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Student Name:

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2003

CHEMISTRY

Unit 4 Trial Examination
Total writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOK

Structure of book

Section	*Number of Questions*	*Number of questions to be answered*	*Number of marks*	*Suggested times (minutes)*
A	20	20	20	25
B	6	6	52	65

Materials
Question and answer book of 19 pages plus a Multiple Choice Answer Sheet and a Data Sheet.
You should have at least one pencil and an eraser. An approved calculator may be used.

The task
Please ensure that you write your **name** in the space provided on the cover of this book and in the space provided on the Multiple Choice Answer Sheet.
This paper consists of two sections, Section A and Section B.
Answer **all** questions from Section A. Section A is worth 20 marks.
Section A questions should be answered in pencil on the Multiple Choice Answer Sheet provided.
Answer **all** questions from Section B. Section B is worth 52 marks.
Section B questions should be answered in ink or ball point pen in the spaces provided in this book.
There is a total of 72 marks available.
All written responses should be in English.

At the end of the task
Place the Multiple Choice Answer Sheet inside the front cover of this book.

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Semester 2, 2003

STAV PublishingPty Ltd

2003

CHEMISTRY

Unit 4 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: **USE PENCIL ONLY**

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by placing a **CROSS** through the letter of your choice.

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D

11.	A	B	C	D
12.	A	B	C	D
13.	A	B	C	D
14.	A	B	C	D
15.	A	B	C	D
16.	A	B	C	D
17.	A	B	C	D
18.	A	B	C	D
19.	A	B	C	D
20.	A	B	C	D

SECTION A

Specific instructions for Section A

Section A consists of 20 multiple-choice questions. Section A is worth approximately 28 per cent of the marks available. You should spend approximately 25 minutes on Section A.

Choose the response that is **correct** or **best answers the question**, and mark your choice on the multiple-choice answer sheet according to the instructions on that sheet.

A correct answer is worth 1 mark; an incorrect answer is worth no marks. No mark will be given if more than one answer is shown for any question. Marks will **not** be deducted for incorrect answers. You should attempt every question.

Question 1

The most efficient conversion of energy would occur in a

A. coal-fired power station

B. solar cell

C. fuel cell

D. methanol fuelled racing car.

Question 2

Oxyacetylene torches may be used to cut metal due to the heat generated by the reaction

$$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(g) \quad \Delta H = -2600 \text{ kJ mol}^{-1}$$

The energy available from the combustion of 1.0 L of acetylene, measured at 25°C and 1.0 atm pressure, is closest to

A. 53 kJ

B. 106 kJ

C. 212 kJ

D. 1300 kJ

Question 3

A nickel medallion is copper plated in an electrolytic cell using 200 mL of 1.00 M copper(II) sulfate solution and a copper anode. A current of 10.72 A is run through the cell for 15.0 minutes. The final concentration of the copper(II) sulfate solution is

A. 0.250 M

B. 0.500 M

C. 0.750 M

D. 1.00 M

Question 4

Considering redox properties, which of the following compounds would be **least** likely to exist in aqueous solution?

A. $FeCl_3$

B. $FeCl_2$

C. FeI_3

D. FeI_2

Question 5

The same quantity of electricity is passed through two solutions, one containing a salt of the unknown metal, X, and the other containing a salt of unknown metal, Y.
If 0.020 mole of X is produced at the cathode of one cell, and 0.040 mole of Y is produced at the cathode of the other, which of the following conclusions can be drawn?

I. The ions of X and Y are positively charged.
II. The X ion has a charge of positive one.
III. The charge on the X ion is double that on the Y ion.
IV. The Y ion has a charge of positive two.

A. I only

B. I and III only

C. II and IV only

D. I, II, IV only.

Question 6

To test whether a car battery is recharging, a student might note whether

A. $[H^+]$ rises and pH rises

B. $[H^+]$ rises and pH falls

C. $[OH^-]$ rises and pH rises

D. $[OH^-]$ rises and pH falls.

Question 7

A steady current of 25.0 amperes is passed through an aqueous solution of $NiSO_4$ for 30.0 minutes. What is the maximum mass, in gram, of nickel that can be deposited?

