



Chemistry Assessment

Task 2 Term 1 2013

Acidic Environment
& Chemical Monitoring

Theory

General Instructions

- Reading time – 5 minutes
 - Working time – 55 minutes
 - Write using black or blue pen
 - Write your Student Number on top of pages 6 & 7
 - Board-approved calculators may be used
- A data sheet and a periodic table are provided

Total Marks – 49

Part A – 11 marks

- Attempt Questions 1–11
- Allow about 10 minutes for this part

Part B – 38 marks

- Attempt Questions 12 – 18
- Allow about 45 minutes for this part

Part A: Multiple Choice:
Attempt Questions 1 – 11
Allow about 10 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

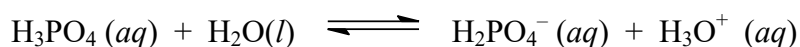
If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

A B C D
correct →

▶ **Mark your answers for the multiple choice questions in the multiple choice grid on page 6**

Multiple Choice (Mark your answers on the multiple choice grid on page 6)

1. Which of the following is the systematic name for citric acid?
- (A) tricarboxylic acid
 - (B) hydrogen citrate
 - (C) 1,2,3 – trihydroxy propanoic acid
 - (D) 2-hydroxypropane-1,2,3-tricarboxylic acid
2. A buffering system in the blood involving phosphoric acid (H_3PO_4) and dihydrogen phosphate ion (H_2PO_4^-) is given below.



Which of the above species are amphoteric?

- (A) H_3PO_4 and H_2O
 - (B) H_2O and H_3O^+
 - (C) H_2O and H_2PO_4^-
 - (D) H_3PO_4 and H_2PO_4^-
3. Which of the following solutes would cause a solution of phenolphthalein to turn pink?
- (A) O_2
 - (B) HF
 - (C) NH_3
 - (D) NH_4Cl
4. Lemon juice has a pH of about 2 and tomato juice has a pH of about 4. Which statement correctly compares the hydrogen ion concentration of tomato juice with that of lemon juice?
- (A) The hydrogen ion concentration of tomato juice is less, by a factor of 2.
 - (B) The hydrogen ion concentration of tomato juice is less, by a factor of 100.
 - (C) The hydrogen ion concentration of tomato juice is greater, by a factor of 2.
 - (D) The hydrogen ion concentration of tomato juice is greater, by a factor of 100.

5. Which of the following chemists proposed that compounds containing hydrogen were acids?
- (A) Bronsted
 - (B) Arrhenius
 - (C) Davy
 - (D) Lavoisier
6. What is the most likely cause of oxides of nitrogen emitted from the exhaust of a motorcycle?
- (A) excessive nitrogen gas in the combustion chamber
 - (B) high temperature present in the combustion chamber
 - (C) low temperature in the combustion chamber
 - (D) insufficient oxygen present in the combustion chamber
7. Which of the following is a natural source of sulfur dioxide in the atmosphere?
- (A) metal sulfide smelting
 - (B) lightning
 - (C) volcanoes
 - (D) respiration
8. Methanol and acetic acid react under reflux to produce methyl acetate. The reflux mixture is then distilled. Three pure liquids are collected in separate flasks and labelled A, B and C in order of collection.
- Which flask(s) contain(s) methyl acetate?
- (A) Flask A
 - (B) Flask B
 - (C) Flask C
 - (D) Flasks A and B

9. A compound Z has the following properties:

- (i) it is soluble in water
- (ii) it has no immediate reaction with bromine water
- (iii) it reacts readily with dilute sodium hydroxide

Which one below could be compound Z?

