CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Advanced Subsidiary Level and Advanced Level

CHEMISTRY 9701/1

PAPER 1 Multiple Choice

MAY/JUNE SESSION 2002

1 hour

Candidates answer on the question paper.
Additional materials:
Multiple Choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)
Data Booklet

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

There are **forty** questions in 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 very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

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.

This question paper consists of 13 printed pages and 3 blank pages.

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate
[Turn over

Section A

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

1 In the radioactive decay of an isotope of lead to an isotope of bismuth, a particle $^{0}_{-1}X$ is emitted.

Which particle is $^{0}_{-1}X$?

A electron

B ion

C neutron

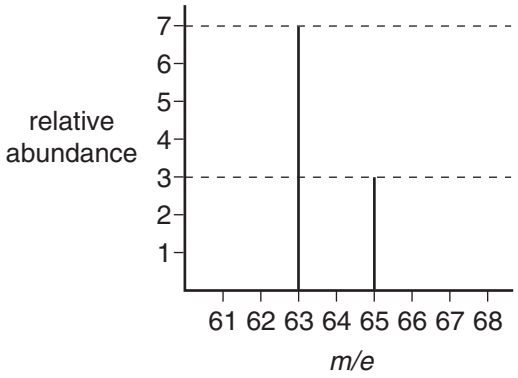
D proton

2 As a simplification, an adult human can be considered to have a daily diet of 1.80 kg of carbohydrate (empirical formula CH_2O).

Which mass of carbon dioxide does a person produce each day if all the carbohydrate eaten is digested and oxidised?

A 0.267 kg **B** 0.800 kg **C** 1.32 kg **D** 2.64 kg

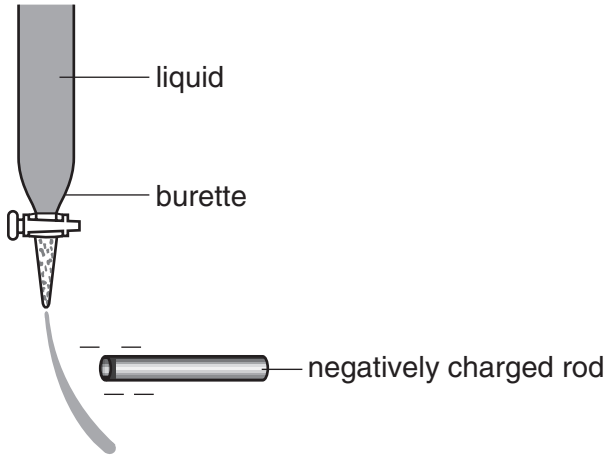
3 The diagram shows the mass spectrum of a sample of naturally-occurring copper.



What is the relative atomic mass of this copper?

A 63.3 **B** 63.5 **C** 63.6 **D** 64.0

4 A slow stream of water from a tap can be deflected by an electrostatically charged plastic rod because water is a polar molecule.



Why is a water molecule polar?

A Molecules are bonded together by hydrogen bonds.

B The oxygen and hydrogen atoms have different electronegativities.

C The oxygen atom has two lone pairs of electrons.

D Water is able to dissociate into ions.

5 Why does copper wire conduct electricity when a potential difference is applied?

A Bonding electrons in the crystal lattice move.

B Copper(II) ions move to the cathode.

C The atoms of copper become ionised.

D The crystal lattice breaks down.

6 Flask X contains 1 dm^3 of helium at 2 kPa pressure and flask Y contains 2 dm^3 of neon at 1 kPa pressure.

If the flasks are connected at constant temperature, what is the final pressure?

A $1\frac{1}{3}$ kPa **B** $1\frac{1}{2}$ kPa **C** $1\frac{2}{3}$ kPa **D** 2 kPa

[Turn over

7 When heated, solid iodine readily forms iodine vapour.

What does this information suggest about the nature of the particles in these two physical states of iodine?

	solid	*vapour*
A	ionic	atomic
B	ionic	molecular
C	molecular	atomic
D	molecular	molecular

8 Which statement about the standard enthalpy change of formation of carbon dioxide is correct?

A It is equal to the standard enthalpy change of combustion of carbon.

