radioactive and will decay into lithium-7.
 B Lithium-6 has different chemical properties compared to lithium-7.
 C Lithium-6 has a different number of protons compared to lithium-7.
 D Lithium-6 is found naturally in very small proportions as compared to lithium-7.
- 9 An ion X^{3-} has m nucleons and n electrons.

What does the nucleus of an atom of X contain?

	number of protons	number of neutrons
A	n	$m - n$
B	$n + 3$	$m - (n + 3)$
C	$n - 3$	$m - (n - 3)$
D	$n - 3$	$m - n$

- 10 Ammonium ion is found in ammonium chloride.
 The diagram shows the bonding in an ammonium ion. (Note that only valence electrons are shown.)



Which statement about ammonium chloride is **not** correct?

- A Five electrons in the nitrogen atom are involved in bonding.
 B The ammonium ion forms covalent bonds with the chloride ion.
 C Both covalent and ionic bonds are found in ammonium chloride.
 D One of the hydrogen atom loses an electron to a chlorine atom.

15 Which substance will dissolve in water to produce H^+ ions?

- A** aluminium oxide **B** calcium oxide
C carbon monoxide **D** nitrogen dioxide

16 X is a Group 1 element while Y is a transition element.

Which of the following states the correct similarity and difference in their properties?

	similarity	difference
A	X and Y have high melting points.	Y is harder than X.
B	X and Y have high melting points.	Y has higher density than X.
C	X and Y form coloured compounds.	X does not conduct electricity while Y conducts electricity.
D	X and Y are good conductors of electricity.	X is soluble in water while Y is insoluble in water.

17 Many properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

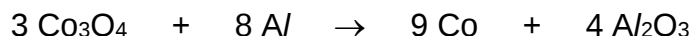
What property can **not** be predicted in this way?

- A** the nature of its oxide
B the formula of its oxide
C the number of isotopes
D its metallic or non-metallic properties

18 Which statement about astatine and its compounds is **not** correct?

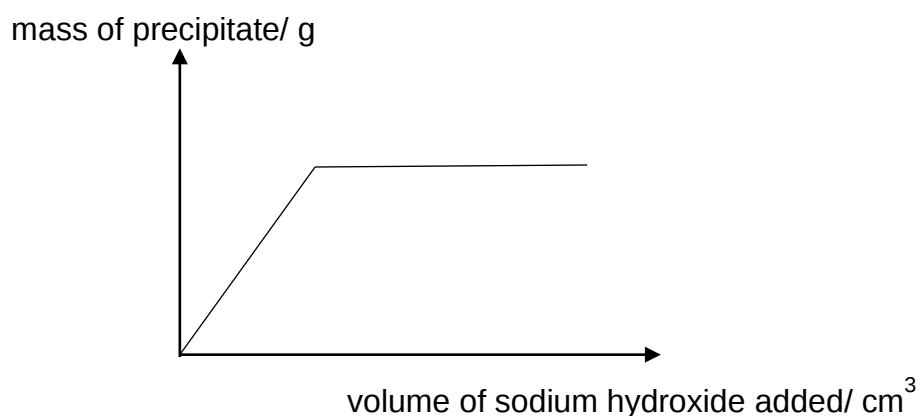
- A** Solid astatine is yellow brown.
- B** Silver astatide is insoluble in water.
- C** Hydrogen astatide is a covalent molecule.
- D** Bromine displaces astatine from a solution of potassium astatide.

- 19 Cobalt metal is extracted by the reaction shown below.



Which of the following is true about cobalt?

- A It is more reactive than aluminium.
 - B It reacts explosively with cold water.
 - C It loses its electrons more readily than aluminium.
 - D It can be formed when magnesium powder is placed in aqueous cobalt(II) nitrate.
- 20 An aqueous salt solution was placed in a beaker and aqueous sodium hydroxide was gradually added from the burette in an experiment. The mass of the precipitate was obtained when various volumes of aqueous sodium hydroxide was added, and the graph was obtained as shown.



Which of the following is likely to be the aqueous solution?

- | | |
|----------------------|----------------------|
| A aluminium chloride | B zinc nitrate |
| C ammonium sulfate | D copper(II) sulfate |

- 21 A salt has the chemical formula $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$.

