

**Barker College****2007
YEAR 12
EXAMINATION
TERM 1****Chemistry****ANSWER SHEET**

Staff Involved:

AM MONDAY 26 MARCH

- RJP*
- RZS
- JFH

95 copies

Section I – Multiple Choice

Choose the best response and fill in the response oval completely

1.	(A)	(B)	(C)	(D)
2.	(A)	(B)	(C)	(D)
3.	(A)	(B)	(C)	(D)
4.	(A)	(B)	(C)	(D)
5.	(A)	(B)	(C)	(D)
6.	(A)	(B)	(C)	(D)
7.	(A)	(B)	(C)	(D)
8.	(A)	(B)	(C)	(D)
9.	(A)	(B)	(C)	(D)
10.	(A)	(B)	(C)	(D)
11.	(A)	(B)	(C)	(D)
12.	(A)	(B)	(C)	(D)
13.	(A)	(B)	(C)	(D)
14.	(A)	(B)	(C)	(D)
15.	(A)	(B)	(C)	(D)



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**2007
YEAR 12
EXAMINATION
TERM 1**

Chemistry

Staff Involved:

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AM MONDAY 26 MARCH

95 copies

General Instructions

- Reading time – 5 minutes
- Working time – 2 hours
- Write using blue or black pen
- Board-approved calculators may be used
- Draw diagrams using pencil
- A Data Sheet and Periodic Table are provided at the back of this paper
- Write your Barker Student Number at the top of the Answer Sheet and Cover Sheet and ALL pages in Section II

Total marks (80)

Section I Pages – 2 – 5

15 marks

- Indicate all answers on the Answer Sheet provided
- Allow about 25 minutes for this section

Section II Pages 6 – 18

65 marks

- Attempt ALL questions
- Indicate all answers in the spaces provided on the Answer Sheets
- Show all working for this section
- Allow about 1½ hours this section

Section I

15 marks

Allow about 25 minutes for this section

Attempt ALL questions

Use the multiple-choice answer sheet

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.

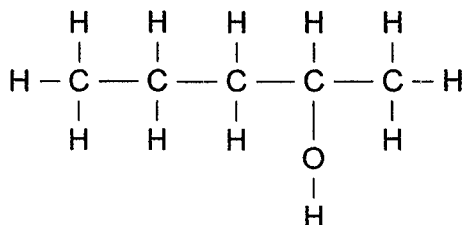
(A) (B) (C) (D)

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

(A) (B) (C) (D)

correct
↖

- Which of the following processes is used to convert some fractions from the refining of petroleum into ethylene?
 - polymerisation
 - fermentation
 - dehydration
 - catalytic cracking
- What is the term used to describe the conversion of ethanol into ethylene?
 - condensation
 - hydrogenation
 - addition
 - dehydration
- What is the name of the compound represented below?



- 2-butanol
 - 4-pentanol
 - pentan-4-ol
 - 2-pentanol
- Polystyrene is an example of an addition polymer. What is the common name and the systematic name for the monomer from which this polymer is formed?
 - common name: styrene, systematic name: phenylethene
 - common name: phenylethene, systematic name: styrene
 - common name: ethenyl benzene, systematic name: styrene
 - common name: vinyl chloride, systematic name 2-dichloroethene
 - Which of the following is a monomer of cellulose?
 - ethylene
 - glucose
 - starch
 - galactose

6. What is the oxidation state (number) of Mn in MnO_4^- ?

- (A) +1
- (B) +2
- (C) -7
- (D) +7

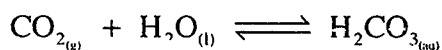
7. The reaction that goes in the direction shown is:

- (A) $Mg^{2+}_{(aq)} + Fe_{(s)} \rightarrow Mg_{(s)} + Fe^{2+}_{(aq)}$
- (B) $Zn_{(s)} + Pb^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Pb_{(s)}$
- (C) $Pb_{(s)} + Fe^{2+}_{(aq)} \rightarrow Pb^{2+}_{(aq)} + Fe_{(s)}$
- (D) $2Ag_{(s)} + Sn^{2+}_{(aq)} \rightarrow 2Ag^+_{(aq)} + Sn_{(s)}$

8. Iron-58 is bombarded with neutrons in a nuclear fission reactor. A single neutron is captured by the Fe-58 nucleus to form a new isotope of iron? This isotope then undergoes beta decay, producing a daughter nucleus. What is the identity of the daughter nucleus?

- (A) $^{59}_{27}Co$
- (B) $^{59}_{26}Fe$
- (C) $^{57}_{26}Fe$
- (D) $^{59}_{25}Fe$

9. Consider the following reaction (the forward reaction is exothermic):



Which of the following changes to equilibrium conditions would favour the formation of bubbles of carbon dioxide?