- (A) $\text{CH}_3\text{CH}_2\text{OH}$
 - (B) $\text{CH}_3\text{CH}_2\text{CH}_3$
 - (C) $\text{CH}_3\text{CH}_2\text{COOH}$
 - (D) CH_2CHCH_3
10. Why is iron in the form of magnetite used in the commercial production of ammonia?
- (A) to increase the yield of ammonia
 - (B) to increase the rate of the reaction
 - (C) to increase the activation energy for the reaction
 - (D) to remove impurities present in the reaction
11. What were the two main reasons which were significant in the production of ammonia between 1910 and 1920?
- (A) to produce cleaners and fertilisers
 - (B) to produce cleaners and explosives
 - (C) to produce explosives and fertilisers
 - (D) to produce explosives and nitric acid

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 |
| 8. | A O | B O | C O | D O |
| 9. | A O | B O | C O | D O |
| 10 | A O | B O | C O | D O |
| 11. | A O | B O | C O | D O |

Total

Part B: Free Response Questions: (38 marks)

Attempt Questions 12 – 18. Allow about 45 minutes for this part.

▶ *Show all relevant working in questions involving calculations.*

Marks

Question 12 (11 marks)

A bottle of soda water contains carbon dioxide dissolved under pressure, forming carbonic acid.

- (a) Carbonic acid is described as a weak acid. Explain this statement using a relevant equation.

2

.....
.....
.....
.....

- (b) Explain the change in pH of the contents of the bottle of soda water after it has been opened.

3

.....
.....
.....
.....

Question 12 continues on the next page

- (c) A bottle of soda water was weighed before and after opening and these results were obtained.

Mass of the bottle before opening = 312.8 g

Mass of the bottle after opening = 305.9 g

What volume of carbon dioxide gas at 25 °C and 100 kPa was released from the bottle after opening?

3

.....

.....

.....

.....

.....

.....

.....

- (d) During the last century the concentration of carbon dioxide in the troposphere increased from 270 ppm to 400 ppm.

Identify the effect of this atmospheric change on the pH of a freshwater lake and describe ONE problem which could result.

3

.....

.....

.....

.....

.....

.....

.....

Question 13 (4 marks)

Marks

In reaction with sodium hydroxide, hydrochloric acid forms a neutral salt, whereas acetic acid forms a basic salt.

With the aid of equations, explain why these two acids form salts with different properties.

4

.....

.....

.....

.....

.....

.....

Question 14 (4 marks)

1.00 g of magnesium is reacted with 200 mL of 0.500 mol L^{-1} HCl solution.

(a) What mass of hydrogen gas is produced at $25 \text{ }^\circ\text{C}$ and 100 kPa?

2

.....

.....

.....

.....

.....

.....

(b) What is the pH of the resultant solution?

2

.....

.....

.....

.....

.....

.....

Question 15 (2 marks)**Marks**

Explain the use of acids as food additives.

2

.....

.....

.....

.....

.....

Question 16 (4 marks)

- (a) Draw the structural formula of propanoic acid, pentan-1-ol and the products which form when these two compounds are refluxed with a small amount of concentrated sulfuric acid.

2

propanoic acid	pentan-1-ol	products

- (b) Name the products formed.

1

.....

.....

- c) Name this process.

