

INSIGHT

Trial Exam Paper

2007

CHEMISTRY

Written examination 2

STUDENT NAME:

QUESTION AND ANSWER BOOK

Reading time: 15 minutes
Writing time: 1 hour 30 minutes

Structure of book

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
A	20	20	20
B	9	9	59
			Total 79

- Students are permitted to bring the following items into the examination: pens, pencils, highlighters, erasers, sharpeners, rulers and one scientific calculator.
- Students are NOT permitted to bring sheets of paper or white out liquid/tape into the examination.

Materials provided

- The question and answer book of 19 pages, with a separate data sheet.
- An answer sheet for multiple-choice questions.

Instructions

- Write your **name** in the box provided.
- Remove the data sheet during reading time.
- You must answer the questions in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

Students are NOT permitted to bring mobile phones or any other electronic devices into the examination.

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SECTION A – Multiple choice questions**Instructions for Section A**

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.

Choose the response that is **correct** or that **best answers** the question.

1 mark will be awarded for a correct answer; no marks will be awarded for an incorrect answer.

Marks are **not** deducted for incorrect answers.

No marks will be awarded if more than one answer is completed for any question.

Question 1

The elements in Dimitri Mendeleev's periodic table were arranged in order of

- A. increasing atomic mass and those with similar chemical properties grouped in columns.
- B. increasing atomic number and those with similar chemical properties grouped in columns.
- C. increasing atomic mass and those with similar chemical properties grouped in rows.
- D. increasing atomic number and those with similar chemical properties grouped in rows.

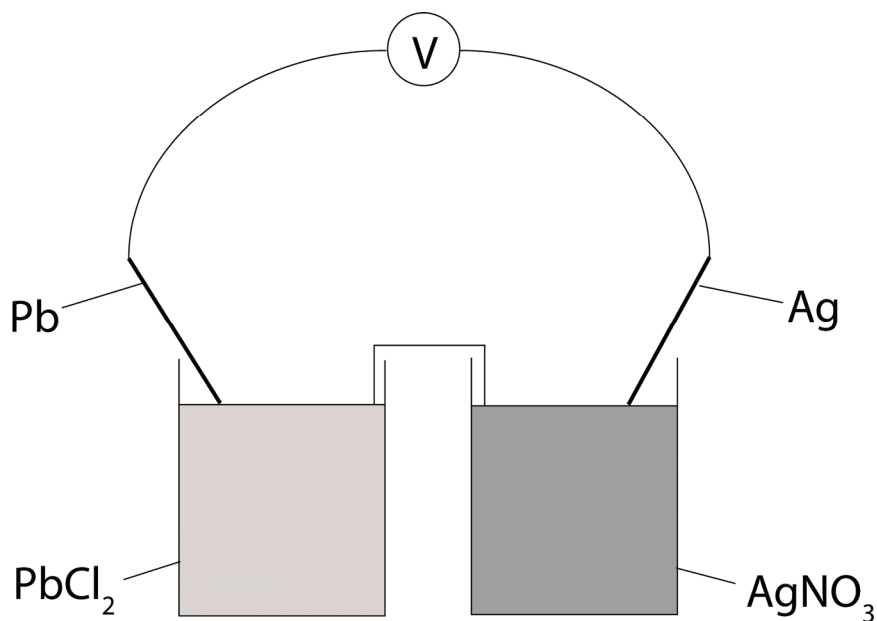
Question 2

The amount of energy required to raise the temperature of 75.0 g of lead by 14.6°C is 142 J. The specific heat capacity of lead in $\text{J g}^{-1} \text{ } ^\circ\text{C}^{-1}$, is

- A. 1.30×10^{-4}
- B. 6.58×10^{-3}
- C. 0.130
- D. 7.71

Questions 3 and 4 refer to the following information.

The following diagram represents a galvanic cell.



Question 3

Which one of the following correctly describes the anode, cathode and direction of electron flow when the wires are connected at 25°C?

