Cambridge Assessment International Education

Cambridge O Level

CHEMISTRY **5070/12**

Paper 1 Multiple Choice **October/November 2021**

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.

This document has **20** pages. Any blank pages are indicated.

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1 In a titration, 25.0 cm^3 of aqueous sodium hydroxide is transferred into a conical flask. A few drops of indicator are added. Dilute hydrochloric acid is then added to the flask until the end-point is reached.

Which pieces of apparatus are used to measure volume in this experiment?

	to measure dilute hydrochloric acid	to measure aqueous sodium hydroxide
A	burette	beaker
B	burette	pipette
C	pipette	pipette
D	pipette	beaker

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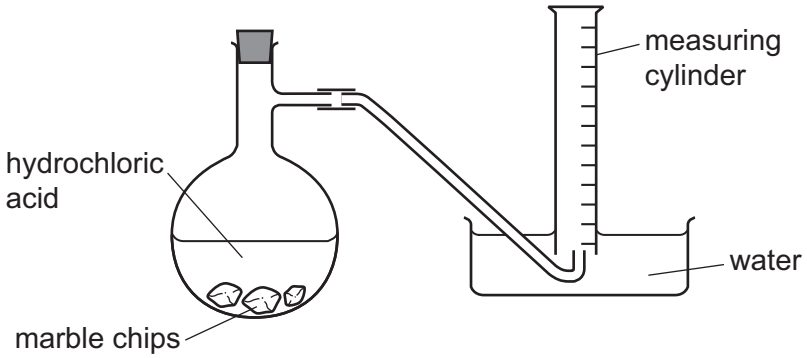
2 A student follows the rate of the reaction between marble chips, $CaCO_3$, and dilute hydrochloric acid.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

Which diagrams show apparatus that, with a stopwatch, is suitable for this experiment?

1



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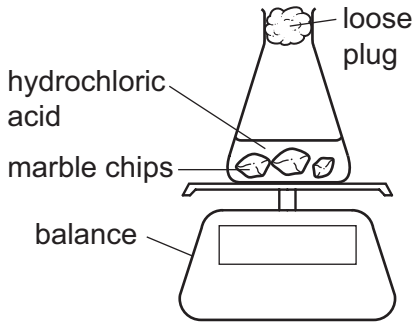

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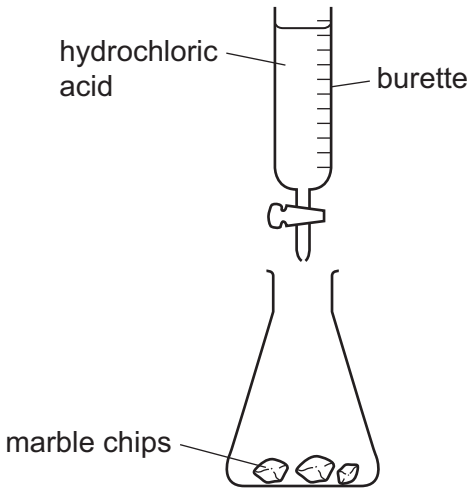

A 1 only **B** 1 and 2 only **C** 2 and 3 only **D** 1, 2 and 3

3 Pure oxygen is needed by many industries.

How is pure oxygen obtained in large amounts for such uses?

A by decomposition of calcium carbonate

B by decomposition of hydrogen peroxide

C by filtration of liquid air

D by fractional distillation of liquid air

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4 An impure sample of compound X has a melting point of 120 °C.

X is purified and its melting point is measured again.

Which row is correct?

	method of purifying X	melting point of pure X / °C
A	crystallisation	115
B	distillation	115
C	crystallisation	125
D	distillation	125

5 When aqueous sodium hydroxide is added to aqueous compound X, a red-brown precipitate is formed. When dilute nitric acid followed by aqueous barium nitrate is added to aqueous compound X, a white precipitate is formed.

What is X?

