

FOR OFFICIAL USE

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X012/301

Total
Section B

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NATIONAL
QUALIFICATIONS
2005

TUESDAY, 31 MAY
9.00 AM – 11.30 AM

CHEMISTRY
HIGHER

Fill in these boxes and read what is printed below.

Full name of centre

--

Town

--

Forename(s)

--

Surname

--

Date of birth

Day Month Year

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Scottish candidate number

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Number of seat

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Reference may be made to the Chemistry Higher and Advanced Higher Data Booklet (1999 edition).

SECTION A—Questions 1–40 (40 marks)

Instructions for completion of **Section A** are given on page two.

SECTION B (60 marks)

- 1 All questions should be attempted.
- 2 The questions may be answered in any order but all answers are to be written in the spaces provided in this answer book, and must be written clearly and legibly in ink.
- 3 Rough work, if any should be necessary, should be written in this book and then scored through when the fair copy has been written. If further space is required, a supplementary sheet for rough work may be obtained from the invigilator.
- 4 Additional space for answers will be found at the end of the book. If further space is required, supplementary sheets may be obtained from the invigilator and should be inserted inside the **front** cover of this book.
- 5 The size of the space provided for an answer should not be taken as an indication of how much to write. It is not necessary to use all the space.
- 6 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

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SECTION A

Read carefully

- 1 Check that the answer sheet provided is for **Chemistry Higher (Section A)**.
- 2 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) and **Centre Name** printed on it.
Do not change any of these details.
- 3 If any of this information is wrong, tell the Invigilator immediately.
- 4 If this information is correct, **print** your name and seat number in the boxes provided.
- 5 Use **black or blue ink** for your answers. **Do not use red ink.**
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the exam, put the **answer sheet for Section A inside the front cover of your answer book.**

Sample Question

To show that the ink in a ball-pen consists of a mixture of dyes, the method of separation would be

- A fractional distillation
- B chromatography
- C fractional crystallisation
- D filtration.

The correct answer is **B**—chromatography. The answer **B** has been clearly marked with a horizontal line (see below).

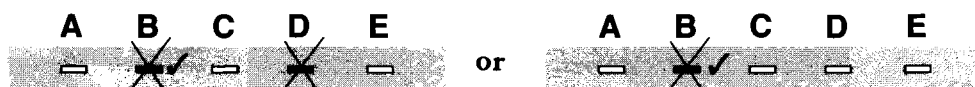


Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **B**.



If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



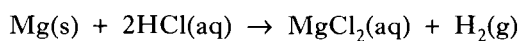
1. Isotopes of an element have
- the same mass number
 - the same number of neutrons
 - equal numbers of protons and neutrons
 - different numbers of neutrons.
2. Which of the following pairs of solutions would react to produce a precipitate?
- Barium nitrate and sodium chloride
 - Barium hydroxide and potassium nitrate
 - Copper(II) sulphate and sodium carbonate
 - Copper(II) chloride and potassium sulphate

3. Dilute hydrochloric acid, concentration 2 mol l^{-1} , is added to a mixture of copper metal and copper(II) carbonate.

Which of the following happens?

- The only gas produced is carbon dioxide.
- The only gas produced is hydrogen.
- A mixture of carbon dioxide and hydrogen is produced.
- There is no production of gas.

4. How many moles of magnesium will react with 20 cm^3 of 2 mol l^{-1} hydrochloric acid?

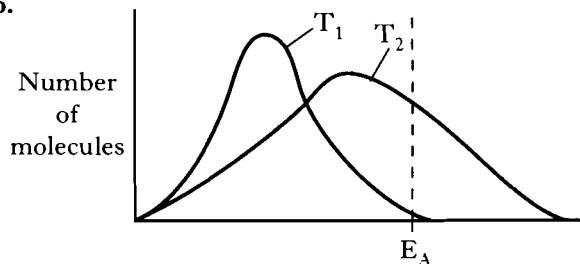


- 0.01
- 0.02
- 0.04
- 0.20

5. The continuous use of large extractor fans greatly reduces the possibility of an explosion in a flour mill. This is mainly because

- a build up in the concentration of oxygen is prevented
- local temperature rises are prevented by the movement of the air
- particles of flour suspended in the air are removed
- the slow accumulation of carbon monoxide is prevented.

6.

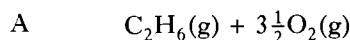


Kinetic energy of molecules

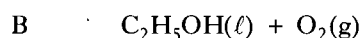
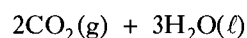
Which of the following is the correct interpretation of the above energy distribution diagram for a reaction as the temperature **decreases** from T_2 to T_1 ?

	Activation energy (E_A)	Number of successful collisions
A	remains the same	increases
B	decreases	decreases
C	decreases	increases
D	remains the same	decreases

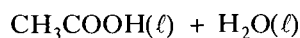
7. Which of the following equations illustrates an enthalpy of combustion?



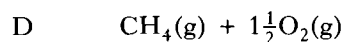
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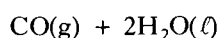
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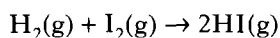
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[Turn over

8. The bond enthalpy of a gaseous diatomic molecule is the energy required to break one mole of the covalent bonds. It is also the energy released in the formation of one mole of the bonds from the atoms involved.

Bond	Bond enthalpy/kJ mol ⁻¹
H — H	432
I — I	149
H — I	295



What is the enthalpy change, in kJ mol⁻¹, for the above reaction?