A. 6.84

B. 13.7

C. 27.4

D. 58.7

Question 8

In the electrolysis of very dilute sodium chloride solution using platinum electrodes, a product at the anode is most likely to be

A. chlorine

B. oxygen

C. sodium

D. hydrogen.

Question 9

Which of the following compounds would release the most energy per gram on oxidation?

A. $CH_3(CH_2)_{16}COOH$

B. $C_6H_{12}O_6$

C. $CH_2OHCHOHCH_2OH$

D. NH_2CH_2COOH

Question 10

Fatty acids combine in cells with another important biomolecule to form fats.
This biomolecule is called

A. glycogen

B. glucose

C. glycerol

D. glycine.

Question 11

Which of the following types of bonding is responsible for the primary structure of proteins?

A. ester linkages

B. dipole-dipole bonds

C. peptide linkages

D. hydrogen bonds

Questions 12 and 13 refer to the following information.

The table contains information about fatty acids that are found in foods.

Fatty acid	Semi -Structural formula
Stearic acid	$CH_3(CH_2)_{16}COOH$
Oleic acid	$CH_3(CH_2)_7CH=CH(CH_2)_7COOH$
Linoleic acid	$CH_3(CH_2)_4CH=CHCH_2CH=CH(CH_2)_7COOH$
Eleostearic acid	$CH_3(CH_2)_7CH=CHCH=CHCH=CH(CH_2)_3COOH$

Question 12

The fatty acid with the highest melting point is likely to be

A. stearic acid

B. oleic acid

C. linoleic acid

D. eleostearic acid.

Question 13

Each of these four fatty acids is capable of forming a triglyceride. The degree of unsaturation of a triglyceride can be determined by hydrolysing the triglyceride and reacting the resulting fatty acids with iodine. The triglyceride requiring the greatest amount of iodine would be composed solely of

A. stearic acid

B. oleic acid

C. linoleic acid

D. eleostearic acid.

Question 14

The oxidation numbers of chromium in $CrCl_3$, CrO_2, $K_2Cr_2O_7$ respectively are

A. +2, +2 and +4

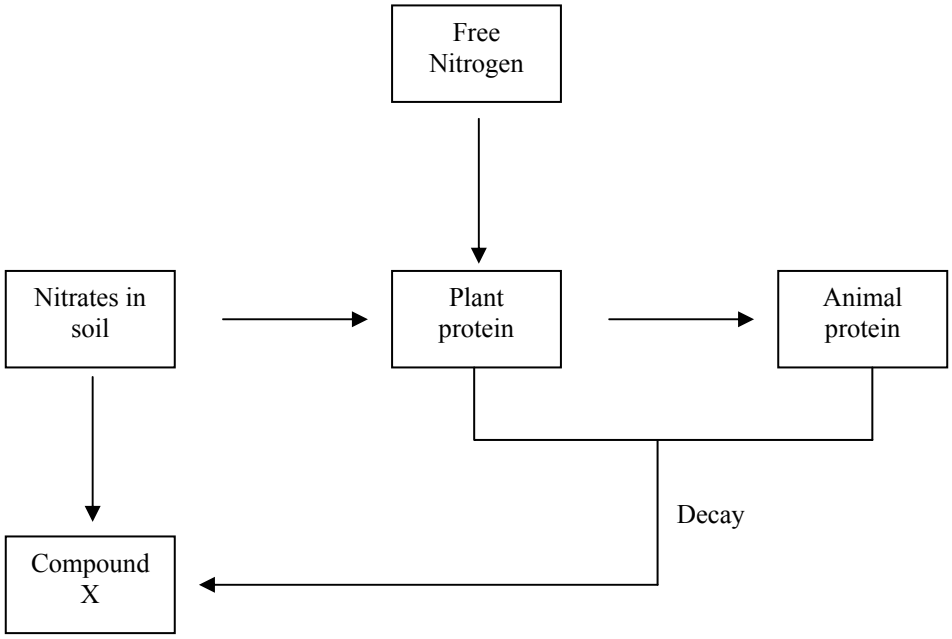
B. +3, +4 and +6

C. +3, +4 and +7

D. +3, +2 and +12.

Question 15

The diagram shows part of the nitrogen cycle.



