

SUPERVISOR TO ATTACH PROCESSING LABEL HERE

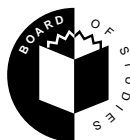
STUDENT NUMBER

Letter

Figures

Words

--



**Victorian Certificate of Education
1996**

CHEMISTRY**Common Assessment Task 1: Written examination**

Tuesday 11 June 1996: 2.45 pm to 4.30 pm

Reading time: 2.45 pm to 3.00 pm

Writing time: 3.00 pm to 4.30 pm

Total writing time: 1 hour 30 minutes

QUESTION AND ANSWER BOOKLET**Structure of booklet**

<i>Section</i>	<i>Number of questions</i>	<i>Number of questions to be answered</i>
A	18	18
B	6	6

Directions to students**Materials**

Question and answer booklet of 18 pages, with a detachable data sheet in the centrefold.
Answer sheet for multiple-choice questions. You should have at least one pencil and an eraser.
An approved calculator may be used.

The task

Detach the data sheet from the centre of this booklet during reading time.
Please ensure that you write your **student number** in the space provided on this booklet and that you sign your **name** in the space provided on the answer sheet for multiple-choice questions.
This paper consists of two sections, Section A and Section B.
Answer **all** questions from Section A. Section A is worth 18 marks.
Section A questions should be answered on the answer sheet provided for multiple-choice questions.
Answer **all** questions from Section B. Section B is worth 50 marks.
Section B questions should be answered in the spaces provided in this booklet.
There is a total of 68 marks available.
Working space is provided throughout this booklet.
All written responses should be in English.

At the end of the task

Place the answer sheet for multiple-choice questions inside the front cover of this booklet and hand them in.

SECTION A**Specific instructions for Section A**

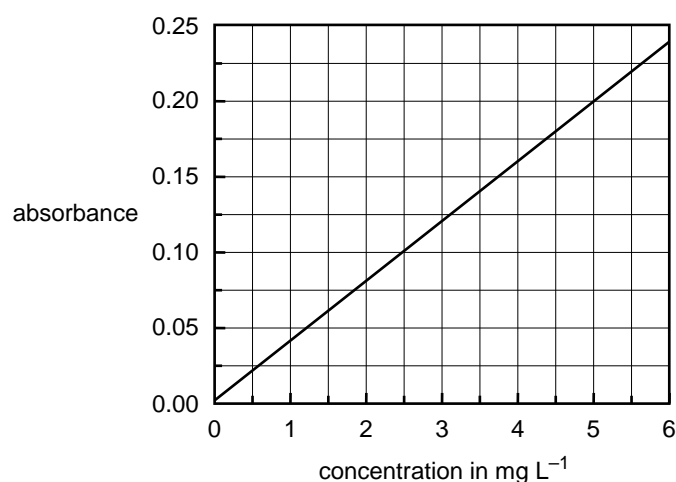
Section A consists of 18 multiple-choice questions. Section A is worth 18 marks which is approximately 26 per cent of the total marks available. You should spend approximately 23 minutes on this section.

Choose the response that is **correct** or **best answers the question**, and indicate 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 completed for any question. Marks will **not** be deducted for incorrect answers. You should attempt every question.

The following graph is referred to in Question 1.

This calibration graph shows the absorbance of a series of standard solutions containing iron, recorded with an atomic absorption spectrometer.

**Question 1**

In order to release the iron in an 8.40 g sample of peas, the sample was reacted with moderately concentrated hydrochloric acid and the volume made up to 100 mL. The absorbance of a sample of the resultant solution was measured to be 0.10 with an atomic absorption spectrometer, set to an appropriate wavelength. Using the calibration graph given above, the mass of iron in the original sample of peas in milligrams is

- A. 0.21
- B. 0.25
- C. 2.1
- D. 2.5

Question 2

Consider the reaction

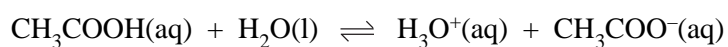


If more NO gas is added to this system at equilibrium then there will be

- A. an increase in the amount of NO_2 gas.
- B. an increase in the value of the equilibrium constant.
- C. an increase in the amount of N_2O_3 gas.
- D. a decrease in the value of the equilibrium constant.

Question 3

Acetic acid is a weak acid that ionises in water according to the equation



If a 0.10 M solution of acetic acid is diluted with water, which of the following correctly shows the expected change in the percentage ionisation and pH?

