Student Number	
Mark /	

Chemistry Assessment

Task 2 Term 1 2008

**Acidic Environment
& Chemical Monitoring**

Theory

General Instructions

- Reading time – 5 minutes
- Working time – 50 minutes
- Write using black or blue pen
- Write your Student Number at the top of this page and on the response sheets on pages 5 and 6
- Board-approved calculators may be used

  A data sheet and a periodic table are provided at the back of the paper.

Total Marks – 41

Part A – 7 marks – pages 3 – 4

- Attempt Questions **1-7**
- Allow about **5** minutes for this part

Part B – 34 marks – pages 6 - 12

- Attempt Questions **8- 15**
- Allow about **45** minutes for this part

Part A: Multiple Choice: 7 marks
Attempt Questions 1-7
Allow about 5 minutes for this part

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: 2 + 4 =   (A) 2   (B) 6   (C) 8   (D) 9

A ◯   B ⬤   C ◯   D ◯

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ⬤   B ✖   C ◯   D ◯

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

correct

A ✖   B ✖   C ◯   D ◯

▸ **Mark your answers for Questions 1-7 in the multiple choice grid on page 5**

1. Which of the following 0.1 mol L^{-1} solutions has a pH greater than 7 at 25 $^{\circ}$C?

    (A)   Ammonium chloride
    (B)   Ammonium nitrate
    (C)   Sodium fluoride
    (D)   Sodium acetate

2. Which of the following is a conjugate acid/base pair?

    (A) PO_4^{3-} / $H_2PO_4^{-}$

    (B) H_3O^{+} / OH^{-}

    (C) H_2O / OH^{-}

    (D) HPO_4^{2-} / H_3PO_4

3. What is produced when an acidic oxide and a base react?

    (A)   carbon dioxide and water
    (B)   hydrogen and a salt
    (C)   water and a basic oxide
    (D)   water and a salt

4. Which equation best shows the formation of acid rain?

    (A.) $S(s) + O_2(g) \rightarrow SO_2(g)$

    (B) $C(s) + O_2(g) \rightarrow CO_2(g)$

    (C) $2NO_2(g) + H_2O(l) \rightarrow HNO_3(aq) + HNO_2(aq)$

    (D) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

5. What is the maximum volume of nitrogen (IV) oxide that could be produced when 1 litre of nitrogen (II) oxide and 1 litre of oxygen are reacted?

    (A)   0.5 L
    (B)   1.0 L
    (C)   1.5 L
    (D)   24.79 L

6. The chemical formula of a flavouring agent compound used to give an orange odour is shown.

$$CH_3 \overset{\overset{\textstyle O}{\|}}{C} \text{-} OCH_2\, CH_2\, CH_2\, CH_2\, CH_2\, CH_2\, CH_2\, CH_3$$
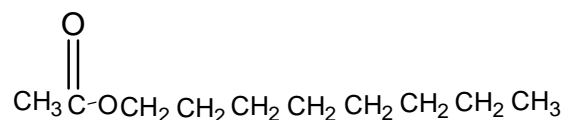
What is the IUPAC name of this compound?

(A)   ethyl octanoate
(B)   octyl ethanoate
(C)   2-ethyl octanoate
(D)   propyl hexanoate

7. A student's refluxing apparatus used in esterification is shown.
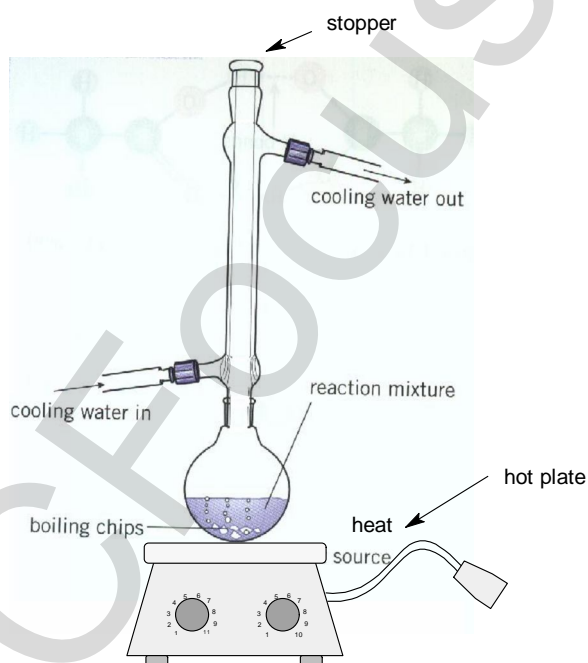
What is *incorrect* about the student's refluxing apparatus?