Excess aqueous sodium hydroxide was added slowly, with shaking, to a hot solution of the salt in a boiling tube until there is no further reaction. The boiling tube was then left to stand for some time.

Which of the following observations would **not** be made?

- A A green precipitate was produced.
 - B On standing, the precipitate turned brown.
 - C The precipitate dissolved in excess sodium hydroxide.
 - D A pungent gas which turned damp red litmus blue was produced.
- 22 Iron(III) chloride reacts with hydrogen sulfide according to the following equation.



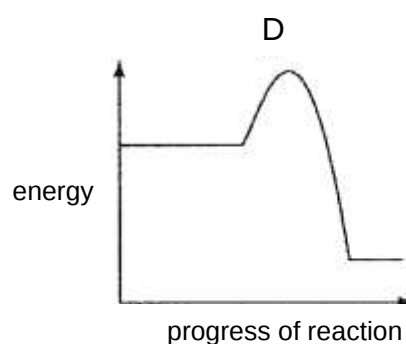
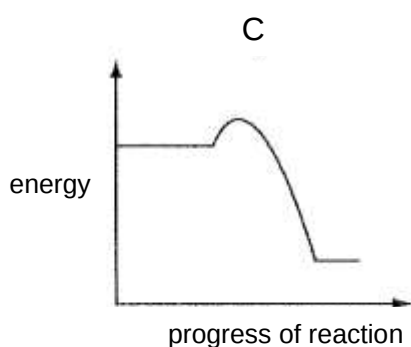
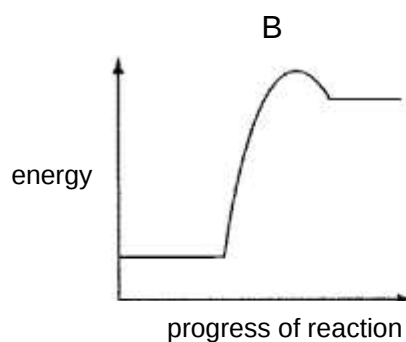
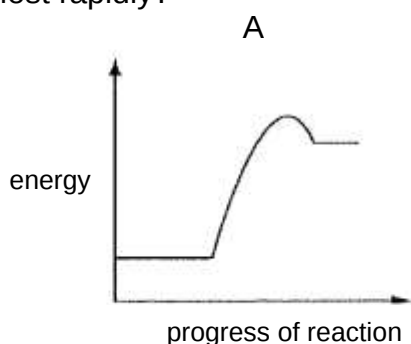
Which statement about this reaction is **not** correct?

- A Iron(III) ions gain electrons.
 - B The oxidation state of sulfur decreases.
 - C Iron(III) chloride is acting as an oxidising agent.
 - D The solution changes from yellowish brown to pale green.
- 23 Which process does **not** involve either oxidation or reduction?
- A formation of ammonium sulfate from ammonia and sulfuric acid
 - B formation of sulfuric acid from sulfur
 - C formation of nitrogen monoxide from ammonia
 - D formation of zinc from zinc sulfide

- 24 What are the effects of particle size of reactants on the activation energy and enthalpy change of a reaction?

	activation energy	enthalpy change
A	no change	no change
B	no change	decreases
C	decreases	no change
D	decreases	decreases

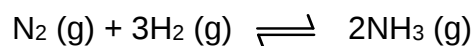
- 25 Which is the correct energy profile diagram for the reaction that would proceed most rapidly?



