Cambridge Assessment International Education

Cambridge International AS & A Level

CHEMISTRY **9701/11**

Paper 1 Multiple Choice **May/June 2020**

1 hour

You must answer on the multiple choice answer sheet.

6841780614

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

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. A mark will not be deducted for a wrong answer.
- Any rough working should be done on this question paper.

This document has **16** pages. Blank pages are indicated.

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Section A

For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

Use of the Data Booklet may be appropriate for some questions.

1 Ethene can be oxidised to form epoxyethane, C_2H_4O.

$$C_2H_4(g) + \tfrac{1}{2}O_2(g) \rightleftharpoons C_2H_4O(g) \qquad \Delta H^{\ominus} = -107\,kJ\,mol^{-1}$$

Which set of conditions gives the greatest yield of epoxyethane at equilibrium?

	pressure	temperature / °C
A	high	100
B	high	200
C	low	100
D	low	200

2 Cobalt can form the positive ion $Co(NH_3)_4Cl_2^+$.

What is the oxidation number of cobalt in this ion?

A +1 **B** +2 **C** +3 **D** +6

3 When considering one molecule of ethene, which row describes both the hybridisation of the atomic orbitals in the carbon atoms and the overall bonding?

	hybridisation	bonding
A	sp^2	4 σ bonds 1 π bond
B	sp^2	5 σ bonds 1 π bond
C	sp^3	4 σ bonds 1 π bond
D	sp^3	5 σ bonds 1 π bond

4 10 cm^3 of ethane is burned in 45 cm^3 of oxygen at a pressure of 101 kPa and a temperature of 200 °C. Complete combustion takes place.

What is the total volume of gas present when the reaction is complete, measured under the same conditions?

A 30 cm^3 **B** 50 cm^3 **C** 55 cm^3 **D** 60 cm^3

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5 Two reactions are shown.

$$H_2(g) \rightarrow 2H(g)$$

$$CO(g) + \tfrac{1}{2}O_2(g) \rightarrow CO_2(g)$$

If molar amounts are used, how can the two energy changes associated with these reactions be described?

A enthalpy of atomisation and enthalpy of combustion

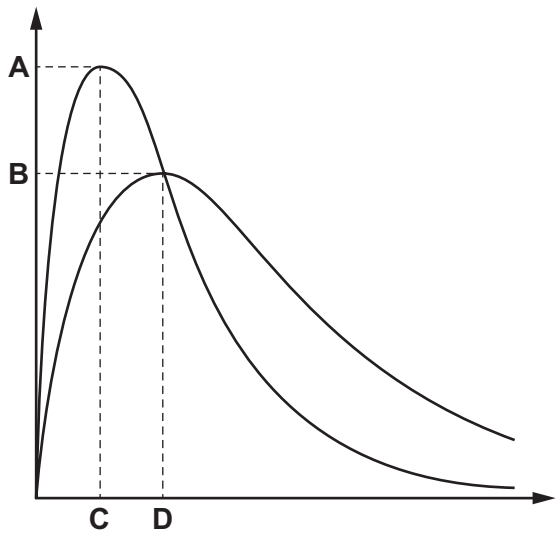
B enthalpy of atomisation and enthalpy of formation

C bond energy and enthalpy of combustion

D bond energy and enthalpy of formation

6 The diagram shows the Boltzmann energy distribution curves for molecules of a sample of a gas at two different temperatures.

Which letter on the axes represents the most probable energy for molecules of the same sample of gas at the **lower** temperature?



7 What are the units of K_p for the reaction shown?

$$H_2O(g) + C(s) \rightleftharpoons H_2(g) + CO(g)$$

A Pa^{-1} **B** Pa **C** Pa^2 **D** no units

8 In this question you should use changes in oxidation numbers to balance a chemical equation.

Acidified potassium dichromate(VI) solution can oxidise a solution of V^{2+} ions. The equation for this reaction is shown.

$$a\,Cr_2O_7^{2-} + b\,V^{2+} + c\,H^+ \rightarrow d\,Cr^{3+} + e\,VO_3^- + f\,H_2O$$

What is the ratio $a : b$ in the correctly balanced equation?