- A +9
 B -9
 C +286
 D -286
9. Which of the following equations represents the first ionisation energy of chlorine?
- A $\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$
 B $\text{Cl}^+(\text{g}) + \text{e}^- \rightarrow \text{Cl}(\text{g})$
 C $\text{Cl}(\text{g}) \rightarrow \text{Cl}^+(\text{g}) + \text{e}^-$
 D $\text{Cl}^-(\text{g}) \rightarrow \text{Cl}(\text{g}) + \text{e}^-$
10. Which of the following elements has the smallest electronegativity?
- A Lithium
 B Caesium
 C Fluorine
 D Iodine
11. A substance melts at 1074°C and boils at 1740°C. The passage of an electric current through the molten substance results in electrolysis.
- What type of structure is present in the substance?
- A Ionic
 B Metallic
 C Covalent molecular
 D Covalent network

12. Which of the following occurs when crude oil is distilled?
- A Covalent bonds break and form again.
 B Van der Waals' bonds break and form again.
 C Covalent bonds break and van der Waals' bonds form.
 D Van der Waals' bonds break and covalent bonds form.

13. Which of the following has a covalent molecular structure?
- A Radium chloride
 B A noble gas
 C Silicon dioxide
 D A fullerene

14. A metal (melting point 328°C, density 11.3 g cm⁻³) was obtained by electrolysis of its molten chloride (melting point 501°C, density 5.84 g cm⁻³).

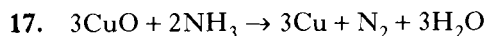
During the electrolysis, how would the metal occur?

- A As a solid on the surface of the electrolyte
 B As a liquid on the surface of the electrolyte
 C As a solid at the bottom of the electrolyte
 D As a liquid at the bottom of the electrolyte
15. Which of the following gases contains the smallest number of molecules?
- A 100 g fluorine
 B 100 g nitrogen
 C 100 g oxygen
 D 100 g hydrogen

16. Approximately how many atoms will be present in 11.5 litres of carbon monoxide?

(Take the molar volume of carbon monoxide to be 23 litres mol⁻¹.)

- A 1.5×10^{23}
 B 3×10^{23}
 C 6×10^{23}
 D 1.2×10^{24}

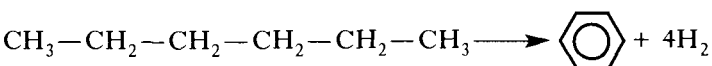


What volume of gas, in cm^3 , would be obtained by reaction between 100cm^3 of ammonia gas and excess copper(II) oxide?

(All volumes are measured at atmospheric pressure and 20°C .)

- A 50
- B 100
- C 200
- D 400

18. The following reaction



can take place during

- A dehydration
- B cracking
- C hydrogenation
- D reforming.

19. Biogas is produced under anaerobic conditions by the fermentation of biological materials.

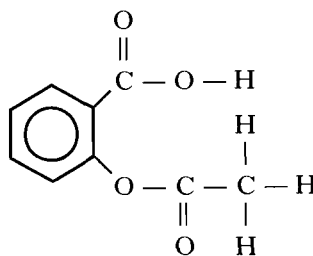
What is the main constituent of biogas?

- A Butane
- B Ethane
- C Methane
- D Propane

20. Which of the following organic compounds is an isomer of hexanal?

- A 2-Methylbutanal
- B 3-Methylpentan-2-one
- C 2,2-Dimethylbutan-1-ol
- D 3-Ethylpentanal

21. Aspirin is one of the most widely used pain relievers in the world. It has the structure:



Which **two** functional groups are present in an aspirin molecule?

- A Aldehyde and ketone
- B Carboxyl and ester
- C Ester and aldehyde
- D Hydroxyl and carboxyl

22. Which of the following hydrocarbons always gives the same product when one of its hydrogen atoms is replaced by a chlorine atom?

- A Hexane
- B Hex-1-ene
- C Cyclohexane
- D Cyclohexene

23. Oxidation of 4-methylpentan-2-ol using copper(II) oxide results in the alcohol

- A losing 2 g per mole
- B gaining 2 g per mole
- C gaining 16 g per mole
- D not changing in mass.

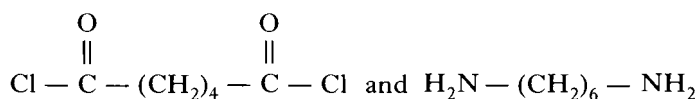
24. Ozone has an important role in the upper atmosphere because it

- A reflects certain CFCs
- B absorbs certain CFCs
- C reflects ultraviolet radiation
- D absorbs ultraviolet radiation.

25. Synthesis gas consists mainly of

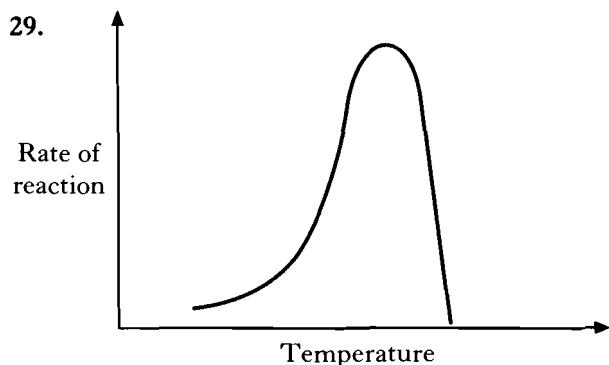
- A CH_4 alone
- B CH_4 and CO
- C CO and H_2
- D CH_4 , CO and H_2 .

