

FOR OFFICIAL USE

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**X012/201**

Section B      Total  
Marks

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NATIONAL  
QUALIFICATIONS  
2001

THURSDAY, 24 MAY  
9.00 AM – 11.00 AM

CHEMISTRY  
INTERMEDIATE 2

**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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Necessary data will be found in the Chemistry Data Booklet for Standard Grade and Intermediate 2 (1999 Edition).

**Section A —Part 1 Questions 1 to 25 and Part 2 Questions 26, 27 and 28**

Instructions for completion of **Part 1** and **Part 2** are given on pages two and eight respectively.

**Section B (Questions 1 to 16)**

All questions should be attempted.

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.

Rough work, if any should be necessary, as well as the fair copy, is to be written in this book.

Rough work should be scored through when the fair copy has been written.

Additional space for answers and rough work 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.

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.

## SECTION A

### PART 1

Check that the answer sheet provided is for Chemistry Intermediate 2 (Section A).

Fill in the details required on the answer sheet.

**In questions 1 to 25 of this part of the paper, an answer is given by indicating the choice A, B, C or D by a stroke made in INK in the appropriate place in Part 1 of the answer sheet—see the sample question below.**

**For each question there is only ONE correct answer.**

Rough working, if required, should be done only on this question paper, or on the rough working sheet provided—not on the answer sheet.

At the end of the examination the answer sheet for Section A **must** be placed **inside** this answer book.

**This part of the paper is worth 25 marks.**

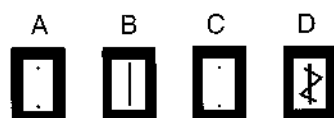
#### SAMPLE QUESTION

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

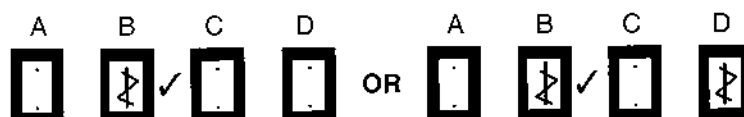
- A fractional distillation
- B chromatography
- C fractional crystallisation
- D filtration.

**The correct answer is B**—chromatography. A **heavy** vertical line should be drawn joining the two dots in the appropriate box in the column headed **B** as shown **in the example on the answer sheet**.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and put a vertical stroke in the box you now consider to be correct. Thus, if you want to change an answer **D** to an answer **B**, your answer sheet would look like this:



If you want to change back to an answer which has already been scored out, you should **enter a tick (✓)** to the **RIGHT** of the box of your choice, thus:



# SECTION A

## PART 1

1. Which element is an alkali metal?

- A Aluminium
- B Calcium
- C Copper
- D Sodium

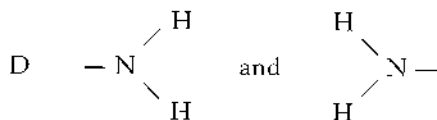
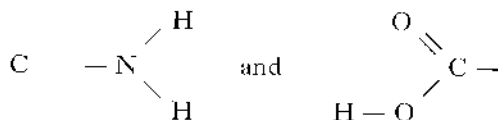
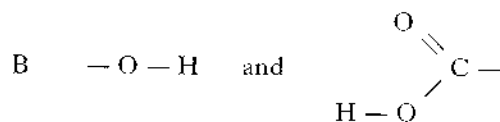
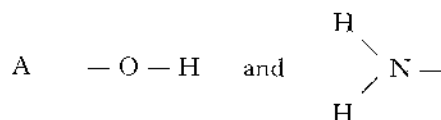
2. Which of the following is the electron arrangement for a metal?

- A 2, 8, 1
- B 2, 8, 5
- C 2, 8, 7
- D 2, 8, 8

3. Metallic bonding is a force of attraction between

- A positive ions and delocalised electrons
- B negative ions and delocalised electrons
- C negative ions and positive ions
- D a shared pair of electrons and two nuclei.

4. Which of the following groups can react together to form an amide (peptide) link?



5. Which pair of reactants would produce hydrogen most slowly?

- A Magnesium powder and  $4 \text{ mol l}^{-1}$  acid
- B Magnesium ribbon and  $2 \text{ mol l}^{-1}$  acid
- C Magnesium powder and  $2 \text{ mol l}^{-1}$  acid
- D Magnesium ribbon and  $4 \text{ mol l}^{-1}$  acid

6. The charge on the iron ion in  $\text{Fe}_2(\text{SO}_4)_3$  is

- A  $2^+$
- B  $3^+$
- C  $2^-$
- D  $3^-$

7. In a reaction,  $60 \text{ cm}^3$  of gas were collected in 20 s.

The average rate at which gas was given off, in  $\text{cm}^3 \text{ s}^{-1}$ , was

- A  $\frac{1}{20}$
- B  $\frac{1}{60}$
- C  $\frac{20}{60}$
- D  $\frac{60}{20}$

8. The gram formula mass of sodium carbonate is 106 g.

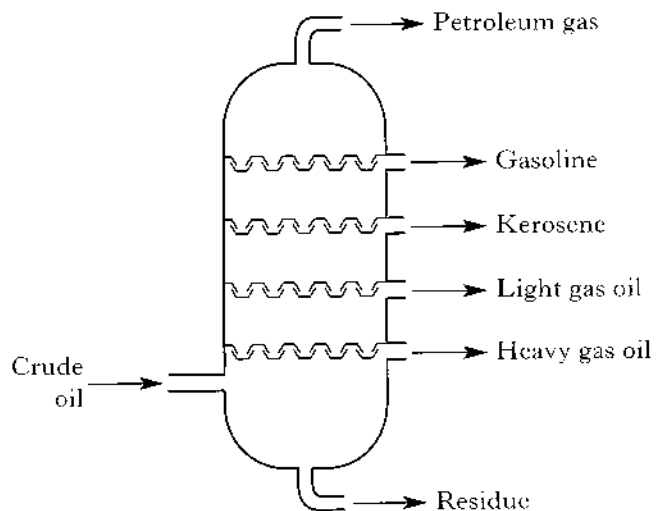
How many moles are present in 5.3 g of sodium carbonate?

