QATs
Quality Assessment Tasks

NAME: _____

Practice Examination

VCE Chemistry

Reading time: 15 minutes

Writing time: 90 minutes

QUESTION AND ANSWER BOOK

Section	Number of questions	Number of questions to be answered		Number of marks
A	20	20		20
B	7	7		55
			Total	75

- 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 book of 19 pages.
- A data book (provided by your teacher).
- Answer sheet for multiple-choice questions.

Instructions
- Write your **student name** in the space provided above on this page.
- Check that your **name** is printed on your answer sheet for multiple-choice.
- 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 book.
- Return the data book to your teacher.

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

SECTION A- Multiple-choice questions

+---+
| **Instructions for Section A** |
| Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions by shading in |
| your choice. |
| 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

A solution calorimeter was accidently calibrated with 110 ml of distilled water instead of 100 ml. The calorimeter was emptied, dried and then used to determine the heat of reaction of powdered magnesium in 100 ml of HCl. It can be deduced from this information that the correct calibration factor should be

    A. higher and the heat of reaction should be lower.

    B. higher and the heat of reaction should be higher.

    C. lower and the heat of reaction should be higher.

    D. lower and the heat of reaction should be lower.

Question 2

A catalyst is thought to increase the rate of a chemical reaction by

    A. increasing the temperature of the reaction.

    B. providing more surface area for the reaction.

    C. providing an alternative reaction pathway with lower activation energy.

   **D.** supplying the energy needed to overcome the activation energy.

Question 3

A gas syringe contains an equilibrium mixture of the gases NO_2 and N_2O_4. $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$ When the plunger is pushed inwards, all concentrations increase immediately. Which of the following will occur after the system experiences this change?

    A. The concentration of NO_2 in the system decreases further while the concentration of N_2O_4 increases.

    B. The concentration of NO_2 in the system increases further while the concentration of N_2O_4 decreases.

    C. All concentrations decrease further in order to regain a new position of equilibrium.

    D. All concentrations increase further in order to regain a new position of equilibrium.

Question 4

A button cell has the following reaction as current is drawn.

$Ag_2O_{(s)} + Zn_{(s)} + H_2O_{(l)} \rightarrow 2Ag_{(s)} + Zn(OH)_{(s)}$
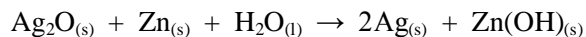
In this cell $Ag_2O(s)$ forms the

    A. positive electrode and is oxidised.

    B. positive electrode and is reduced.

    C. negative electrode and is oxidised.

    D. negative electrode and is reduced.

Question 5

A solution is made by dissolving 1.139 g of solid barium hydroxide in distilled water and then adding more distilled water until the total volume of the solution is one litre. The molarity of the barium hydroxide solution, the hydroxide concentration in mol dm^{-3} and the pH of the solution would be closest to

    A. 0.01M, 0.02M, 12.3

    B. 0.02M, 0.01M, 12.3

    C. 12.3, 0.01M, 0.02M

    D. 0.02M, 12.3, 0.01M

Question 6

The overall cell potential of the galvanic cell constructed from a Cu^{2+}/Cu electrode and a Mg^{2+}/Mg electrode under standard conditions would be expected to be

    A. O.34V

    B. -2.34V

    C. 2.68V

    D. -2.00V

Question 7

In the production of copper and aluminium by electrolysis, when the same quantity of electricity is passed through the cells, the simplest ratio of the **mass** of copper deposited compared to the **mass** of aluminium deposited would be

    A. 1:1

    B. 4:3

   **C.** 7:2

    D. 8:9

Question 8

The best explanation for the fact that at higher temperatures the rate of most chemical reactions increases is that the

    A. shape of the colliding particles is more suitable to react.

    B. activation energy for the reaction is decreased.

    C. colliding particles have sufficient energy to react.

    D. orientation of the colliding particles is more suitable to react.

Question 9

Plants use energy from the sun, along with carbon dioxide and water during the process of photosynthesis according to the equation:

$6CO_{2(g)} + 6H_2O_{(l)} \rightarrow C_6H_{12}O_{6(aq)} + 6O_{2(g)}$ (in the presence of UV light and Chlorophyll)
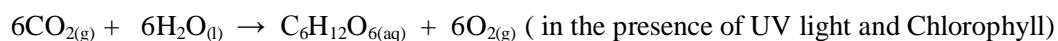
The total chemical energy of the products in this reaction is

    A. greater than that of the reactants and the reaction is exothermic.

    B. less than that of the reactants and the reaction is exothermic.

    C. less than that of the reactants and the reaction is endothermic.

    D. greater than that of the reactants and the reaction is endothermic.

Question 10

Which of the following acids will show the greatest percentage ionization in solution?