26. The following monomers can be used to prepare nylon-6,6.



What molecule is released during the polymerisation reaction between these monomers?

- A HCl
 B H₂O
 C NH₃
 D HOCl
27. Which of the following statements about nylon and polystyrene is true?
- A Both are thermosetting plastics.
 B Both are condensation polymers.
 C Both give off carbon dioxide and water vapour on burning.
 D Both have hydrogen bonds between the polymer chains.
28. Proteins can be denatured under acid conditions.
 During this denaturing, the protein molecule
- A changes shape
 B is dehydrated
 C is neutralised
 D is polymerised.



The above diagram could represent

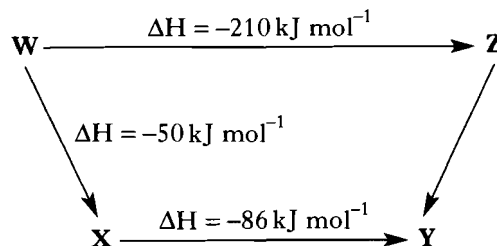
- A fermentation of glucose
 B neutralisation of an acid by an alkali
 C combustion of sucrose
 D reaction of a metal with acid.

30. The costs involved in the industrial production of a chemical are made up of fixed costs and variable costs.

Which of the following is most likely to be classified as a variable cost?

- A The cost of land rental
 B The cost of plant construction
 C The cost of labour
 D The cost of raw materials
31. Which of the following is produced by a batch process?
- A Sulphuric acid from sulphur and oxygen
 B Aspirin from salicylic acid
 C Iron from iron ore
 D Ammonia from nitrogen and hydrogen

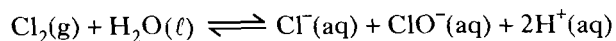
32. Consider the reaction pathway shown below.



According to Hess's Law, the ΔH value, in kJ mol^{-1} , for reaction Z to Y is

- A +74
 B -74
 C +346
 D -346.
33. Chemical reactions are in a state of dynamic equilibrium only when
- A the reaction involves zero enthalpy change
 B the concentrations of reactants and products are equal
 C the rate of the forward reaction equals that of the backward reaction
 D the activation energies of the forward and backward reactions are equal.

34.



The addition of which of the following substances would move the above equilibrium to the right?

- A Hydrogen
- B Hydrogen chloride
- C Sodium chloride
- D Sodium hydroxide

35. A trout fishery owner added limestone to his loch to combat the effects of acid rain. He managed to raise the pH of the water from 4 to 6.

The concentration of the $\text{H}^+(\text{aq})$

- A increased by a factor of 2
- B increased by a factor of 100
- C decreased by a factor of 2
- D decreased by a factor of 100.

36. The concentration of $\text{OH}^-(\text{aq})$ ions in a solution is 0.1 mol l^{-1} .

What is the pH of the solution?

- A 1
- B 8
- C 13
- D 14

37. A white solid dissolves in water, giving an alkaline solution, and reacts with dilute hydrochloric acid, giving off a gas.

(You may wish to refer to the data booklet.)

The solid could be

- A copper(II) ethanoate
- B potassium carbonate
- C ammonium chloride
- D lead(II) carbonate.

38. Which of the following is a redox reaction?

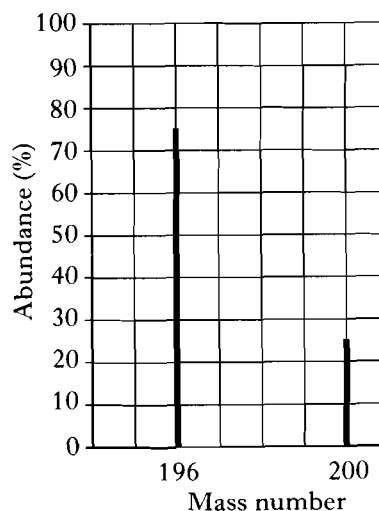
- A $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
- B $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- C $\text{NiO} + 2\text{HCl} \rightarrow \text{NiCl}_2 + \text{H}_2\text{O}$
- D $\text{CuCO}_3 + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

39. Phosphorus-32 is made by neutron capture for use as a tracer in phosphate fertilisers.

From which of the following isotopes is phosphorus-32 made by neutron capture?

- A ${}_{16}^{31}\text{S}$
- B ${}_{15}^{31}\text{P}$
- C ${}_{14}^{31}\text{Si}$
- D ${}_{16}^{32}\text{S}$

40. The chart below was obtained from an 8-day old sample of an α -emitting radioisotope.



What is the half-life of the radioisotope?

- A 2 days
- B 4 days
- C 8 days
- D 12 days

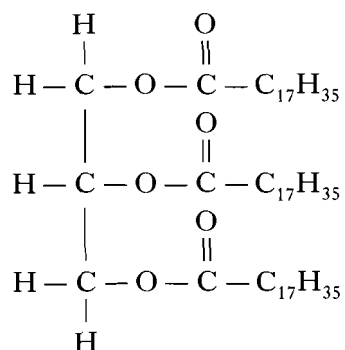
Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of this answer book.