- (A) increasing the pressure
- (B) increasing the temperature
- (C) decreasing the temperature
- (D) addition of water

10. What is the pH of orange juice closest to?

- (A) 6.5
- (B) 1.5
- (C) 7.5
- (D) 3.5

11. A nitric acid solution had a pH of 2. 10mL of the solution was diluted to 100mL. What is the pH of the final solution closest to?
- (A) 0.2
 - (B) 2.5
 - (C) 1.0
 - (D) 3.0
12. Which one of the following statements concerning equimolar (equal concentrations) solutions of a strong monoprotic acid (HA) and a weak monoprotic acid (HB) is **incorrect**?
- (A) HA has a higher pH than HB.
 - (B) The concentration of A^- is greater than the concentration of B^- .
 - (C) The degree of ionization is greatest in HA.
 - (D) HA has a lower pH than HB.
13. Which of the following is the conjugate base of HSO_4^- ?
- (A) SO_4^{2-}
 - (B) H_2SO_4
 - (C) HSO_3^-
 - (D) H_2SO_3
14. Which of the substances below could be classified as an Arrhenius base?
- (A) water
 - (B) potassium hydroxide
 - (C) sodium carbonate
 - (D) calcium oxide
15. Which of the following groups of carbon compounds is listed in order of increasing solubility in water?
- (A) acetic acid, octanoic acid, ethanol, ethane
 - (B) ethane, octanoic acid, ethanol, acetic acid
 - (C) acetic acid, ethanol, octanoic acid, ethane
 - (D) ethane, ethanol, octanoic acid, acetic acid

Section II

65 marks

Attempt ALL questions

Allow about 1½ hours for this section

Use the spaces provided on the paper.

Marks

Question 16 (5 marks)

A student is given two test tubes during a practical lesson. He is told that one test tube contains cyclohexane while the other contains cyclohexene.

- (a) What chemical should the student use to identify which test tube contains the cyclohexane and which test tube the cyclohexene? **1**

.....

- (b) The student adds one mL of the reagent mentioned in (a) to each of the test tubes and shakes the tubes. Write down the immediate observations made by the student. **2**

Cyclohexane:

.....

Cyclohexene:

.....

- (c) Draw structural formulae to show the reaction of cyclohexane with the reagent mentioned in (a) (assuming the reaction was allowed to take place exposed to light (uv) and left for some time). **2**

Question 17 (5 marks)

Vinyl chloride has the condensed formula CH_2CHCl .

- (a) What is the systematic name for this compound? 1

.....

- (b) Draw a diagram using structural formulae to show the formation of a section of poly (vinyl chloride). Show at least three monomer units. 2

- (c) Give ONE use for PVC, explaining the properties which make it suitable for this purpose. 2

.....

.....

Question 18 (5 marks)

An experiment was performed to determine the Heats of Combustion of two alkanols. The amount of fuel required to heat 200 mL of water by approximately 10 degrees was measured. The following results were obtained.

	1-butanol	1-pentanol
initial mass of burner (g)	25.25	28.42
final mass of burner (g)	24.96	28.24
initial temperature of water (°C)	22.5	22.0
final temperature of water (°C)	33.0	35.0

- (a) Calculate the Molar Heat of Combustion for 1-butanol using the data given and your data sheet. (Density of water is 1.0 g mL^{-1})

3

- (b) The theoretical value for the Molar Heat of Combustion for 1-butanol is 2677 kJ mol^{-1} . Discuss the reasons for any discrepancy from your result calculated in part (a).

2

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Question 20 (6 marks)

(a) Write an equation for the fermentation of glucose $C_6H_{12}O_6$. 1

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(b) Name TWO conditions under which fermentation is promoted. 1

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(c) Identify a factor which causes the fermentation process to cease after a few days. 1

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(d) Outline an investigation you carried out in the laboratory to monitor the process of fermentation of glucose. 3

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Question 21 (6 marks)

In the laboratory you have conducted an experiment to measure the voltage of an electrochemical cell that you set up. One of the combinations you used was a lead electrode in a lead (II) nitrate solution connected to a zinc electrode in a zinc nitrate solution.

- (a) Draw a neat, **labelled** diagram of the experimental setup showing the direction of electron flow in the external circuit as well as the movement of ions in the salt bridge. 3

(b) oxidation half equation:

reduction half equation: 1

- (c) Calculate the EMF of the cell and comment on why the voltage you obtained in the lab when doing this experiment was lower than the theoretical EMF for the cell. 2

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Question 23 (11 marks)

Sulfur was burnt in a gas jar of oxygen. There was enough oxygen for all the sulfur to react. The product of this reaction was dissolved in water and tested with phenolphthalein. The indicator remained colourless.

- (a) Is the solution acidic or basic? 1

.....

- (b) Write a balanced chemical equation for the reaction involving the burning of sulfur, including states. 1

.....

- (c) Identify ONE natural and ONE industrial source of sulfur dioxide.