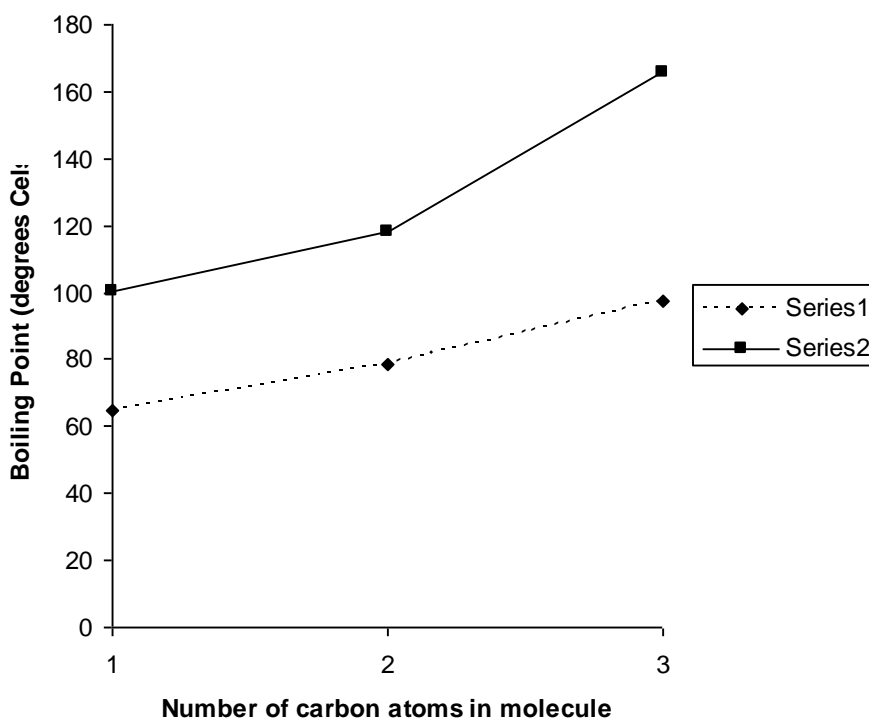
1

.....

Question 17 (3 marks)

Marks

(a) Identify the trends in the boiling points of alkanols and alkanolic acids as shown in the graph below. 1



_____ = alkanolic acid
..... = alkanols

.....
.....

(b) Explain the differences in the boiling points of the alkanols and alkanolic acids.

2

.....
.....
.....
.....
.....
.....

Question 18 (10 marks)

(a) Write a balanced chemical equation for the Haber process. **2**

.....

(b) If 1.0 kg of nitrogen is reacted with 3.0 kg of hydrogen, calculate the theoretical amount of ammonia produced. **4**

.....

.....

.....

.....

.....

(c) If the yield obtained in practice is only 20% how much ammonia will be produced ? **1**

.....

.....

(c) Describe three industrial reaction conditions in the Haber process which are monitored to maximise the yield. **3**

.....

.....

.....

.....

.....

.....

.....

.....

🔔 END of Theory Test



Chemistry Assessment

Task 2 Term 1 2013

Theory

Acidic Environment
& Chemical Monitoring

Answers

General Instructions

- Reading time – 5 minutes
- Working time – 55 minutes
- Write using black or blue pen
- Write your Student Number on pages..
- Board-approved calculators may be used

A data sheet and a periodic table are provided

Total Marks – 49

Part A – 11 marks

- Attempt Questions 1- 11
- Allow about 10 minutes for this part

Part B – 38 marks

- Attempt Questions 12 - 18
- Allow about 45 minutes for this part

Part A: Multiple Choice:
Attempt Questions 1 – 11
Allow about 15 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.

A B C D
correct ↙

▶ **Mark your answers for the multiple choice questions in the multiple choice grid on page**

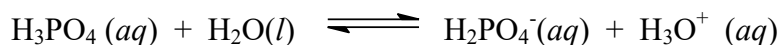
Multiple Choice (Mark your answers on the multiple choice grid on page..)

1. Which of the following is the systematic name for citric acid?

- (A) tricarboxylic acid
- (B) hydrogen citrate
- (C) 1,2,3 – trihydroxy propanoic acid
- (D) 2-hydroxy propane-1,2,3-tricarboxylic acid**

Outcomes :H9

2. A buffering system in the blood involving phosphoric acid (H_3PO_4) and dihydrogen phosphate ion (H_2PO_4^-) is given below.



Which of the above species are amphoteric?

- (A) H_3PO_4 and H_2O
- (B) H_2O and H_3O^+
- (C) H_2O and H_2PO_4^-**
- (D) H_3PO_4 and H_2PO_4^-

Outcomes :H9, H8

3. Which of the following solutes would cause a solution of phenolphthalein to turn pink?

- (A) O_2
- (B) HF
- (C) NH_3**
- (D) NH_4Cl

Outcomes : H8

4. Lemon juice has a pH of about 2 and tomato juice has a pH of about 4. Which statement correctly compares the hydrogen ion concentration of tomato juice with that of lemon juice?