- | percentage ionisation | pH |
|-----------------------|-----------|
| A. increases | increases |
| B. increases | decreases |
| C. decreases | increases |
| D. decreases | decreases |

Question 4

Which one of the following is **not** a conjugate acid-base pair?

- A. $\text{H}_2\text{O}/\text{OH}^-$
- B. $\text{H}_3\text{O}^+/\text{H}_2\text{O}$
- C. $\text{H}_3\text{O}^+/\text{OH}^-$
- D. $\text{OH}^-/\text{O}^{2-}$

Question 5

A commercial liquid medication is known to contain 400 mg of magnesium hydroxide, $\text{Mg}(\text{OH})_2$, per 10.0 mL of the medication. How many mole of magnesium would there be in 1.0 L of the medication? (M_r of $\text{Mg}(\text{OH})_2$ is 58.3)

- A. 6.9×10^{-4}
- B. 6.9×10^{-3}
- C. 6.9×10^{-2}
- D. 6.9×10^{-1}

Question 6

100 mL of 0.1 M $\text{HNO}_3(\text{aq})$ and 100 mL of 0.1 M $\text{NaOH}(\text{aq})$ are mixed. The pH of the resulting solution will be closest to

- A. 0
- B. 1
- C. 7
- D. 13

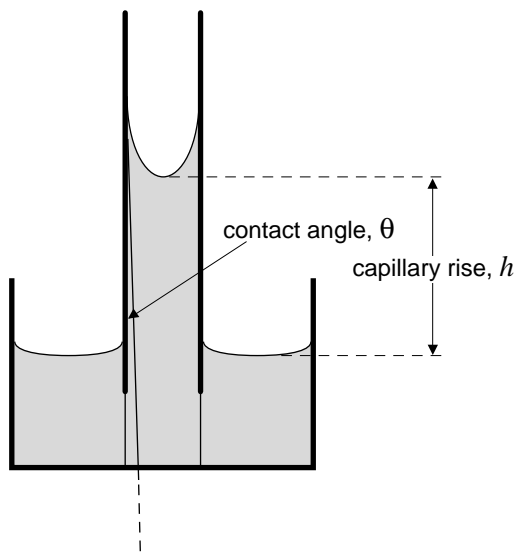
Question 7

Some small insects can walk across the surface of a pond without falling through the surface. Their legs are covered with a waxy substance that

- A. is hydrophobic.
- B. is hydrophilic.
- C. forms an oil in water emulsion.
- D. forms a water in oil emulsion.

The diagram below is referred to in Questions 8, 9 and 10.

This diagram is a representation of a liquid rising up a very narrow glass capillary. The case illustrated shows a liquid such as water that wets glass so that the contact angle is very small; that is, close to 0° . The height to which the water rises in the capillary is given by h .



Question 8

Provided a liquid wets the material of a capillary, which of the following combination of conditions would result in a maximum value of h ?

	surface tension of liquid	diameter of capillary
A.	high	large
B.	high	small
C.	low	large
D.	low	small

Question 9

Mercury is a liquid with a very high surface tension that does **not** wet glass. If the end of a thin glass capillary is dipped into a beaker of mercury, which of the following would be observed?

	contact angle between mercury and glass	capillary behaviour
A.	θ is greater than 90°	capillary rise observed
B.	θ is greater than 90°	capillary depression observed
C.	θ is less than 90°	capillary rise observed
D.	θ is less than 90°	capillary depression observed

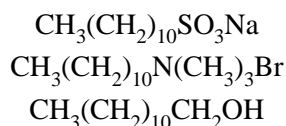
Question 10

Formamide is a liquid with a very high surface tension that wets glass. If the end of a thin glass capillary is dipped into a beaker of formamide, which of the following would be observed?

	contact angle between formamide and glass	capillary behaviour
A.	θ is greater than 90°	capillary rise observed
B.	θ is greater than 90°	capillary depression observed
C.	θ is less than 90°	capillary rise observed
D.	θ is less than 90°	capillary depression observed

Question 11

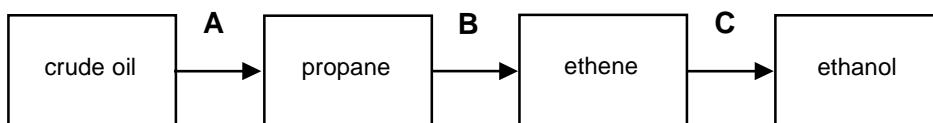
You have samples of the following three solid substances



Identify the possible cationic detergent and anionic detergent.

