



INSIGHT
YEAR 12 Trial Exam Paper
2012

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	8	8	53
			Total 73

- 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 removable data book.
- An answer sheet for multiple-choice questions.

Instructions

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

At the end of the examination

- Place the multiple-choice answer sheet inside the front cover of this question and answer 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 the multiple-choice questions. Choose the response that is **correct** or that **best answers** the questions.

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 chosen for any question.

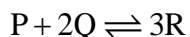
Question 1

A chemical change will occur in the fuel tank of a car

- A. whenever an oxygen molecule collides with a hydrocarbon molecule in the fuel.
- B. only when an oxygen molecule collides with a hydrocarbon molecule in the fuel in the presence of a catalyst.
- C. only when an oxygen molecule collides with a hydrocarbon molecule in the fuel with enough energy to overcome the activation energy barrier.
- D. never, as only a physical change will result from the collision between oxygen and hydrocarbon molecules in the fuel.

Question 2

Consider the following equilibrium equation.

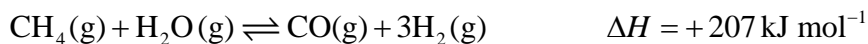


The expression for the equilibrium constant for the backward reaction is

- A. $K = \frac{[R]^3}{[P][Q]^2}$
- B. $K = \frac{3[R]}{[P]2[Q]}$
- C. $K = \frac{[P][Q]^2}{[R]^3}$
- D. $K = \frac{[P]2[Q]}{3[R]}$

Questions 3 and 4 refer to the following information.

Hydrogen gas can be produced industrially by the following reaction.



Question 3

A catalyst is added to a mixture of gaseous methane and water that is at equilibrium. As a result of this change, the rate at which hydrogen gas is produced will

- A. decrease.
- B. increase.
- C. initially increase and then decrease over time.
- D. remain unchanged.

Question 4

0.450 mol of methane and 0.540 mol of gaseous water were placed in a sealed and insulated reaction vessel. Once equilibrium was established, the temperature change in the reaction vessel indicated 72.5 kJ of energy had been absorbed in the reaction.

The amount of gaseous water remaining in the vessel at equilibrium is

- A. 0.100 mol
- B. 0.140 mol
- C. 0.190 mol
- D. 0.350 mol

Question 5

A large equilibrium constant indicates a particular reaction

- I reacts very quickly.
- II has a large amount of products present at equilibrium.
- III is most likely to be exothermic.

Which of the following are correct statements?

- A. II only
- B. I and II only
- C. II and III only
- D. I, II and III

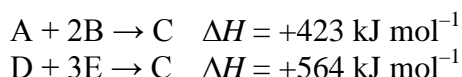
Question 6

In an exothermic equilibrium reaction

- A. the enthalpy of the products is greater than the enthalpy of the reactants.
- B. increasing the temperature will decrease the rate of the reaction.
- C. the rate of the forward reaction is always greater than the rate of the backward reaction.
- D. the activation energy of the reverse reaction is greater than the activation energy of the forward reaction.

Question 7

Consider the following reactions.



The enthalpy change for the reaction $\text{A} + 2\text{B} \rightarrow \text{D} + 3\text{E}$ is

- A. $+141 \text{ kJ mol}^{-1}$
- B. -141 kJ mol^{-1}
- C. $+987 \text{ kJ mol}^{-1}$
- D. -987 kJ mol^{-1}

Question 8

The complete combustion of 5.00 g of methane in a fully insulated calorimeter is used to heat 200.0 g of water with an initial temperature of 23.4°C . The temperature of the water after the combustion, in $^\circ\text{C}$, will be closest to

- A. 59.0
- B. 82.0
- C. 332
- D. 355

Question 9

A packet of dried noodles is labelled as having an energy content of 2620 kJ per 100 g. A 2.85 g sample of the noodles was combusted in a bomb calorimeter that has a calibration factor of $2.94 \times 10^3 \text{ J } ^\circ\text{C}^{-1}$. The expected temperature increase, in $^\circ\text{C}$, observed over the course of the reaction is