- (A) The hydrogen ion concentration of tomato juice is less, by a factor of 2.
- (B) The hydrogen ion concentration of tomato juice is less, by a factor of 100.**
- (C) The hydrogen ion concentration of tomato juice is greater, by a factor of 2.
- (D) The hydrogen ion concentration of tomato juice is greater, by a factor of 100.

Outcomes : H10

5. Which of the following chemists proposed that compounds containing hydrogen were acids?

- (A) Bronsted
- (B) Arrhenius
- (C) Davy**
- (D) Lavoisier

Outcomes : H1, H2

6. What is the most likely cause of oxides of nitrogen emitted from the exhaust of a motorcycle?
- (A) excessive nitrogen gas in the combustion chamber.
 - (B) high temperature present in the combustion chamber.**
 - (C) low temperature in the combustion chamber.
 - (D) Insufficient oxygen present in the combustion chamber.

Outcomes : H4

7. Which of the following is a natural source of sulfur dioxide in the atmosphere?
- (A) metal sulfide smelting
 - (B) lightning
 - (C) volcanoes**
 - (D) respiration

Outcomes : H4

8. Methanol and acetic acid react under reflux to produce methyl acetate. The reflux mixture is then distilled. Three pure liquids are collected in separate flasks and labelled A, B and C in order of collection.

Which flask contains methyl acetate?

- (A) Flask A**
- (B) Flask B
- (C) Flask C
- (D) Flasks A and B

Outcomes :H8

9. A compound Z has the following properties :
- (i) it is soluble in water
 - (ii) it has no immediate reaction with bromine water
 - (iii) it reacts readily with dilute sodium hydroxide

Which one below could be compound Z ?

- (A) $\text{CH}_3\text{CH}_2\text{OH}$
- (B) $\text{CH}_3\text{CH}_2\text{CH}_3$
- (C) $\text{CH}_3\text{CH}_2\text{COOH}$**
- (D) CH_2CHCH_3

Outcomes :H9

10. Why is iron in the form of magnetite used in the commercial production of ammonia ?
- (A) To increase the yield of ammonia.
 - (B) To increase the rate of the reaction.**
 - (C) To increase the activation energy for the reaction.
 - (D) To remove impurities present in the reaction.

Outcomes :H10

11. What were the two main reasons which were significant in the production of ammonia at this crucial time in history ?
- (A) To produce cleaners and fertilisers
 - (B) To produce cleaners and explosives
 - (C) To produce explosives and fertilisers**
 - (D) To produce explosives and nitric acid

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

- | | | | | |
|-----|-----|-----|-----|-----|
| 1. | A O | B O | C O | D ● |
| 2. | A O | B O | C ● | D O |
| 3. | A O | B O | C ● | D O |
| 4. | A O | B ● | C O | D O |
| 5. | A O | B O | C ● | D O |
| 6. | A O | B ● | C O | D O |
| 7. | A O | B O | C ● | D O |
| 8. | A ● | B O | C O | D O |
| 9. | A O | B O | C ● | D O |
| 10 | A O | B ● | C O | D O |
| 11. | A O | B O | C ● | D O |

Total

Part B: Free Response Questions: (38 marks)**Attempt Questions . Allow about 45 minutes for this part.**

▶ Show all relevant working in questions involving calculations.

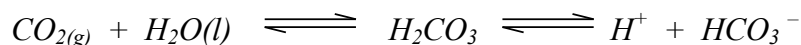
Marks**Question 12 (11 marks)**

A bottle of soda water contains carbon dioxide dissolved under pressure, forming carbonic acid.

- (a) Carbonic acid is described as a weak acid. Explain this statement and include a relevant equation in your answer. (2 marks)

Sample answer

Carbonic acid is a weak acid as it only ionizes to a small extent in water producing a low concentration of hydrogen ions.