- A 0.05
- B 0.5
- C 2
- D 20

[Turn over]

Questions 9 and 10 refer to the following information.

The fractional distillation of crude oil produces a number of different fractions.



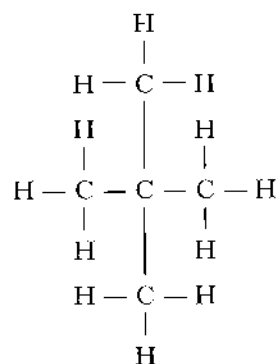
9. Which properties apply to a fraction which has a high boiling point?

- A High viscosity and low flammability
- B Low viscosity and low flammability
- C High viscosity and high flammability
- D Low viscosity and high flammability

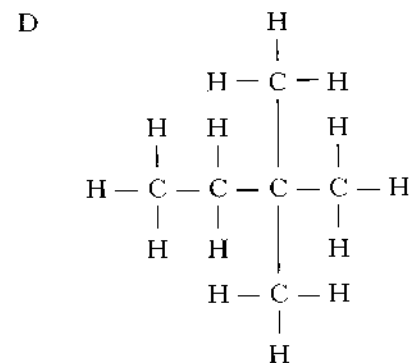
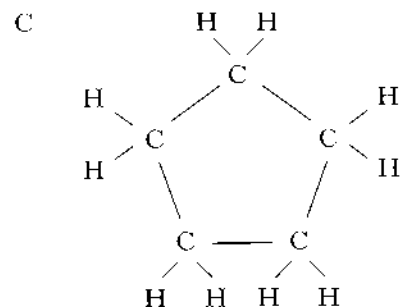
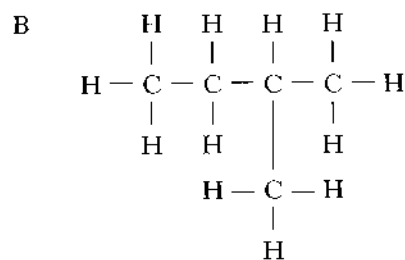
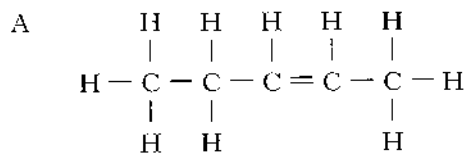
10. Which molecule is most likely to be present in kerosene?

- A  $C_5H_{12}$
- B  $C_{12}H_{26}$
- C  $C_{19}H_{40}$
- D  $C_{26}H_{54}$

11.



Which compound is an isomer of the one shown above?



12. A compound burns in air. The only products of the reaction are carbon dioxide, sulphur dioxide and water vapour.

The compound **must** contain

- A carbon and hydrogen only
- B carbon and sulphur only
- C carbon, hydrogen and sulphur
- D carbon, hydrogen, sulphur and oxygen.

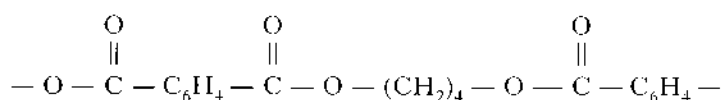
13. One way in which ethanol is produced industrially is shown below.



What name is given to this type of reaction?

- A Condensation
  - B Hydration
  - C Hydrolysis
  - D Oxidation
14. Biopol is a polymer which is
- A natural and biodegradeable
  - B synthetic and biodegradeable
  - C natural and non-biodegradeable
  - D synthetic and non-biodegradeable.

15. A section of a polymer is shown below.

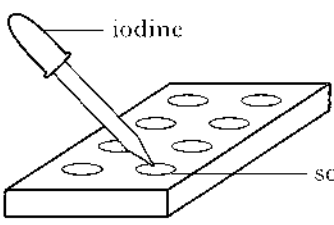


The polymer is

- A a polyamide formed by addition polymerisation
- B a polyamide formed by condensation polymerisation
- C a polyester formed by addition polymerisation
- D a polyester formed by condensation polymerisation.

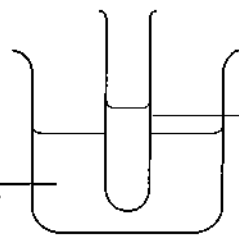
16. A solution containing two carbohydrates was tested as shown.

**Iodine test**



**Result:**  
The iodine turned blue-black

**Benedict's test**



**Result:**  
The Benedict's solution turned orange.

The solution could have contained

- A starch and sucrose
  - B starch and glucose
  - C glucose and maltose
  - D fructose and sucrose.
17. Which of the following correctly shows the elements present in carbohydrates and proteins?

	Carbohydrates	Proteins
A	C and H	C, H and O
B	C and H	C, H, O and N
C	C, H and O	C, H, O and N
D	C, H, O and N	C, H and O

[Turn over

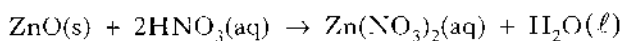
18. Ammonia dissolves in water to produce a solution with a pH of

- A 1
- B 4
- C 7
- D 11.

19. An acidic solution contains

- A only hydrogen ions
- B equal numbers of hydrogen and hydroxide ions
- C more hydrogen ions than hydroxide ions
- D more hydroxide ions than hydrogen ions.

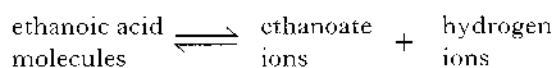
20.



What type of chemical reaction is represented by the above equation?