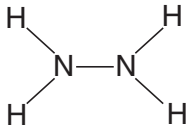
B It is equal to twice the bond energy of the C=O bond.

C It is the energy released when one mole of carbon dioxide is formed from carbon at the temperature of combustion of the carbon.

D It is the same for carbon dioxide produced from graphite and from diamond.

9 *Use of the Data Booklet is relevant to this question.*

Hydrazine was used as a fuel for the Messerschmidt 163 rocket fighter in World War II and for the American Gemini and Apollo spacecraft. It has the following formula.



What is the enthalpy change of atomisation of 1 mol of gaseous hydrazine?

A 550 kJ

B 1720 kJ

C 1970 kJ

D 2554 kJ

10 For which equilibrium does K_c have *no units*?

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

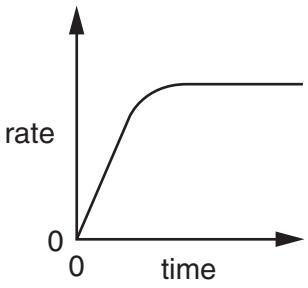
B $CH_3OH(l) + CH_3CO_2H(l) \rightleftharpoons CH_3CO_2CH_3(l) + H_2O(l)$

C $Cu^{2+}(aq) + 4NH_3(aq) \rightleftharpoons Cu(NH_3)_4^{2+}(aq)$

D $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

11 Which curve is obtained if the rate of reaction is plotted against time for an autocatalytic reaction (i.e. a reaction in which one of the products catalyses the reaction)?

A



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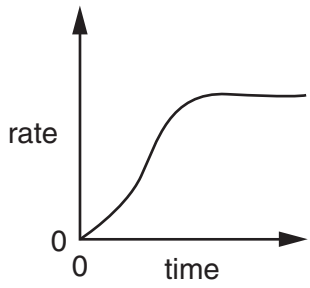

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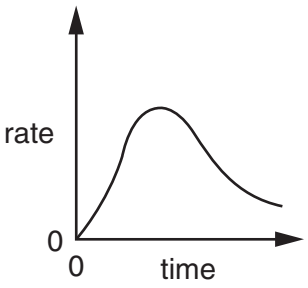

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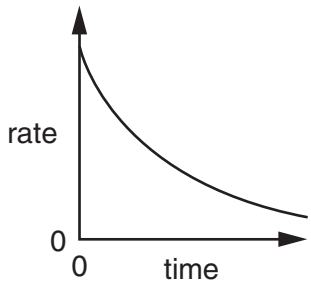


12 Which species represented by the following formulae has the largest radius?

A P^{3-} **B** Cl^- **C** Ar **D** K^+

13 Which of the following oxides is **unlikely** to dissolve in aqueous sodium hydroxide?

A Al_2O_3 **B** MgO **C** SO_2 **D** SiO_2

14 An element of the third period (Na to S) is heated in chlorine. The product is purified and then added to water. The resulting solution is found to be neutral.

What is the element?

A sodium

B aluminium

C silicon

D phosphorus

15 Which equation represents the reaction that occurs when calcium nitrate is heated strongly?

A $Ca(NO_3)_2 \rightarrow Ca(NO_2)_2 + O_2$

B $Ca(NO_3)_2 \rightarrow CaO + N_2O + 2O_2$

C $Ca(NO_3)_2 \rightarrow CaO_2 + 2NO_2$

D $2Ca(NO_3)_2 \rightarrow 2CaO + 4NO_2 + O_2$

[Turn over

16 During electrolysis of brine in a diaphragm cell, chlorine, hydrogen and sodium hydroxide are produced.

What is the molar ratio of these products?

	chlorine	*hydrogen*	*sodium hydroxide*
A	1	1	1
B	1	1	2
C	2	1	1
D	2	2	1

17 Which statement explains the observation that magnesium hydroxide dissolves in aqueous ammonium chloride, but not in aqueous sodium chloride?

