CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Advanced Subsidiary Level and Advanced Level

CHEMISTRY 9701/1

PAPER 1 Multiple Choice

OCTOBER/NOVEMBER 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.

Section A

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

1 A mixture of 10 cm^3 of methane and 10 cm^3 of ethane was sparked with an excess of oxygen. After cooling to room temperature, the residual gas was passed through aqueous potassium hydroxide.

What volume of gas was absorbed by the alkali?

A 15 cm^3

B 20 cm^3

C 30 cm^3

D 40 cm^3

2 One of the most important chemical species responsible for the removal of ozone from the stratosphere is a free radical of chlorine, $^{35}Cl^{\bullet}$.

What does $^{35}Cl^{\bullet}$ contain?

	protons	neutrons	electrons
A	17	18	16
B	17	18	17
C	18	17	17
D	18	17	18

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

In the gas phase, aluminium and a transition element require the same amount of energy to form one mole of an ion with a 2+ charge.

What is the transition element?

A Co

B Cr

C Cu

D Ni

4 The African weaver ant defends its territory by spraying an intruder with a mixture of compounds. The ease by which these compounds are detected by other ants depends upon the volatility, which decreases as the strength of the intermolecular forces in the compound increases.

Which compound would be the most volatile?

A $CH_3CH_2CH_2CH_2CH_2CH_3$

B $CH_3CH_2CH_2CH_2CH_2CHO$

C $CH_3CH_2CH_2CH_2CH_2NH_2$

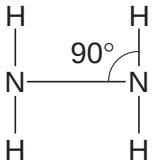
D $CH_3CH_2CH_2CH_2CH_2OH$

5 Which of the following molecules has **no** permanent dipole?

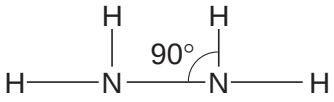
A CCl_2F_2 **B** $CHCl_3$ **C** C_2Cl_4 **D** C_2H_5Cl

6 Which is the most likely shape of a molecule of hydrazine, N_2H_4?

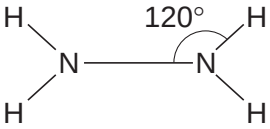
A



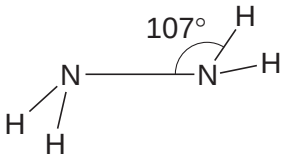
B



C



D



7 Which of the following exists in the solid state as a giant covalent lattice?

A ice

B iodine

C silicon(IV) oxide

D tin(IV) chloride

8 A 2 g sample of hydrogen at temperature T and of volume V exerts a pressure p.
Deuterium, $^{2}_{1}H$, is an isotope of hydrogen.

Which of the following would also exert a pressure p at the same temperature T?

A 2 g of deuterium of volume V

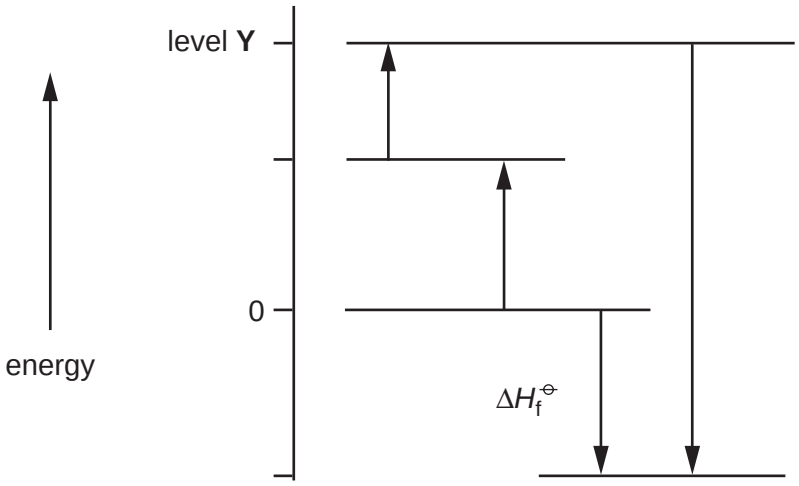
B 4 g of deuterium of volume $\frac{V}{2}$

C a mixture of 1 g of hydrogen and 2 g of deuterium of total volume V

D a mixture of 2 g of hydrogen and 1 g of deuterium of total volume $2V$

9 The following energy cycle represents the enthalpy changes in the formation of carbon dioxide from its constituent elements in their standard states.