- A Condensation
- B Dehydration
- C Neutralisation
- D Precipitation

21. Dilute ethanoic acid exists as an equilibrium mixture.



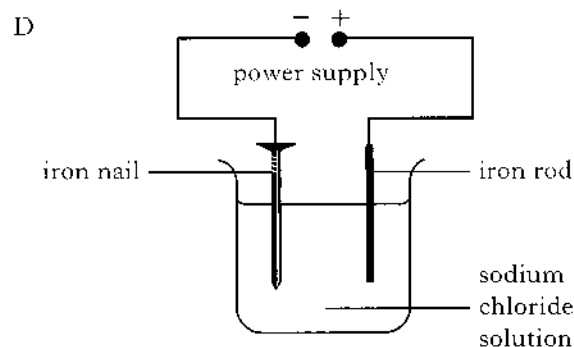
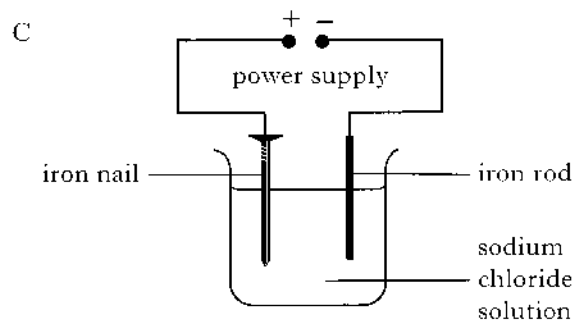
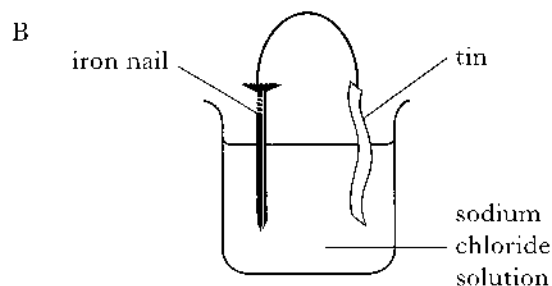
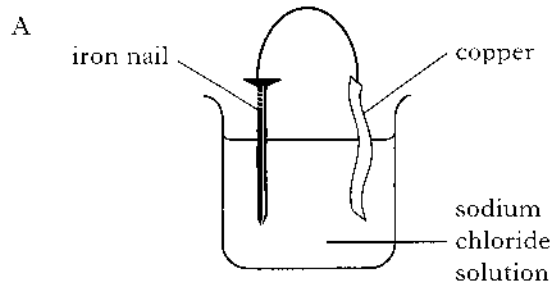
Which statement about the mixture is correct?

- A The ethanoic acid molecules have stopped dissociating into ions.
- B The ethanoic acid molecules have all dissociated into ions.
- C The concentrations of ethanoate ions and hydrogen ions are equal.
- D The concentrations of ethanoic acid molecules and ethanoate ions are equal.

22. Which of the following **does not** happen during the corrosion of iron?

- A The iron is reduced.
- B A compound is formed.
- C Iron(II) ions lose one electron to become iron(III) ions.
- D Iron atoms lose two electrons to form iron(II) ions.

23. In which experiment would the iron nail **not** rust?

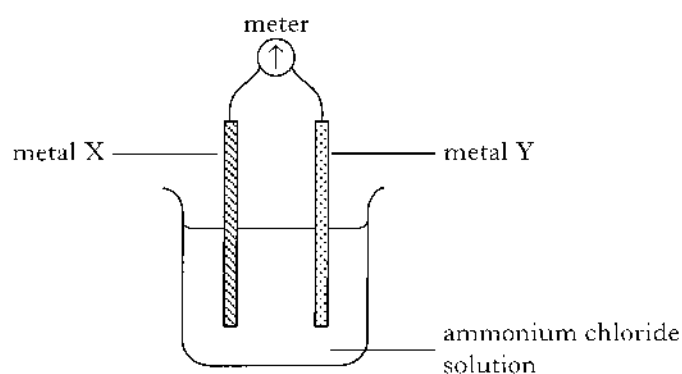


24. Which solution will react with magnesium metal?

You may wish to refer to page 7 of the Data Booklet.

- A Magnesium chloride
- B Potassium chloride
- C Sodium chloride
- D Zinc chloride

25. Which pair of metals, when connected in a cell, would give the highest voltage and a flow of electrons from X to Y?



	Metal X	Metal Y
A	magnesium	copper
B	copper	magnesium
C	zinc	tin
D	tin	zinc

[Turn over

## SECTION A

### PART 2

In Questions 26, 27 and 28 of this part of the paper, an answer is given by circling the appropriate letter (or letters) in the answer grid provided.

In some questions, two letters are required for full marks.

If more than the correct number of answers is given, marks will be deducted.

In some cases, the number of correct responses may NOT be identified in the question.

A total of 5 marks is available in this part of the paper.

#### SAMPLE QUESTION

A	CH <sub>4</sub>	B	H <sub>2</sub>	C	CO <sub>2</sub>
D	CO	E	C <sub>2</sub> H <sub>5</sub> OH	F	C

(a) Identify the hydrocarbon.

<input checked="" type="radio"/> A	B	C
D	E	F

The one correct answer to part (a) is A. This should be circled.

(b) Identify the **two** elements.

A	<input checked="" type="radio"/> B	C
D	E	<input checked="" type="radio"/> F

As indicated in this question, there are **two** correct answers to part (b). These are B and F. Both answers are circled.

(c) Identify the substance(s) which can burn to produce **both** carbon dioxide and water.

<input checked="" type="radio"/> A	B	C
D	<input checked="" type="radio"/> E	F

There are **two** correct answers to part (c). These are A and E.

Both answers are circled.

If, after you have recorded your answer, you decide that you have made an error and wish to make a change, you should cancel the original answer and circle the answer you now consider to be correct. Thus, in part (a), if you want to change an answer A to an answer D, your answer sheet would look like this:

<input checked="" type="radio"/> A	B	C
<input checked="" type="radio"/> D	E	F

If you want to change back to an answer which has already been scored out, you should enter a tick (✓) in the box of the answer of your choice, thus:

✓ <input checked="" type="radio"/> A	B	C
<input checked="" type="radio"/> D	E	F



26. Ions are formed when atoms lose or gain electrons.

A		B	
	fluorine		oxygen
C		D	
	potassium		sulphur

Which **two** elements form ions with the same electron arrangement as **argon atoms**?