Marking Criteria	Marks
<ul style="list-style-type: none"> Explanation and a relevant equation 	2
<ul style="list-style-type: none"> A relevant equation OR an explanation 	1

- (b) Explain the change in pH of the contents of the bottle of soda water after it has been opened. (3 marks)

Sample Answer

After the bottle is opened, the pressure is reduced. According to Le Chatelier's Principle, equilibrium will shift to oppose the change, that is, to increase the pressure. The reaction that produces pressure is the one with more gas volumes, i.e., the reverse reaction (1:0), therefore equilibrium will shift left. This will reduce the concentration of hydrogen ions in solution so the pH will increase.

Marking Criteria	Marks
<ul style="list-style-type: none"> Clearly explains the equilibrium shift with gas volume ratios and correctly identifies the change in pH. 	3
<ul style="list-style-type: none"> Clearly explains the equilibrium shift and correctly identifies the change in pH. 	2
<ul style="list-style-type: none"> Identifies the change in pH OR States Le Chateliers Principle OR Gives the correct explanation but the incorrect pH change OR Gives the correct explanation. 	1

- (c) A bottle of soda water was weighed before and after opening. The change in mass of the bottle is given below.

Mass of the bottle before opening 312.8 g

Mass of the bottle after opening 305.9 g

What volume of carbon dioxide gas at 25⁰C and 100 kPa was released from the bottle after opening? (3 marks)

Sample answer

$$\text{Mass of CO}_2 = 312.8 - 305.9 = 6.9 \text{ g}$$

$$\text{Mol CO}_2 = \text{mass/molar mass} = 6.9 / [12.01 + 2(16.00)] = 0.1568 \text{ mol (intermediate calculation not rounded off)}$$

$$\text{Volume CO}_2 = \text{mol} \times 24.79 = 3.88 \text{ L} = 3.9 \text{ L (two significant figures)}$$

Marking Criteria	Marks
<ul style="list-style-type: none"> All relevant calculations and correct sig figs 	3
<ul style="list-style-type: none"> All relevant calculations 	2
<ul style="list-style-type: none"> Some relevant calculations 	1

- (d) During the last century the concentration of carbon dioxide in the troposphere increased from 270 ppm to 400 ppm.
Identify the effect of this atmospheric change on the pH of a freshwater lake and describe ONE problem which could result. (3 marks)

Sample Answer

The pH of the lake may decrease as an increase in carbon dioxide will cause the above equilibrium to shift to the right creating more hydrogen ions.

One problem that may arise is the dissolving of the shells of shellfish by the extra acid in the water as the shells are made of calcium carbonate which reacts with acid. This could make them more vulnerable to predators as the shells would be thinner or cause them to fail completely and die.

Marking Criteria	Marks
<ul style="list-style-type: none"> Describes one problem and identifies the effect on pH 	3
<ul style="list-style-type: none"> Outlines one problem and identifies the effect on pH OR Describes one problem 	2
<ul style="list-style-type: none"> Identifies the effect on pH OR Outlines one problem 	1

Outcomes : H4, H8, H9, H10,

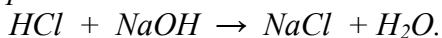
Question 13 (4 marks)

In reaction with sodium hydroxide, hydrochloric acid forms a neutral salt, whereas acetic acid forms a basic salt.

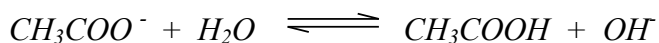
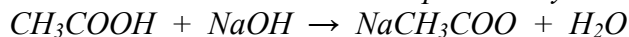
With the aid of equations, explain why these two acids form salts with different properties.

Sample answer

Hydrochloric acid is a strong acid that completely ionizes in water. When it forms salts, the ions produced don't react with water and so the resultant solution is neutral.



Acetic acid is a weak acid and acetate salts are basic. When the salt dissociates, acetate ions are produced. Acetate ions react with water to produce hydroxide ions so the resultant solution is basic.