A The ionic radius of the NH_4^+ ion is similar to that of Mg^{2+} but not that of Na^+.

B NH_4Cl dissociates less fully than $NaCl$.

C The ions Na^+ and Mg^{2+} are isoelectronic (have the same number of electrons).

D The ion NH_4^+ acts as an acid.

18 Sulphur dioxide is an important food preservative.

What property makes sulphur dioxide useful in this role?

A It is a gas.

B It is a reducing agent.

C It reacts with oxygen to form sulphur trioxide.

D It reacts with water to form an acidic solution.

19 The anaesthetic *halothane,* $CF_3CHBrCl$, is made industrially as shown below.

$$CCl_2{=}CHCl \xrightarrow[\text{stage 1}]{HF} CF_3CH_2Cl \xrightarrow[\text{stage 2}]{Br_2} CF_3CHBrCl$$

What type of reaction is occurring in stage 2?

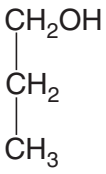
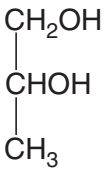
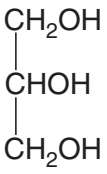
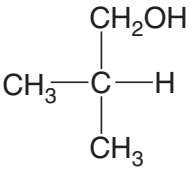
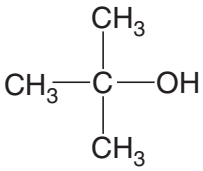
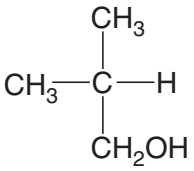
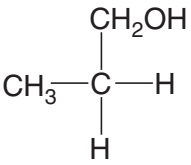
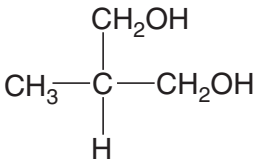
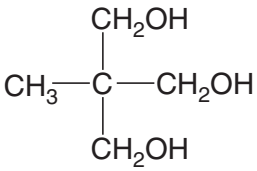
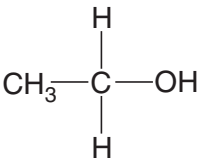
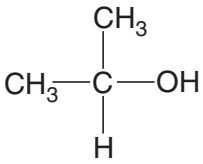
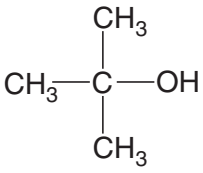
A electrophilic addition

B electrophilic substitution

C free radical substitution

D nucleophilic addition

20 Which set of alcohols correctly shows a primary, a secondary and a tertiary alcohol?

	primary	*secondary*	*tertiary*
A			
B			
C			
D			

21 What is the total number of different chloroethanes (formula $C_2H_{6-n}Cl_n$, where n can be any integer from 1 to 6)?

A 6 **B** 8 **C** 9 **D** 10

22 Polymerisation of chloroethene gives pvc.

How does the carbon-carbon bond in pvc compare with that in chloroethene?

A	longer	stronger
B	longer	weaker
C	shorter	stronger
D	shorter	weaker

[Turn over

23 2-Bromopropane, $(CH_3)_2CHBr$, may be used as the starting point for making $(CH_3)_2CHCO_2H$.

Which of the following sequences would be most suitable?