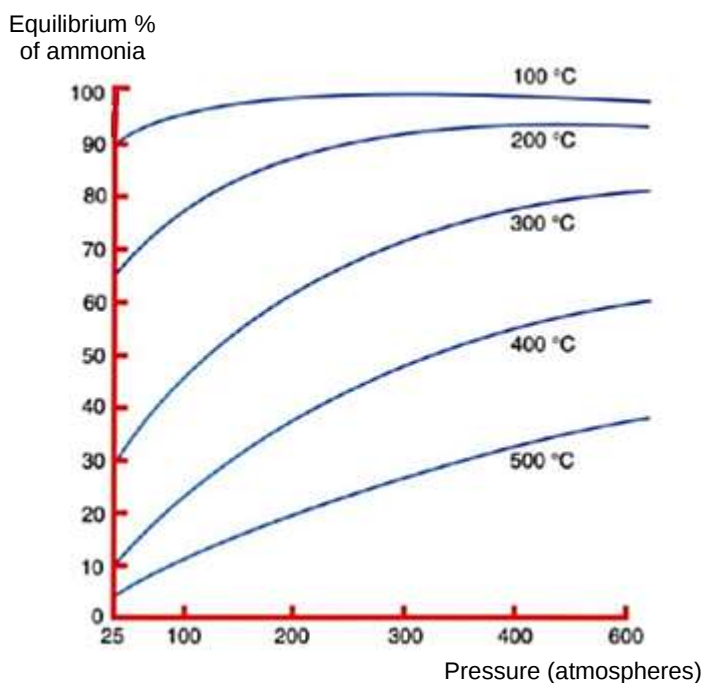
- 26 In which reaction is pressure **least** likely to affect the rate of reaction?

- A $2\text{CO (g)} + \text{O}_2 \text{ (g)} \rightarrow 2\text{CO}_2 \text{ (g)}$
 B $\text{C}_2\text{H}_4 \text{ (g)} + \text{Br}_2 \text{ (aq)} \rightarrow \text{C}_2\text{H}_4\text{Br}_2 \text{ (g)}$
 C $\text{NaOH (aq)} + \text{HCl (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O (l)}$
 D $\text{CO}_2 \text{ (g)} + \text{Ca(OH)}_2 \text{ (aq)} \rightarrow \text{CaCO}_3 \text{ (s)} + \text{H}_2\text{O (l)}$

- 27 Ammonia is produced from Haber Process using a suitable catalyst.



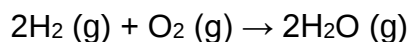
The following graph shows the different yields of ammonia at different temperature and pressure.



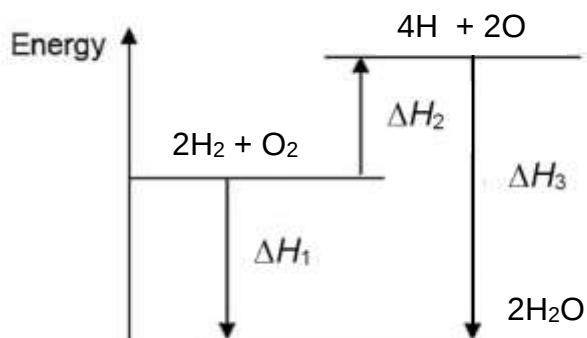
Which of the following is **not** true?

- A A higher percentage yield of ammonia can be obtained at higher pressure.
- B A higher percentage yield of ammonia can be obtained at lower temperature.
- C Some of the ammonia formed will decompose to form hydrogen and nitrogen.
- D At the right conditions of temperature and pressure, all the hydrogen and nitrogen can be converted into ammonia.

- 28 Hydrogen and oxygen react to form steam, as shown in the equation below.



The energy level diagram below represents this reaction.