Natural source:

Industrial source:

2

Question 23 continues on page 14

Question 23 (continued)

- (e) If 22.00 g of sulfur were burned, calculate the volume of gas produced at 0°C and 100 kPa.

2

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Question 24 (3 marks)

- (a) Define Le Chatelier's Principle.

1

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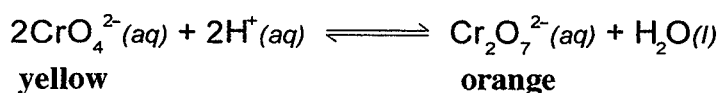
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- (b) Use Le Chatelier's Principle to explain what will happen to the following reaction at equilibrium when sodium hydroxide solution was added to the system. State any colour changes.

2



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Question 26 (5 marks)**Show ALL working.**

The equation for the reaction between potassium hydroxide and sulfuric acid is



A chemist carries out a titration to find the concentration of a sulfuric acid solution. In the titration, the acid is in the burette. These are the details of the titration:

- concentration of potassium hydroxide solution: $0.0671 \text{ mol L}^{-1}$
- volume of potassium hydroxide solution used in each titration: 20.0 mL
- average volume of sulfuric acid used to just react with the base: 27.5 mL

(a) Calculate the number of moles of KOH used in each titration. 1

(b) Calculate the concentration of the sulfuric acid solution in mol L^{-1} 2

(c) Outline TWO possible sources of error when carrying out a titration 2

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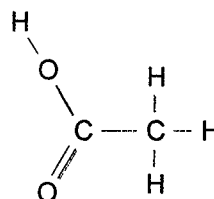
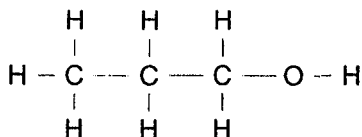
Question 27 (5 marks)

Esters are fruity organic compounds made by reacting an alcohol (alkanol) with a carboxylic acid (alkanoic acid).

- (a) Describe the purpose of using concentrated acid in esterification and name the acid used. 2

.....

- (b) Identify the IUPAC nomenclature for describing the ester produced from the following reactants i.e. name the ester produced when the reactants below are refluxed. 1



Name of ester produced:

- (c) Explain the need for refluxing during esterification. 2

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End of Paper



Barker College

FINAL PRINTED VERSION
19 / 3 / 07

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4.	<input checked="" type="radio"/>	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
5.	<input type="radio"/> A	<input checked="" type="radio"/>	<input type="radio"/> C	<input type="radio"/> D
6.	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input checked="" type="radio"/>
7.	<input type="radio"/> A	<input checked="" type="radio"/>	<input type="radio"/> C	<input type="radio"/> D
8.	<input checked="" type="radio"/>	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
9.	<input type="radio"/> A	<input checked="" type="radio"/>	<input type="radio"/> C	<input type="radio"/> D
10.	<input type="radio"/> A	<input type="radio"/> B	<input type="radio"/> C	<input checked="" type="radio"/>
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12.	<input checked="" type="radio"/>	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
13.	<input checked="" type="radio"/>	<input type="radio"/> B	<input type="radio"/> C	<input type="radio"/> D
14.	<input type="radio"/> A	<input checked="" type="radio"/>	<input type="radio"/> C	<input type="radio"/> D
15.	<input type="radio"/> A	<input checked="" type="radio"/>	<input type="radio"/> C	<input checked="" type="radio"/>

B NOT C



Barker College

RJP MCQ
 RJP 6, 7, 8, 9
 JFH 10 - ~~11~~ 15
 RZS 16, 17, 18

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TERM 1

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correct
↖

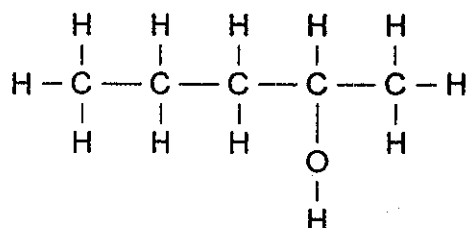
1. Which of the following processes is used to convert some fractions from the refining of petroleum into ethylene?

- (A) polymerisation
- (B) fermentation
- (C) dehydration
- (D) catalytic cracking

2. What is the term used to describe the conversion of ethanol into ethylene?

- (A) condensation
- (B) hydrogenation
- (C) addition
- (D) dehydration

3. What is the name of the compound represented below?



- (A) 2-butanol
- (B) 4-pentanol
- (C) pentan-4-ol
- (D) 2-pentanol

4. Polystyrene is an example of an addition polymer. What is the common name and the systematic name for the monomer from which this polymer is formed?