A 1 : 1 **B** 1 : 2 **C** 2 : 1 **D** 4 : 1

9 A sample of argon gas has a mass of 0.20 g, at a pressure of 100 000 Pa and a temperature of 12 °C.

Which volume does the gas occupy?

A $1.2 \times 10^{-4}\,cm^3$

B $5.0\,cm^3$

C $59\,cm^3$

D $119\,cm^3$

10 In which pair does each species have the same number of unpaired electrons?

A A*l* and Cu^{2+}

B Ca and Cr^{3+}

C Ca and Ni^{2+}

D Fe^{3+} and O^{2-}

11 A sample of solid ammonium chloride decomposes on heating.

solid ammonium chloride $\rightarrow$ ammonia gas + hydrogen chloride gas

A total of 2.4×10^{21} molecules of gas is formed.

How many hydrogen atoms are present in the gaseous products?

A 1.2×10^{21} **B** 2.4×10^{21} **C** 4.8×10^{21} **D** 9.6×10^{21}

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12 A white powder is a mixture of sodium chloride and sodium iodide. It is dissolved in water in a test-tube. An excess of aqueous silver nitrate is added to the test-tube. A precipitate, X, is observed.

An excess of concentrated ammonia is then added to the test-tube containing X. After the test-tube has been shaken, a precipitate, Y, is observed.

Which statement about X or Y is correct?

A X is a pure white colour.

B X is pure silver iodide.

C Y is pure silver chloride.

D Y is yellow.

13 6.90 g of an ammonium salt is heated with an excess of aqueous sodium hydroxide. The volume of ammonia produced, measured under room conditions, is 2.51 dm^3.

Which ammonium salt is used?

A ammonium carbonate (M_r = 96.0)

B ammonium chloride (M_r = 53.5)

C ammonium nitrate (M_r = 80.0)

D ammonium sulfate (M_r = 132.1)

14 An excess of MgO is shaken with water. The resulting mixture is filtered into test-tube P.

An excess of BaO is shaken with water. The resulting mixture is filtered into test-tube Q.

Which oxide reacts more readily with water and which filtrate has the **lower** pH?

	oxide reacts more readily with water	test-tube with filtrate of **lower** pH
A	BaO	P
B	BaO	Q
C	MgO	P
D	MgO	Q

15 Element Z has a giant structure.

The chloride of Z reacts with water to give a solution with a pH less than 5.

Which pair shows two elements which could be Z?

A aluminium, magnesium

B aluminium, silicon

C phosphorus, magnesium

D phosphorus, silicon

16 Sodium, aluminium and silicon are three elements in Period 3. Each element forms an oxide.

Which row has three correct properties of these oxides?

	sodium oxide	aluminium oxide	silicon dioxide
A	basic	basic	amphoteric
B	giant ionic	giant ionic	simple molecular
C	high melting point	low melting point	high melting point
D	reacts with water	no reaction with water	no reaction with water

17 0.25 g of anhydrous magnesium nitrate is heated strongly until it completely decomposes.

What is the total volume of gas produced, measured under room conditions?

A 40 cm^3 **B** 81 cm^3 **C** 101 cm^3 **D** 202 cm^3

18 Astatine, At, is below iodine in Group 17 of the Periodic Table.

Which statement is most likely to be correct?

A AgAt(s) reacts with an excess of dilute aqueous ammonia to form a solution of a soluble complex.

B Astatine and KCl(aq) react to form KAt(aq) and chlorine.

C KAt(aq) and dilute sulfuric acid react to form HAt(g).

D NaAt(s) and concentrated sulfuric acid react to form astatine.

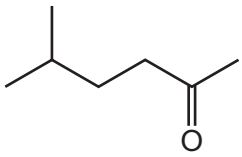
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19 What is the order of increasing melting point of the three chlorides shown?

CCl_4 $MgCl_2$ PCl_5

	lowest melting point →		highest melting point
A	CCl_4	PCl_5	$MgCl_2$
B	$MgCl_2$	CCl_4	PCl_5
C	$MgCl_2$	PCl_5	CCl_4
D	PCl_5	CCl_4	$MgCl_2$

20 The skeletal formula of compound X is shown.



Which row is correct?

	molecular formula of X	observation on addition of X to Fehling's reagent
A	$C_7H_{14}O$	no change
B	$C_7H_{14}O$	red precipitate forms
C	$C_7H_{16}O$	no change
D	$C_7H_{16}O$	red precipitate forms

21 Which statement is correct?

A 2,2-dimethylpropanoic acid is an isomer of propyl methanoate.