A	B
C	D

27. Caesium forms a compound with fluorine.

Which statement(s) can be applied to this compound?

A	The formula is $\text{CsF}_2$
B	The bonding is covalent
C	The melt conducts electricity
D	The solid conducts electricity
E	The melting point is higher than $0^\circ\text{C}$

A
B
C
D
E

[Turn over

28. The grid shows some sulphur compounds.

<div data-bbox="215 235 268 291">A</div> $\text{CH}_3 - \text{S} - \text{C}_2\text{H}_5$	<div data-bbox="710 235 762 291">B</div> $\text{C}_2\text{H}_5 - \text{S} - \text{C}_2\text{H}_5$
<div data-bbox="215 537 268 593">C</div> $\begin{array}{c} \text{CH}_3 \\   \\ \text{CH}_3 - \text{C} - \text{S} - \text{H} \\   \\ \text{H} \end{array}$	<div data-bbox="710 537 762 593">D</div> $\begin{array}{cc} \text{CH}_2 & - & \text{CH}_2 \\   & &   \\ \text{CH}_2 & & \text{CH}_2 \\ & \diagdown & / \\ & \text{S} & \end{array}$

(a) Identify the **two** compounds which have the same molecular formula.

A	B
C	D

(b) Identify the compound which has the general formula  $\text{C}_n\text{H}_{2n}\text{S}$ .

A	B
C	D

**Candidates are reminded that the answer sheet MUST be returned INSIDE this answer book.**

Marks

## SECTION B

50 marks are available in this section of the paper.

1. The most common isotope of potassium is  ${}^{39}_{19}\text{K}$ .

- (a) Complete the table to show the number of particles in an atom of  ${}^{39}_{19}\text{K}$ .

Type of particle	Number of particles
proton	
neutron	
electron	

1

- (b) How do isotopes of potassium differ from each other?

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1  
(2)

[Turn over]

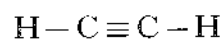
Marks

2. A very hot flame is produced when ethyne gas ( $C_2H_2$ ) burns in a plentiful supply of oxygen.

(a) Name the products formed in this reaction.

1

- (b) Ethyne is the first member of an homologous series called the alkynes. Ethyne has the following structure.



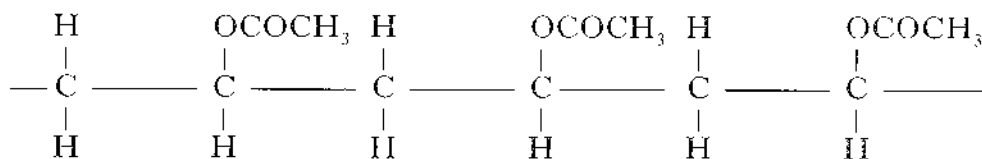
All the members of the alkyne series have a triple carbon to carbon bond.

Complete the table below.

Position in series	Name	Molecular formula
1st	ethyne	$C_2H_2$
2nd		$C_3H_4$
3rd	butyne	

2  
(3)

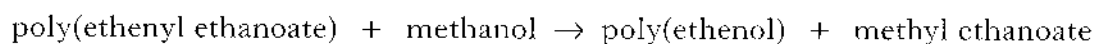
- 2 Poly(ethenyl ethanoate) is an addition polymer. Part of its structure is shown below.



- (a) Draw the structural formula for the monomer used to make this polymer.

1

- (b) Poly(ethenyl ethanoate) is used to make the polymer poly(ethenol).



Methyl ethanoate is also formed in the reaction.

- (i) What property of poly(ethenol) makes it useful for laundry bags?

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1

- (ii) Draw a structural formula for methyl ethanoate.

1  
(3)

[Turn over]

Marks

**1**

4. (a) Write the formula for copper(II) nitrate.

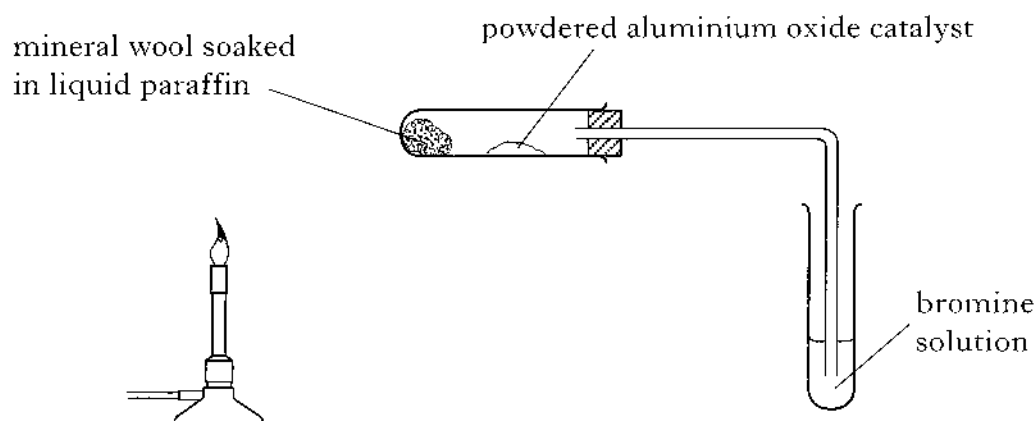
(b) Calculate the number of moles of solute contained in  $250\text{ cm}^3$  of  $0.2\text{ mol l}^{-1}$  copper(II) nitrate solution.

Answer \_\_\_\_\_ moles

**1  
(2)**

Marks

5. Students set up the apparatus below to carry out the **PPA "Cracking"**.



- (a) The PPA gives special instructions as to how the test tube should be heated.

Describe how the test tube should be heated.

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1

- (b) (i) The bromine solution is decolourised.

What does this tell you about the gases produced by cracking?

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1

- (ii) How is "suck back" avoided?

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1

- (c) In this experiment, the aluminium oxide is acting as a heterogeneous catalyst.

What is meant by a **heterogeneous** catalyst?

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1

(4)

[Turn over

Marks

6. (a) What type of chemical reaction takes place when a metal is obtained from a metal oxide?