- (A) common name: styrene, systematic name: phenylethene
- (B) common name: phenylethene, systematic name: styrene
- (C) common name: ethenyl benzene, systematic name: styrene
- (D) common name: vinyl chloride, systematic name 2-dichloroethene

5. Which of the following is a monomer of cellulose?

- (A) ethylene
- (B) glucose
- (C) starch
- (D) galactose

6. What is the oxidation state (number) of Mn in MnO_4^- ?

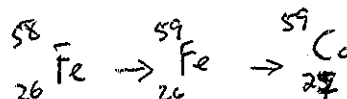
- (A) +1
- (B) +2
- (C) -7
- (D) +7

7. The reaction that goes in the direction shown is:

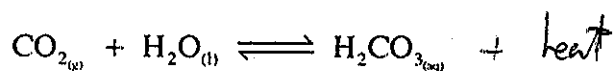
- (A) $Mg^{2+}_{(aq)} + Fe_{(s)} \rightarrow Mg_{(s)} + Fe^{2+}_{(aq)}$
- (B) $Zn_{(s)} + Pb^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Pb_{(s)}$
- (C) $Pb_{(s)} + Fe^{2+}_{(aq)} \rightarrow Pb^{2+}_{(aq)} + Fe_{(s)}$
- (D) $2Ag_{(s)} + Sn^{2+}_{(aq)} \rightarrow 2Ag^+_{(aq)} + Sn_{(s)}$

8. Iron-58 is bombarded with neutrons in a nuclear fission reactor. A single neutron is captured by the Fe-58 nucleus to form a new isotope of iron? This isotope then undergoes beta decay, producing a daughter nucleus. What is the identity of the daughter nucleus?

- (A) $^{59}_{27}Co$
- (B) $^{59}_{26}Fe$
- (C) $^{57}_{26}Fe$
- (D) $^{59}_{25}Fe$



9. Consider the following reaction (the forward reaction is exothermic):



Which of the following changes to equilibrium conditions would favour the formation of bubbles of carbon dioxide?

- (A) increasing the pressure
 - (B) increasing the temperature
 - (C) decreasing the temperature
 - (D) addition of water
10. What is the pH of orange juice closest to?
- (A) 6.5
 - (B) 1.5
 - (C) 7.5
 - (D) 3.5

11. A nitric acid solution had a pH of 2. 10mL of the solution was diluted to 100mL. What is the pH of the final solution closest to?

- (A) 0.2
(B) 2.5
(C) 1.0
(D) 3.0

$$\begin{aligned} (10 \times 10^{-2}) \cancel{x} &= 100 \times x \\ x &= \frac{1 \times 10^{-1}}{1 \times 10^{-2}} \\ &= 1 \times 10^{\underline{1}} \end{aligned}$$

12. Which one of the following statements concerning equimolar (equal concentrations) solutions of a strong monoprotic acid (HA) and a weak monoprotic acid (HB) is incorrect?

- (A) HA has a higher pH than HB.
(B) The concentration of A^- is greater than the concentration of B^- . ✓
(C) The degree of ionization is greatest in HA. ✓
(D) HA has a lower pH than HB. ✓

13. Which of the following is the conjugate base of HSO_4^- ?

- (A) SO_4^{2-}
(B) H_2SO_4
(C) HSO_3^-
(D) H_2SO_3

14. Which of the substances below could be classified as an Arrhenius base?

- (A) water
(B) potassium hydroxide
(C) sodium carbonate
(D) calcium oxide

15. Which of the following groups of carbon compounds is listed in order of increasing solubility in water?

- (A) acetic acid, octanoic acid, ethanol, ethane
(B) ethane, octanoic acid, ethanol, acetic acid = ?
(C) acetic acid, ethanol, octanoic acid, ethane
(D) ethane, ethanol, octanoic acid, acetic acid

Section II

65 marks

Attempt ALL questions

Allow about 1½ hours for this section

Use the spaces provided on the paper.

Marks

Question 16 (5 marks)

A student is given two test tubes during a practical lesson. He is told that one test tube contains cyclohexane while the other contains cyclohexene.

- (a) What chemical should the student use to identify which test tube contains the cyclohexane and which test tube the cyclohexene? 1

BROMINE, Br_2 OR BROMINE WATER.

- (b) The student adds one mL of the reagent mentioned in (a) to each of the test tubes and shakes the tubes. Write down the immediate observations made by the student. 2