	Anode	Cathode	Direction of electron flow
A.	Pb	Ag	left to right
B.	Pb	Ag	right to left
C.	Ag	Pb	left to right
D.	Ag	Pb	right to left

Question 4

When the circuit is made complete, 5.00 g of one metal is consumed. The mass, in g, produced of the other metal is

- A. 1.30
- B. 2.60
- C. 5.00
- D. 5.21

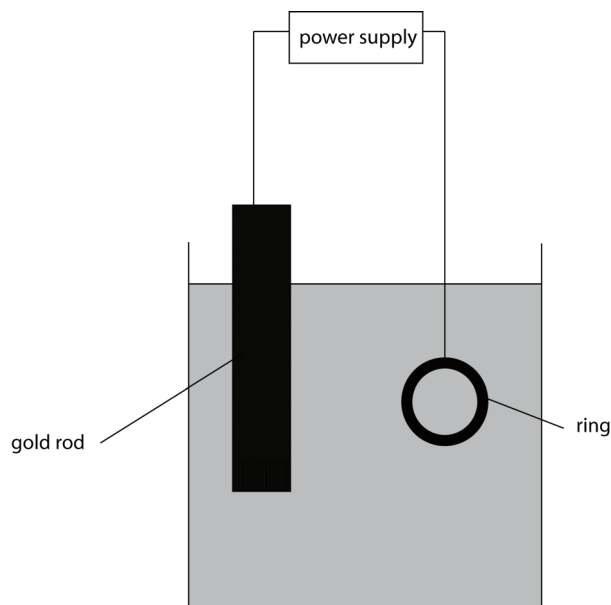
Question 5

The products of the electrolysis of a 1.0 M solution of aluminium chloride at 25°C are

- A. $\text{Cl}_2(\text{g})$, $\text{Al}(\text{s})$
- B. $\text{O}_2(\text{g})$, $\text{H}_2(\text{g})$
- C. $\text{Cl}_2(\text{g})$, $\text{H}_2(\text{g})$, $\text{OH}^-(\text{aq})$
- D. $\text{Al}(\text{s})$, $\text{O}_2(\text{g})$, $\text{H}^+(\text{aq})$

Questions 6 and 7 refer to the following information.

An electrolytic cell is constructed to gold plate some jewellery.



Question 6

Which one of the following is correct when the power is switched on?

- A. The gold rod acts as the cathode and the ring acts as the anode.
- B. The anode is negative and the cathode is positive.
- C. Anions in the electrolyte are attracted to the gold rod.
- D. Reduction occurs at the gold rod.

Question 7

Calculate the mass, in g, of gold deposited from gold ions (Au^{3+}) on the ring when the cell is run at 6.00 V and 4.00 A for 20.0 min.

- A. 0.0544
- B. 3.27
- C. 29.4
- D. 58.8

Question 8

Which of the following energy sources **cannot** be traced back to the Sun as the original provider of energy?

- A. hydroelectricity
- B. natural gas
- C. nuclear fission
- D. coal

Question 9

Which formula represents an α -amino acid in acidic solution?

- A. $^+\text{H}_3\text{NCH}(\text{CH}_3)\text{COOH}$
- B. $^+\text{H}_3\text{NCH}_2\text{CH}_2\text{COOH}$
- C. $\text{H}_2\text{NCH}(\text{CH}_3)\text{COO}^-$
- D. $\text{H}_2\text{NCH}_2\text{CH}_2\text{COO}^-$

Question 10

Which of the following correctly describes the main type of bonding responsible for primary and secondary structure in proteins?

	Primary structure	Secondary structure
A.	covalent	dispersion
B.	hydrogen	covalent
C.	covalent	hydrogen
D.	hydrogen	peptide

Question 11

The functional groups involved in a condensation reaction between a glucose molecule and a fructose molecule are

- A. hydroxyl and hydroxyl
- B. carboxyl and carboxyl
- C. hydroxyl and carboxyl
- D. carboxyl and amino

Question 12

The main energy reserves in the body are

- A. glucose and fats
- B. glycerol and fats
- C. glycogen and fats
- D. proteins and fats

Question 13

A mass spectrometer is used to identify the existence of isotopes. Which of the following are all parts of a mass spectrometer?