[Turn over for SECTION B on Page eight]

Marks

SECTION B

1. The structure of a fat molecule is shown below.



- (a) When the fat is hydrolysed, a fatty acid is obtained.
Name the other product obtained in this reaction.

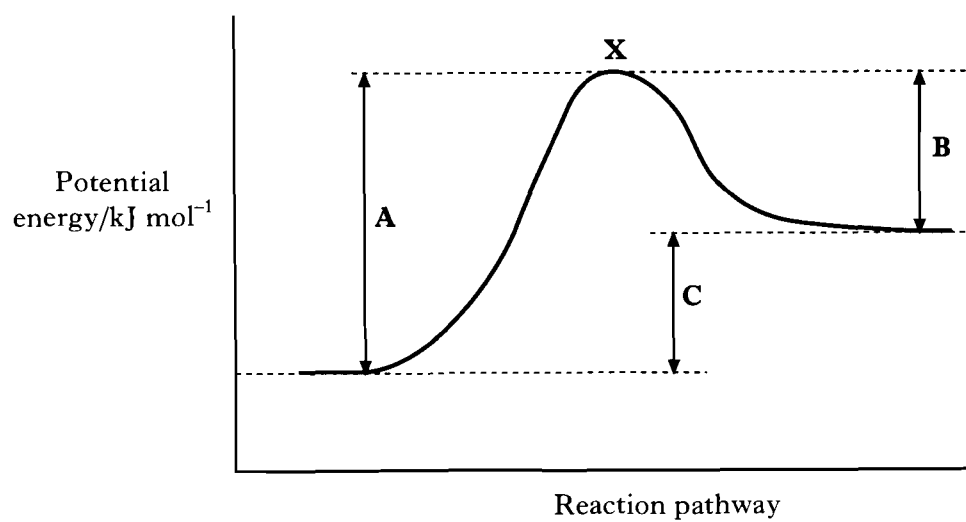
1

- (b) Oils are liquid at room temperature; fats are solid.
Why do oils have lower melting points than fats?

1
(2)

Marks

2. The diagram below shows energy changes **A**, **B** and **C** for a reversible reaction.



- (a) What could be used to decrease both **A** and **B** but **not** change **C**?
- (b) Give the name of the unstable arrangement of atoms formed at point **X**.

1

1
(2)

[Turn over

Marks

3. (a) Acidified potassium dichromate solution can be used to oxidise some alcohols to aldehydes and then to carboxylic acids, eg



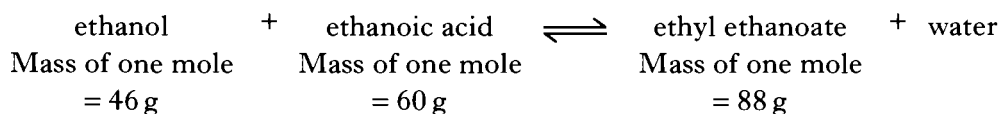
- (i) Name the type of alcohol that can be oxidised to an aldehyde.

1

- (ii) What colour change would be observed when acidified potassium dichromate solution is used to produce ethanoic acid from ethanal?

1

- (b) Ethanol and ethanoic acid react to form the ester, ethyl ethanoate.



- (i) Clearly describe how the reaction mixture would be heated in the laboratory formation of the ester.

1

- (ii) Use the above information to calculate the percentage yield of ethyl ethanoate if 5.0 g of ethanol produced 5.8 g of ethyl ethanoate on reaction with excess ethanoic acid.

Show your working clearly.

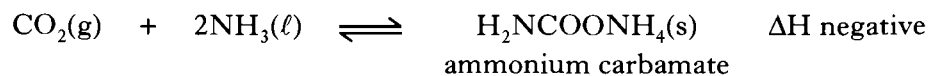
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(5)

Marks

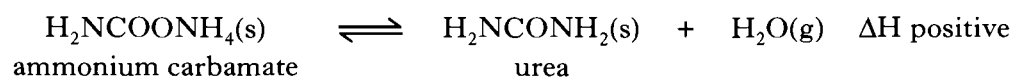
4. Urea, H_2NCONH_2 , has several uses, eg as a fertiliser and for the manufacture of some thermosetting plastics.

It is produced in a two-step process.

Step one



Step two



- (a) (i) What would happen to the equilibrium position in **step one** if the temperature was increased?

1

- (ii) **Step two** is carried out at low pressure.

Why does lowering the pressure move the equilibrium position to the right?

1

- (b) Draw the full structure for the negative ion in ammonium carbamate.

1

(3)