<i>Marking Criteria</i>	<i>Marks</i>
<ul style="list-style-type: none"> Two explanations and two relevant equations 	4
<ul style="list-style-type: none"> Two explanations and one relevant equations OR One explanation and two relevant equations 	3
<ul style="list-style-type: none"> Two explanations OR Two relevant equations OR One explanation and one relevant equation 	2
<ul style="list-style-type: none"> One explanation OR one equation 	1

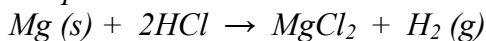
Outcomes : H8, H9

Question 14 (4 marks)

1.00 g of magnesium is reacted with 200 mL of 0.500 M HCl solution.

(a) What mass of hydrogen gas is produced at 25⁰C and 100 kPa. (2 marks)

Sample answer



$$Mol Mg = mass / molar mass = 1.00 / 24.3 = 0.0411 mol$$

$$Mol HCl = M \times V = 0.500 \times 0.200 = 0.100 mol \text{ (excess)}$$

$$Mol Mg = mol H_2$$

$$Mass H_2 = mol \times molar mass = 0.0411 \times 2(1.008) = 0.0829 g$$

<i>Marking Criteria</i>	<i>Marks</i>
<ul style="list-style-type: none"> • <i>Correct mass with relevant working</i> 	2
<ul style="list-style-type: none"> • <i>Correct equation OR</i> • <i>Correct mol Mg OR</i> • <i>Correct mol HCl</i> 	1

(b) What is the pH of the resultant solution? (2 marks)

Sample Answer

$$\text{Mol HCl} = 0.100$$

$$\begin{aligned} \text{Mol HCl left in solution} &= \text{initial mols} - \text{used mols} \\ &= 0.100 - 2(0.0411) = 0.0178 \text{ mol} \end{aligned}$$

$$[\text{HCl}] = \text{mol}/V = 0.0178/0.200 = 0.089 \text{ molL}^{-1}$$

$$[\text{HCl}] = [\text{H}^+]$$

$$\text{pH} = -\log [\text{H}^+] = -\log 0.089 = 1.05$$

<i>Marking Criteria</i>	<i>Marks</i>
<ul style="list-style-type: none"> • <i>Correct pH with relevant working</i> 	2
<ul style="list-style-type: none"> • <i>pH calculated from incorrect $[\text{H}^+]$</i> 	1

Outcomes : H10

Question 15 (2 marks)

Explain the use of acids as food additives.

Micro organisms that cause food to spoil cannot grow in acidic environments. Acids like acetic acid are added to food to prevent the growth of these micro organisms.

<i>Marking Criteria</i>	<i>Marks</i>
<ul style="list-style-type: none"> • <i>Explains the use of acids as food additives.</i> 	2
<ul style="list-style-type: none"> • <i>Identifies an acid added to food</i> 	1

Outcomes : H4, H9

Question 16 (4 marks)

- (a) Draw the structural formula of propanoic acid, pentan-1-ol and the products which form when these two compounds are refluxed with a small amount of concentrated sulfuric acid. 2

$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \\ \quad \quad // \\ \text{H}-\text{C}-\text{C}-\text{C} \\ \quad \quad \backslash \\ \text{H} \quad \text{H} \quad \text{OH} \end{array} $	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{OH} \\ \quad \quad \quad \quad \\ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array} $	$ \begin{array}{c} \text{H} \quad \text{H} \quad \text{O} \quad \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad // \quad \quad \quad \quad \quad \quad \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{O}-\text{C}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ \quad \quad \quad \quad \quad \quad \quad \quad \\ \text{H} \quad \text{H} \quad \quad \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \end{array} $ <p>+ H₂O</p>
propanoic acid	pentan-1-ol	Products: pentyl propanoate and water

Outcomes :H9

- (b) Name the products formed. (1 mark)

.....