A chromium(III) sulfate

B chromium(III) chloride

C iron(III) chloride

D iron(III) sulfate

6 An aqueous solution of zinc chloride is tested by adding reagents.

Which observation is correct?

	reagent added to zinc chloride (aq)	observations
A	acidified aqueous barium nitrate	forms a white precipitate
B	aqueous ammonia	forms a white precipitate, soluble in excess of the reagent
C	aqueous sodium hydroxide	forms a white precipitate, insoluble in excess of the reagent
D	powdered copper	forms a grey precipitate

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7 A sample of gas is released at a particular point in a laboratory.

A detecting device is placed ten metres from the point where the gas is released. This device detects and records the time when the concentration of the gas is ten molecules in every million molecules of air.

The experiment is carried out with two gases at different temperatures.

In which experiment was the time recorded by the detector **greatest**?

	gas	temperature of laboratory / °C
A	SF_6	20
B	SF_6	40
C	CO_2	20
D	CO_2	40

8 The table shows data for some particles.

particle	proton number	nucleon number	number of protons	number of neutrons	number of electrons
sodium ion	11	23	11	W	10
fluoride ion	9	19	9	10	X
magnesium ion	12	24	Y	12	10

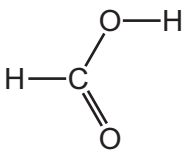
What are the values of W, X and Y?

	W	X	Y
A	10	10	12
B	11	12	10
C	12	10	12
D	12	10	10

9 A covalent compound P has the empirical formula CH_2O.

Which structure represents P?

A



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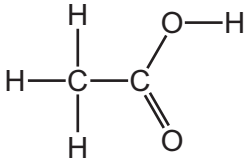

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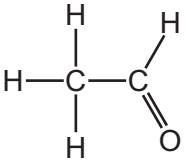

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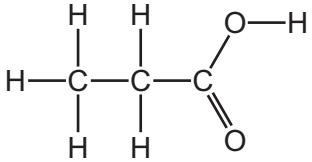

10 Which statement about the structure or bonding of metals is correct?

A A metal lattice consists of negative ions in a 'sea of electrons'.

B Electrons in a metal move randomly through the lattice.

C Metals are malleable because the ions present are mobile.

D The ions in a metal move when positive and negative electrodes are attached.

11 The relative atomic mass of chlorine is 35.5.

What is the mass of 2.0 mol of chlorine gas?

A 17.75 g **B** 35.5 g **C** 71 g **D** 142 g

12 When gases react, the volume of gaseous reactants may be different from the volume of gaseous products.

For which reaction is the percentage change in the volume of gas largest? (Assume each reaction goes to completion.)

A $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

C $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

D $2C_2H_6(g) + 7O_2(g) \rightarrow 6H_2O(g) + 4CO_2(g)$

13 Sodium carbonate reacts with dilute hydrochloric acid.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$

A sample containing 0.0800 mol of sodium carbonate is added to a solution containing 0.100 mol of hydrochloric acid.

Which volume of carbon dioxide is produced, measured at room temperature and pressure?

A 0.96 dm^3 **B** 1.20 dm^3 **C** 1.92 dm^3 **D** 2.40 dm^3

14 Which statement about the electrolysis of solutions is correct?

A During the electrolysis of concentrated aqueous sodium chloride solution, hydrogen is produced at the cathode.

B During the electrolysis of dilute sulfuric acid, oxygen is produced at the cathode.

C When aqueous copper(II) sulfate is electrolysed, the reaction taking place at the cathode is

$$Cu^+(aq) + e^- \rightarrow Cu(s).$$

D When aqueous copper(II) sulfate is electrolysed using copper electrodes, the mass of the anode at the end of the reaction will be greater than at the beginning.