Cyclohexane: THE ORANGE/BROWN BROMINE COLOUR REMAINS ✓

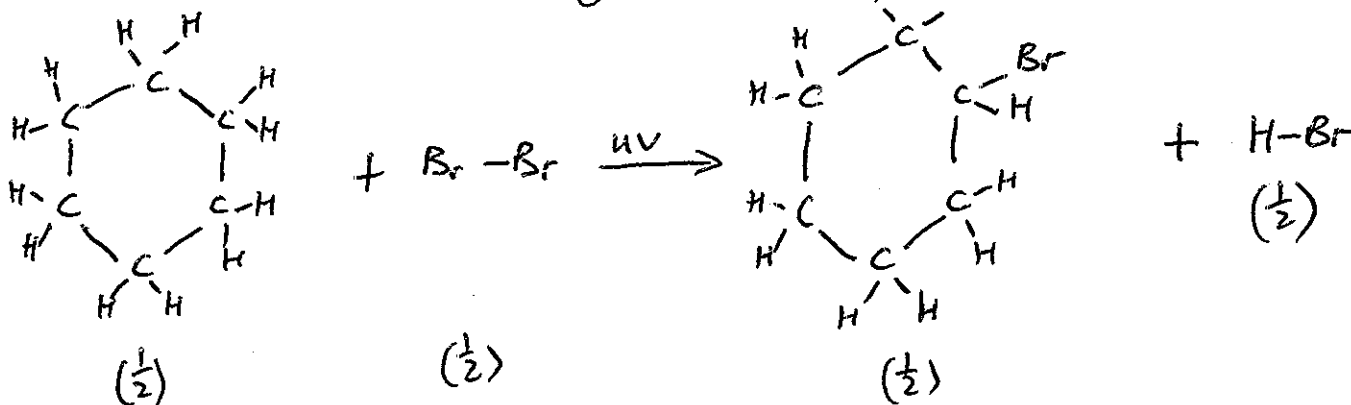
Many said what they know about reactions in light/dark after some time but question asks for IMMEDIATE OBSERVATION.

Cyclohexene: THE ORANGE/BROWN BROMINE COLOUR CHANGES TO COLOURLESS. ✓

They had to give the colour change for the full mark if they just wrote colourless then they only got half a mark.

- (c) Draw structural formulae to show the reaction of cyclohexane with the reagent mentioned in (a) (assuming the reaction was allowed to take place exposed to light (uv) and left for some time). 2

Quite few lost the ½ marks for Br_2 and HBr not showing the covalent bond.



Question 17 (5 marks)

Vinyl chloride has the condensed formula CH_2CHCl .

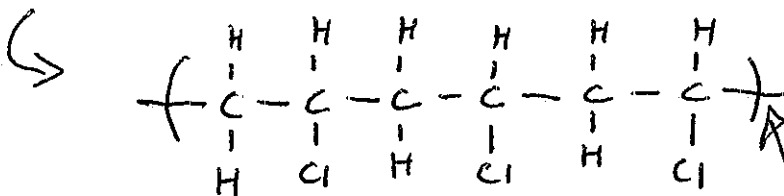
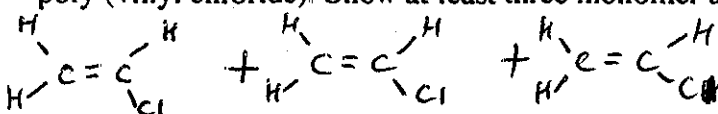
(a) What is the systematic name for this compound?

1

CHLOROETHENE

(b) Draw a diagram using structural formulae to show the formation of a section of poly (vinyl chloride). Show at least three monomer units.

2



✓
 1/2 mark if only showed trimer i.e H's here

(c) Give ONE use for PVC, explaining the properties which make it suitable for this purpose.

2

ELECTRICAL INSULATION: DOES NOT CONDUCT ELECTRICITY

GARDEN HOSES: STRONG, FLEXIBLE

DRAINAGE PIPES: STRONG, DOES NOT CORRODE

✓ USE
 ✓ PROPERTY (FAMILY GENERAL)

Most did well here as many answers accepted

Question 18 (5 marks)

An experiment was performed to determine the Heats of Combustion of two alkanols. The amount of fuel required to heat 200 mL of water by approximately 10 degrees was measured. The following results were obtained.

	1-butanol	1-pentanol
initial mass of burner (g)	25.25	28.42
final mass of burner (g)	24.96	28.24
initial temperature of water (°C)	22.5	22.0
final temperature of water (°C)	33.0	35.0

- (a) Calculate the Molar Heat of Combustion for 1-butanol using the data given and your data sheet. (Density of water is 1.0 g mL^{-1})

3

$$q = mc\Delta T$$

$$q = (200 \times 4.18)(10.5)$$

$$q = 8778 \text{ J} \quad \checkmark$$

ONE MARK OFF IF DID NOT HAVE MASS AND SPECIFIC HEAT CAPACITY IN SAME UNITS, EITHER g OR kg.

$$\Delta H = \frac{8778 \text{ J}}{3.9125 \times 10^{-3}}$$

$$\Delta H = 2243535.7 \text{ J} \cdot \text{mol}^{-1}$$

$$\Delta H = 2243.5 \text{ kJ} \cdot \text{mol}^{-1} \quad \checkmark$$

AMOUNT OF BUTANOL BURNED

$$n = \frac{m}{M}$$

$$n = \frac{0.29}{74.12} \quad \checkmark$$

$$n = 0.0039125 \text{ mol}$$

$$n = 3.91 \times 10^{-3} \text{ mol}$$

$$M_{\text{C}_4\text{H}_9\text{OH}} = 48.04 + 10.08 + 16.00 = 74.12 \text{ g} \cdot \text{mol}^{-1}$$

MARKED POSITIVELY.