Compound X is most likely to be

A. urea

B. nitrogen dioxide

C. ammonia

D. alanine.

Question 16

A sample of neon is analysed by using a mass spectrometer. Four peaks are observed corresponding to $^{20}Ne^{+}$, $^{20}Ne^{2+}$, $^{22}Ne^{+}$, $^{22}Ne^{2+}$. Which of the particles was **least** deflected in the magnetic field?

A. $^{22}Ne^{+}$

B. $^{22}Ne^{2+}$

C. $^{20}Ne^{+}$

D. $^{20}Ne^{2+}$

Question 17

Which of the following elements is **least** likely to have been synthesized by an exothermic reaction in the lifetime of a very massive star?

A. Helium

B. Carbon

C. Iron

D. Uranium

Question 18

In a certain nuclear reaction, the nucleus ^{40}K emits an electron. The nucleus produced is

A. ^{39}K

B. ^{41}K

C. ^{40}Ar

D. ^{40}Ca

Questions 19 and 20 refer to the following information.

Atoms of element X form an ionic compound with scandium having the formula Sc_2X_3.

Question 19

Which of the following is the electron configuration of Sc in this compound?

A. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1$

B. $1s^2 2s^2 2p^6 3s^2 3p^6 3d^1 4s^2$

C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4p^1$

D. $1s^2 2s^2 2p^6 3s^2 3p^6$

Question 20

The element X could be

A. Oxygen

B. Nitrogen

C. Fluorine

D. Hydrogen

END OF SECTION A

SECTION B

Specific instructions for Section B

Section B consists of six short-answer questions numbered 1 to 6; you must answer all of these questions. This section is worth 52 marks or approximately 72 per cent of the total. You should spend approximately 65 minutes on this section.

The marks allotted to each question are shown and suggested times are shown at the end of each question.

Questions must be answered in the spaces provided in this book.

To obtain full marks for your response you should

- give simplified answers with an appropriate number of significant figures for all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- make sure all chemical equations are balanced and that the formulas for individual substances include an indication of state (for example, $H_2(g)$; NaCl(s)).

Question 1

Write concise explanations for the following observations.

a. A car battery can be recharged.

_____

_____

_____

_____

b. Elements become more metallic down a Group on the Periodic Table.

_____

_____

_____

_____

c. Atomic radius decreases across a Period on the Periodic Table.

_____

_____

_____

_____

Question 1 continued on next page.

d. The electronegativity of fluorine is greater than that of chlorine.

_____

_____

_____

_____

e. The transition element zinc forms colourless ionic compounds while most ionic compounds of transition metals are coloured.

_____

_____

_____

_____

f. Polyunsaturated margarine often contains antioxidants such as α-tocopherol (vitamin E) and emulsifiers such as soyabean lecithin.

