Neap:

Trial Examination 2008

VCE Chemistry Unit 2

Written Examination

Question and Answer Booklet

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

Student's Name: _____

Teacher's Name: _____

Structure of Booklet

Section	Number of questions	Number of questions to be answered	Marks	Suggested time (minutes)
A Multiple-choice	20	20	20	25
B Short-answer	7	7	50	65
			Total 70	Total 90

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

Materials supplied

Question and answer booklet of 13 pages, with a detachable data booklet in the centrefold.
Answer sheet for multiple-choice questions.

Instructions

Detach the data booklet from the centre of this booklet during reading time.
Please ensure that you write **your name** and your **teacher's name** in the space provided on this booklet and in the space provided on the answer sheet for multiple-choice questions.
All written responses must be in English.

At the end of the examination

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

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

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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.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

Which statement concerning nitrogen dioxide and environmental effects is **incorrect**?

Nitrogen dioxide

A. is a major greenhouse gas.
B. can act as a reactant in the formation of acid rain.
C. produces the brown haze found in photochemical smog.
D. contributes to the formation of ground-level ozone.

Question 2

Under which of the following conditions would one mole of oxygen gas occupy the smallest volume?

A. 0°C and 1.1×10^5 Pa
B. 10°C and 3.5×10^5 Pa
C. 25°C and 4.1×10^5 Pa
D. 35°C and 2.0×10^5 Pa

Question 3

A student is given pure samples of carbon dioxide, nitrogen and hydrogen gases in separate test tubes labelled only as *X*, *Y* and *Z*. Each tube contains only one of the gases.

Which of the following tests alone would determine which test tube contains carbon dioxide gas?

A. testing the odour of each gas
B. comparing the colour of each gas
C. inserting a glowing splint into each gas
D. adding water to each test tube and testing the pH of the resulting solution

Question 4

Which of the following describes the movement of charged particles during the operation of a galvanic cell based on the reaction shown below?

$$Zn(s) + Pb^{2+}(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$$

	Electron movement in the external circuit	Ion movement in the solution
A.	from Zn to Pb	$Pb^{2+}(aq)$ move away from Pb(s)
B.	from Zn to Pb	$Pb^{2+}(aq)$ move towards Pb(s)
C.	from Pb to Zn	$Pb^{2+}(aq)$ move away from Pb(s)
D.	from Pb to Zn	$Pb^{2+}(aq)$ move towards Pb(s)

Question 5

Which of the following is **not** consistent with the principles of green chemistry?

A. maximising energy use in each chemical process
B. minimising the use of toxic chemicals by replacing them with safer alternatives
C. maximising the atom efficiency of each reaction pathway
D. minimising the formation of wastes and by-products

Question 6

Which of the following equations represents an ionisation process?

A. $Na_2SO_4(aq) + Pb(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + PbSO_4(s)$

B. $NH_3(g) + H_2O(l) \rightarrow NH_4OH(aq)$

C. $C_2H_4(g) + Cl_2(g) \rightarrow C_2H_4Cl_2(g)$

D. $NaOH(aq) \xrightarrow{H_2O} Na^+(aq) + Cl^-(aq)$

Question 7

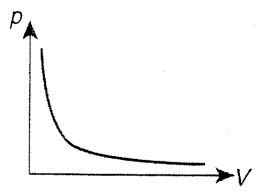
Which of the following contains the greatest number of Na^+ ions?

A. 200 L of a 10 ppm NaCl solution
B. 30 mL of a 5.0% m/v NaCl solution
C. 250 mL of 0.50 M NaCl solution
D. 0.035 mol of solid NaCl

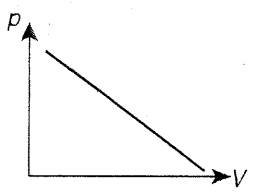
Question 8

Which of the following graphs represents the change in pressure of an ideal gas as the volume is increased at constant temperature?

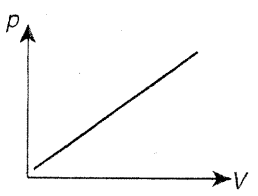
A.



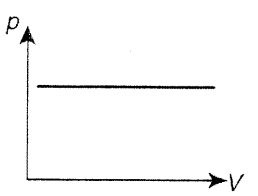
B.