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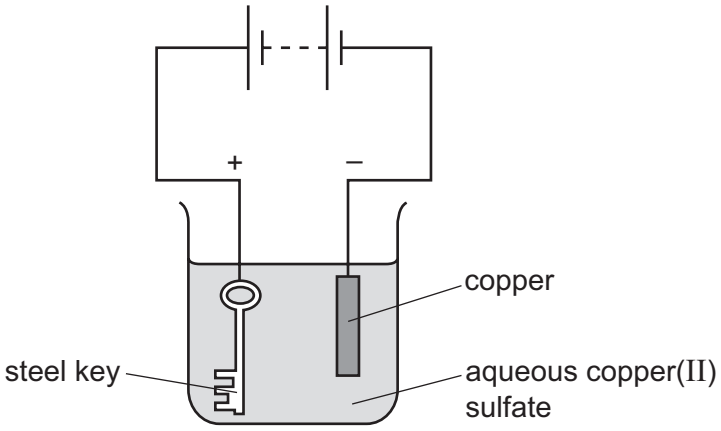
15 The apparatus shown is set up to plate a steel key with copper.



The key does not get coated with copper.

Which change needs to be made to plate the key?

A Increase the concentration of the aqueous copper(II) sulfate.

B Increase the voltage.

C Replace the solution with dilute sulfuric acid.

D Reverse the electrical connections.

16 The equation shows the reaction of glucose with oxygen.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

Which statement about this reaction is correct?

A It can occur in the dark.

B It is endothermic.

C It needs chlorophyll as a catalyst.

D It occurs in plants but not in animals.

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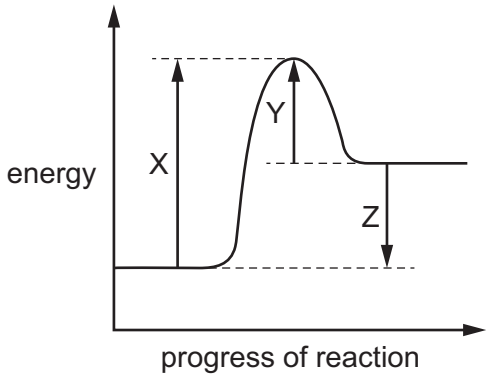
17 The energy profile diagram of a chemical reaction is shown.



Which statement is correct?

A The reaction is exothermic.

B X represents the activation energy for the reaction.

C Y represents ΔH for the reaction.

D Z represents the energy given out as the reaction proceeds.

18 The equation shows the reaction for the manufacture of ammonia.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Which change will decrease the activation energy of the reaction?

A addition of a catalyst

B decrease in temperature

C increase in concentration

D increase in pressure

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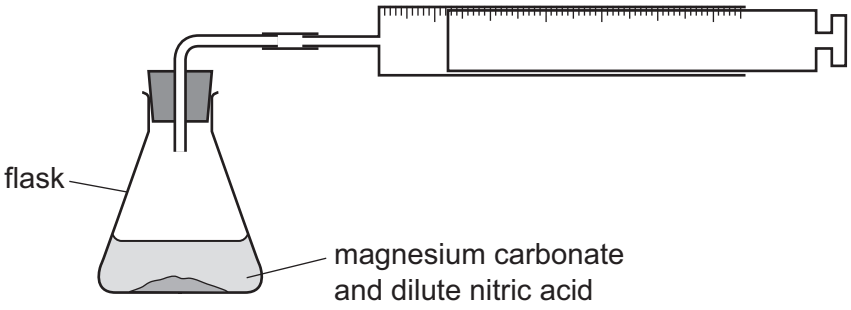
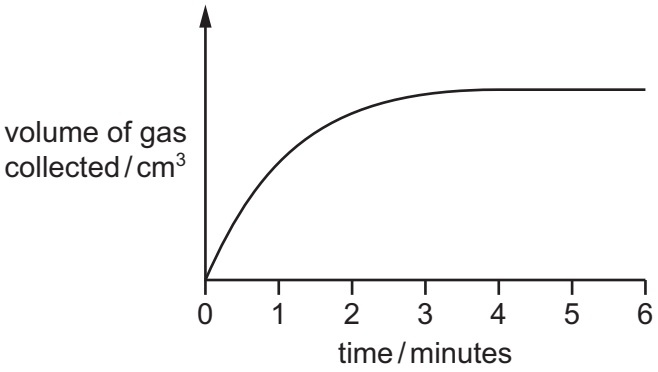
19 The apparatus shows a method of following the rate of the reaction between magnesium carbonate, $MgCO_3$, and dilute nitric acid, HNO_3.

$$MgCO_3(s) + 2HNO_3(aq) \rightarrow Mg(NO_3)_2(aq) + H_2O(l) + CO_2(g)$$



The graph shows the volume of gas collected against time.