\_\_\_\_\_

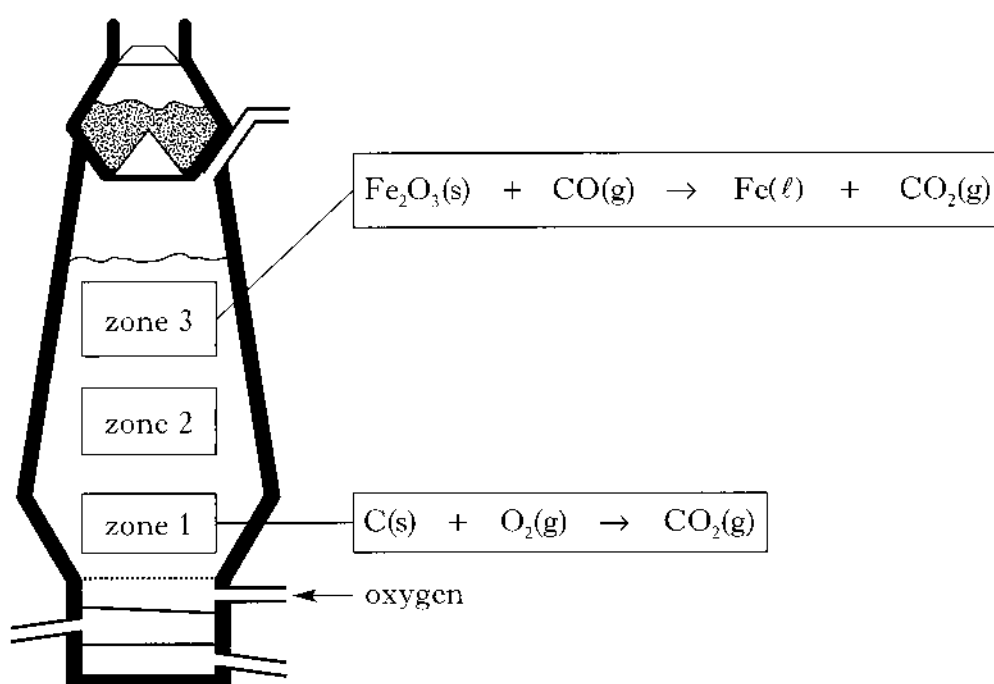
1

- (b) Name a metal which can be obtained from its oxide using only heat.

\_\_\_\_\_

1

- (c) Iron is produced from iron oxide in a Blast Furnace.



Blast Furnace

In zone 1, the coke (carbon) initially reacts with oxygen to produce carbon dioxide.

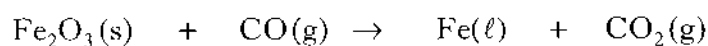
In zone 3, the iron oxide in the ore reacts with carbon monoxide to produce molten iron metal.

- (i) How is the carbon dioxide converted to carbon monoxide in zone 2?

\_\_\_\_\_  
\_\_\_\_\_

1

- (ii) The equation for the reaction taking place in zone 3 is shown below.



Balance this equation.

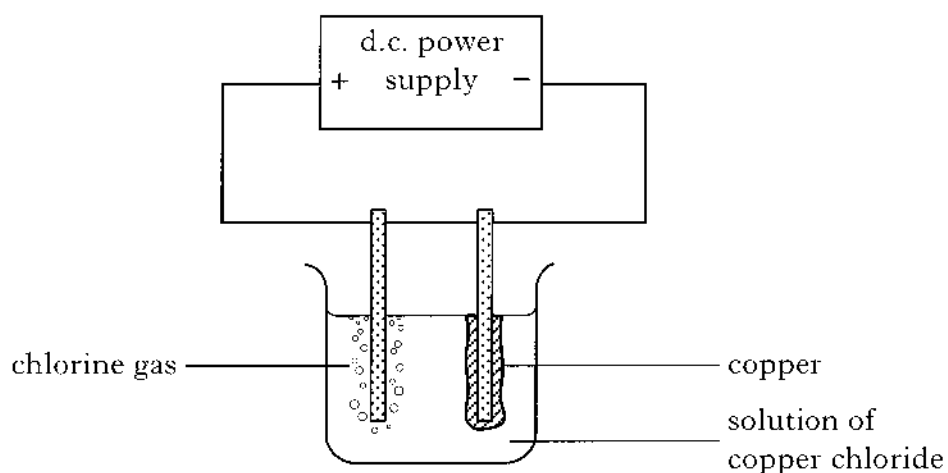
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(4)



Marks

7. A copper chloride solution was electrolysed as shown.



- (a) Why would a d.c. supply have been used?

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1

- (b) The chlorine gas can be identified using pH paper or blue litmus paper. Describe how chlorine gas affects pH paper or blue litmus paper.

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1

(2)

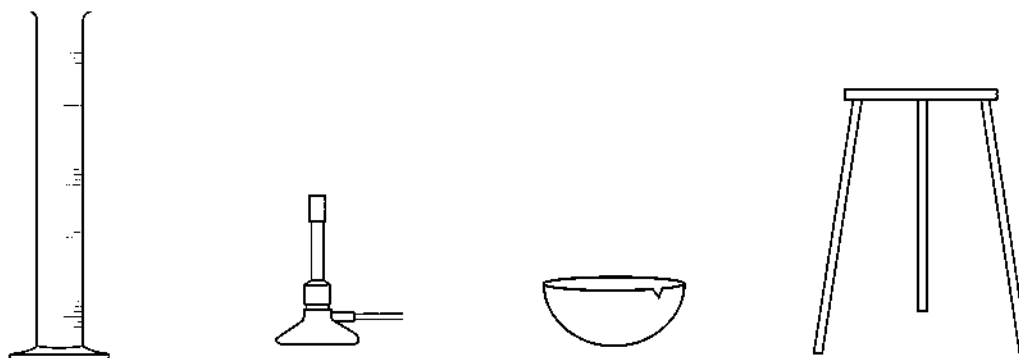
**[Turn over**

Marks

8. A dilute solution has a lower concentration of dissolved substance than a concentrated solution.

Describe an experiment which could be used to show that  $0.1 \text{ mol l}^{-1}$  sodium chloride solution has less dissolved salt than  $0.2 \text{ mol l}^{-1}$  sodium chloride solution.