	cationic detergent	anionic detergent
A.	$\text{CH}_3(\text{CH}_2)_{10}\text{N}(\text{CH}_3)_3\text{Br}$	$\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{OH}$
B.	$\text{CH}_3(\text{CH}_2)_{10}\text{CH}_2\text{OH}$	$\text{CH}_3(\text{CH}_2)_{10}\text{SO}_3\text{Na}$
C.	$\text{CH}_3(\text{CH}_2)_{10}\text{SO}_3\text{Na}$	$\text{CH}_3(\text{CH}_2)_{10}\text{N}(\text{CH}_3)_3\text{Br}$
D.	$\text{CH}_3(\text{CH}_2)_{10}\text{N}(\text{CH}_3)_3\text{Br}$	$\text{CH}_3(\text{CH}_2)_{10}\text{SO}_3\text{Na}$

The flow chart below refers to the industrial preparation of ethanol and is referred to in Questions 12, 13, 14 and 15.

**Question 12**

Process **A** could best be described as

- A. reduction.
- B. combustion.
- C. chromatography.
- D. distillation.

Question 13

Process **B** could best be described as

- A. cracking.
- B. distillation.
- C. hydrogenation.
- D. hydration.

Question 14

Process **C** could best be described as

- A. cracking.
- B. distillation.
- C. hydrogenation.
- D. hydration.

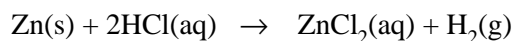
Question 15

The formulas of ethene and propane are, respectively,

- A. C_2H_4 , C_2H_6
- B. C_2H_6 , C_3H_8
- C. C_2H_6 , C_3H_6
- D. C_2H_4 , C_3H_8

The following information is referred to in Questions 16, 17 and 18 below.

6.54 g of zinc metal is completely dissolved in 250 mL of concentrated hydrochloric acid to give gaseous hydrogen according to the equation



Question 16

The volume in litres of hydrogen gas produced at 25 °C and 1.00 atm pressure is

- A. 0.205
- B. 2.44
- C. 205
- D. 248

Question 17

The concentration of zinc ions in the solution after all the zinc has reacted would be

- A. 0.10 M
- B. 0.20 M
- C. 0.40 M
- D. 0.025 M

Question 18

The reaction between zinc and hydrochloric acid is best described as

- A. an acid-base reaction.
- B. a precipitation reaction.
- C. a redox reaction.
- D. a gravimetric reaction.

Working space

SECTION B**Specific instructions for Section B**

Section B consists of six short-answer questions. You should answer all of these questions. The section is worth 50 marks or approximately 74 per cent of the total. You should spend approximately 67 minutes on this section.

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

Questions should be answered in the spaces provided in this booklet.

To obtain full marks for your responses 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, $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$ }.

Question 1

- a. Write a balanced ionic half-equation for the reduction of molecular bromine (Br_2) to bromide ions (Br^-) in aqueous solution.

- b. Write a balanced ionic half-equation for the oxidation of hydrogen sulfide (H_2S) to the sulfate ion (SO_4^{2-}) in acid solution.

- c. Write a balanced equation for the oxidation of hydrogen sulfide to sulfate by molecular bromine.

1 + 2 + 1 = 4 marks
(suggested time: 5 minutes)

Question 2

The flow chart shown on the opposite page was drawn in a student's log book. It describes a procedure to be used in separating and identifying the individual dye components of a commercial food colouring.

- a. Identify three fundamental errors in the flow chart and in each case explain how the error should be corrected.