Three statements are made about the experiment.

1 The mass of the flask and its contents decreases as time increases.

2 The rate of the reaction decreases as time increases.

3 The reaction has finished after four minutes.

Which statements are correct?

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

20 Aqueous bromine is added to aqueous sodium chloride.

Which statement is correct?

A Bromine is oxidised and chloride ions are reduced.

B Bromine is reduced and chloride ions are oxidised.

C Neither oxidation nor reduction takes place.

D Sodium ions are oxidised.

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21 Which statement is correct for all reversible reactions that have reached dynamic equilibrium?

A Introduction of a catalyst changes the position of the equilibrium.

B The number of moles of products equals the number of moles of reactants.

C The rate of the forward reaction equals the rate of the reverse reaction.

D When the reaction reaches the position of equilibrium the reaction stops.

22 Which statement about acids and bases is correct?

A A $0.1\,\text{mol}/\text{dm}^3$ solution of ethanoic acid has a higher pH than a $0.1\,\text{mol}/\text{dm}^3$ solution of hydrochloric acid.

B All bases dissolve in water to produce OH^- ions.

C Bases react with nitrates to produce ammonia.

D Oxides of metals are always acidic in character.

23 Which compound can be formed by precipitation?

A $NaCl$ **B** K_2SO_4 **C** $Ca(NO_3)_2$ **D** $PbSO_4$

24 Which methods could be used to make a pure sample of copper(II) sulfate?

1 acid + metal carbonate

2 acid + metal oxide

3 acid + metal

4 precipitation

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

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25 Ammonia is made by a reversible reaction.

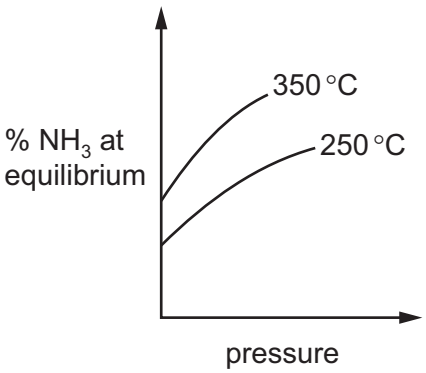
$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92\,kJ/mol$$

A chemist investigates how the percentage of ammonia at equilibrium changes with pressure.

The experiment is carried out both at 250 °C and at 350 °C.

Which graph shows the chemist's results?

A



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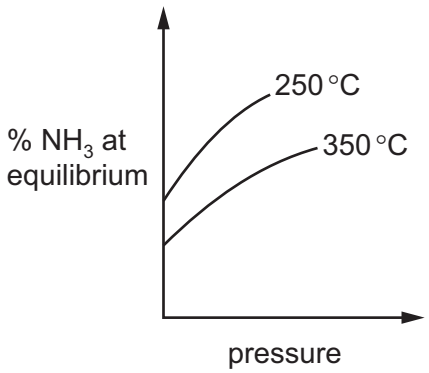

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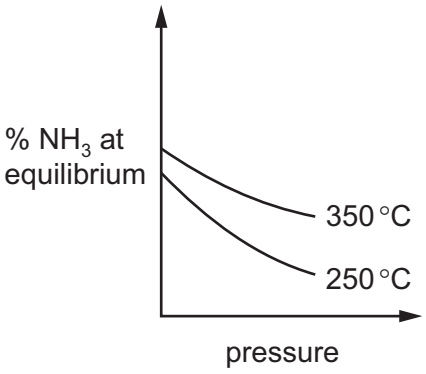