_____

_____

_____

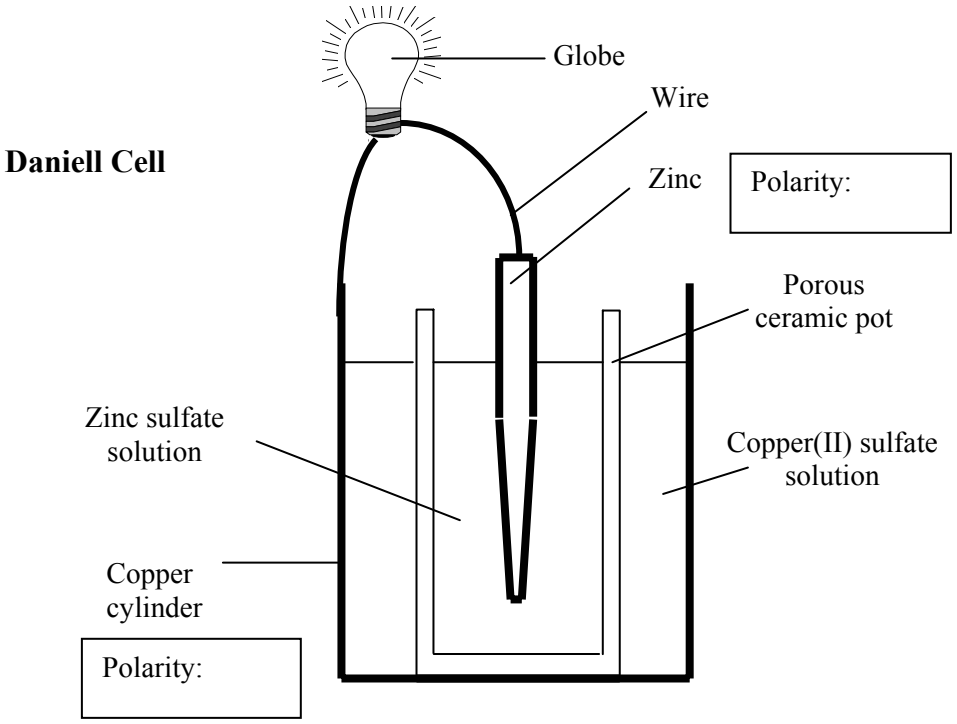
_____

2 + 2 + 2 + 2 + 2 + 2 = 12 marks

Suggested time: 15 minutes

Question 2

A small scale source of safe electrical energy used in school laboratories prior to the mains connected 'Power Pack' was the Daniell cell. This cell typically consisted of a zinc rod dipping into a 1.0 M zinc sulfate solution. This solution was contained in a porous ceramic pot that, in turn, was placed in a copper cylinder containing 1.0 M copper(II) sulfate. The cell is capable of producing a maximum cell potential of 1.10 volts.



a. On the diagram indicate:

i. The direction of movement of the electrons in the wire to the globe

ii. The polarity of the zinc rod and copper cylinder

b. Give the half-cell equations for the processes that occur as the cell discharges.

Equation for the process occurring at the positive electrode (cathode)

_____

Equation for the process occurring at the negative electrode (anode)

_____

c. Write the overall cell reaction for the Daniell cell.

_____

Question 2 continued on next page.

d. The porous barrier is made of a chemically inert material. What is the main function of the porous barrier?

_____

_____

e. The cell could be constructed with a zinc cylinder container zinc sulfate with the porous pot containing copper(II) sulfate solution and a copper rod. Explain why the outer cylinder is made of copper rather than zinc.

_____

_____

f. i. If the original zinc rod has a mass of 125 g, what is the amount of charge, in coulombs, produced by the complete reaction of the zinc?

_____

_____

_____

_____

ii. Calculate the amount of energy released (in kJ) by the complete reaction of 125 g of zinc in this cell.