- A. 25.4×10^{-3}
- B. 0.891
- C. 25.4
- D. 298

Question 10

The molar enthalpy of combustion for a particular fuel is

- A. the energy released when 1 g of the fuel completely reacts in oxygen.
- B. the energy released when 1 mole of the fuel completely reacts in oxygen
- C. the energy released when 1, 2 or 3 mole of the fuel completely reacts in oxygen, depending on the balanced chemical equation.
- D. always less than the energy released by the fuel in terms of kJ g^{-1} .

Question 11

A galvanic cell consists of one half-cell that is made up of an inert electrode in a solution containing 1.0 M of $\text{Sn}^{4+}(\text{aq})$ and 1.0 M of $\text{Sn}^{2+}(\text{aq})$.

Which one of the following could be used as the second half-cell so that a current is produced and the polarity of the electrode in the $\text{Sn}^{4+}(\text{aq})/\text{Sn}^{2+}(\text{aq})$ half-cell is positive?

- A. a sodium electrode in a solution of 1.0 M $\text{NaCl}(\text{aq})$
- B. an inert electrode in a solution containing 1.0 M $\text{Fe}^{2+}(\text{aq})$ and 1.0 M $\text{Fe}^{3+}(\text{aq})$
- C. an iron electrode in a solution containing 1.0 M $\text{Fe}^{2+}(\text{aq})$
- D. a silver electrode in a solution containing 1.0 M $\text{Ag}^{+}(\text{aq})$

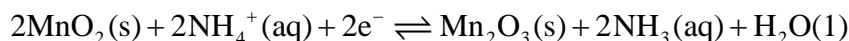
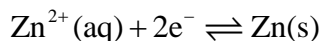
Question 12

The predicted maximum voltage produced by a galvanic cell containing $\text{Br}_2(\text{aq})/\text{Br}^{-}(\text{aq})$ and $\text{I}_2(\text{s})/\text{I}^{-}(\text{aq})$ half-cells is

- A. 0.54 V
- B. 0.55 V
- C. 1.09 V
- D. 1.64 V

Questions 13–15 refer to the following information.

The zinc–carbon dry cell utilises the following half-equations.



When the cell is in operation, solid zinc acts as the anode.

Question 13

The species acting as the reductant when the cell is in operation is

- A. MnO_2
- B. Mn_2O_3
- C. Zn^{2+}
- D. Zn

Question 14

When the dry cell is in operation the energy transformation occurring is

- A. chemical \rightarrow electrical + heat
- B. chemical + heat \rightarrow electrical
- C. kinetic \rightarrow electrical + heat
- D. kinetic + heat \rightarrow electrical

Question 15

Which of the following best describes why the zinc–carbon dry cell is a primary cell and not a secondary cell?

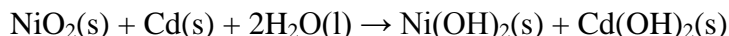
- A. The cell can be connected to an external power source and be recharged.
- B. When the cell is in operation, the reaction is exothermic.
- C. When the cell is in operation, the products of the reaction migrate away from the electrodes.
- D. Over a period of time, the cell will eventually become ‘flat’ and can no longer be used to produce a voltage.

Section A – continued
TURN OVER

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Question 16

The overall reaction in the rechargeable nickel–cadmium cell while it is powering a computer tablet is



The reaction that occurs at the positive electrode when the cell is recharging is

- A. $\text{Ni}(\text{OH})_2(\text{s}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{NiO}_2(\text{s}) + 2\text{H}_2\text{O}(\text{l}) + 2\text{e}^-$
- B. $\text{Cd}(\text{OH})_2(\text{s}) + 2\text{e}^- \rightarrow \text{Cd}(\text{s}) + 2\text{OH}^-(\text{aq})$
- C. $\text{NiO}_2(\text{s}) + 2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{Ni}(\text{OH})_2(\text{s}) + 2\text{OH}^-(\text{aq})$
- D. $\text{Cd}(\text{s}) + 2\text{OH}^-(\text{aq}) \rightarrow \text{Cd}(\text{OH})_2(\text{s}) + 2\text{e}^-$