- A. ionisation chamber, prism, magnetic field
- B. flame, magnetic field, detector
- C. prism, magnetic field, ion collector
- D. magnetic field, ion collector, detector

Question 14

Element X has a relative atomic mass of 63.5. It has two naturally occurring isotopes of masses 62.9 and 64.9. The percentage abundance of the lighter isotope is

- A. 30.0%
- B. 50.0%
- C. 70.0%
- D. 90.0%

Question 15

Beryllium is produced by a nuclear fusion reaction between two helium nuclei. The mass of the beryllium nucleus, relative to the combined mass of the helium nuclei, is

- A. lower
- B. higher
- C. equal
- D. sometimes higher and sometimes lower

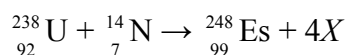
Question 16

The element that has a +2 ion with the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10}$ is

- A. Ca
- B. Fe
- C. Ni
- D. Zn

Question 17

Consider the nuclear reaction represented by the equation



Species X is

- A. a neutron
- B. an electron
- C. a proton
- D. a helium nucleus

Question 18

The fatty acid with the greatest amount of unsaturation is

- A. $\text{C}_{17}\text{H}_{35}\text{COOH}$
- B. $\text{C}_{17}\text{H}_{33}\text{COOH}$
- C. $\text{C}_{19}\text{H}_{35}\text{COOH}$
- D. $\text{C}_{19}\text{H}_{37}\text{COOH}$

Question 19

The formula of an acidic oxide formed from a period 3 element is

- A. Na_2O
- B. MgO
- C. Al_2O_3
- D. SO_3

Question 20

A polysaccharide is formed by condensation reactions between 100 glucose ($\text{C}_6\text{H}_{12}\text{O}_6$) molecules. The molar mass of the polysaccharide, in g mol^{-1} , is

- A. 16 200
- B. 16 218
- C. 18 000
- D. 19 782

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END OF SECTION A
TURN OVER

SECTION B – Short-answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

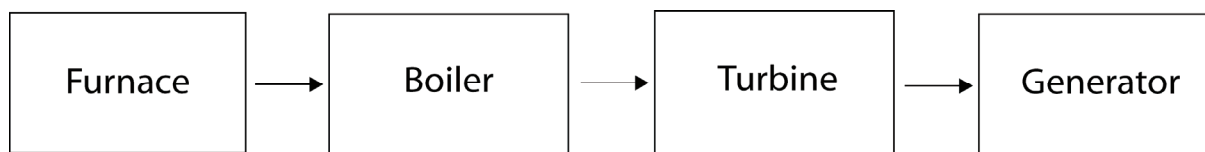
To obtain full marks for your answers you should

- give simplified answers with an appropriate number of significant figures to all 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 chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$

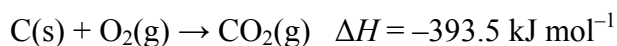
Question 1

Maintaining an adequate energy supply into the future while being mindful of environmental issues presents a challenge for Australia.

- a. Most of Australia's electricity is currently produced from coal via a series of energy transformations in a coal-fired power station, which is represented by the flow chart below.



- i. The main reaction in the furnace is



Calculate the amount of heat energy produced by the complete combustion of 1.00 tonne of carbon. (*Note:* 1 tonne = 10^6 g)

3 marks

- ii. What is the main energy conversion occurring in the turbine?

1 mark

iii. What is the main energy conversion occurring in the generator?

1 mark

b. Wind power is being considered as an alternative to coal as an energy source. Give **one** advantage and **one** disadvantage of wind power as a source of electricity.

2 marks

c. Fuel cell technology also promises to be a potential alternative source of energy.

i. Give **one** reason why using a fuel cell produces more electricity per mass unit of fuel than if the same amount of fuel was burnt in a power station.

1 mark

ii. Give **one** reason why the use of fuel cells to produce electricity is not more widespread.

1 mark

Total 9 marks

Question 2

A calibrated bomb calorimeter can be used in the laboratory to determine the energy content of food.