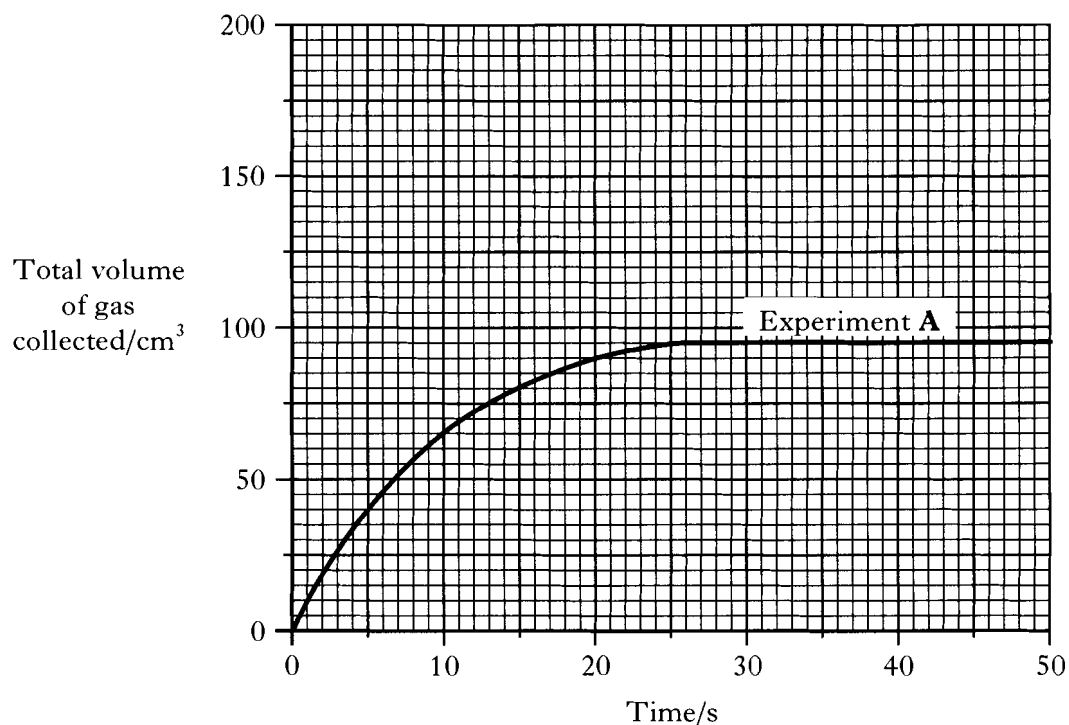
[Turn over

Marks

5. The rate of carbon dioxide production was measured in three laboratory experiments carried out at the same temperature and using excess calcium carbonate.

Experiment	Acid	Calcium carbonate
A	40 cm ³ of 0.10 mol l ⁻¹ sulphuric acid	1 g lumps
B	40 cm ³ of 0.10 mol l ⁻¹ sulphuric acid	1 g powder
C	40 cm ³ of 0.10 mol l ⁻¹ hydrochloric acid	1 g lumps

The curve obtained for Experiment A is shown.



- (a) Use the graph to calculate the average reaction rate, in cm³ s⁻¹, between 10 and 20 s.

5. (continued)

Marks

(b) Draw curves on the graph to show results that could be obtained for experiments **B** and **C**.

Label each curve clearly.

2

(Additional graph paper, if required, can be found on page 31.)

(c) Draw a labelled diagram of the assembled apparatus which could be used to carry out this experiment.

2

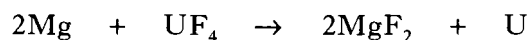
(5)

[Turn over

Marks

6. Uranium ore is converted into uranium(IV) fluoride, UF_4 , to produce fuel for nuclear power stations.

(a) In one process, uranium can be extracted from the uranium(IV) fluoride by a redox reaction with magnesium, as follows.



(i) Give another name for this type of redox reaction.

1

(ii) Write the ion-electron equation for the reduction reaction that takes place.

1

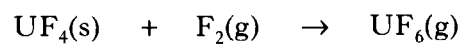
(iii) The reaction with magnesium is carried out at a high temperature. The reaction vessel is filled with argon rather than air. Suggest a reason for using argon rather than air.

1

Marks

6. (continued)

(b) In a second process, the uranium(IV) fluoride is converted into UF₆ as shown.



(i) Name the type of bonding in UF₆(g).

1

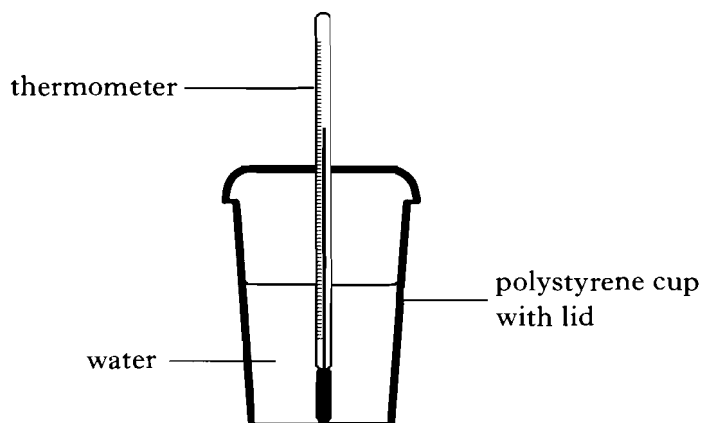
(ii) Both UF₄ and UF₆ are radioactive.

How does the half-life of the uranium in UF₄ compare with the half-life of the uranium in UF₆?

**1
(5)****[Turn over**

Marks

7. The following apparatus can be used to determine the enthalpy of solution of a substance.



- (a) Why was the experiment carried out in a polystyrene cup with a lid?

1

- (b) In an experiment to find the enthalpy of solution of potassium hydroxide, KOH, a student added 3.6 g of the solid to the water in the polystyrene cup and measured the temperature rise. From this, it was calculated that the heat energy produced in the reaction was 3.5 kJ.

Use this information to calculate the enthalpy of solution of potassium hydroxide.

Show your working clearly.

2
(3)

Marks

8. Acid-base reactions are common in chemistry.

- (a) Write the balanced equation for the reaction between copper(II) oxide and nitric acid.