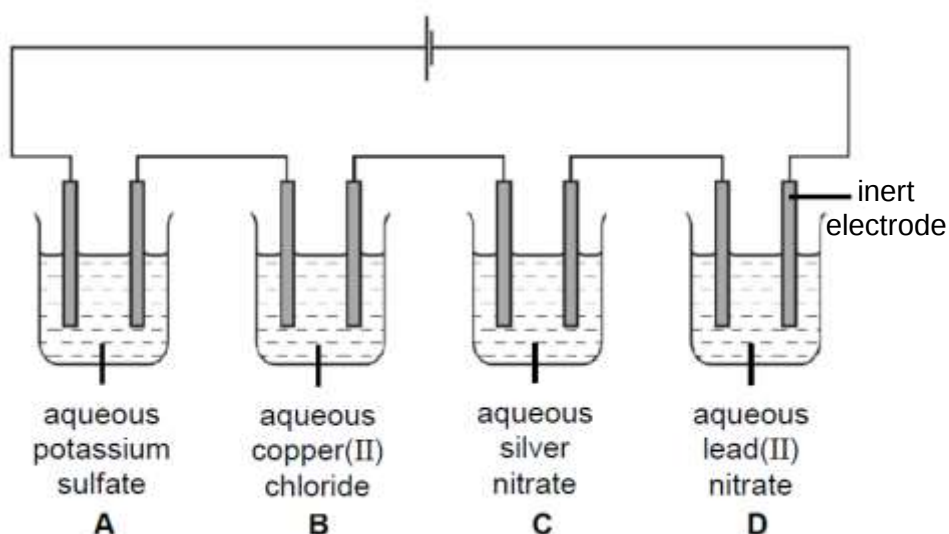


Which symbols represent the energy involved in bond breaking and formation?

	energy involved in bond breaking only / kJ	energy involved in bond formation only / kJ
A	ΔH_1	ΔH_2
B	ΔH_1	ΔH_3
C	ΔH_2	ΔH_1
D	ΔH_2	ΔH_3

- 29 When electrolysed using inert electrodes, which dilute salt solution would produce the greatest increase in mass of the cathode?

[Ar: K, 39; Cu, 64; Ag, 108; Pb, 207]



- 30** The same number of moles of a molten chloride of a Group 1 metal, XCl , and a molten chloride of a Group 2 metal, YCl_2 , are separately electrolysed using the same current for the same period of time.

Which statement is true?

- A** An equal number of moles of X and Cl_2 are formed.
 - B** An equal number of moles of Y and Cl_2 are formed.
 - C** An equal number of moles of X and Y are deposited.
 - D** Cl_2 is produced at the cathode for electrolysis with XCl .
- 31** Which pollutant can cause limestone buildings to corrode?
- A** carbon
 - B** carbon monoxide
 - C** nitrogen dioxide
 - D** unburnt hydrocarbons
- 32** A catalytic converter in a car exhaust system changes pollutants into less harmless products.

Which change does **not** occur in a catalytic converter?

- A** carbon dioxide $\rightarrow$ carbon
 - B** carbon monoxide $\rightarrow$ carbon dioxide
 - C** nitrogen oxides $\rightarrow$ nitrogen
 - D** unburned hydrocarbons $\rightarrow$ carbon dioxide and water
- 33** Which statements about ozone are correct?

1	Ozone is produced when oxygen molecules react with oxygen atoms.
2	Ozone is a pollutant in the upper layer of the atmosphere.
3	Ozone irritates the eyes and lungs.
4	Compounds such as $CFCI_3$ destroy the ozone layer.

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

- 34** Biodiesel, an alternative fuel made from vegetable oil, can be used as a fuel for vehicles. Although carbon dioxide is released during the combustion of biodiesel, scientists still claim that it is a carbon neutral fuel.

Which is the basis for this claim?

- A** Biodiesel is not a carbon compound.
- B** Plants release carbon dioxide during respiration.
- C** Biodiesel produces less carbon dioxide when it burns.
- D** Plants absorb carbon dioxide during photosynthesis.

- 35** Which row correctly compares the properties between petrol and diesel oil?

	boiling point of petrol	flammability of petrol
A	higher than diesel	lower than diesel
B	lower than diesel	lower than diesel
C	lower than diesel	higher than diesel
D	higher than diesel	higher than diesel

- 36** One mole of a hydrocarbon X reacted completely with 1 mole of hydrogen gas in the presence of a heated catalyst.

What could be the formula of X?

- A** C_2H_6
- B** C_3H_8
- C** C_5H_{10}
- D** C_7H_{16}

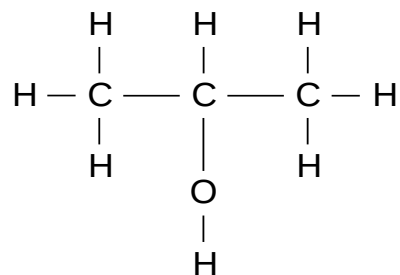
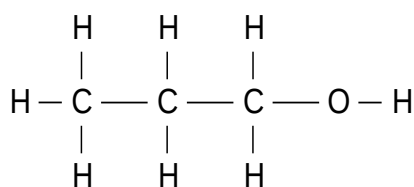
- 37** Two esters have the same molecular formula, $C_3H_6O_2$.