A $(CH_3)_2CHBr \rightarrow (CH_3)_2CHOH \rightarrow (CH_3)_2CHCO_2H$

B $(CH_3)_2CHBr \rightarrow (CH_3)_2CHCN \rightarrow (CH_3)_2CHCO_2H$

C $(CH_3)_2CHBr \rightarrow (CH_3)_2CHOH \rightarrow (CH_3)_2CHCN \rightarrow (CH_3)_2CHCO_2H$

D $(CH_3)_2CHBr \rightarrow (CH_3)_2CHCN \rightarrow (CH_3)_2CHOH \rightarrow (CH_3)_2CHCO_2H$

24 Which substance in a vehicle exhaust results from incomplete combustion of a hydrocarbon fuel?

A CO **B** H_2O **C** N_2 **D** NO

25 Which compound on reaction with hydrogen cyanide produces a compound with a chiral centre?

A CH_3CHO

B $CH_3CH_2COCH_2CH_3$

C $CH_3CO_2CH_3$

D HCHO

26 An organic compound will decolorise dilute acidified aqueous potassium manganate(VII) on warming, but will not decolorise bromine water.

What could the organic compound be?

A butane

B ethanol

C ethene

D ethanoic acid

27 A compound **X** has all of the following properties:

it is a liquid at room temperature and atmospheric pressure;

it does not mix completely with water;

it does not decolorise acidified potassium manganate(VII).

What could **X** be?

A ethane

B ethanoic acid

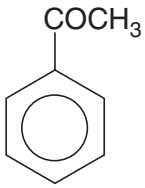
C ethanol

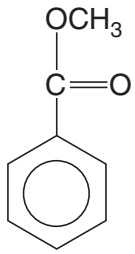
D ethyl ethanoate

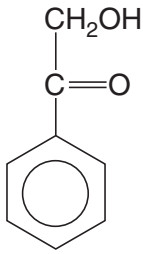
28 A compound **R** has all of the following properties:

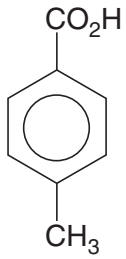
it is neutral;
it gives an orange precipitate with 2,4-dinitrophenylhydrazine;
it evolves hydrogen chloride when treated with PCl_5 in the cold.

What could **R** be?

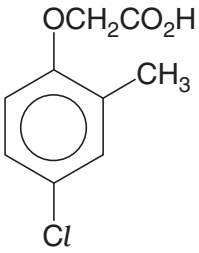
A 

B 

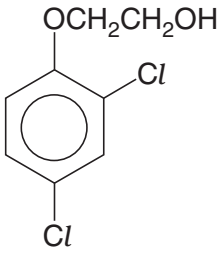
C 

D 

29 MCPA and 2,4-D are two widely-used selective weedkillers.



MCPA



2,4-D

Which reagent will distinguish MCPA from 2,4-D?

A acidified $AgNO_3(aq)$

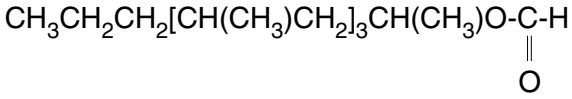
B Fehling's solution

C Na

D $Na_2CO_3(aq)$

[Turn over

30 The acarid mite releases *lardolure* to attract other mites to a host: this chemical can be destroyed by hydrolysis with acid.



A simplified formula for *lardolure* may be written as  .

What are the products of its hydrolysis?

A $RCH(CH_3)CO_2H + CH_3OH$

B $RCH(CH_3)CO_2H + HCO_2H$

C $RCH(CH_3)OH + CO_2$

D $RCH(CH_3)OH + HCO_2H$

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.

31 Which pairs of compounds have the same empirical formula?

1 ethane and ethene

2 ethene and cyclohexane

3 cyclohexane and oct-1-ene

32 In which sequences are the molecules quoted in order of increasing bond angle within the molecule?

1 H_2O NH_3 CH_4

2 H_2O SF_6 BF_3

3 CH_4 CO_2 SF_6

33 The concepts of bond energy, bond length and bond polarity are useful when comparing the behaviour of similar molecules, e.g. thermal stability.

For example, it could be said

*"Compared with the HCl molecule, the bond …….**X**……. of the HI molecule is ……..**Y**…….."*

Which pairs of words correctly complete the above sentence?