Sample Answer : water and pentyl propanoate

Marking guidelines

Criteria	Mark
2 correct names	1
1 correct name	0

- (c) Identify the name of this process. (1 mark)

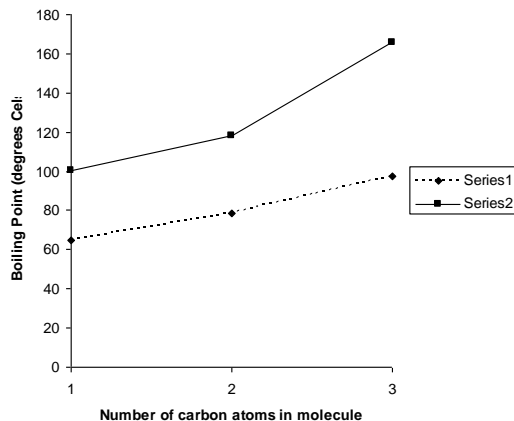
.....
Sample answer esterification

Criteria	Mark
Correct name of process	1

Outcomes :H6

Question 17

- (a) Describe the trends in the B.P. of alkanols and alkanolic acids as shown in the graph below. (1 mark))



_____ = alkanolic acid

..... = alkanols

.....

Sample Answer

As the number of carbon atoms increases in the molecule, the B.P. increases.

Marking guidelines

Criteria	Mark
Correct description of trend	1

- (b) Explain the differences in B.P. of the alkanols and alkanolic acids in terms of bonding. (2 marks)

.....

Sample Answer :

For compounds of similar size, alkanolic acids have the highest B.P. due to the presence of polar bonds and hydrogen bonds. These occur because of the carboxyl group, -COOH. Alkanols also have H-bonding but the -OH group has lower polarity than -COOH thus lower B.P. than alkanolic acids.

Marking Guidelines

Criteria	Mark
Thorough explanation of differences in relation to bonding	2
Brief description of differences in relation to bonding.	1

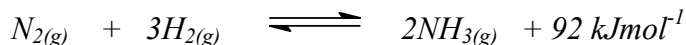
Outcomes :H10

Question 18

- (a) Write a balanced chemical equation for the Haber process. (2 marks)

.....

Sample Answer :



If a thermochemical equation was specified in the question, then an energy factor is required in the answer. Since only a balanced chemical equation was required, no energy factor was needed.

Marking guidelines

Criteria	Mark
Correct balanced equation including states	2
Any one of the above incorrect	1

- (b) If 1.0 kg of nitrogen is reacted with 3.0 kg of hydrogen, calculate the theoretical amount of ammonia produced. (4 marks)

.....

Sample Answer :

Mole ratio from balanced equation is 1 mol N₂ : 3 mol H₂ : 2 mol NH₃

1.0 kg N₂ = 1000g = 1000/28 = 35.71 mol ; 3.0 kg H₂ = 3000g = 3000 /2 = 1500mol

Thus 35.71 : 1500 = 1 : 42 thus 35.71 N₂ reacts with 3 x 35.71 = 107.13 H₂

And 2 x 35.71 mol = 71.42 mol NH₃ formed.

Mass of NH₃ formed = 71.42 x M(NH₃) = 71.42 x 17.0g = 1214.14 g = 1.2141 kg

Criteria	Mark
Correct mol ratios and calculations of mass of ammonia from correct conversions of mols to mass and identifying that hydrogen is in excess	4
One calculation error	3
Two calculation error	2
Three calculation errors	1

(c) If the yield obtained in practice is only 20% how much ammonia will be produced ? (1 mark)

.....
.....

Sample Answer :

1.2141 X 20 /100 = 0.243 kg or 243 g

Marking criteria

Criteria	Mark
Correct calculation of mass of 20% yield	1

Outcomes :H8

(c) Describe three industrial reaction conditions in the Haber process which are monitored to maximise the yield. (3 marks)

.....
.....
.....
.....

Sample Answer : change the catalyst, increase the pressure, remove ammonia as it is made so reaction shifts to produce more ammonia, keep temperature at about 500⁰C.

Marking guidelines

Criteria	Mark
Correct description of three conditions to maximise yield	3
Correct description of two condition to maximise yield	2
Correct description of one condition to maximise yield	1

🔔 END of Theory Test