C.



D.



Question 9

The pH of a solution is 2.

If the pH is increased to 4, by what factor is the concentration of hydrogen ions in the original solution changed?

A. 2
B. 20
C. 100
D. 1000

Question 10

Which of the following statements concerning ozone (O_3) is **incorrect**?

Ozone

A. is present in the stratosphere at a concentration of around 10 ppm.
B. is an allotrope of oxygen.
C. present at ground-level is an eye and respiratory irritant.
D. is important in reducing the levels of infrared radiation reaching the Earth's surface.

Questions 11 and 12 refer to the following information.

Four metals are identified only by the symbols *W*, *X*, *Y* and *Z*.

Metal *W* reacts with hot water.

Metal *X* reacts spontaneously with cold water producing hydrogen gas rapidly.

Metal *Y* does not react with hot or cold water but reacts with dilute acid and steam.

Metal *Z* does not react with water, steam or dilute acid.

Question 11

The order of reactivity of the metals, from the most reactive to the least reactive, is

A. *W*, *X*, *Y*, *Z*.
B. *X*, *W*, *Y*, *Z*.
C. *Y*, *W*, *X*, *Z*.
D. *Z*, *W*, *X*, *Y*.

Question 12

For which of the following combinations would a spontaneous redox reaction be expected to occur?

A. metal *X* placed in a solution containing metal *Z* ions
B. metal *Y* placed in a solution containing metal *X* ions
C. metal *Z* placed in a solution containing metal *W* ions
D. metal *Y* placed in a solution containing metal *W* ions

Question 13

10.0 g of sodium hydroxide is completely dissolved in water so that the final volume of the solution is 250.0 mL.

The pH of the resulting solution, at 25°C, is

A. 11
B. 12
C. 13
D. 14

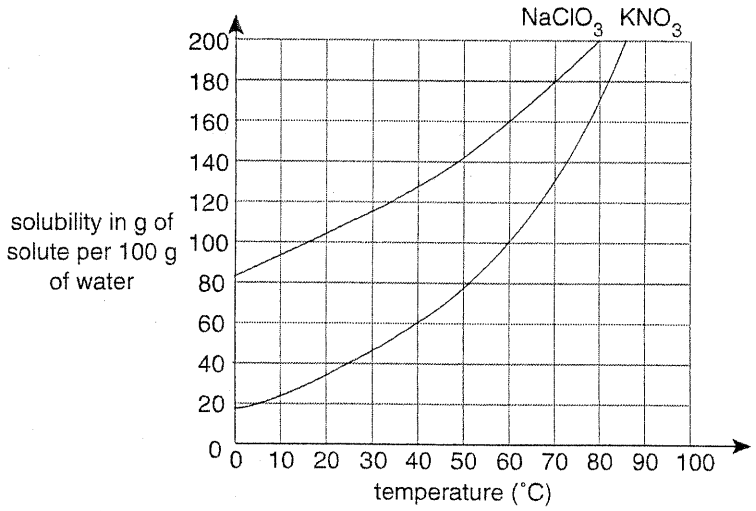
Question 14

Equal volumes of sulfur dioxide gas and sulfur trioxide gas at the same temperature and pressure would have an equal

A. mass.
B. number of oxygen atoms.
C. percentage by mass of sulfur.
D. number of molecules.

Questions 15 and 16 refer to the following information.

The graph below shows solubility curves for two metal salts: potassium nitrate (KNO_3) and sodium chlorate ($NaClO_3$).



Where necessary, assume that the density of water = 1 g mL^{-1}.

Question 15

50 mL of a saturated solution of KNO_3 was cooled from 80°C to 40°C.

What mass of KNO_3 would be expected to have crystallised from the solution?

A. 55 g
B. 60 g
C. 85 g
D. 110 g

Question 16

A solution contains 10 g of $NaClO_3$ dissolved in 50 g of solution at 60°C.

The minimum mass of $NaClO_3$ that must be added to saturate the solution is closest to

A. 20 g
B. 40 g
C. 50 g
D. 150 g

Question 17

A sample of neon gas occupies 58 L at 13°C and 700 mmHg.