Question 17

If a primary cell is compared to a recharging secondary cell, it is true to state that

- A. in the primary cell, reduction occurs at the negative electrode.
- B. in the primary cell, oxidation occurs at the positive anode.
- C. in the recharging secondary cell, products are continuously removed.
- D. the reaction in the recharging secondary cell is endothermic.

Question 18

An electrolytic cell was used to deposit 0.060 mol of chromium on a carbon electrode. If the amount of electricity passed through the cell is X , how much electricity, in terms of X , would be required to deposit 0.060 mol of silver on a carbon electrode using the same cell?

- A. X
- B. $3X$
- C. X^3
- D. $\frac{X}{3}$

Question 19

When electroplating an object, the object to be plated will be the

- A. negative electrode, which is the cathode.
- B. negative electrode, which is the anode.
- C. positive electrode, which is the cathode.
- D. positive electrode, which is the anode.

Question 20

In a 100 mL solution of 0.10 M of nitrous acid

- A. the molar concentration of $\text{NO}_2^-(\text{aq})$ is greater than the molar concentration of hydronium ions.
- B. the molar concentration of hydronium ions is less than the molar concentration of hydroxide ions.
- C. apart from H_2O , the species present in the highest concentration is HNO_3 .
- D. the pH is higher than a 10 mL solution of 0.10 M nitric acid.

END OF SECTION A

**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 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 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

During this semester you studied the production of one of the following chemicals as part of your study of the industrial production of an important chemical. Place a tick in the box next to the chemical you studied.

	ammonia
	ethene
	nitric acid
	sulfuric acid

a. The chemical you studied is produced by a series of chemical reactions from raw materials.

- i. Give the name and formula of a raw material that can be used in the production of your chosen chemical.

1 mark

- ii. Write a balanced equation for a chemical reaction in which the raw material given in part i. is used. State symbols are not necessary.

1 mark

- b.** Excess heat results from the production of your chemical. Describe one way in which waste heat from the production of your chosen chemical is reused to reduce energy costs.

1 mark

- c.** Identify two risks to humans of exposure to your selected chemical.

2 marks

Total 1 + 1 + 1 + 2 = 5 marks

Section B – continued
TURN OVER

Question 2

The energy sources currently available to society include a range of renewable and non-renewable sources. Governments need to make choices about future energy needs and the best energy sources available.

- a. i.** Describe one renewable energy source and give one reason why you would recommend this energy source, in addition to it being renewable.

1 mark

- ii.** Give one disadvantage of using this energy source.

1 mark

- b. i.** Describe one non-renewable energy source and give one reason why you would recommend this energy source.

1 mark

- ii.** Give one disadvantage, besides it being non-renewable, of using this energy source.

1 mark

c. Fuel cells offer a clean and efficient way of producing electricity directly from chemicals.

i. What main feature makes a fuel cell different to a primary or secondary cell?

1 mark

ii. Give the names of two reactants used in a fuel cell you are familiar with.

1 mark

iii. Give possible anode and cathode reaction half-equations in this fuel cell.

Anode reaction: _____

Cathode reaction: _____

2 marks

Total 1 + 1 + 1 + 1 + 1 + 1 + 2 = 8 marks

Section B – continued
TURN OVER

Question 3

70.0 mL of 1.3 M HCl and 30.0 mL of 2.0 M NaOH, both at 21.3°C, are mixed in a calorimeter. After the reaction is complete the temperature inside the calorimeter has reached 29.2°C. The calibration factor for the calorimeter and contents is 423 J K⁻¹.

- a. Write a balanced equation for the chemical reaction between HCl and NaOH.