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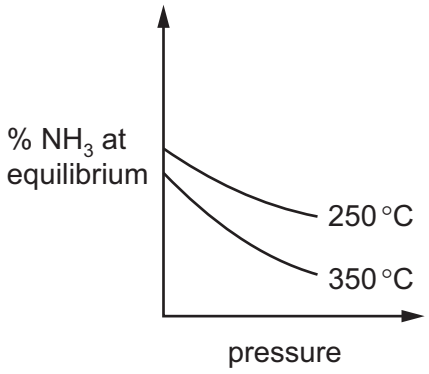


26 Which statement about sulfur dioxide, SO_2, is correct?

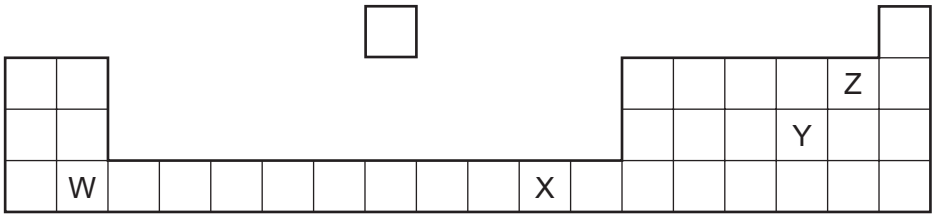
A It is dissolved in water to make sulfuric acid for car batteries.

B It is the final product of the Contact process.

C It is used as a food preservative.

D It turns aqueous potassium iodide brown.

27 The diagram shows part of the Periodic Table.



Which two letters represent elements that can react together to form covalent compounds?

A W and X **B** W and Y **C** X and Y **D** Y and Z

28 Which statement about some of the elements in the Periodic Table is correct?

A The element germanium, in Group IV, has less metallic character than gallium, in Group III.

B Elements in Group V form ions with a charge of 5+.

C Elements in the same group react in a similar way because they all contain the same number of electrons.

D Transition elements are given this name as they easily change from solids to liquids.

29 These statements are about the halogens.

1 All halogens are non-metallic, diatomic molecules.

2 Chlorine displaces both bromine and iodine from aqueous solutions of their salts.

3 The halogens become more reactive on descending Group VII of the Periodic Table.

Which statements are correct?

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

30 Which two statements indicate that metal M may have a proton number between 21 and 30?

1 It conducts electricity.

2 It does not react with water.

3 It forms two basic oxides with formulae MO and M_2O_3.

4 It forms two coloured sulfates.

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

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31 The table gives properties of four metals, P, Q, R and S.

	method of extraction	reaction with water	reaction with acid
P	electrolysis only	no reaction	reacts slowly
Q	heating oxide with carbon	reacts slowly with steam	reacts slowly
R	electrolysis only	reacts rapidly with steam	reacts rapidly
S	heating oxide with carbon	no reaction	no reaction

Which statement is correct?

A P is the least reactive.

B Q would displace R from a solution of its salt.

C R could be zinc.

D S could be copper.

32 Which statements about extracting metals from their ores are correct?

1 Aluminium is extracted by the electrolysis of aluminium oxide dissolved in cryolite.

2 Silver is difficult to extract from its ores because of its low reactivity.

3 Iron is extracted from haematite by reduction in the blast furnace.

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

33 Which statements about the corrosion of iron are correct?

1 Corrosion can be prevented by coating the iron with zinc.

2 Corrosion only occurs in the presence of both air and water.

3 Rust is an alloy of iron and oxygen.

4 Sacrificial protection occurs when iron is connected to a less reactive metal.

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

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34 In the extraction of aluminium from aluminium oxide, the following three reactions take place.

1 $Al^{3+} + 3e^- \rightarrow Al$

2 $2O^{2-} \rightarrow O_2 + 4e^-$

3 $C + O_2 \rightarrow CO_2$

Which reactions take place at the positive electrode?