-1/2 if no units on final answer.

- (b) The theoretical value for the Molar Heat of Combustion for 1-butanol is 2677 kJ mol^{-1} . Discuss the reasons for any discrepancy from your result calculated in part (a).

2

The calculate value is less due to HEAT LOST TO THE AIR, HEAT LOST TO THE CONTAINER.

NOT EXACTLY 200ML OF WATER MEASURED

INACCURACY IN TAKING THE TEMPERATURE READINGS by allowing ERROR OF PARALLAX.

Question 19 (5 marks)

Discuss the advantages and disadvantages of using ethanol as a fuel or fuel additive for motor cars and assess its potential as an alternative fuel.

5

ADVANTAGES:

It is a RENEWABLE RESOURCE and so would reduce the use of NON-RENEWABLE FOSSIL FUELS.

It could REDUCE GREENHOUSE GAS EMISSIONS

~~LOWER THAN~~ ETHANOL BURNS MORE COMPLETELY THAN OCTANE UNDER THE SAME CONDITIONS. ✓ ADVANTAGES

DISADVANTAGES

* Large areas of agricultural land would need to be devoted to growing suitable crops.

* This could cause environmental problems like SOIL EROSION, DEFORESTATION, FERTILISER RUN-OFF and SALINITY.

* Disposal of large amounts of SMELLY WASTE FERMENTATION LIQUORS after removal of ethanol causes further environmental problems.

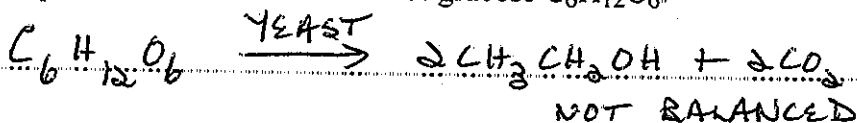
* OCTANE PRODUCES MORE ENERGY THAN ETHANOL ON a molar basis.

* FLASHPOINT of ethanol is higher than that of petrol so combustible mixtures of ethanol vapour are not as readily formed in cold climates. ✓ DISADVANTAGES

The assessing of its potential could go either way as long as it was backed up. Most students were able to do well in this question. ✓ ASSESS.

Question 20 (6 marks)

- (a) Write an equation for the fermentation of glucose $C_6H_{12}O_6$. 1



(1/2)

- (b) Name TWO conditions under which fermentation is promoted. 1

KEPT AT TEMP. OF 37°C

AIR IS EXCLUDED i.e. ANAEROBIC

- (c) Identify a factor which causes the fermentation process to cease after a few days. 1

HIGH LEVEL OF ALCOHOL PRESENT KILLS THE YEAST

(ALC CONC > 15% KILLS THE YEAST) SAYING "JUST AN ALCOHOL..." (1/2)

- (d) Outline an investigation you carried out in the laboratory to monitor the process of fermentation of glucose. 3

e.g. A teaspoon of yeast was mixed with a sugar solution in a conical flask with cotton wool at the mouth. The flask was weighed and placed in an incubator at 37°C for a week. The apparatus was removed from the incubator every day to be reweighed.

* OUTLINE OF PRACTICAL PROCEDURE

CORRECT SEQUENCE OF STEPS (1/2)

* MAINTAIN TEMP. AT 37°C

NOT JUST WARM (1/2)

* SUGAR SOLUTION + YEAST (1/2)

* EXCLUSION OF AIR (1/2)

* MONITORING: REGULAR WEIGHINGS OF FLASK & MIXTURE

OR

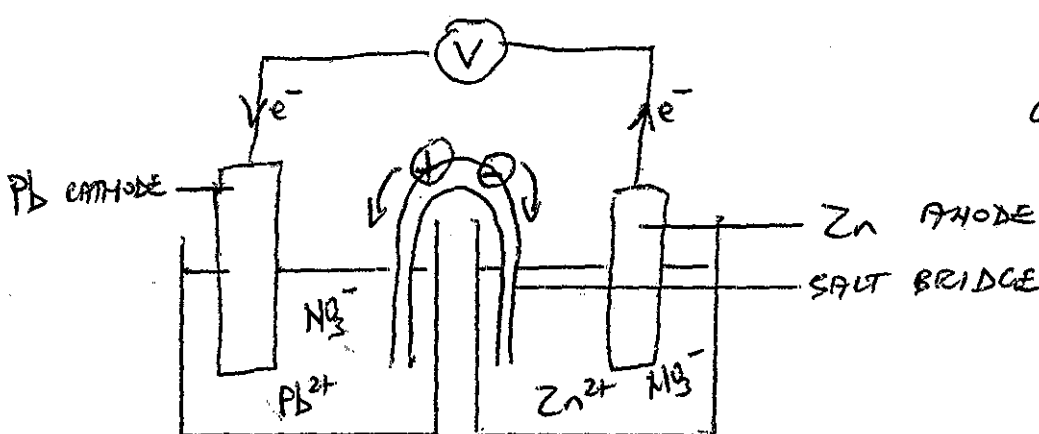
FINAL ACT CONFIRMING PRESENCE OF ETHANOL (1)