    A. Benzoic

    B. Lactic

    C. Hydrocyanic

    D. Hypobromous

Question 11

Magnesium reacts with oxygen according to the thermochemical equation

$$2Mg_{(s)} + O_{2(g)} \rightarrow 2MgO_{(s)} \quad \Delta H = -1200 \text{ kJmol}^{-1}$$

The mass, in grams, of magnesium that would need to react to release 8000 kJ of energy is

    A. 162

    B. 3.65

    C. 324

    D. 1.8

Question 12

A 1.00M solution of zinc chloride was electrolysed using graphite electrodes. In this electrolytic cell water is acting as

    A. a solvent.

    B. a reductant and a solvent.

    C. an oxidant and a solvent.

   **D.** a solvent, a reductant and an oxidant.

Question 13

Which of the procedures below is likely to decrease the rate of the following reaction?

$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad \Delta H = -191kJ \, mol^{-1}$

    A. Increasing the temperature

    B. Adding vanadium pentoxide as a catalyst

    C. Decreasing the volume of the reaction vessel

    D. Using air instead of pure oxygen

Question 14

Water undergoes self-ionisation according to the equation below:

$H_2O_{(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + OH^-_{(aq)} \quad \Delta H > 0$
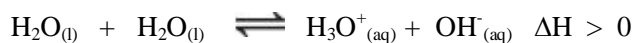
The pH of pure water is 7 at 25^0C. What would the pH of pure water be at 30^0C?

    A. Less than 7

    B. Greater than 7

    C. Equal to 7

    D. Unable to tell from the information given

Question 15

Which of the following metals cannot be extracted commercially from their aqueous solutions?

    A. Copper

    B. Nickel

    C. Potassium

    D. Tin

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Question 16

Which of the following is **not** an example of using the principles of green chemistry?

    A. Reducing the use of toxic chemicals by replacing them with safer alternatives

    B. Maximising the atom efficiency of each of the reaction pathways

    C. Reducing the formation of wastes and by-products

    D. Maximising the energy usage in each chemical process

Question 17

Hydrogen gas has been proposed as a fuel of the future. Research and development has enabled it to be used to power a motor car but there are however, still some problems with its use. Which of the following is true for hydrogen gas?

    A. The products of combustion have stronger bonds than hydrogen gas

    B. It has a very high energy per gram

    C. The infrastructure is still not available for extensive use as an alternative fuel for cars

    D. All of the above

Question 18

Nitric acid ionises in water according to the equation below:

$$HNO_{3(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + NO_3^-_{(aq)}$$

The equilibrium constant for this reaction at 25^0C is K.

What is the value for the equilibrium constant at 25^0C for the reaction below?

$$2H_3O^+_{(aq)} + 2NO_3^-_{(aq)} \rightleftharpoons 2HNO_{3(aq)} + 2H_2O_{(l)}$$

    A. 2K

    B. ½ K

    C. $1/K^2$

    D. $K^2/2$

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Question 19

The next two questions refer to the galvanic cell shown below.
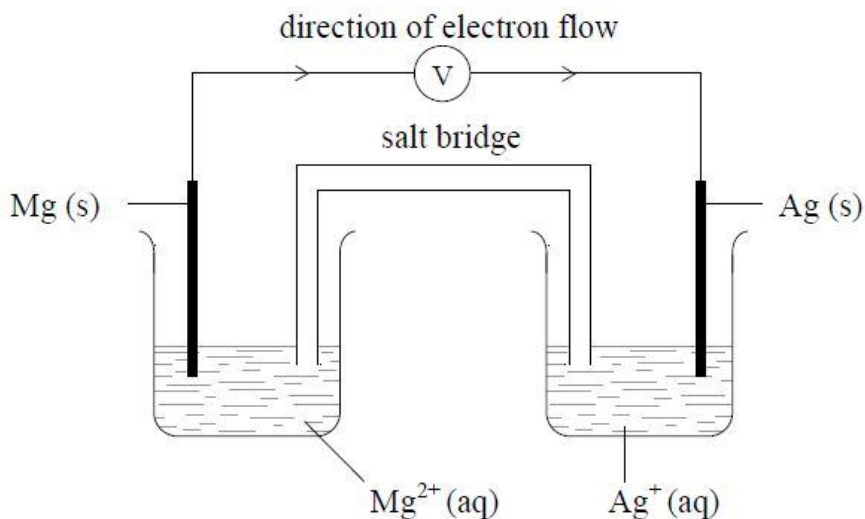
In the galvanic cell

    A. the Ag electrode is the anode and Ag^+ ions are reduced.

    B. the Mg electrode is the anode and has a negative charge.

    C. the Mg electrode is the cathode and Mg2+ ions are reduced.

    D. the Ag electrode is the cathode and has a negative charge.

Question 20

If the salt bridge was soaked in a saturated solution of KNO_3, then as the cell discharges

    A. K^+ ions would migrate towards the half- cell containing the Mg electrode.

    B. K^+ ions would migrate towards the half-cell containing the Ag electrode.

    C. NO_3^- ions would migrate to the half-cell containing the Mg electrode.

    D. Mg^{2+} ion would migrate towards the electrode containing the Mg electrode.

**SECTION B- Short answer questions**

Instructions for Section B

Answer **all** questions in the spaces provided in blue or black pen or pencil.
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.
- ensure chemical equations are balanced and that the formulas for individual substances include an indication of state for example $H_{2(g)}$ and $NaCl_{(s)}$.