- a. A student calibrated a bomb calorimeter by passing an electric current of 1.56 A and 8.50 V through the calorimeter for 10.00 min. The student found that the temperature of the water inside the calorimeter rose from 16.0°C to 18.7°C. Calculate the calibration factor, in $\text{J } ^\circ\text{C}^{-1}$, for this bomb calorimeter.

2 marks

- b. To find the energy content of a sample of dried pasta, 3.60 g of the dried pasta was burnt in the calorimeter that was calibrated above. The temperature of the water rose by 23.5°C. Calculate, in kJ g^{-1} , the energy content of the pasta.

2 marks

- c. A possible source of error in this experiment is that the pasta was not completely dried before being weighed and burned in the calorimeter. Explain the effect that this will have on the student's results.

2 marks

- d. Give a reason why the energy provided to the body by the pasta is less than the amount of energy determined correctly using a bomb calorimeter.

1 mark

Total 7 marks

Question 3

The diaphragm cell is used for the industrial production of chlorine.

- a. Give the chemical formula and state of the substance used as the electrolyte.

1 mark

- b. Write a half-equation for the reaction that occurs at the

i. anode

1 mark

ii. cathode

1 mark

- c. A membrane cell has also been developed for the production of chlorine. Give **two** advantages the membrane cell has over the diaphragm cell.

2 marks

Total 5 marks

SECTION B – continued
TURN OVER

Question 4

A student eats a hamburger in a bun with lettuce, tomato and cheese.

- a. Chemical digestion of starch, a polysaccharide present in the bun, begins in the mouth.
- i. What type of reaction is involved in chemical digestion?

1 mark

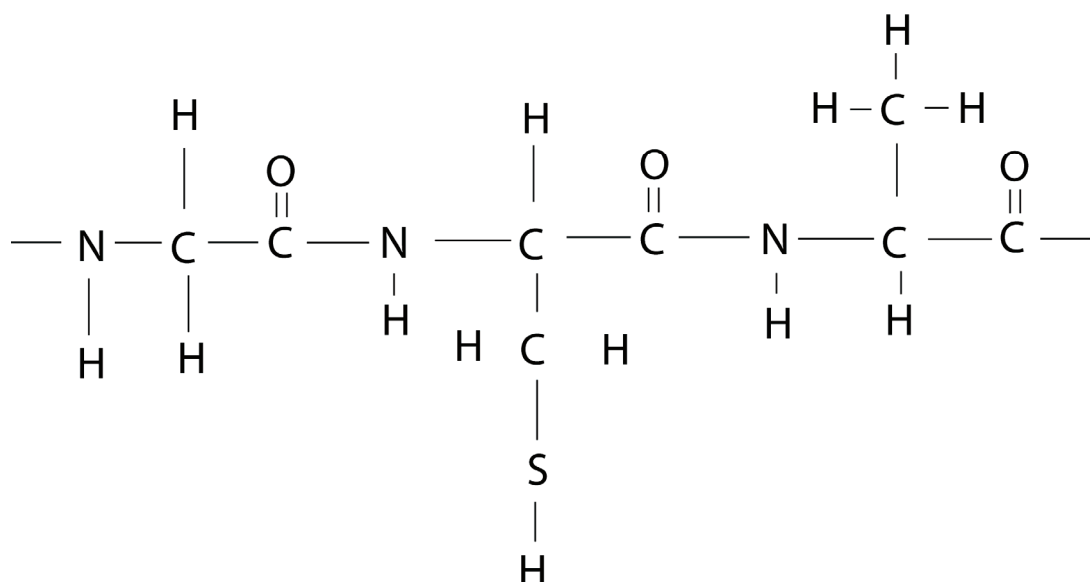
- ii. Give the molecular formula of the other reactant required for this reaction.

1 mark

- iii. Lettuce, a plant material, contains a different type of polysaccharide that cannot provide energy for the student. Give the name of this polysaccharide and explain why it cannot provide any energy.

2 marks

- b. When the food enters the stomach, chemical digestion of the protein in the meat and cheese begins. The following diagram represents part of a protein.



- i. What is the name of the link between different amino acids in the protein?

1 mark

- ii. Circle **one** of these links on the diagram above.