JUST USING LIMewater (1/2)

Question 21 (6 marks)

In the laboratory you have conducted an experiment to measure the voltage of an electrochemical cell that you set up. One of the combinations you used was a lead electrode in a lead (II) nitrate solution connected to a zinc electrode in a zinc nitrate solution.

- (a) Draw a neat, **labelled** diagram of the experimental setup showing the direction of electron flow in the external circuit as well as the movement of ions in the salt bridge. 3



ELECTRON FLOW (1/2)
 CORRECT ION MOVEMENT (1/2)
 ANODE/CATHODE (1/2)
 CORRECT
 SALT BRIDGE LABELED (1/2)
 IONS IN SOLUTION (1/2)
 VOLTMETER/CELL CORRECT (1/2)

- (b) oxidation half equation: $Zn(s) \rightarrow Zn^{2+}(aq) + 2e^-$
 reduction half equation: $Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$ 1
 1/2 ea
 - states not important
- (c) Calculate the EMF of the cell and comment on why the voltage you obtained in the lab when doing this experiment was lower than the theoretical EMF for the cell. 2

$$EMF = E_{RED} + E_{OX}$$

$$= -0.13V + 0.76V$$

$$EMF = 0.63V$$

(1)
 1/2 OFF IF NO UNITS

CONC. OF SOLUTIONS NOT 1 MOL L -1

TEMP. NOT AT 25°C

METALS NOT COMPLETELY PURE

IMPURITIES IN THE ELECTROLYTE SOLUTION

(1) FOR ONE VALID POINT

NOT ISSUED - Salt bridge may have dried out
 NOT - as reaction progresses etc conc. electrolyte changes

Question 22 (4 marks)

Describe, with examples, how commercial radioisotopes are produced.

4

RADIOISOTOPES CAN BE PRODUCED IN

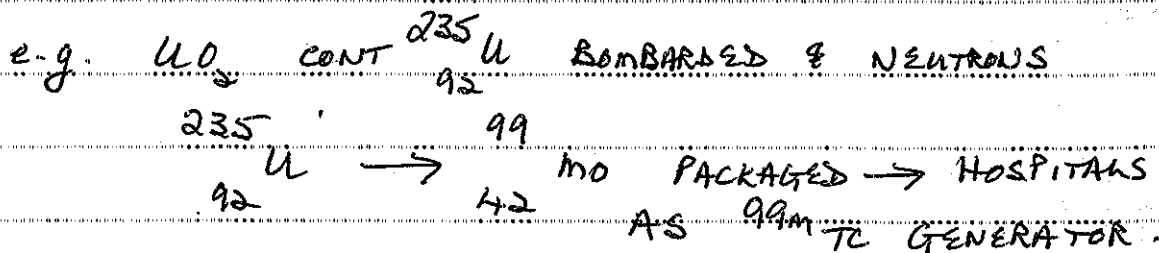
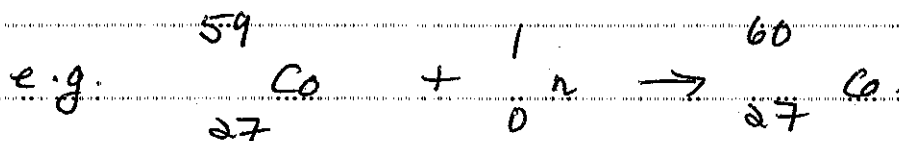
* NUCLEAR REACTORS

* CYCLOTRONS (OR PARTICLE ACCELERATORS)

NUCLEAR REACTORS

* SOURCES OF NEUTRONS

* USED TO MAKE RADIOISOTOPES THAT CAN BE PREPARED BY NEUTRON BOMBARDMENT OF TARGET NUCLEI.



CYCLOTRONS

TARGET NUCLEI BOMBARDED WITH SMALL +VE PARTICLES

e.g. HELIUM OR CARBON NUCLEUS



MUST DISCUSS BOTH METHODS.

NUCLEAR REACTOR (1/2)

METHOD (USING NEUTRONS) (1/2)

PROCESS EXAMPLE (1)
OR
[JUST MENTION CO-60 (1/2)]

CYCLOTRON (1/2)

METHOD (USING +VE PARTICLES) (1/2)

PROCESS EXAMPLE (1)
OR
[JUST MENTION RADIOISOTOPE (1/2)]

12

Question 23 (11 marks)

Sulfur was burnt in a gas jar of oxygen. There was enough oxygen for all the sulfur to react. The product of this reaction was dissolved in water and tested with phenolphthalein. The indicator remained colourless.