Question 1

Nitrosyl bromide decomposes according to the following equation:

$$2NOBr_{(g)} \rightarrow 2NO_{(g)} + Br_{2(g)}$$
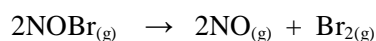
A student placed some nitrosylbromide in a container and used a manometer (an instrument for comparing pressures) to collect the data below.

Time (sec)	Concentration NOBr (M)
0	0.0100
2	0.0071
4	0.0055
6	0.0045
8	0.0038
10	0.0038
12	0.0038

The data collected was used to plot the following graph.
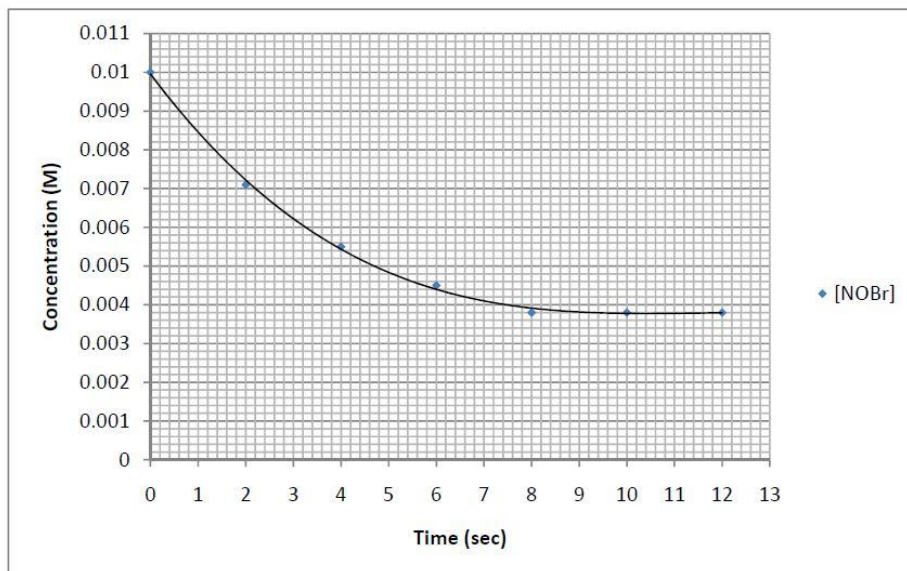
a) Determine the initial rate of reaction in terms of [NOBr]   (1 mark)

b) Determine the average rate of reaction in terms of [NOBr] for the first 8s.   (1 mark)

c) Why is the initial rate of reaction greater than the average rate over the first 8s?   (1 mark)

_____

_____

_____

d) On the graph above, show how the concentration of Br_2 would change over the period of 10s.

(2 marks)

e) The student repeats the experiment this time using a higher pressure. This was achieved by decreasing the volume of the container at constant temperature. State what will happen to the reaction rate giving a reason for the observed change.

_____

_____

_____

_____

(2 marks)

f) An increase in pressure (by decreasing the volume) does not increase the rate of the following reaction type

$2XY_{(g)} \rightarrow X_{2(g)} + Y_{2(g)}$
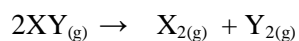
Explain why and suggest two ways the reaction rate could be increased.   (3 marks)

_____

_____

_____

_____

Total 10 marks

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Question 2

Methanoic acid, HCOOH is a weak acid.

   a) Explain what is meant by the term 'weak acid'.   (1 mark)

_____

_____

   b) Determine the concentration of the methanoate ion, $HCOO^-$, in a 0.0500M solution of methanoic

       acid at 25^0C.   (4 marks)

_____

_____

_____

_____

_____

_____

   b) A base in water produces hydroxide ions by accepting a proton from water. An aqueous solution
       of a **weak** base, sodium methanoate, HCOONa, contains hydroxide ions. Write an **ionic** equation
       to describe this equilibrium reaction.   (2 marks)

_____

_____

   c) A basicity constant, K_b, can be calculated from the above equation. A K_b value is an indication of
       the extent of ionisation of a weak base. Write an expression for K_b of the methanoate ion (1 mark)

_____

_____

Total 8 marks

Question 3

Chlorine and sodium hydroxide are produced by the electrolysis of concentrated sodium chloride. The net cell reaction can be represented by:

$2Cl^-_{(aq)} + 2H_2O_{(l)} \rightarrow Cl_{2(g)} + H_{2(g)} + 2OH^-_{(aq)}$
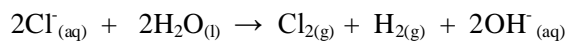
   a) For each electrode, write the corresponding half equation.   (2 marks)

   Positive electrode:_____

   Negative electrode:_____

   b) i) Calculate the volume of chlorine gas that would be produced from 1.00 L of 10.0M sodium chloride solution. Assume that the gas is collected at a temperature of 298 K and a pressure of 101.3 kPa.   (2 marks)

   _____

   _____

   _____

   _____

   ii) Calculate the time (in hours) required to produce this volume of chlorine gas using a current of 20 A.   (3 marks)

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

   _____

$\rightarrow$

c) What energy transformation/s is/are occurring when the electrolytic cell above is operating?

_____

_____

(1 mark)

Total 8 marks

Question 4

A caravan refrigerator has more than one source of energy. It is powered from either a 12V car battery or the 240V commercial electricity grid.

a) State whether each source of energy is renewable or non-renewable.   (2 marks)

240V power supply:_____

12V car battery:_____

b) State **one advantage** and **one disadvantage** of using each energy source   (4 marks)

ADVANTAGE

240V power supply:_____

12V car battery:_____

DISADVANTAGE

240V power supply:_____

12V car battery_____

Total 6 marks

Question 5

Two experiments were conducted in a bomb calorimeter to determine whether the extraction of aluminium or iron from their respective ores would require more energy. The calibration factor of the calorimeter and its contents was determined to be 1076 J ^{0}C^{-1}.

In the first experiment, a 0.503g sample of aluminium was oxidised in the bomb calorimeter and the temperature rose by 5.84^{0}C.

    a) Calculate the energy released (J) when the aluminium was oxidised in the calorimeter. (1 mark)

_____

_____

    b) Calculate ΔH for the reaction: $2Al_{(s)} + 3/2O_{2\,(g)} \rightarrow Al_2O_{3(s)}$ (3 marks)

_____

_____

_____

_____

_____

_____

    In the second experiment, a 0.561g sample of iron was oxidised in the same bomb calorimeter. The reaction was: $2Fe_{(s)} + 3/2O_{2(g)} \rightarrow Fe_2O_{3(s)}$ $\Delta H = -828kJ\,mol^{-1}$

    c) Determine the temperature change that occurred during the second experiment.   (3 marks)

_____

_____

_____

_____

_____

_____

$\longrightarrow$

d) Which metal, Aluminium or Iron, requires more energy to extract it from its ore? Give a reason for your choice. (2 marks)

_____

_____

_____

Total 9 marks

Question 6

For the reaction $2X_{(g)} + Y_{(g)} \rightleftharpoons 2Z_{(g)}$

The equilibrium constant K_c is equal to 3.0 at particular temperature. 2.0 mol of X and 3.0 mol of Y and 3.0 mol of Z are introduced into a 1.0L flask.

a) Write an expression for the equilibrium constant K_c (1 mark)

_____

_____

b) Prove the mixture is not at equilibrium . (2 marks)

_____

_____

_____

_____

$\rightarrow$

c) If the volume of the equilibrium mixture was doubled, what effect would this have on the amount of reactant Y and the concentration of Y? Explain your answer.   (3 marks)

_____

_____

_____

_____

_____

_____

Total 6 marks

Question 7

For the industrial chemical you have studied

a) Write the equation for the main equilibrium step involved including the sign of ΔH (2 marks)

_____

b) State **two** applications of the principles of green chemistry that has been used in the production of this chemical.   (2 marks)

_____

_____

_____

_____

_____

_____

$\longrightarrow$

c) State **two** major uses for the chemical using equations to support the uses.   (4 marks)

_____

_____

_____

_____

_____

_____

Total 8 marks

END OF QUESTIONS AND ANSWER BOOKLET

VCE CHEMISTRY

NAME: _____

Circle your choice using a pencil. If you make an error place a clear cross to eliminate that choice and then circle your preferred choice.

Multiple- choice answer sheet

1.	A	B	C	D	**11.**	A	B	C	D
2.	A	B	C	D	**12.**	A	B	C	D
3.	A	B	C	D	**13.**	A	B	C	D
4.	A	B	C	D	**14.**	A	B	C	D
5.	A	B	C	D	**15.**	A	B	C	D
6.	A	B	C	D	**16.**	A	B	C	D
7.	A	B	C	D	**17.**	A	B	C	D
8.	A	B	C	D	**18.**	A	B	C	D
9.	A	B	C	D	**19.**	A	B	C	D
10.	A	B	C	D	**20.**	A	B	C	D