1

- (b) An acid can be thought of as a chemical which can release H^+ ions.

In an acid-base reaction the H^+ ions released by the acid are accepted by the base.

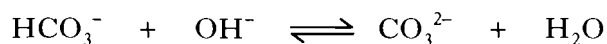
Some acid-base reactions are reversible. In these reactions both forward and reverse reactions involve the transfer of H^+ ions from the acid to the base.

- (i) Using the information given above, complete the table showing the acid and base produced when HS^- ions react with H_3O^+ ions.

Acid	Base		Acid	Base
H_2O	NH_3	\rightleftharpoons	NH_4^+	OH^-
H_3O^+	HS^-	\rightleftharpoons		

1

- (ii) Another reversible acid-base reaction is shown.



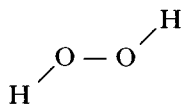
In the reverse reaction, state whether the water is acting as an acid or a base.

1
(3)

[Turn over

Marks

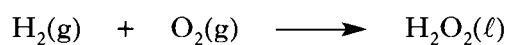
9. Hydrogen peroxide has a high viscosity.
The structure of hydrogen peroxide is shown below.



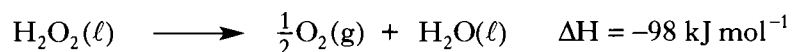
- (a) Name the type of intermolecular force that is responsible for hydrogen peroxide's high viscosity.

1

- (b) Hydrogen peroxide may be prepared from its elements.
The equation for the reaction is:



Calculate the enthalpy change, in kJ mol^{-1} , for the above reaction using the enthalpy of combustion of hydrogen from the data booklet and the enthalpy change for the following reaction.



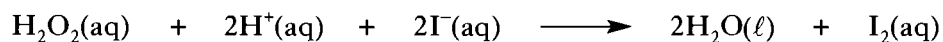
Show your working clearly.

2

Marks

9. (continued)

- (c) The following solution mixtures were used in a series of experiments involving the reaction between hydrogen peroxide in acid solution and potassium iodide solution.



	Volume of KI(aq)/cm ³	Volume of H ₂ O(ℓ)/cm ³	Volume of H ₂ O ₂ (aq)/cm ³	Volume of H ₂ SO ₄ (aq)/cm ³	Volume of Na ₂ S ₂ O ₃ (aq)/cm ³	Rate/ s ⁻¹
A	25	0	5	10	10	0.020
B	20	5	5	10	10	0.016
C	15	10	5	10	10	0.012
D	10	15	5	10	10	0.008
E	5	20	5	10	10	0.004

- (i) From the information in the shaded columns in the table above, what variable is being kept constant throughout the series of experiments?

1

- (ii) What was the aim of the series of experiments?

1

- (iii) Calculate the time, in seconds, for the reaction in Experiment A.

1

(6)

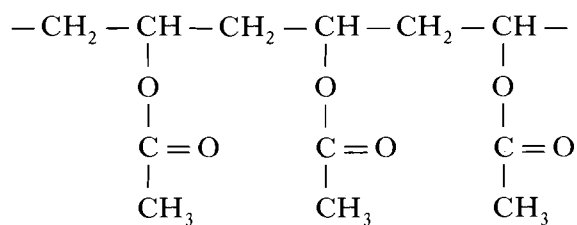
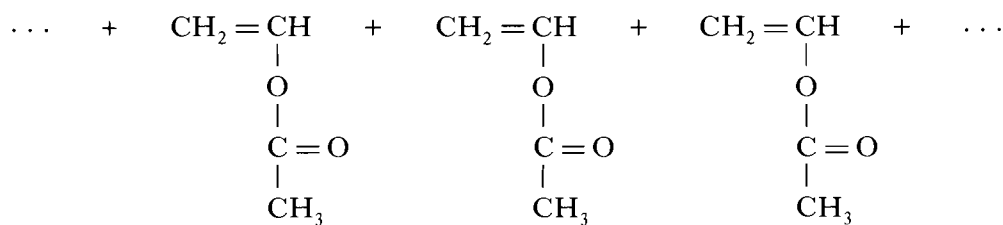
Marks

10. Poly(ethenol) has an unusual property for a plastic.

(a) What is this unusual property?

1

(b) (i) A step in the manufacture of poly(ethenol) is shown below.



poly(ethenyl ethanoate)

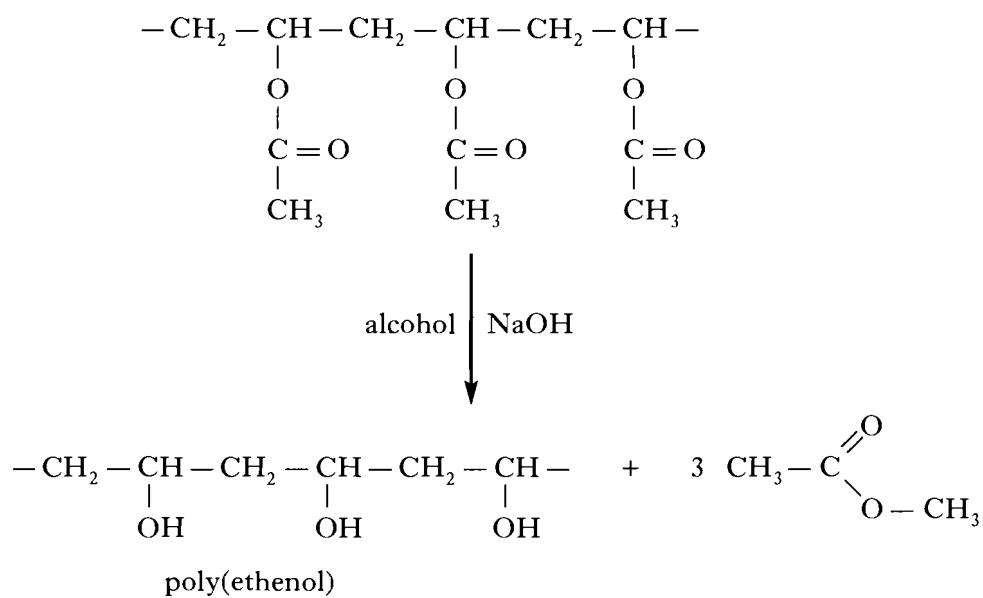
Name the type of polymerisation which takes place in this step.