You may wish to use some or all of the apparatus shown below. You may use other apparatus if required.



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(2)

Marks

9. (a) (i) Describe the test for oxygen gas.

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1

- (ii) Explain why this test is not positive with air.

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1

- (b) The astronauts in a space station require a constant supply of oxygen. In emergencies, oxygen can be produced by decomposing lithium perchlorate ( $\text{LiClO}_4$ ). The equation for the decomposition is shown below.



Calculate the mass of oxygen produced when 1000 g of lithium perchlorate completely decomposes.

Answer = \_\_\_\_\_ g      2  
(4)

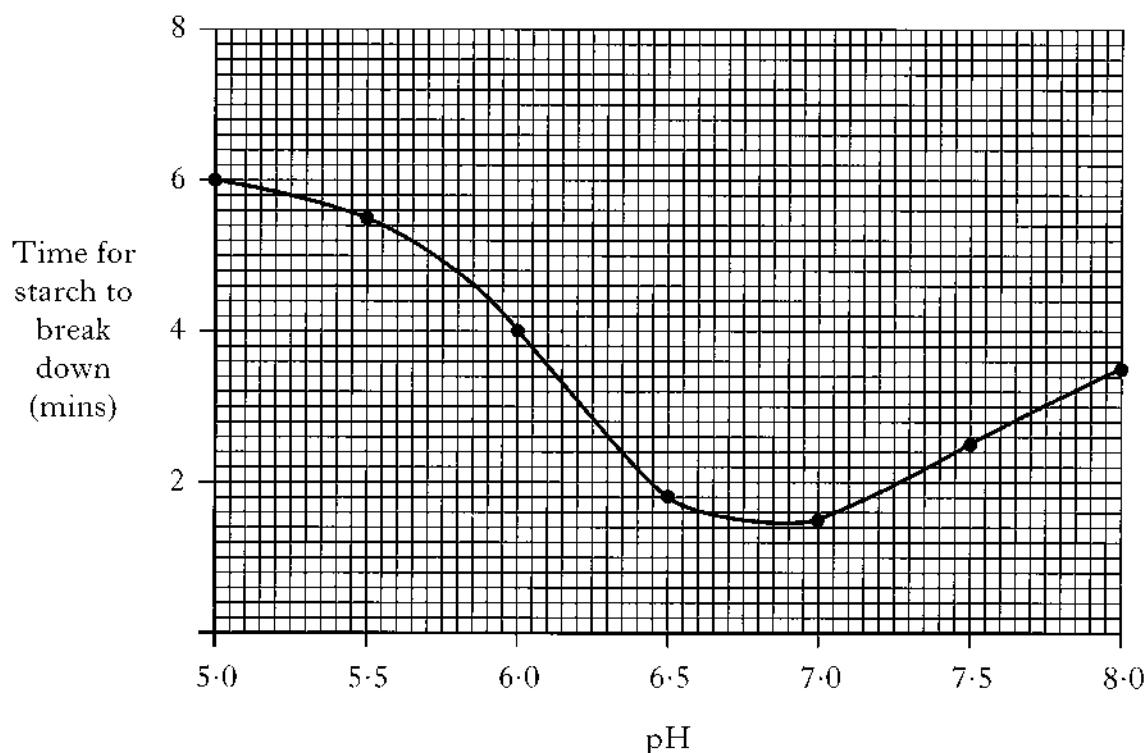
[Turn over

Marks

10. Enzymes are biological catalysts. A chemistry class was investigating how the activity of an enzyme changed with pH.

They carried out experiments at different pH values and timed how long it took for the enzyme to break down starch. The more active the enzyme, the shorter the time taken to break down the starch.

Here are their results.



- (a) Name the type of chemical reaction taking place when starch is broken down.

\_\_\_\_\_

1

- (b) To which class of compounds do enzymes belong?

\_\_\_\_\_

1

- (c) What effect does increasing the pH from 5 to 6 have on the **activity of the enzyme**?

\_\_\_\_\_

\_\_\_\_\_

1

*Marks***10. (continued)**

- (d) Some students suggested speeding up the rate of the reaction by heating the starch and enzyme mixtures in boiling water baths.

Why would this **not** speed up the reaction rate?

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**1**

- (e) During the experiment, small samples were removed and tested with iodine solution to see if all the starch had been broken down.

Suggest how the students would have known that all the starch had been broken down.

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

Marks

11. Hydrochloric acid is a strong acid. The table shows the pH values of some hydrochloric acid solutions.

Concentration ( $\text{mol l}^{-1}$ )	1.0	0.1	0.01	0.001
pH	0	1	2	3

- (a) Predict the concentration of hydrochloric acid solution with a pH of 5.

\_\_\_\_\_  $\text{mol l}^{-1}$

1

- (b) Ethanoic acid is a weak acid. The pH of a  $0.1 \text{ mol l}^{-1}$  solution of ethanoic acid is 3.

Why does this solution have a higher pH than a  $0.1 \text{ mol l}^{-1}$  solution of hydrochloric acid?

\_\_\_\_\_  
\_\_\_\_\_

1

- (c) Describe an experiment which you could carry out to compare the rate of reaction of hydrochloric acid and ethanoic acid with magnesium.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2

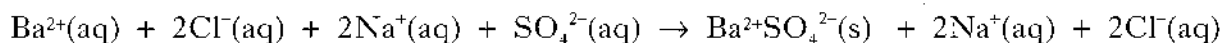
(4)

Marks

12. Metal salts can be made by using different methods.

- (a) Barium sulphate can be made by reacting solutions of barium chloride and sodium sulphate.