If the sample is heated to 100°C and the volume drops to 33 L, the new pressure (**in kPa**) will be closest to

A. 10
B. 100
C. 200
D. 1600

Question 18

In which of the following pairs of acids is the first species a better conductor of electricity than the second species?

A. CH_3COOH and HCl

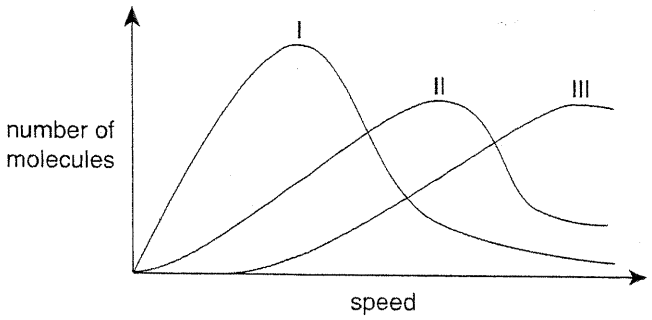
B. HCOOH and H_2O

C. $HOOCCH_2COOH$ and HNO_3

D. H_2CO_3 and H_2SO_4

Question 19

The graph below shows the distribution of speeds of gaseous molecules.



Which of the following is consistent with the information presented in the graph above?

A. Graphs I and III represent distributions for the same gas at the same temperature and different pressures.

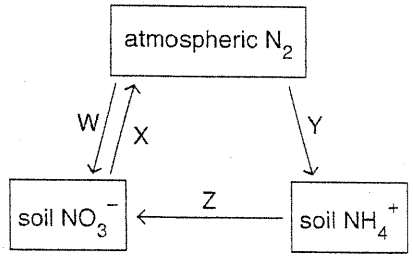
B. Graphs I and II represent distributions for the same gas at different temperatures in the same sized containers.

C. Graphs II and III represent distributions for the same gas at the same temperature in different sized containers.

D. Graphs I, II and III represent the distributions for different amounts of the same gas at the same pressure and temperature.

Question 20

The diagram below shows a simplified version of the nitrogen cycle.



Which of the following statements concerning this diagram is **incorrect**?

A. Process W can occur through a series of reactions involving lightning and rain.

B. Process X is due to the action of denitrifying bacteria.

C. Process Y can result from the industrial production of fertilisers.

D. Process Z can be carried out by nitrogen fixing bacteria in the soil.

SECTION B: SHORT-ANSWER QUESTIONS

Instructions for Section B

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

To obtain full marks for your responses you should

- give simplified answers with an appropriate number of significant figures to 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 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

Large-scale combustion of fossil fuels has created a number of atmospheric problems. Among the products of fossil fuel combustion are carbon dioxide and carbon monoxide.

a. **i.** Write an equation to show how the combustion of octane (C_8H_{18}) can produce carbon monoxide.

_____

ii. Suggest **one** method by which the production of carbon monoxide may be reduced.

_____

_____

1 + 1 = 2 marks

b. One possible effect of increased levels of atmospheric carbon dioxide is global warming due to the enhanced greenhouse effect.

i. Suggest **one** reason why carbon dioxide might be considered the most important greenhouse gas.

_____

_____

ii. Suggest **one** reason why methane might be considered a more important greenhouse gas than carbon dioxide.

_____

_____

iii. Write a balanced equation to represent one naturally occurring process which lowers atmospheric levels of carbon dioxide.

_____

1 + 1 + 1 = 3 marks

c. A gaseous mixture containing carbon dioxide, water and nitrogen is to be separated into its component gases.

Suggest a technique which could be used to

i. remove the water from the mixture.

_____

_____

ii. remove the carbon dioxide from the nitrogen in the remaining mixture.

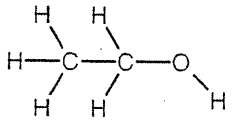
_____

_____

1 + 1 = 2 marks
Total 7 marks

Question 2

a. The molecular structure of ethanol is shown below.



Show why ethanol is soluble in water by adding to and labelling the above diagram.

2 marks

b. A particular brand of beer has an ethanol content of 4.50% v/v.

i. Determine the volume of ethanol consumed when a person drinks a 375 mL bottle of this beer.