What substances are present at level **Y** in this diagram?



A C(g) + 2O(g)

B C(g) + O_2(g)

C C(s) + O_2(g)

D CO_2(g)

10 At 600 °C oxides of nitrogen react with unburnt hydrocarbons in a catalytic converter in a car exhaust. The equation using methane as representative of a hydrocarbon molecule would be as follows.

$$4NO + CH_4 \rightarrow 2N_2 + CO_2 + 2H_2O$$

Which statement is likely to be true about the energy change of this reaction?

A It is endothermic as heat energy is converted into chemical energy.

B It is exothermic as a high temperature is required.

C It is exothermic as the triple bond N ⇌ O is broken.

D It is exothermic as the products have large negative enthalpy changes of formation.

11 In an experiment, *b* mol of hydrogen iodide were put into a sealed vessel under pressure p. At equilibrium, *x* mol of the hydrogen iodide had dissociated, the reaction being represented by the following equation.

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

Which expression for K_p is correct?

A $\dfrac{x^2}{(b-x)^2}$

B $\dfrac{x^2p^2}{(b-x)^2}$

C $\dfrac{x^2p^2}{4b(b-x)}$

D $\dfrac{x^2}{4(b-x)^2}$

12 A piece of zinc foil dissolved completely in 20 cm^3 of a dilute sulphuric acid solution and the volume of hydrogen evolved was noted at equal, short time intervals. Another piece of zinc foil of the same surface area and mass was added to 40 cm^3 of the same solution of dilute sulphuric acid.

How will the initial rate of reaction and the total volume of hydrogen evolved in this second experiment compare to the first experiment?

	initial rate of reaction	*total volume of hydrogen evolved*
A	no change	decrease
B	no change	no change
C	increase	no change
D	increase	increase

13 The chloride of element **Q** is hydrolysed by water to form an acidic solution and its oxide reacts with acid to form a salt.

What could be the element **Q**?

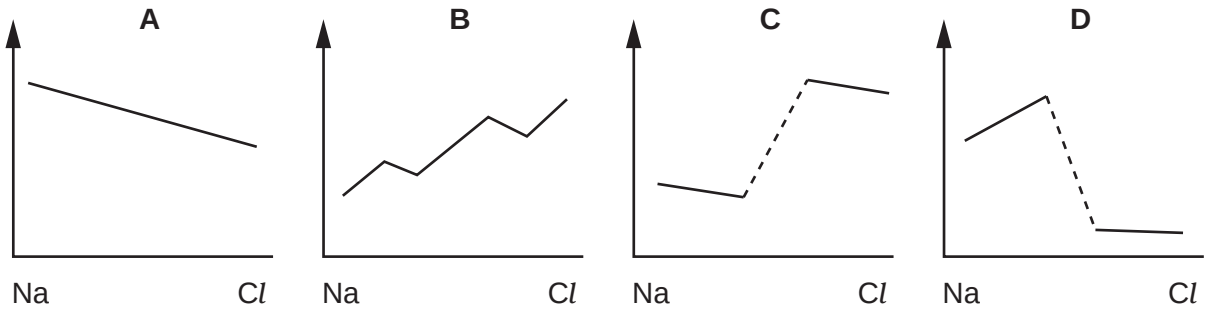
A magnesium

B aluminium

C silicon

D phosphorus

14 Which diagram represents the change in ionic radius of the elements across the third period (Na to C*l*)?



15 The propellant used in the solid rocket booster of a space shuttle is a mixture of aluminium and compound **X**. Compound **X** contains chlorine in an oxidation state of +7.

Which of the following could be compound **X**?

A NH_4Cl **B** NH_4ClO_3 **C** NH_4ClO_4 **D** N_2H_5Cl

16 River water in a chalky agricultural area may contain Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^-, Cl^-, and NO_3^- ions. In a waterworks, such water is treated by adding a calculated quantity of calcium hydroxide.

What will be precipitated following the addition of calcium hydroxide?

A $CaCl_2$

B $CaCO_3$

C $MgCO_3$

D $Mg(NO_3)_2$

17 The standard enthalpy changes of formation of HC*l* and HI are –92 kJ mol^{-1} and +26 kJ mol^{-1} respectively.

Which statement is **most** important in explaining this difference?