The ionic equation for this reaction is:



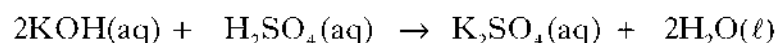
- (i) Rewrite the equation omitting spectator ions.

1

- (ii) Name the type of reaction taking place.

1

- (b) Potassium sulphate can be made by titrating sulphuric acid with potassium hydroxide solution.



If  $12.5 \text{ cm}^3$  of dilute sulphuric acid were required to neutralise  $20 \text{ cm}^3$  of  $0.1 \text{ mol l}^{-1}$  potassium hydroxide solution, calculate the concentration of the sulphuric acid.

2

(4)

**[Turn over]**

Marks

13. Human blood contains  $\text{Fe}^{3+}$  ions.

To find the concentration of  $\text{Fe}^{3+}$  in blood, the  $\text{Fe}^{3+}$  ions are first converted into  $\text{Fe}^{2+}$  ions.

- (a) Write an ion-electron equation for this change.

1

- (b)  $\text{Fe}^{2+}$  ions are then reacted to form a purple compound.

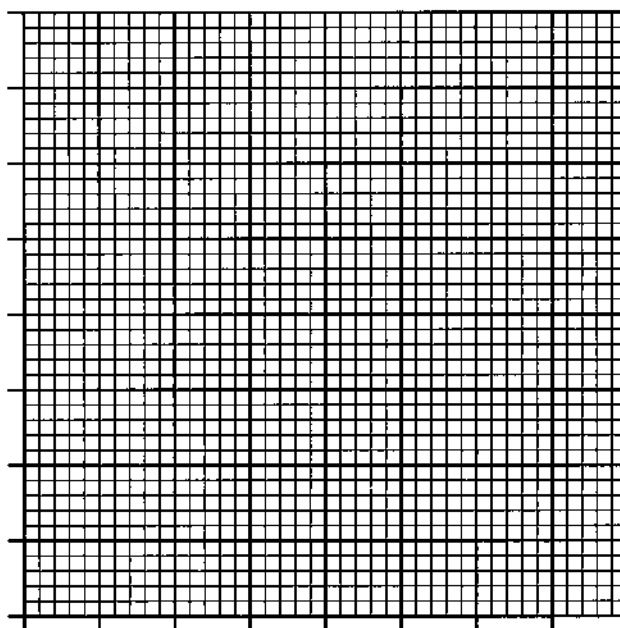
When the solution is placed in a beam of light only some of the light is transmitted.

These results show the percentage of light transmitted for a series of solutions of known  $\text{Fe}^{2+}$  concentration.

Concentration of $\text{Fe}^{2+}$ ( $\text{mg l}^{-1}$ )	1.0	2.0	3.0	4.0	6.0	8.0
% transmittance	79	65	55	44	27	18

- (i) Plot the results as a line graph.

(Additional graph paper, if required, can be found on page 28.)



2

- (ii) Using your graph, estimate the concentration of  $\text{Fe}^{2+}$  ions present in a solution with a transmittance of 36%.

\_\_\_\_\_  $\text{mg l}^{-1}$

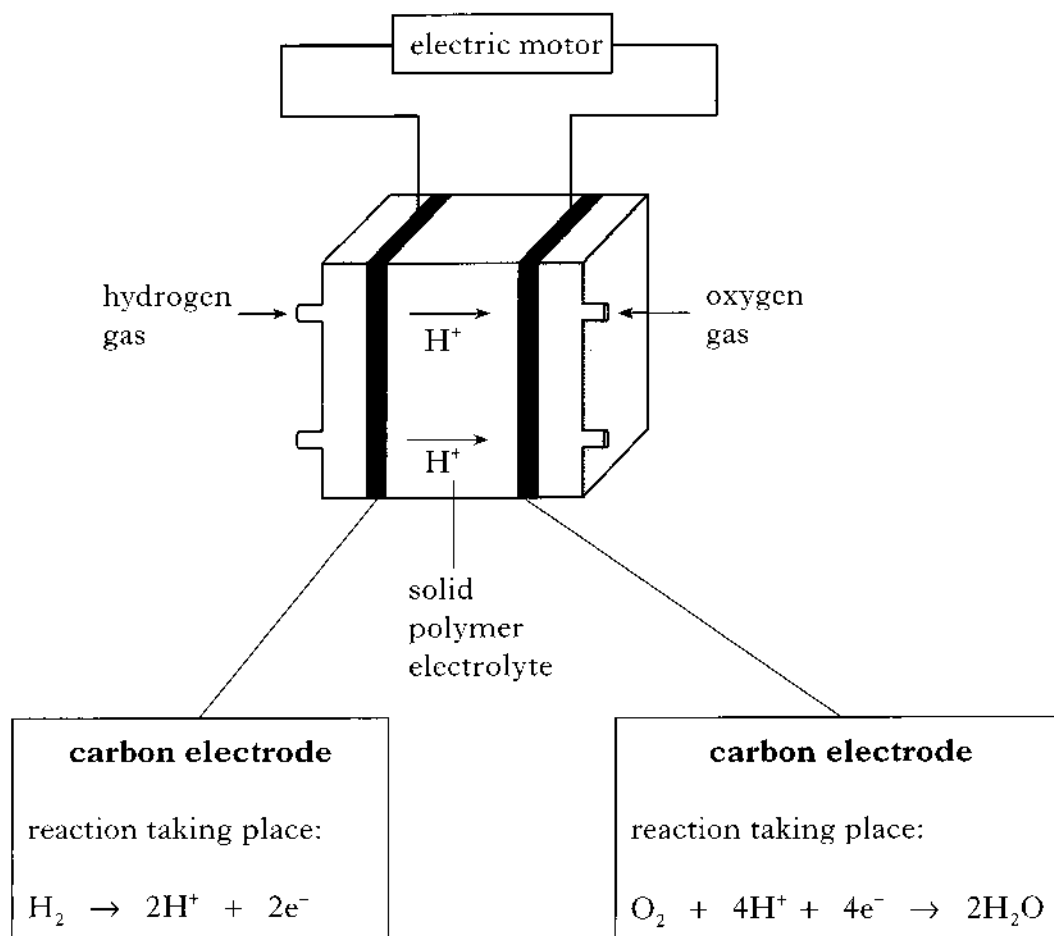
1

(4)



Marks

14. A fuel cell which can supply electricity to run a car uses hydrogen and oxygen. The electrodes are made of carbon cloth which is coated with finely divided platinum. The electrodes press against a solid polymer electrolyte.