_____

_____

ii. Determine the concentration, in mole per litre (M), of ethanol in the beer given that the density of ethanol is 0.785 g mL^{-1}.

_____

_____

_____

_____

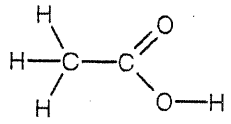
_____

1 + 3 = 4 marks

c. When a driver is breathalysed, the driver's blood alcohol content can be determined by a reaction that occurs between ethanol and potassium dichromate crystals as shown by the redox equation below.

$$2Cr_2O_7^{2-}(aq) + 3CH_3CH_2OH(aq) + 16H^+(aq) \rightarrow 4Cr^{3+}(aq) + 3CH_3COOH(aq) + 11H_2O(l)$$

In this redox reaction, ethanol is converted to ethanoic acid. The structure of ethanoic acid is shown below.



i. State **one** reason why the conversion of ethanol to ethanoic acid is considered to be an oxidation process.

_____

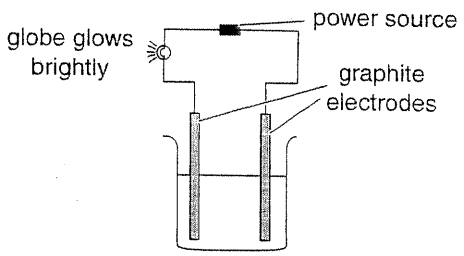
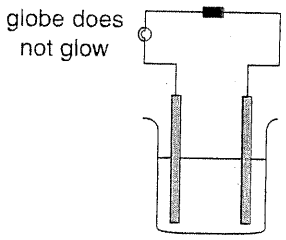
_____

ii. Ethanoic acid is a weak acid.

On the diagram of ethanoic acid above, circle **one** ionisable (acidic) proton.

1 + 1 = 2 marks

d. 0.10 M solutions of ethanol, ethanoic acid and methanoic acid (HCOOH) were prepared. Tests were conducted to determine the pH and conductivity of these three solutions. Partial results of these tests are shown in the table below.

Solution	Conductivity test results	pH of 0.10 M solution
A		2.4
B		?
C	?	2.9

i. State the expected pH for solution B at 25°C.

_____

ii. State the expected appearance of the globe for solution C.

_____

iii. Identify solution B.

_____

iv. Given that methanoic acid is a stronger acid then ethanoic acid, identify solution A.

_____

1 + 1 + 1 + 1 = 4 marks

Total 12 marks

Question 3

Magnesium hydroxide ($Mg(OH)_2$) and sodium hydrogen carbonate ($NaHCO_3$) can both act as antacids to neutralise excess acid production in the stomach.

a. Write an equation for the reaction of hydrochloric acid with

i. magnesium hydroxide solid.

_____

ii. sodium hydrogen carbonate solution.

_____

1 + 1 = 2 marks

b. An experiment was conducted to compare the effectiveness of each antacid. 0.50 g of each antacid was neutralised using 0.10 M HCl solution.

Which antacid would be expected to neutralise the greater amount of HCl solution? Include all relevant calculations in your answer.

_____

_____

_____

_____

_____

4 marks

c. What volume of carbon dioxide gas would be released if 0.50 g of sodium hydrogen carbonate antacid reacted completely with the HCl present in the stomach at 37°C and a pressure of 1.0 atm?

_____

_____

_____

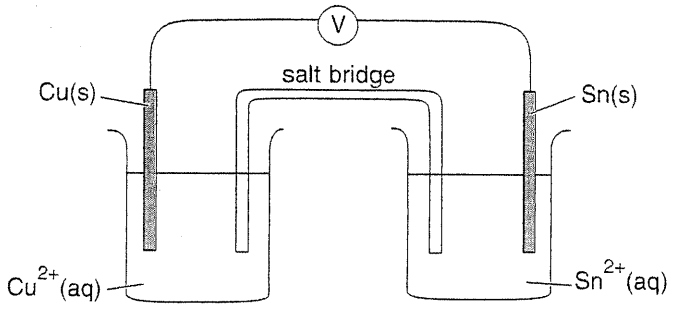
_____

2 marks

Total 8 marks

Question 4

A galvanic cell may be constructed as shown in the diagram below.



a. **i.** Write a balanced ionic equation for the reaction occurring in the cell.