A Chlorine is more electronegative than iodine.

B The activation energy for the H_2/Cl_2 reaction is much less than that for the H_2/I_2 reaction.

C The bond energy of HI is smaller than the bond energy of HC*l*.

D The bond energy of I_2 is smaller than the bond energy of Cl_2.

18 In the industrial electrolysis of brine to manufacture chlorine, the diaphragm used is a porous screen which allows the flow of electrolytes but keeps other chemicals separate.

Which substance needs to be kept separate from the chlorine by the diaphragm?

A hydrogen

B sodium hydroxide

C sodium chloride

D water

19 Which gas is present in the exhaust fumes of a car engine in a much greater amount than any other gas?

A carbon dioxide

B carbon monoxide

C nitrogen

D water vapour

20 The Russian composer Borodin was also a research chemist who discovered a reaction in which two ethanal molecules combine to form a compound commonly known as aldol (reaction I). Aldol forms another compound on heating (reaction II).

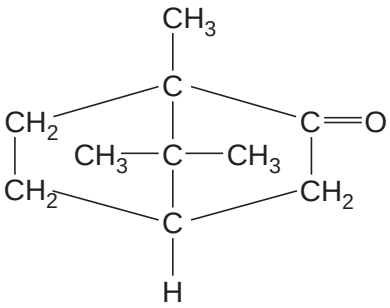
I $2CH_3CHO \rightarrow CH_3CH(OH)CH_2CHO$

II $CH_3CH(OH)CH_2CHO \rightarrow CH_3CH{=}CHCHO + H_2O$

Which of the following best describes reactions I and II?

	I	II
A	addition	elimination
B	addition	reduction
C	elimination	reduction
D	substitution	elimination

21 Camphor is used for medical purposes, the diagram shows its structure.



How many chiral centres are present in one molecule of camphor?

A 0 **B** 1 **C** 2 **D** 3

22 Chloroethane is used as a starting material for the production of 'time-release capsules' in pharmaceutical products. One way of preparing chloroethane is to react chlorine and ethane in the presence of ultraviolet light.

Which statement is correct about the **first** stage of the mechanism of this reaction?

A The C*l* – C*l* bond is split homolytically.

B The C*l* – C*l* bond is split heterolytically.

C The C – H bond is split homolytically.

D The C – H bond is split heterolytically.

23 Chloroethene, CH_2=CHC*l*, is the monomer of pvc.

What are the C–C–C bond angles along the polymeric chain in pvc?

A They are all 109 °.

B Half are 109 ° and half are 120 °.

C They are all 120 °.

D They are all 180 °.

24 Compound **X** undergoes the following reactions.

$$\underset{\textbf{X}}{C_4H_9Br} \xrightarrow{NaOH(aq)\ /\ heat} C_4H_{10}O \xrightarrow{Cr_2O_7^{2-},\ H^+(aq)\ /\ heat} C_4H_8O \text{ only}$$

What is **X**?

A 1-bromobutane

B 2-bromobutane

C 1-bromo-2-methylpropane

D 2-bromo-2-methylpropane

25 Chlorofluorocarbons (CFCs) have been widely used in aerosol sprays, refrigerators and in making foamed plastics, but are now known to destroy ozone in the upper atmosphere.

Which of the following will not destroy ozone, and therefore can be used safely as a replacement for CFCs?

A $CHBr_3$ **B** CCl_3CBr_3 **C** $CHClFCClF_2$ **D** $CH_3CH_2CH_2CH_3$

26 Oxidation of an alkene **Y** gives a diol; further oxidation gives a diketone.

What could be **Y**?

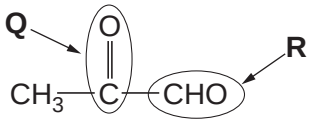
A $CH_3CH{=}C(CH_3)_2$

B $(CH_3)_2CHCH{=}CH_2$

C $C_6H_5CH{=}CHC_6H_5$

D $(C_6H_5)_2C{=}CHCH_3$

27 Burnt sugar has a characteristic smell caused partly by the following compound. It has two functional groups indicated by **Q** and **R**.