- (a) Combine the 2 ion-electron equations for the electrode reactions to produce a **balanced** REDOX equation.

---

1

- (b) Although the polymer is solid, it acts as an electrolyte.  
What is an electrolyte?

---

1

- (c) The platinum catalyst has been finely divided to increase the surface area.  
Why does increasing the surface area increase the rate of reaction?

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1

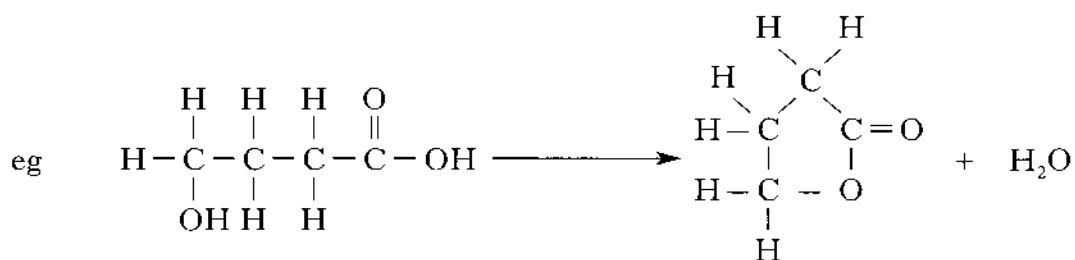
(3)

[Turn over

Marks

15. Hydroxy acids are compounds that contain both a hydroxyl group and a carboxylic acid group within the same molecule.

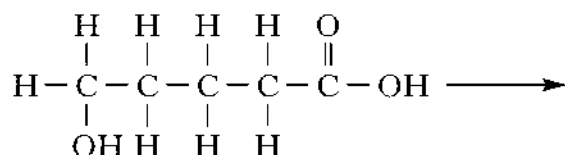
These compounds are able to form cyclic esters called lactones.



hydroxy acid

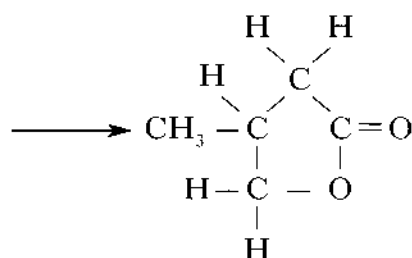
a lactone

- (a) Draw the structural formula for the lactone formed when this hydroxy acid reacts.



1

- (b) Draw the structural formula for the hydroxy acid from which this lactone was formed.

1  
(2)

Marks

16.

INTERMEDIATE 2  
CHEMISTRY

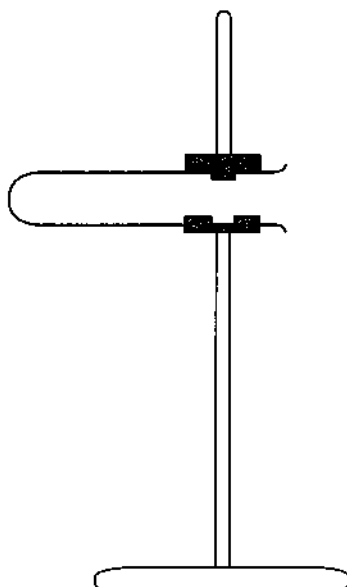
Reaction of Metals with Oxygen

Unit 3  
PPA 3

**Aim:** The aim of this experiment is to place zinc, copper and magnesium in order of reactivity by observing the ease with which they react with oxygen.

**Requirements:** Samples of metals, potassium permanganate, mineral wool, dry test tubes, clamp stand and clamp, bunsen.

- (a) Complete and label the diagram of the test tube to show how it would be set up to burn a metal in oxygen.



1

- (b) During the experiment, safety goggles must be worn.

State **one** other safety precaution which must be taken when heating the test tube.

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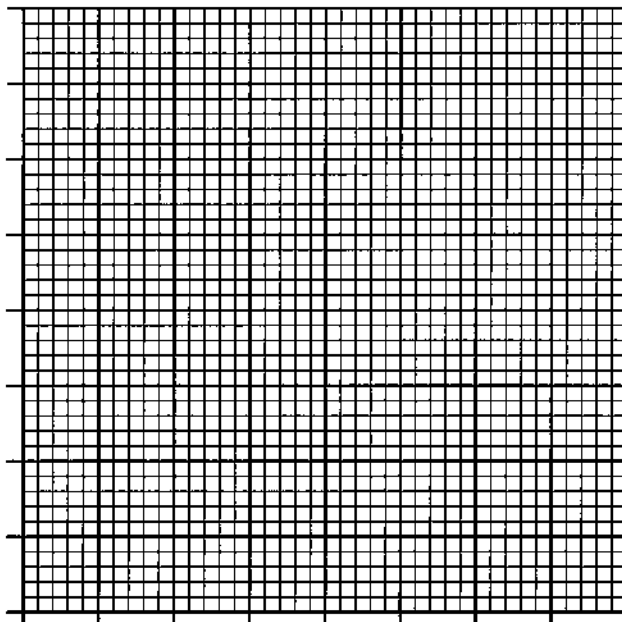
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1  
(2)

[END OF QUESTION PAPER]

**ADDITIONAL SPACE FOR ANSWERS**

ADDITIONAL GRAPH PAPER FOR QUESTION 13(b)(i)



**ADDITIONAL SPACE FOR ANSWERS**

**ADDITIONAL SPACE FOR ANSWERS**

**ADDITIONAL SPACE FOR ANSWERS**

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**ADDITIONAL SPACE FOR ANSWERS**