_____

ii. Which electrode (Sn or Cu) is the cathode?

_____

iii. Which electrode (Sn or Cu) carries a positive charge?

_____

iv. In which direction (towards the Sn half cell or towards Cu half cell) do anions move through the salt bridge?

_____

1 + 1 + 1 + 1 = 4 marks

b. Suggest why sodium hydroxide solution would be unsuitable for use in the salt bridge of this galvanic cell.

_____

_____

1 mark

Total 5 marks

Question 5

The provision of fresh drinking water is a problem worldwide. With over 95% of the world's water present as salt water in seas and oceans, efficient and economical methods of water purification are needed.

a. **i.** Water may be purified by a simple distillation method.

What property of water does this method rely on?

_____

ii. State the major disadvantage of simple distillation as a method of large-scale water purification.

_____

iii. Explain how the use of distillation at reduced pressure (as occurs in flash distillation) overcomes the problem stated in **ii**.

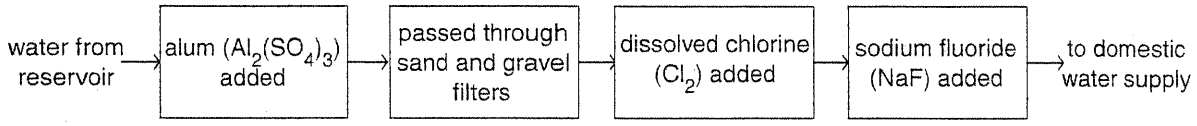
_____

_____

_____

1 + 1 + 2 = 4 marks

b. In many Australian cities, water must be treated before being passed into the domestic water supply for use in homes. Treatment is required to remove suspended solids, colour and bacteria. A simplified flowchart of this process is shown below.



i. Addition of alum to the water causes flocculation (the joining of small particles to form heavier particles which settle in the sample). Alum reacts with hydroxide ions in the water to produce insoluble aluminium hydroxide.

Write an ionic equation for the formation of aluminium hydroxide.

_____

ii. Which stage of the process removes suspended solids?

_____

iii. Which stage of the process has an antibacterial action?

_____

1 + 1 + 1 = 3 marks
Total 7 marks

Question 6

Ascorbic acid ($C_6H_8O_6$) is found in vitamin C tablets. The ascorbic acid content of these tablets can be determined by titration with iodine. The reaction between ascorbic acid and iodine proceeds according to the equation shown below.

$$C_6H_8O_6(aq) + I_2(aq) \rightarrow C_6H_6O_6(aq) + 2H^+(aq) + 2I^-(aq)$$

a. i. Write the redox half equation for the conversion of iodine to iodide ions.

_____

ii. Is the ascorbic acid acting as an oxidant or a reductant in this reaction? Explain your choice.

_____

_____

1 + 2 = 3 marks

b. i. Calculate the amount (in mol) of ascorbic acid in one vitamin C tablet, given that it contains 500 mg of ascorbic acid.

_____

ii. In a titration experiment, 24.55 mL of iodine solution reacted exactly with one dissolved vitamin C tablet.

Determine the concentration of the iodine solution.

_____

_____

_____

1 + 2 = 3 marks
Total 6 marks

Question 7

A gaseous alkane, C_xH_y, has a density of 1.22 g L^{-1} at a temperature of 25°C and a pressure of 1.00 atm.

a. **i.** State the volume of one mole of the alkane at the given conditions of temperature and pressure.

_____

ii. Determine the mass of one mole of the alkane at the given conditions of temperature and pressure.

_____

_____

iii. Name the alkane.

_____

1 + 1 + 1 = 3 marks

b. Changes were made to separate samples of the alkane.

State what would happen to the density of the sample when each change listed in the table below was made. Indicate your answers by placing ticks in the appropriate columns of the table.

	Change made to the sample	density increases	density decreases	density remains unchanged
i.	heated at constant volume			
ii.	heated at constant pressure			

1 + 1 = 2 marks

Total 5 marks

END OF QUESTION AND ANSWER BOOKLET