B 2-methylbutan-2-ol is an isomer of hexan-3-ol.

C 3-methylbutan-2-one is an isomer of pentanal.

D 3,3-dimethylbutan-2-one is an isomer of pentan-3-one.

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22 But-1-ene and but-2-ene are treated separately with cold, dilute acidified manganate(VII) ions.

Four students, W, X, Y and Z, make statements about these alkenes and the diols formed from them.

W One diol contains two primary alcohol groups.

X One diol contains a primary and a secondary alcohol group.

Y One diol contains two secondary alcohol groups.

Z Both alkenes exhibit *cis-trans* isomerism.

Which two students are correct?

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

23 2-bromo-2-methylpentane is a tertiary halogenoalkane.

Which organic products are formed when 2-bromo-2-methylpentane reacts with a hot concentrated ethanolic solution of sodium hydroxide?

A 2-methylpent-1-ene only

B 2-methylpent-1-ene and 2-methylpent-2-ene

C 2-methylpent-2-ene only

D 2-methylpent-2-ene and 4-methylpent-2-ene

24 Poly(propene) is an addition polymer.

What are the C–C–C bond angles along its polymer chain?

A They are all 109°.

B Half of them are 109° and half are 120°.

C Half of them are 90° and half are 180°.

D They are all 120°.

25 An alcohol has the molecular formula $C_5H_{12}O$. It has several isomers.

Which isomer forms a yellow precipitate with alkaline aqueous iodine?

A 2,2-dimethylpropan-1-ol

B 2-methylbutan-2-ol

C 3-methylbutan-2-ol

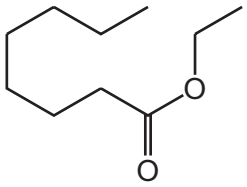
D pentan-3-ol

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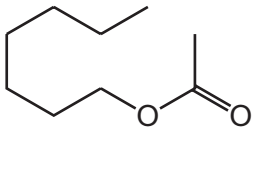
26 When compound X is heated under reflux with aqueous sodium hydroxide solution two products are formed: sodium ethanoate and hexan-1-ol.

What is compound X?

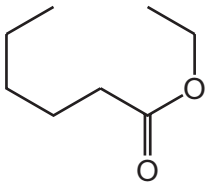
A



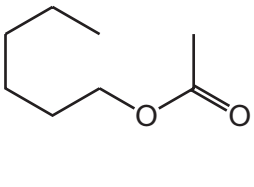
B



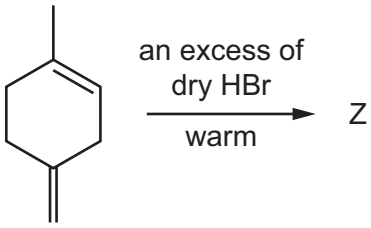
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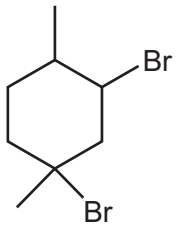
D



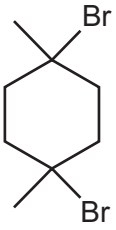
27 What is the major product Z of the following reaction?