What are the names of these two esters?

- 1 methyl ethanoate
- 2 ethyl methanoate
- 3 ethyl propanoate
- 4 propyl methanoate

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

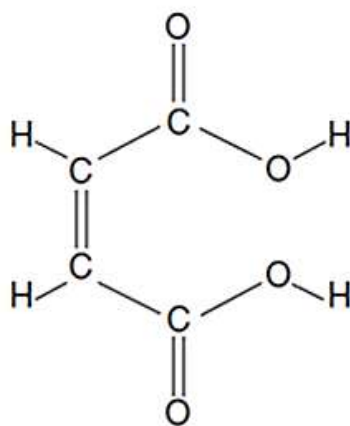
38 The displayed formulae of two compounds are shown.



What are the similarity and difference between the two compounds?

	similarity	difference
A	molecular formula	physical properties
B	molecular formula	relative molecular masses
C	structure	chemical properties
D	structure	boiling point

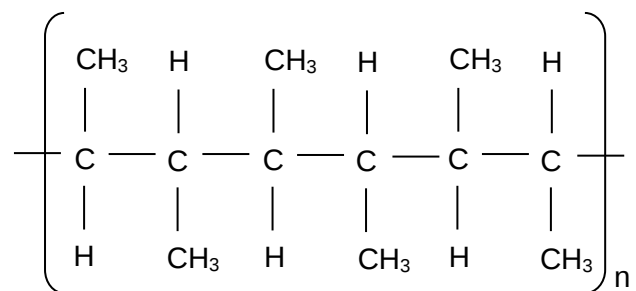
39 Butenedioic acid has the structure shown below.



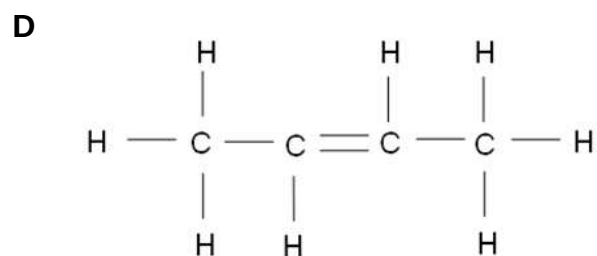
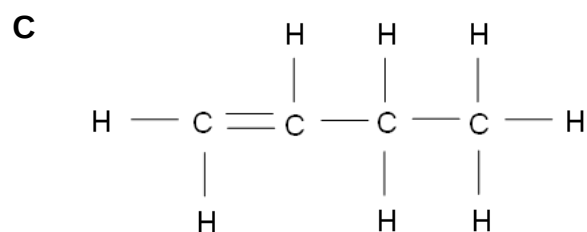
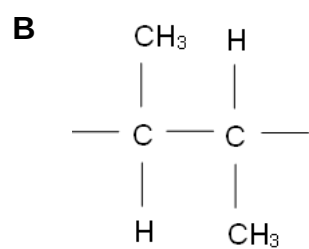
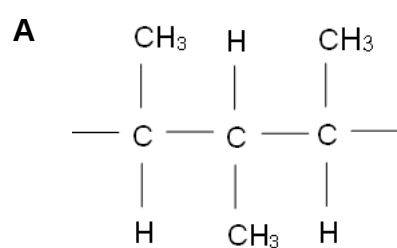
Which statement about butenedioic acid is **not** correct?

- A** It decolourises bromine.
- B** It is an unsaturated compound.
- C** Its relative molecular mass is 116.
- D** Its empirical formula is the same as its molecular formula.

40 The structural formula of a polymer used to make plastic is shown below.



Which structure shows the monomer from which this polymer is made?



END OF PAPER

17 The Periodic Table of Elements

The Periodic Table of Elements																		
Group												13	14	15	16	17	18	
1	2																	2 He helium 4
							1 H hydrogen 1											
3 Li lithium 7	4 Be beryllium 9	Key proton (atomic) number atomic symbol name relative atomic mass										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 oganeson —	

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

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