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

35 Which statements are correct?

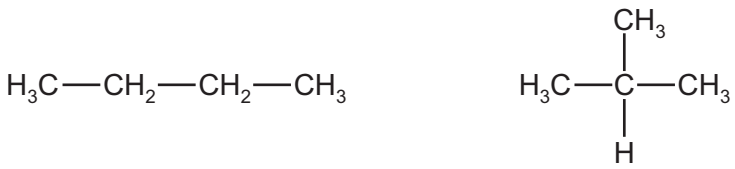
1 Chlorination is used to remove unpleasant tastes from drinking water.

2 Desalination can be achieved using distillation.

3 The presence of phosphates in water and soil encourages plant growth.

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

36 Two isomers are shown.



Which statements about these isomers are correct?

1 They have the same empirical formula.

2 They have different molecular formulae.

3 They are members of the same homologous series.

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

37 A hydrocarbon compound Q has molecular formula C_xH_y.

Q reacts with hydrogen to form a single product with molecular formula C_xH_{y+2}.

Which statement about Q is correct?

A Q does not burn in air.

B Q is a saturated hydrocarbon.

C Q reacts with bromine to form a single product with molecular formula $C_xH_{y-1}Br$.

D Q reacts with steam to form a single product with molecular formula $C_xH_{y+2}O$.

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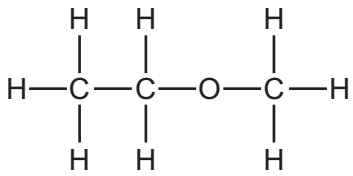
38 Which structural formula represents an alcohol?

A



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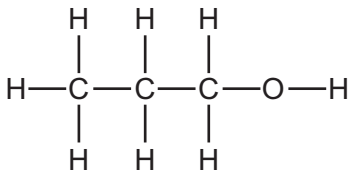

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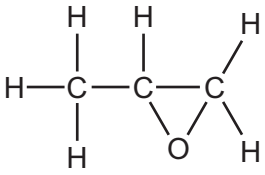

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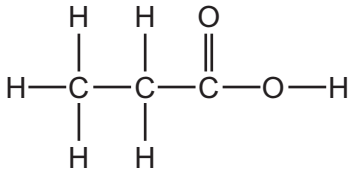


39 Which statement about carboxylic acids is correct?

A They are prepared by the oxidation of alkanes.

B They decolourise bromine water.

C They react with alcohols to form esters.

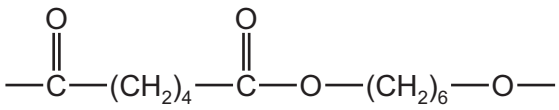
D They react with carbonates to form a salt, hydrogen and water.

40 P is a polymer that:

- has six carbon atoms in each of the monomers from which it is formed
- is **not** a polyester
- is formed using condensation polymerisation.

What is the partial structure of P?

A



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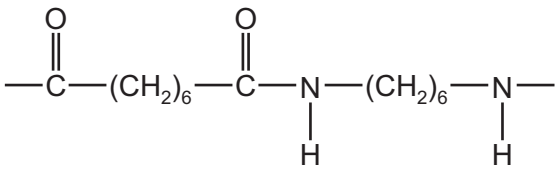

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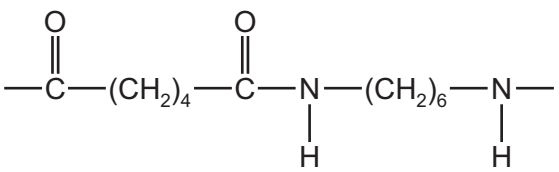

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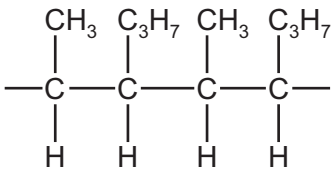

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
							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											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 –		114 Fl flerovium –		116 Lv livermorium –		

Key

atomic number
atomic symbol
name
relative atomic mass

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 dm^3 at room temperature and pressure (r.t.p.).