_____

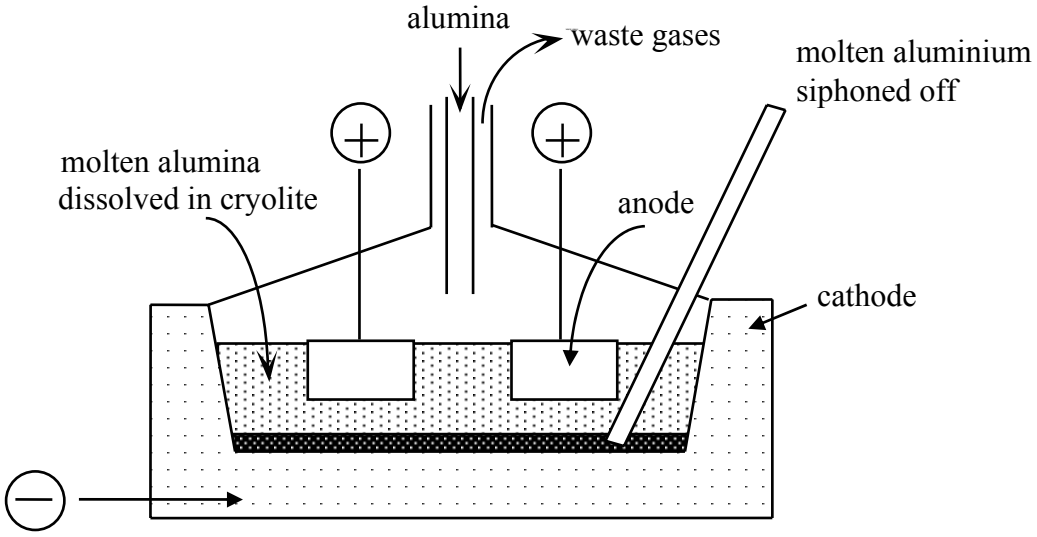
_____

[1 + 1] + 2 + 1 + 1 + 1 + [2 + 1] = 10 marks

Suggested time: 13 minutes

Question 3

The Hall-Heroult process for the industrial production of aluminium involves the electrolysis of alumina, Al_2O_3, dissolved in cryolite, Na_3AlF_6. A diagram of the cell is shown.



a. Complete the following table.

	Electrode material	Electrode reaction
Anode		
Cathode		

b. What is the function of the cryolite?

_____

_____

_____

c. Why is the electrolysis of an aluminium salt not carried out under aqueous conditions?

_____

_____

_____

d. List two environmental implications of this means of extracting aluminium.

_____

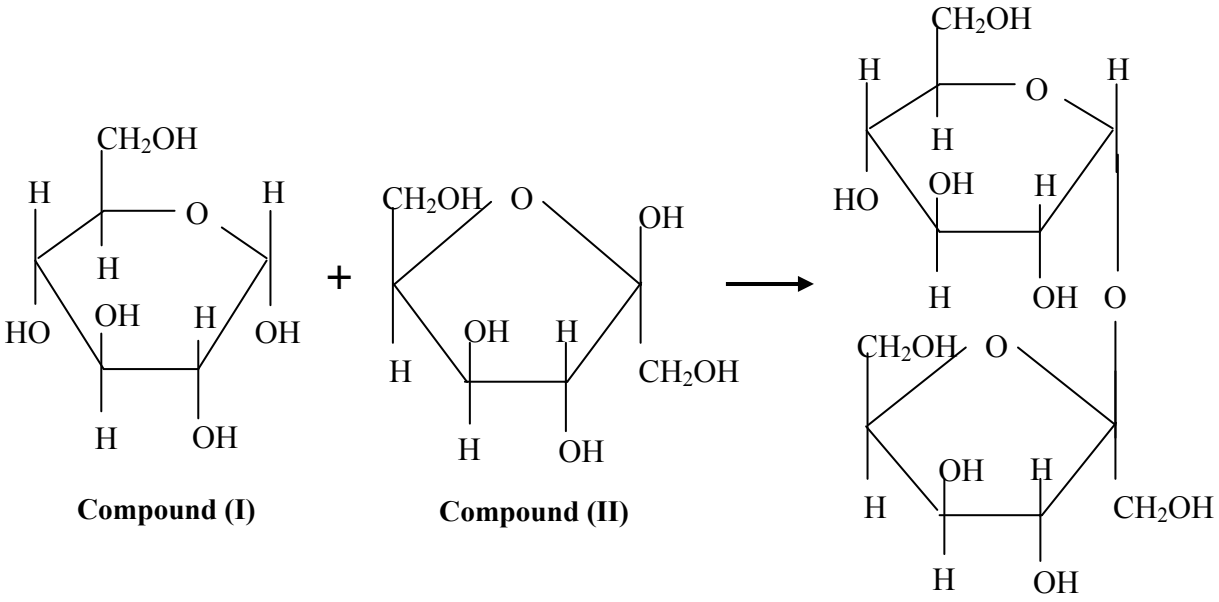
_____

2 + 1 + 1 + 2 = 6 marks

Suggested time: 7 minutes

Question 4

The following flow chart represents the chemical process involving the reaction of compounds (I) and (II) to form compound (III).



Compound (I) **Compound (II)** **Compound (III)**

a. State the name for this type of chemical reaction.

_____

b. Give the **chemical formula** for the **other** product formed in this chemical reaction.

_____

c. Name the **two** groups of carbohydrates represented by these three molecules.