When this compound is tested in a laboratory with 2,4-dinitrophenylhydrazine and Fehling's reagent, which functional groups are responsible for positive tests?

	2,4-dinitrophenylhydazine	Fehling's reagent
A	**Q** and **R**	**Q** and **R**
B	**R** only	**Q** and **R**
C	**Q** and **R**	**R** only
D	**Q** only	**R** only

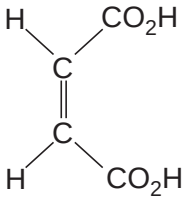
28 Ethanal may be converted into a three-carbon acid in a two-step process.

Which compound is the intermediate?

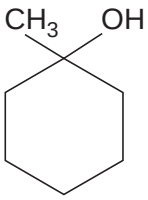
A CH_3CO_2H **B** CH_3CN **C** CH_3CH_2CN **D** $CH_3CH(OH)CN$

29 Which compound is both chiral and acidic?

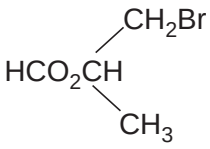
A



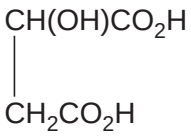
B



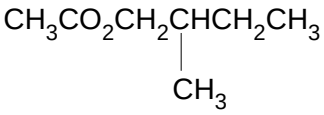
C



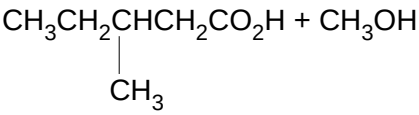
D

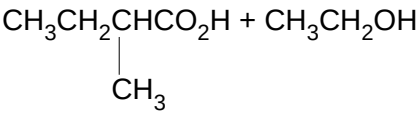


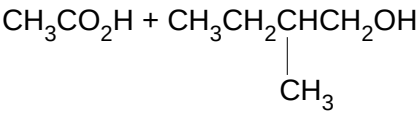
30 An ester with an odour of banana has the following formula.

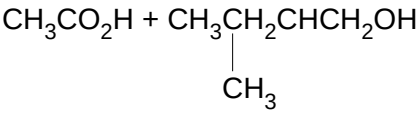


In which of the following do the substances react together, under suitable conditions, to produce this ester?

A 

B 

C 

D 

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 compounds have the empirical formula CH_2O?

1 methanal

2 ethanoic acid

3 methyl methanoate

32 Which of the following are features of the structure of metallic copper?

1 ionic bonds

2 delocalised electrons

3 lattice of ions

33 Which statements about the commercial extraction of aluminium are correct?

1 The cathode reaction is $Al^{3+} + 3e^- \rightarrow Al$.

2 The lining of the electrolytic cell acts as the cathode.

3 The electrolyte is purified Al_2O_3 in Na_3AlF_6.

34 Which of the following magnesium compounds lose mass when heated by a bunsen flame?

1 magnesium carbonate

2 magnesium nitrate

3 magnesium oxide

35 The element astatine lies below iodine in Group VII of the Periodic Table.

What will be the properties of astatine?

1 It forms diatomic molecules which dissociate more readily than chlorine molecules.

2 It reacts explosively with hydrogen.

3 It is a good reducing agent.

36 Ammonia and chlorine react in the gas phase.

$$8NH_3 + 3Cl_2 \rightarrow N_2 + 6NH_4Cl$$

Which statements are correct?

1 Ammonia behaves as a reducing agent.

2 Ammonia behaves as a base.

3 The oxidation number of the hydrogen changes.

37 Which compounds show *cis-trans* isomerism?

1 but-2-ene

2 but-1-ene

3 2-methylpropene

38 When octane is subjected to catalytic cracking, which compounds can be obtained?

1 $CH_2{=}CH_2$

2 $CH_3CH_2CH{=}CH_2$

3 $CH_3(CH_2)_4CH_3$

39 Which ions are present in a solution of ethanol in an excess of concentrated sulphuric acid?

1 $CH_3CH_2O^-$

2 $CH_3CH_2\overset{+}{O}H_2$

3 HSO_4^-

40 In the reaction between an aldehyde and HCN catalysed by NaCN, which statements about the reaction mechanism are true?

1 A new carbon-carbon bond is formed.

2 In the intermediate, the oxygen carried a negative charge.

3 The last stage involves the formation of a hydrogen-oxygen bond.

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