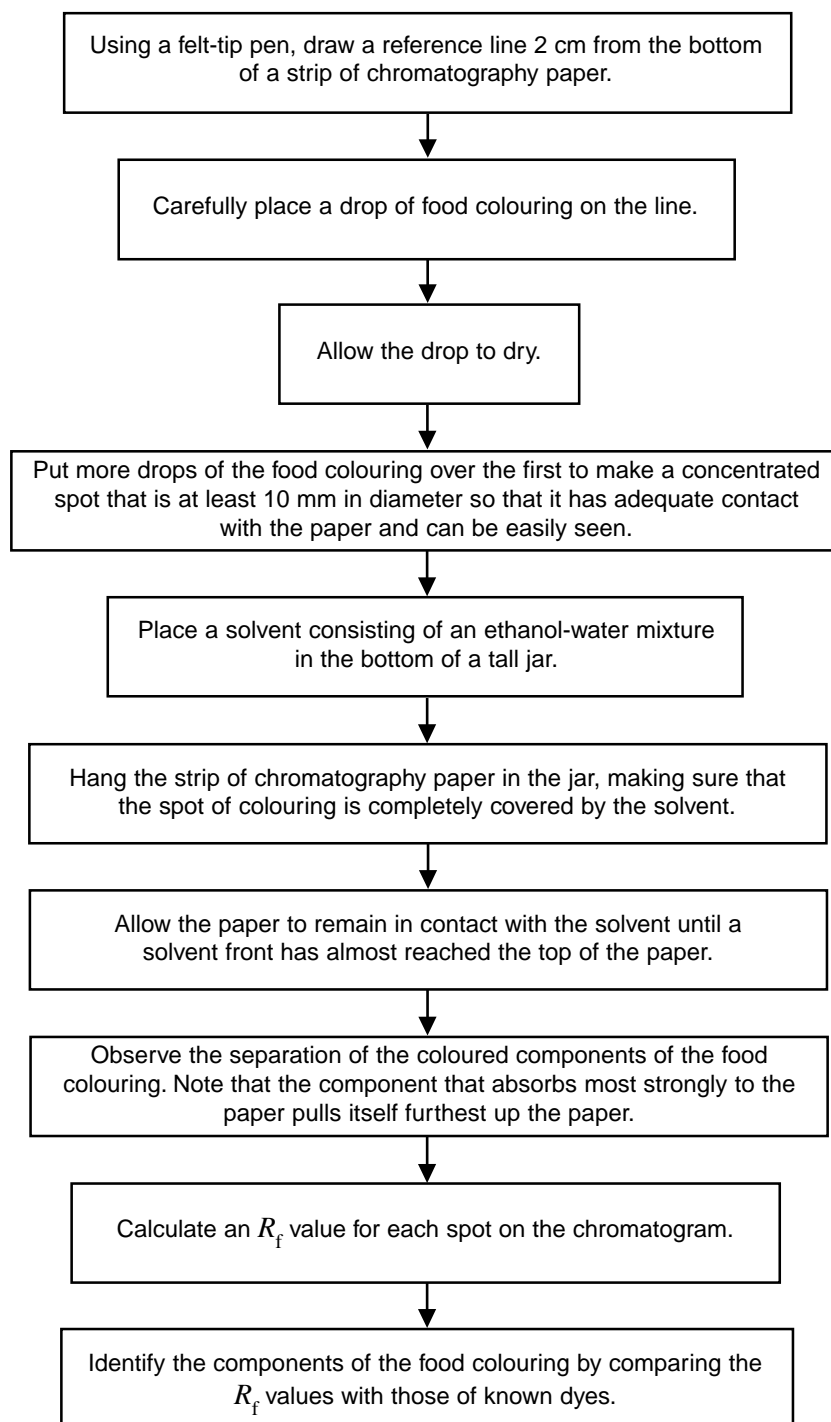
Error 1

Error 2

Error 3

- b. Explain, using a diagram if you wish, how R_f values are calculated.

- c. Paper chromatography is only one kind of chromatographic technique. Briefly explain what features are common to all types of chromatography.



6 + 2 + 3 = 11 marks

(suggested time: 14 minutes)

SECTION B – continued

TURN OVER

Question 3

Iron and sulfuric acid are two very important industrial chemicals. Oxidation and reduction reactions occur in the preparation of both of these substances.

- a. Give an equation for the reaction in which iron oxide is reduced to iron in the blast furnace.

- b. Iron is produced from iron oxide in a reduction reaction, yet molecular oxygen from the air plays a key role in the process. Briefly explain, both in words **and** with a chemical equation, the part molecular oxygen plays in the production of iron.

- c. Give the chemical equations for **two** reactions in the production of sulfuric acid in which molecular oxygen is directly involved.

- d. Iron will react with dilute aqueous sulfuric acid. Give an ionic equation for this reaction.

- e. In the boxes provided, give the oxidation number of each of the atoms in a sulfuric acid molecule.

H

S

O

- f.** There are several environmental hazards associated with both the production of iron and sulfuric acid. Give one example for each process.

i. iron

ii. sulfuric acid

- g.** Give an example of one important use for each of iron and sulfuric acid.