	X	Y
1	energy	greater
2	length	greater
3	polarity	less

[Turn over

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

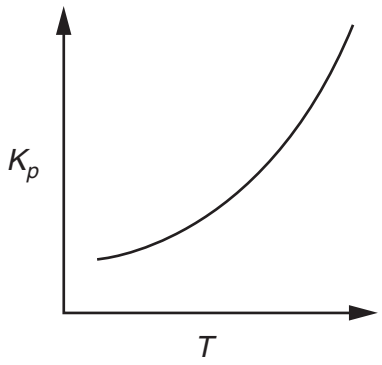
A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

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

34 The equilibrium constant K_p for the reaction

$$X(g) + Y(g) \rightleftharpoons Z(g)$$

varies with temperature as shown in the diagram below.



Which conclusions can be drawn from this information?

1 The reaction is exothermic in the forward direction.

2 The equilibrium mixture contains a greater proportion of *Z* at higher pressures.

3 The equilibrium mixture contains a greater proportion of *Z* at higher temperatures.

35 When decomposing in water, organic refuse is oxidised to form carboxylic acids. The water becomes acidic and aquatic life is destroyed.

Which additives are suitable to remove this acid pollution?

1 calcium carbonate

2 calcium hydroxide

3 potassium nitrate

36 Which properties would be expected for the Group II element, strontium, or its compounds?

1 When heated in oxygen, strontium does not burn.

2 On being heated, strontium carbonate decomposes to give strontium oxide.

3 When strontium oxide is added to water, the solution is alkaline.

37 Which sodium salts form a precipitate when $AgNO_3(aq)$ followed by dilute $NH_3(aq)$ is added to its aqueous solution?

1 chloride

2 bromide

3 iodide

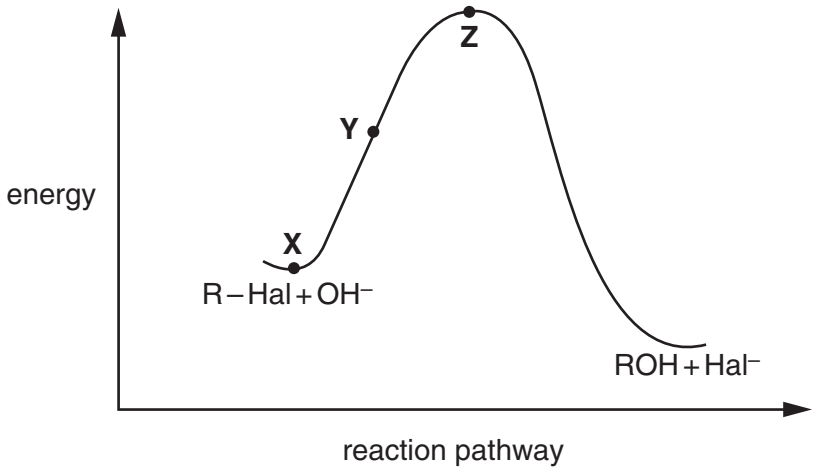
38 Which compounds would be formed in the reaction of ethene with aqueous bromine in the presence of sodium chloride?

1 CH_2ClCH_2Cl

2 CH_2BrCH_2Cl

3 CH_2BrCH_2Br

39 Halogenoalkanes react with aqueous alkali. One mechanism of this reaction has the reaction pathway diagram shown below.



Which of the following statements are correct?

1 The reaction is an example of nucleophilic substitution.

2 Between **X** and **Y** the C-Hal bond will be lengthening.

3 The energy difference between **X** and **Z** represents the activation energy.

40 Which alcohols on oxidation with acidified potassium dichromate(VI) give an organic product which causes an effervescence when reacted with sodium carbonate?

1 butan-1-ol

2 2-methylpropan-1-ol

3 2-methylpropan-2-ol

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