1

Marks

10. (continued)

- (ii) The next step is ester exchange. This involves the removal of the ester side chains by reaction with an alcohol and sodium hydroxide.



Name the alcohol used in this step.

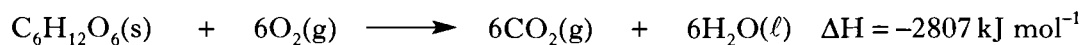
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(3)

[Turn over

Marks

11. Respiration provides energy for the body through “combustion” of glucose.

The equation for the enthalpy of combustion of glucose is:



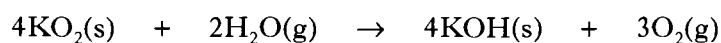
- (a) Calculate the volume of oxygen, in litres, required to provide 418 kJ of energy.
(Take the molar volume of oxygen to be 24 litres mol⁻¹.)

Show your working clearly.

2

- (b) In a poisonous atmosphere, a gas mask can be used to provide the oxygen needed for respiration. One type of gas mask contains potassium superoxide, KO₂, which reacts with water vapour to produce oxygen.

The balanced equation for the reaction is:



- (i) Suggest why this reaction allows the same air to be breathed again and again.

1

- (ii) Why is this type of mask also able to remove the carbon dioxide produced by respiration?

1
(4)

12. Ethanoic acid, $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ (aq), is a weak acid; hydrochloric acid, $\text{HCl}(\text{aq})$, is a strong acid.

Marks

Using ethanoic acid and hydrochloric acid as examples, explain the differences in both pH and conductivity between 0.1 mol l^{-1} solutions of a strong and weak acid.

You may wish to use suitable equations in your answer.

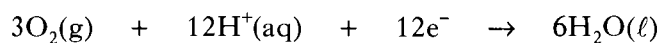
(3)

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Marks

13. Fuel cells can be used to power cars.

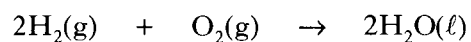
- (a) (i) The ion-electron equations for the oxidation and reduction reactions that take place in a methanol fuel cell are:



Combine the two ion-electron equations to give the equation for the overall redox reaction.

1

- (ii) The equation for the overall redox reaction in a hydrogen fuel cell is



Give a disadvantage of the methanol fuel cell reaction compared to the hydrogen fuel cell reaction.

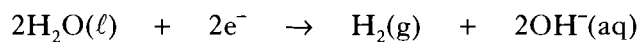
1

Marks

13. (continued)

- (b) The hydrogen gas for use in fuel cells can be produced by the electrolysis of water.

Hydrogen is produced at the negative electrode as shown.



Calculate the volume of hydrogen gas produced when a steady current of 0.50 A is passed through water for 30 minutes.

(Take the molar volume of hydrogen to be 24 litres mol⁻¹.)

Show your working clearly.

3
(5)

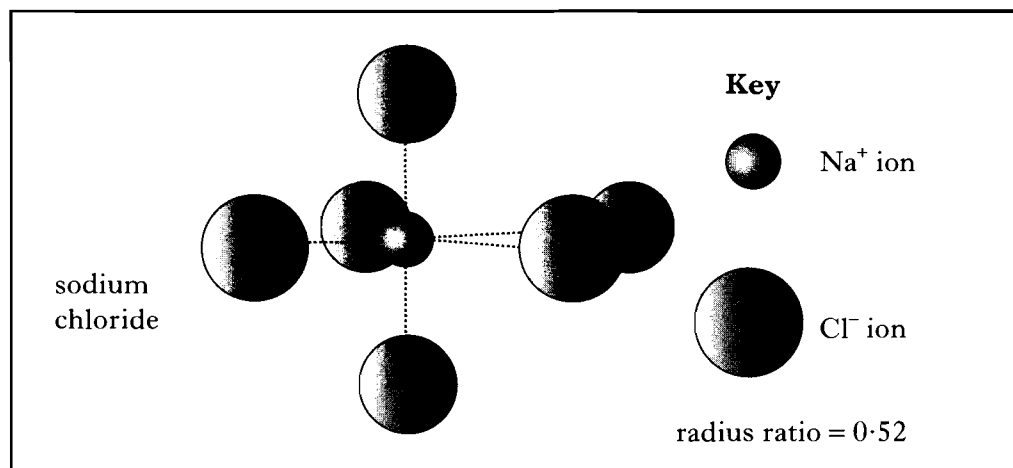
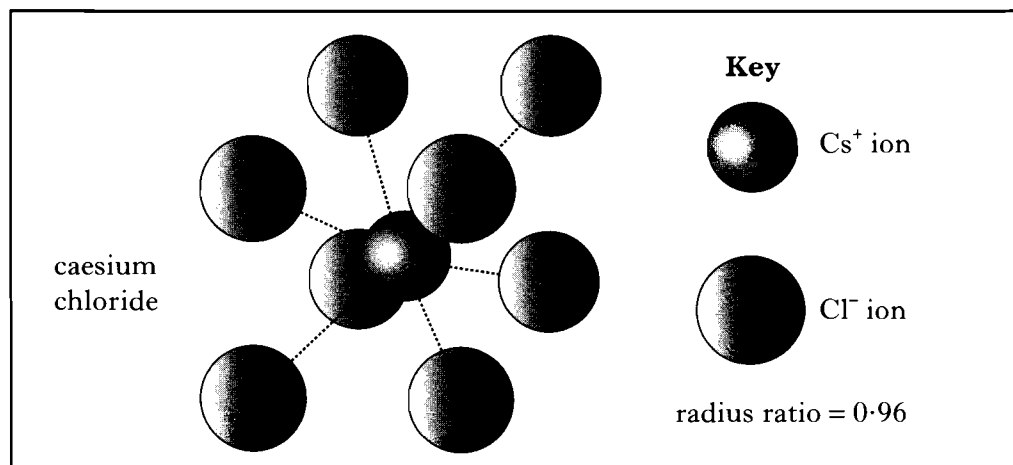
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Marks