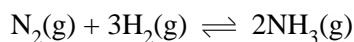
i. iron

ii. sulfuric acid

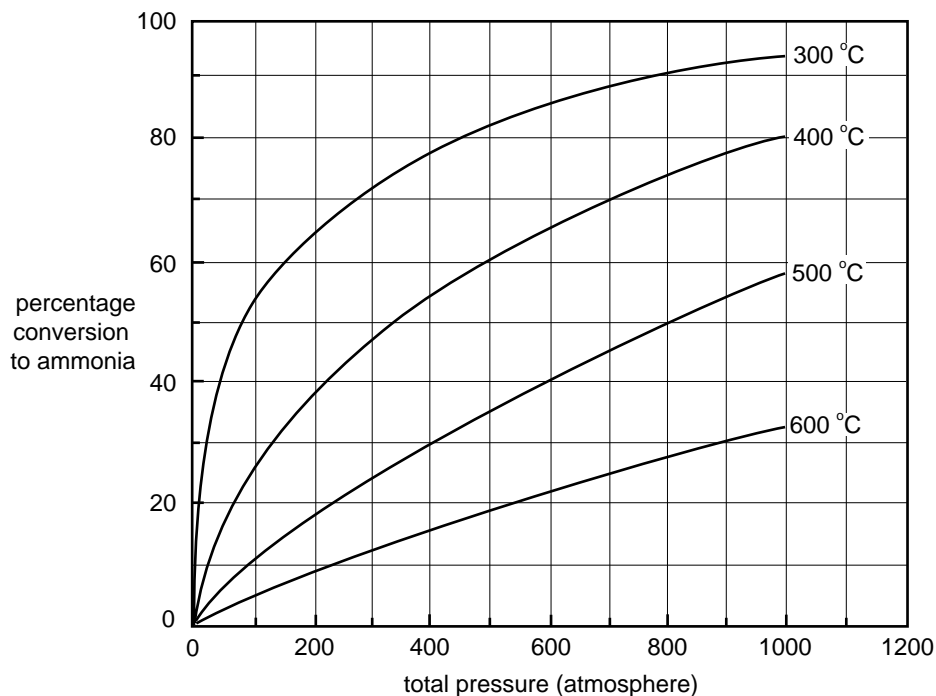
1 + 2 + 2 + 1 + 3 + 2 + 2 = 13 marks
(*suggested time: 18 minutes*)

Question 4

Ammonia can be produced according to the equation



The graph below illustrates the variation in the yield of ammonia with pressure at different temperatures.



a. Write an expression for the equilibrium constant for the formation of ammonia from hydrogen and nitrogen.

b. A particular process uses a pressure of 300 atm and a temperature of 500 °C. From the graph, determine the percentage yield of ammonia under these conditions.

c. State Le Chatelier's principle.

- d. Explain how you can deduce from the graph whether the production of ammonia is an exothermic or an endothermic process.

- e. Suggest a possible reason why a temperature of less than 400 °C is rarely used even though it would apparently result in a greater yield of ammonia.

1 + 1 + 1 + 2 + 1 = 6 marks
(suggested time: 8 minutes)

- c. The hot water and detergent removes grease by taking it into solution. Explain, using a labelled diagram if you wish, why grease 'dissolves' in water with the help of a detergent, although it is quite insoluble in pure water.

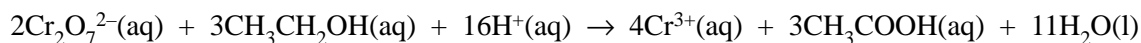
- d. Why is hot water plus detergent preferable to cold water plus detergent for cleaning plates?

3 + 2 + 2 + 1 = 8 marks
(*suggested time: 11 minutes*)

Question 6

A new low alcohol beer, 'LOALC', was tested for its alcohol ($\text{CH}_3\text{CH}_2\text{OH}$) content. A 20.00 mL sample was pipetted into a 500 mL standard flask and the solution made up to the mark. A 25.00 mL aliquot was titrated against a 0.0500 M solution of $\text{K}_2\text{Cr}_2\text{O}_7$ and a titre of 8.20 mL was obtained.

The equation for the reaction is



- a. How many mole of $\text{Cr}_2\text{O}_7^{2-}$ was used in the titration?

- b. How many mole of $\text{CH}_3\text{CH}_2\text{OH}$ was present in the 25.00 mL aliquot?

- c. What was the alcohol concentration in the aliquot?

- d. What was the concentration of alcohol in the original sample of the beer?

- e. Calculate the mass of alcohol in a standard size 200 mL glass of the beer.

- f. State **two** safety precautions you should take during this analysis.

2 + 1 + 1 + 1 + 2 + 1 = 8 marks
(suggested time: 11 minutes)