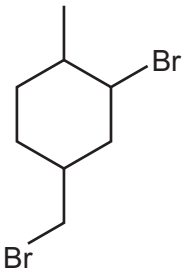
A



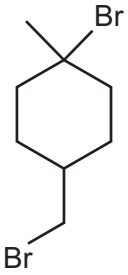
B



C

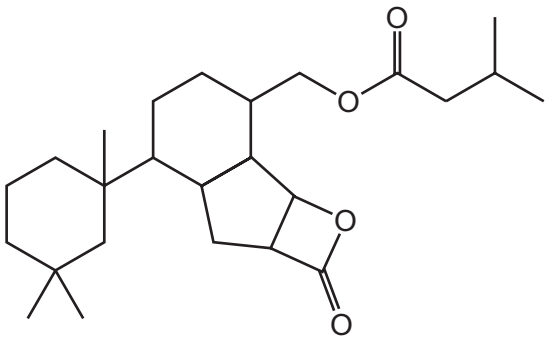


D



28 The structure of compound Q is shown.

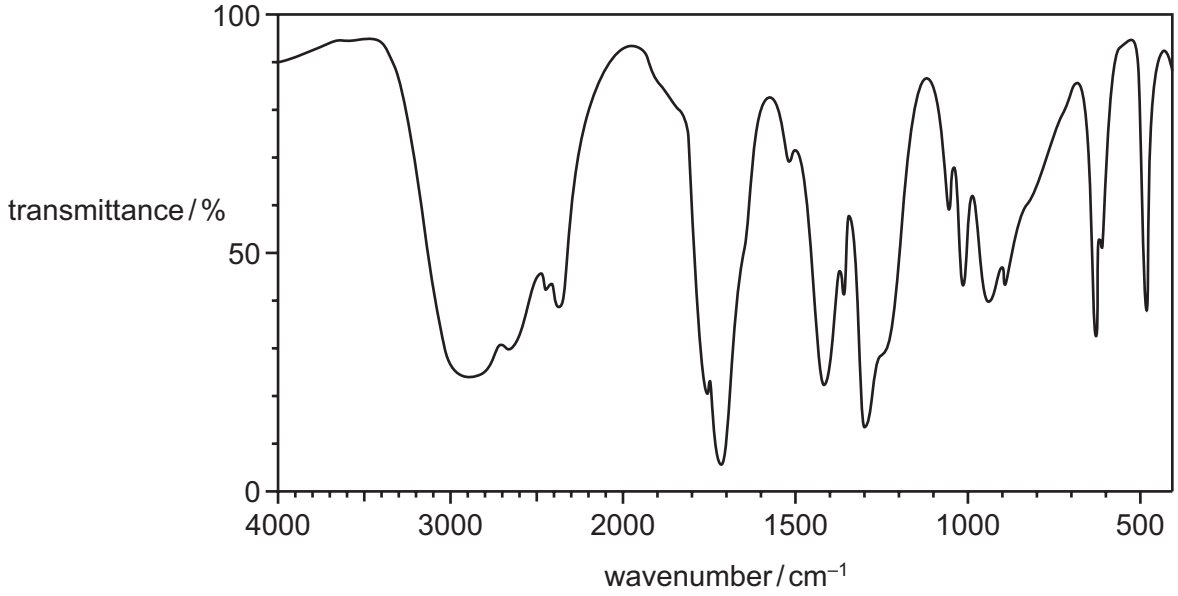
compound Q



How many chiral centres are present in a molecule of Q?

A 4 **B** 5 **C** 6 **D** 7

29 Compound X has the infra-red spectrum shown.



What could be the identity of compound X?

A ethanoic acid

B ethanol

C ethylethanoate

D propanone

30 Which reaction produces an organic anion with a good yield?

A heating ethanenitrile under reflux with dilute sodium hydroxide

B heating ethanenitrile under reflux with dilute sulfuric acid

C heating ethane with sodium metal

D heating ethanol under reflux with dilute sodium hydroxide

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Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

Use of the *Data Booklet* may be appropriate for some questions.

31 The definitions of many chemical terms can be illustrated by chemical equations.

Which terms can be illustrated by an equation that includes the formation of a positive ion?

1 first ionisation energy

2 heterolytic fission of a covalent bond

3 enthalpy change of atomisation

32 Which molecules have no overall dipole moment?

1 boron trifluoride

2 methane

3 phosphorus pentafluoride

33 Carbon exists in several different forms. Two of these forms are buckminsterfullerene and graphene. Buckminsterfullerene is a fullerene allotrope of carbon.

Which statements about buckminsterfullerene and graphene are correct?

1 Both have delocalised electrons.

2 Buckminsterfullerene has a giant molecular structure.

3 The carbon atoms in graphene form a tetrahedral lattice.

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The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

34 Carbon monoxide burns readily in oxygen to form carbon dioxide.

What does this information suggest?

1 The +4 oxidation state of carbon is more stable than the +2 state.

2 The standard enthalpy change of formation of carbon dioxide is more negative than the standard enthalpy change of formation of carbon monoxide.

3 The value of the equilibrium constant for the reaction, $2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$, is likely to be high.