(A)   Water enters the condenser at the base.
(B)   Using a round-bottomed flask as the reaction vessel.
(C)   The use of a hot plate
(D)   Inserting a stopper at the top of the condenser.

Part A . Answer grid for multiple choice questions   **Total ....**

1. A O   B O   C O   D O

2. A O   B O   C O   D O

3. A O   B O   C O   D O

4. A O   B O   C O   D O

5. A O   B O   C O   D O

6. A O   B O   C O   D O

7. A O   B O   C O   D O

Part B. 34 marks
Attempt Questions 8-15
Allow about 45 minutes for this part
▶ *Show all relevant working in questions involving calculations.*

Question 8 (4 marks)   **MARKS**

Antacids are used to combat indigestion by neutralizing excess acid in the stomach.

(a)   Write a chemical equation for the reaction between the antacid, magnesium hydroxide and
        stomach acid, hydrochloric acid.   **1**

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(b)   Stomach acid has a pH of 2.

        Calculate the mass of antacid, magnesium hydroxide, required to neutralize 20 mL of
        stomach acid.   **3**

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Question 9 (5 marks)   **MARKS**

The diagram shows 3 beakers containing acids.
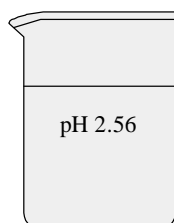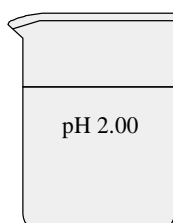
pH 2.56	pH 2.00	pH 1.7
0.01 M citric acid	0.01 M hydrochloric acid	0.01 M sulfuric acid
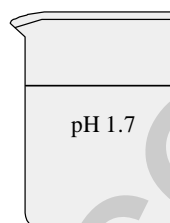
(a)   Explain the difference in pH between the three acids in the diagram.   **3**

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(b)   Calculate the pH after 20 mL of 0.01 mol L^{-1} hydrochloric acid is diluted with
       180 mL of water.   **2**

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Question 10 (6 marks)

Different theories of acid and bases were developed by Lavoisier, Davy, Arrhenius and Bronsted-Lowry.   Sulfuric acid was classified as an acid by all of these scientists.

Explain how each of their theories predict that sulfuric acid is an acid. Support your answer by using equations where appropriate.   **6**

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Question 11 (3 marks)

The hydrogen carbonate ion can act as both an acid and a base, and, with carbonic acid, forms a buffer pair.

(a)   What name is given to a substance that can donate a proton or accept a proton?   **1**

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(b)   Describe the effect of a specific buffer in a natural system.   **2**

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Question 12 (3 marks)

Write balanced chemical equations to show the difference in products when heptane gas is combusted in:

(a) (i)   excess oxygen and   **1**

   (ii)   limited oxygen.   **1**

(b)   Which reaction would require the more careful monitoring? Give a reason for your answer   **1**

(a) (i)…………………………………………………………………………………

   (ii)…………………………………………………………………………………

(b)……………………………………………………………………………….....

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Question 13 (5 marks)

A student carried out an experiment to decarbonate a 300 mL bottle of soft drink. He opened the bottle and noticed the bubbles of carbon dioxide escaping from the soft drink.

(a)   Explain these observations using an equation in your answer.   **3**

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(b)   The student measured the mass of the bottle of soft drink before and after decarbonation and found the mass to have decreased by 1.25 g.   Assume that all carbon dioxide has been removed from the bottle.

What volume of carbon dioxide (at 25º C and 100 kPa) would be required to carbonate 1 L bottle of soft drink?   Show all working.   **2**

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Question 14   (5 marks)

(a)   Using IUPAC nomenclature, give the name of the ester formed from the reaction
between 1-propanol and ethanoic acid.   **1**

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(b)   Using structural formulae write a balanced equation to describe the reaction between
1-propanol and ethanoic acid.

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(c)   State the purpose of including a small quantity of acid in the reaction vessel in
order to prepare the ester.

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(d)   Describe the purpose of refluxing in esterification.   **2**

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Question 15 (3marks)

The boiling points of some alkanoic acids and their equivalent alkanols are presented in the table.

Compound	Boiling point (^{o}C)
Butanoic acid	163
Pentanoic acid	186
Hexanoic acid	206
1-butanol	118
1-pentanol	138
1-hexanol	157

Explain the differences between the boiling points of alkanoic acids and their equivalent alkanols. **3**

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End of Test