1 mark

- b. Calculate the ΔH value of this reaction equation in kJ mol⁻¹.

4 marks

- c. The value determined in part **b.** is found to be slightly less than the actual value. Suggest two likely errors that could contribute to this result.

2 marks

Total 1 + 4 + 2 = 7 marks

Question 4

A student is provided with the following materials:

- iron nails
- carbon rods
- copper rods
- copper(II) chloride
- iron(II) nitrate
- sodium nitrate
- potassium hydroxide
- beakers
- filter paper
- wires
- galvanometer

The student is then asked to set up a galvanic cell that will produce a voltage as close to 0.75 V as possible.

- a.** Draw and fully label how the student should use these materials to construct the cell. Not all of the materials necessarily need to be used.

5 marks

- b.** Label the positive and negative electrodes on the cell you drew in part **a.**

1 mark

- c.** Write the reduction half-equation that occurs in the cell.

1 mark

- d.** State which solution would be best used to soak the filter paper when making the salt bridge.

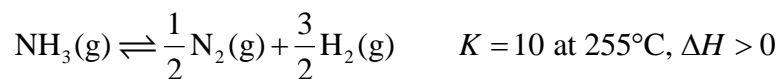
1 mark

Total 5 + 1 + 1 + 1 = 8 marks

Section B – continued
TURN OVER

Question 5

Consider the following equation



- a.** A mixture of these gases in a 2.0 L container, at 255°C, was found to contain 2.0 mol of NH₃, 3.0 mol of N₂ and 1.4 mol of H₂.
- i.** Determine whether this mixture is at equilibrium. Show your working in your answer.

3 marks

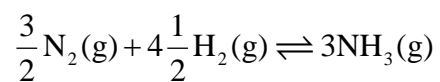
- ii.** In order to reach equilibrium, will the forward or backward reaction need to be favoured? Give a reason for your answer.

1 mark

- b.** Describe two changes you could make to this set-up in order to increase the proportion of products in the equilibrium mixture.

2 marks

- c. Calculate the equilibrium constant for the following reaction at 255°C. The unit is not necessary.



2 marks

Total 3 + 1 + 2 + 2 = 8 marks

Section B – continued
TURN OVER

Question 6

- a. i. Calculate the pH of a 0.20 M solution of hydrofluoric acid at 25°C.

2 marks

- ii. Would you expect the pH of a 0.20 M solution of hydrofluoric acid to be the same or different at a temperature of 50°C? Give a reason for your answer.

1 mark

- b. The following two solutions are prepared.

- Solution A: a 500 mL solution containing 0.200 mole of hypochlorous acid
- Solution B: a 500 mL solution containing 0.200 mole of hypobromous acid

Which solution is the most acidic? Justify your answer in terms of the hydronium ion concentrations present.

2 marks

Total 2 + 2 + 1 = 5 marks

Question 7

Le Chatelier's principle can be used to explain what occurs when changes are made to an equilibrium system.

- a. Briefly outline Le Chatelier's principle.

2 marks

- b. A particular chemical is produced industrially by an exothermic reaction.

- i. Explain why production of this chemical is favoured by low temperatures.

2 marks

- ii. Explain why low temperatures are rarely used industrially, even when the production reaction is exothermic.

1 mark

Total 2 + 2 + 1 = 5 marks

Section B – continued
TURN OVER

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Question 8

Determine each of the following.

- a. The mass of silver deposited on a kettle dipped in a solution of silver nitrate in an electroplating cell that is operated with a current of 1.35 A for 30.0 minutes.

3 marks

- b. The amount of electric charge, in coulombs (C), required to reduce 0.789 mol of Al^{3+} ions to aluminium metal.

2 marks

- c. The amount of electrical energy, in joules (J), provided by a fuel cell that delivers a current of 0.80 A for 15.0 minutes at a voltage of 0.78 V.

2 marks

Total 3 + 2 + 2 = 7 marks

END OF SECTION B

END OF QUESTION AND ANSWER BOOK