35 The catalytic converters fitted to cars remove pollutants from the exhaust gases. Some of the reactions that occur involve oxygen, which comes from the air.

Which pollutants in the exhaust gases will react with oxygen on the surface of the catalytic converter?

1 NO_2

2 unburnt fuel

3 CO

36 Chlorine reacts with sodium hydroxide in two different ways depending upon the temperature.

reaction 1 $Cl_2 + 2OH^- \rightarrow Cl^- + ClO^- + H_2O$

reaction 2 $3Cl_2 + 6OH^- \rightarrow 5Cl^- + ClO_3^- + 3H_2O$

Which statements about these reactions are correct?

1 Reaction 2 requires a higher temperature than reaction 1.

2 The products of reaction 1 show chlorine in two different oxidation states.

3 The products of reaction 2 show oxygen in two different oxidation states.

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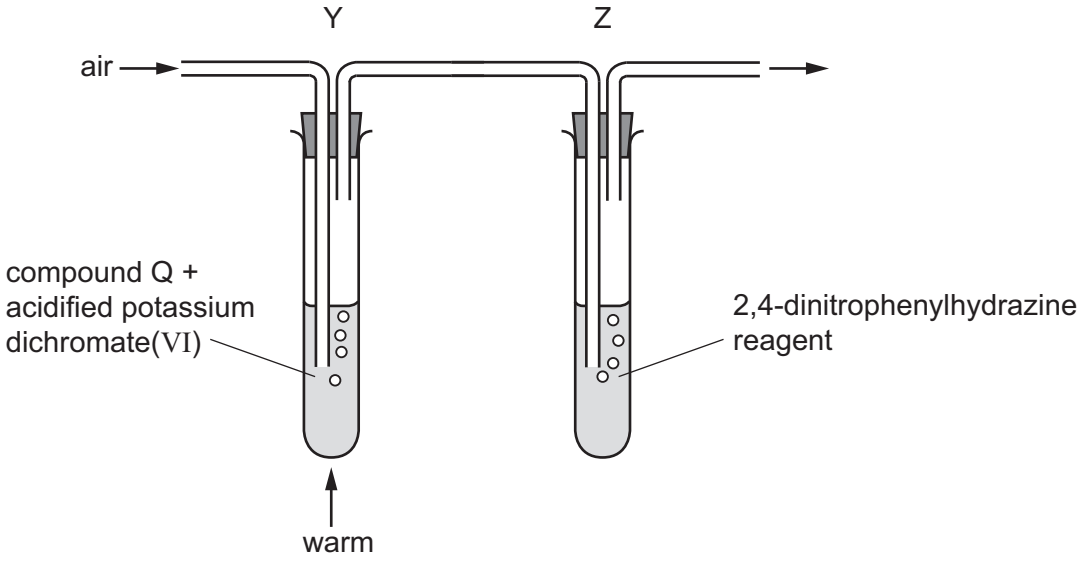
37 In which of the reactions is the organic compound oxidised by the given reagent?

1 CH_3CHO + HCN reagent

2 $CH_3CH_2CH_2CHO$ + Tollens' reagent

3 CH_3CH_2CHO + Fehling's reagent

38 When the apparatus is set up as shown, an orange precipitate forms in test-tube Z.



What could compound Q be?

1 $CH_3CH_2CH_2OH$

2 $CH_3CH(OH)CH_3$

3 $(CH_3)_3COH$

39 Chlorofluoroalkanes that diffuse into the stratosphere are broken down by ultraviolet radiation.

Radicals are generated that cause depletion of ozone.

What are these radicals?

1 chlorine radicals

2 fluorine radicals

3 alkyl radicals

The responses **A** to **D** should be selected on the basis of

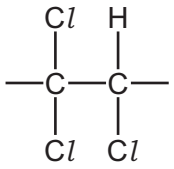
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

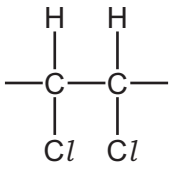
40 A mixture of the three isomers of $C_2H_2Cl_2$ is polymerised.

Which sequences will be seen within the polymer chains?

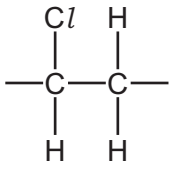
1



2



3



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