14. The structure of an ionic compound consists of a giant lattice of oppositely charged ions. The arrangement of ions is determined mainly by the “radius ratio” of the ions involved.

$$\text{radius ratio} = \frac{\text{radius of positive ion}}{\text{radius of negative ion}}$$

The arrangements for caesium chloride, CsCl, and sodium chloride, NaCl, are shown below.



- (a) By using the table of ionic radii on page 16 of the data booklet, calculate the radius ratio for magnesium oxide, MgO, and state which of the two arrangements, caesium chloride or sodium chloride, it is more likely to adopt.

Marks

14. (continued)

- (b) The enthalpy of lattice breaking is the energy required to completely separate the ions from one mole of an ionic solid.

The table shows the enthalpies of lattice breaking, in kJ mol^{-1} , for some alkali metal halides.

Ions	F^-	Cl^-	Br^-
Li^+	1030	834	788
Na^+	910	769	732
K^+	808	701	671

Write a general statement linking the enthalpy of lattice breaking to ion size.

1
(2)

[Turn over

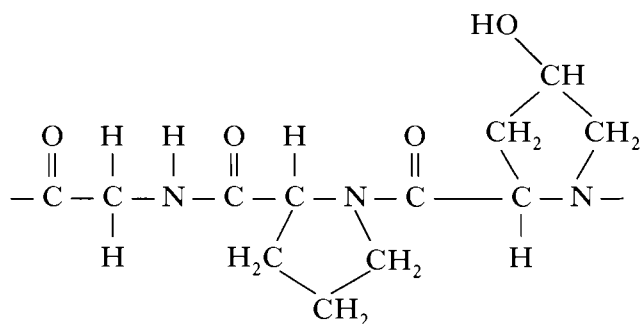
Marks

15. Vitamin C is required by our bodies for producing the protein, collagen. Collagen can form sheets that support skin and internal organs.

- (a) (i) There are two main types of protein.
Which of the two main types is collagen?

1

- (ii) Part of the structure of collagen is shown.



Draw a structural formula for an amino acid that could be obtained by hydrolysing this part of the collagen.

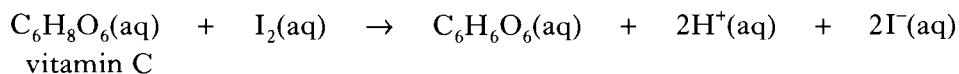
1

Marks

15. (continued)

- (b) A standard solution of iodine can be used to determine the mass of vitamin C in orange juice.

Iodine reacts with vitamin C as shown by the following equation.



In an investigation using a carton containing 500 cm³ of orange juice, separate 50.0 cm³ samples were measured out. Each sample was then titrated with a 0.0050 mol l⁻¹ solution of iodine.

- (i) Why would starch solution be added to each 50.0 cm³ sample of orange juice before titrating against iodine solution?

1

- (ii) Titrating the whole carton of orange juice would require large volumes of iodine solution.

Apart from this disadvantage give another reason for titrating several smaller samples of orange juice.

1

- (iii) An average of 21.4 cm³ of the iodine solution was required for the complete reaction with the vitamin C in 50.0 cm³ of orange juice.

Use this result to calculate the mass of vitamin C, in grams, in the 500 cm³ carton of orange juice.

Show your working clearly.

2

(6)

Marks

16. Carbon compounds take part in many different types of reactions.

ethanol \longrightarrow ethene

ethyne $\xrightarrow{\text{addition}}$ compound **Y** $\xrightarrow{\text{hydrogenation}}$ monochloroethane

cyclohexanol $\xrightarrow{\text{oxidation}}$ compound **Z**

(a) Name the type of reaction that takes place in the formation of ethene from ethanol.

1

(b) Draw a structural formula for

(i) compound **Y**;

1

(ii) compound **Z**.

1
(3)

[END OF QUESTION PAPER]