1 mark

- iii. Draw the structural formula for the compounds produced when this section of protein is broken down in the body.

2 marks

- c. In the small intestine, the fats present in the hamburger are also broken down to produce fatty acids and one other product. Give the name and molecular formula of the other compound that is a product of the digestion of all triglycerides.

2 marks

- d. Each digestion reaction carried out in the body is catalysed by an enzyme. The catalytic process is very specific with most enzymes catalysing just one reaction. Describe how enzymes catalyse reactions in the human body. You may use a diagram in your answer.

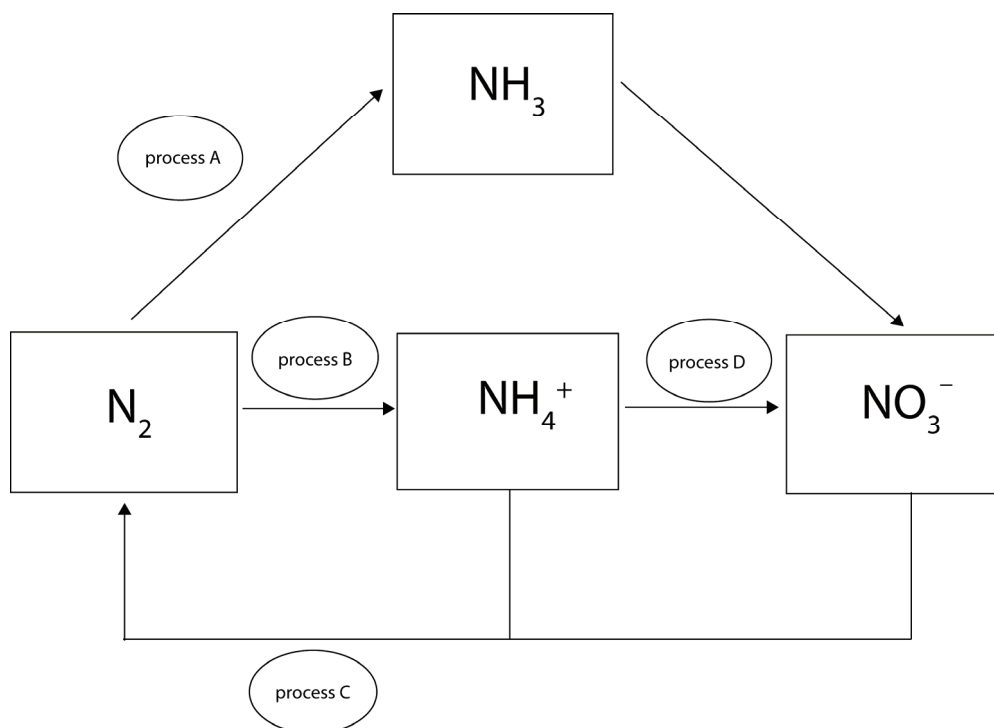
3 marks

Total 13 marks

SECTION B – continued
TURN OVER

Question 5

The cycling of nitrogen plays an important role in food production. A simplistic nitrogen cycle is represented below.



- a. List the letter(s) of the process(es) that involve the action of nitrogen-fixing bacteria.

1 mark

- b. List the letter(s) of the process(es) that involve the reduction of nitrogen atoms.

1 mark

- c. Nitrogen is an important element in proteins. Give the name and structural formula of the nitrogen-containing compound that is the end product of the body's use of proteins.