_____

_____

Question 4 continued on next page.

d. Compound (I) is a very important biomolecule.

i. State the **name** of this compound. _____

ii. Write an equation for the chemical reaction of compound (I) that produces energy in the cells.

_____

iii. Compound (I) and a structural isomer of this compound are monomers that produce three important polymers that are biomolecules. Name the polymer that is most likely to be found in human cells.

_____

Give the empirical formula of this polymer.

_____

State the main function of this polymer.

_____

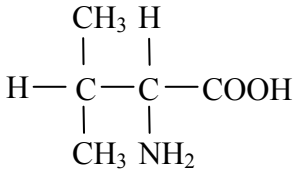
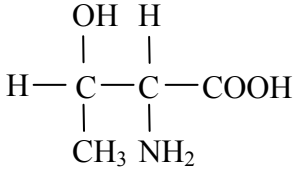
_____

1 + 1 + 2 + [1 + 1 + 1 + 1 + 1] = 9 marks

Suggested time: 11 minutes

Question 5

Amino acids are often shown as in the table.

Name	Structural formula Representation
Valine	
Threonine	
Alanine	Space for part (a) response.

a. In the space provided in the table above draw the structural formula representation of **alanine**.

b. Name the three functional groups on the **threonine** molecule.

_____

_____

_____

Question 5 continued on next page.

c. Amino acids really exist as zwitterions in neutral aqueous solutions.

i. Draw the zwitterion representation of **valine**.

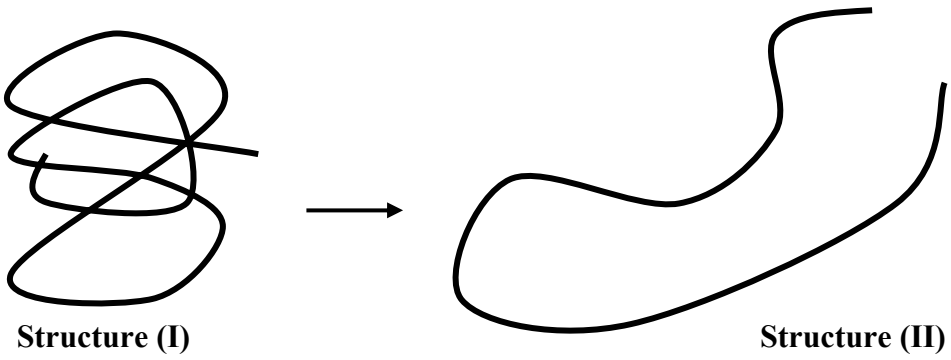
ii. Draw the zwitterion representation of **valine** in an aqueous solution of pH 3.

d. Enzymes are essential to the functioning of all cells.

i. To which group of biological molecules do most enzymes belong?

_____

ii. Globular enzymes represented by structure (I) undergo physical changes to form more linear structures represented by structure (II).



Structure (I) **Structure (II)**

- Name the process causing this unravelling of the enzyme.

_____

- State one agent that can cause this change.

_____

_____

1 + 1 + [1 + 1] + [1 + 2] = 7 marks

Suggested time: 9 minutes

Question 6

A student sets out to prepare a sample of the royal blue coloured complex ion, $Cu(NH_3)_4(H_2O)_2^{2+}$. Blue crystals were first dissolved to produce the hexaquocopper(II) ion, $CuSO_4.6H_2O$.

a. Draw the structure and fully label all of the types of bonding in the hexaquo complex ion.

b. What is the name used to describe the water molecules in this complex ion?

_____

c. Addition of a few drops of concentrated ammonia to the solution containing the complex ion results in the precipitation of a light blue precipitate. Write an ionic equation for the formation of this precipitate.

_____

d. On addition of more of the concentrated ammonia the royal blue complex ion forms. Explain why the colour of $Cu(NH_3)_4(H_2O)_2^{2+}$ is different to the colour of the hexaquocopper(II) ion.

_____

_____

_____

_____

e. Write the electron configuration of the copper(II) ion.

_____

_____

3 + 1 + 1 + 2 + 1 = 8 marks

Suggested time: 10 minutes

END OF EXAMINATION