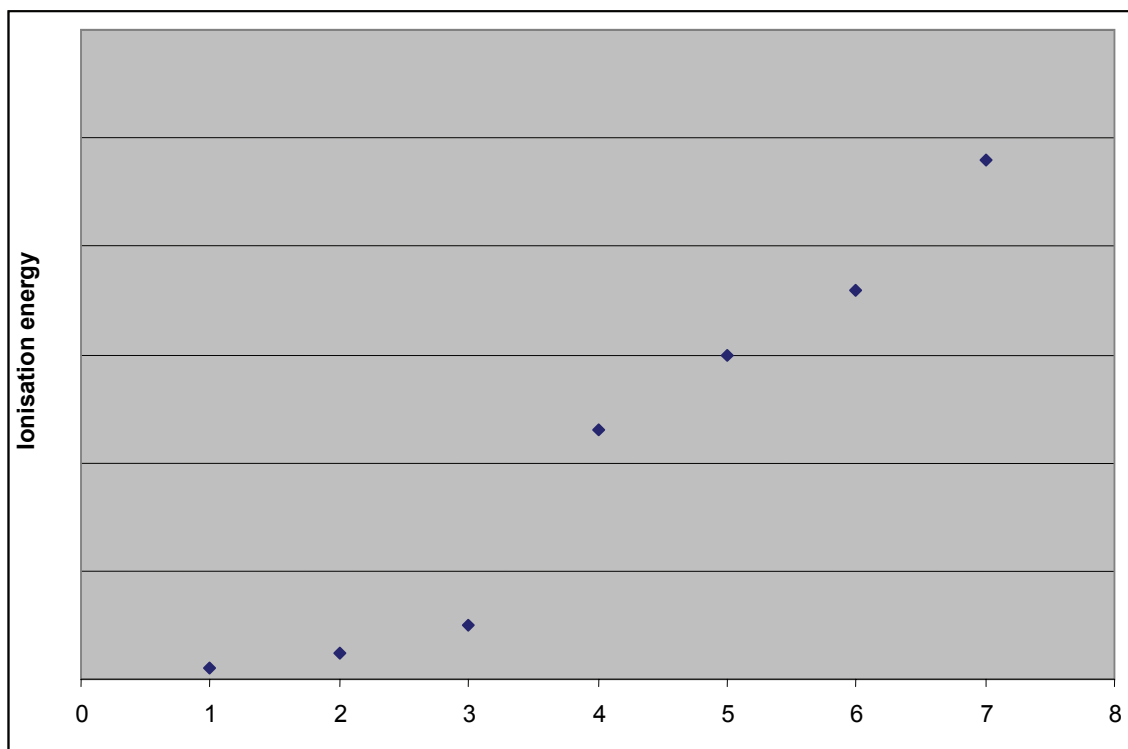
2 marks

Total 4 marks

Question 6

The current model of the atom has evolved over 100 years as new experimental observations came to light.

- a. Neils Bohr used emission spectra and ionisation energies to develop the shell model in which electrons were placed in orbits of fixed energies, called shells. A graph showing the first to sixth ionisation energies of a particular element is given below.



- i. Which of the following is most likely to be this element? Use a circle to select your answer.

boron nitrogen oxygen aluminium

1 mark

- ii. Explain how you determined your answer to part i.

2 marks

- b. i.** Name one other scientist who made a contribution to the development of atomic theory.

1 mark

- ii.** Describe the contribution made by this scientist.

1 mark

Total 5 marks

Question 7

Vanadium is used in tool making and its compounds are used for dyeing and painting fabrics.

a. Write the electronic configuration of the following species.

i. V

1 mark

ii. V^{2+}

1 mark

iii. V^{3+}

1 mark

b. Explain why vanadium is able to exist in more than one oxidation state.

2 marks

c. Explain why compounds of vanadium can be coloured.

2 marks

Total 7 marks

Question 8

Elements X and Y are located in the same period of the periodic table in the relative positions shown below.

X																	Y
---	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	---

- a. Place a tick in the appropriate box to describe which element you would expect to have the **higher** value.

Characteristic	Element X	Element Y
i. atomic radius		
ii. electronegativity		
iii. oxidising strength		

3 marks

- b. Explain your choice for electronegativity.

2 marks

Total 5 marks

Question 9

Give concise explanations for each of the following.

- a.** Molten sodium chloride, rather than aqueous sodium chloride, is used in the Downs cell for the production of sodium metal.

1 mark

- b.** Reducing the temperature of an enzyme-catalysed reaction solution reduces the rate of the chemical reaction significantly.

1 mark

- c.** Explain why the addition of an antioxidant, in the form of vitamin C in lemon juice, prevents cut apples from going brown.

2 marks

Total 4 marks

END OF QUESTION AND ANSWER BOOK