- (a) Is the solution acidic or basic?

1

ACIDIC

- (b) Write a balanced chemical equation for the reaction involving the burning of sulfur, including states.

1



- (c) Identify ONE natural and ONE industrial source of sulfur dioxide.

Natural source: VOLCANOES / HYDROTHERMAL VENTS

NOT JUST

NATURAL
SPRINGS ETC
2

Industrial source: BURNING FOSSIL FUELS (e.g. COAL)

SMELTING OF SULFIDE ORES etc.

NOT JUST BURNING FUEL

Question 23 continues on page 14

Question 23 (continued)

- (d) Discuss reasons for concern about the release into the environment of oxides of sulfur and nitrogen. Include relevant equations.

5

- * "ACID RAIN" (1)
- * 3 BALANCED EQUATIONS ON PROD. OF ACID RAIN (1/2) ea
OR EFFECT OF ACID RAIN
- * ANY EFFECT OF ACID RAIN WITH CAUSE (1/2) ea
e.g. decrease in pH of rainwater results in stripping of waxy coating off leaves etc TO MAXM! (1/2)
- * NO_2 CONTRIBUTES TO SMOG FORMATION (1/2)
- * HUMAN HEALTH EFFECT (WITH CAUSE) (1/2)

Note:

- buildings suffered to most be marble/limestone etc.
- discussion on formation of oxides NO or SO₂ - not asked for.

Answers must be specific to the consequences to the environment and human health of NO_x and SO_2 in the atmosphere.

Question 23 continues on page 15

Question 23 (continued)

- (e) If 22.00 g of sulfur were burned, calculate the volume of gas produced at 0°C and 100 kPa. 2

$$\text{Moles of Sulfur } n = \frac{m}{M} = \frac{22.00}{32.07} \quad n = 0.685 \text{ mol} \quad (1)$$

$$n = \frac{V}{V_m} = \frac{V}{22.71} \quad V = (0.685)(22.71)$$

$$V = 15.58 \text{ L} \quad (1)$$

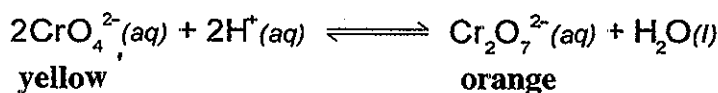
(-1/2 OFF IF NOT 4 SIG FIGS
IN FINAL ANSWER)

Question 24 (3 marks)

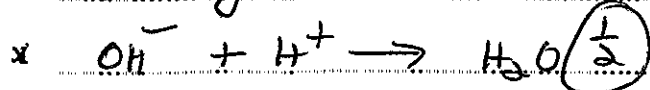
- (a) Define Le Chatelier's Principle. 1

If a system at EQUILIBRIUM (1/2) is disturbed, then the system adjusts itself so as to minimize the disturbance (1/2)

- (b) Use Le Chatelier's Principle to explain what will happen to the following reaction at equilibrium when sodium hydroxide solution was added to the system. State any colour changes. 2



* Adding OH⁻ IONS WILL CAUSE [H⁺] TO DECREASE (1/2)



ACCORDING TO LE CHATELIER'S PRINCIPLE IF THE [H⁺] DECREASES THE EQUILIBRIUM WILL SHIFT TO INCREASE [H⁺] (TO THE LEFT) (1/2)

* THE REVERSE REACTION WILL BE FAVOURED

PRODUCING MORE OF THE YELLOW CHROMATE (i.e. COLOUR CHANGE FROM ORANGE TO YELLOW) (1/2)

NOTE: Many students talked about inc [H₂O] forcing eqm back to the left - UNACCEPTABLE!

Question 25 (5 marks)

Describe an experiment you have performed to measure the pH of a range of salt solutions. (2)
Mention the precautions you took to ensure the accuracy of your results. (1)
For TWO of the salts used explain, using equations, why their pHs were not 7. (2)

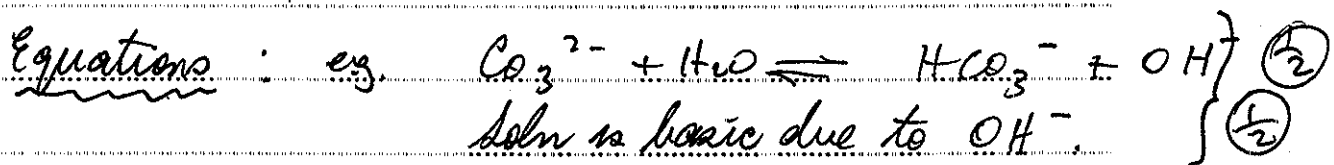
5

Description

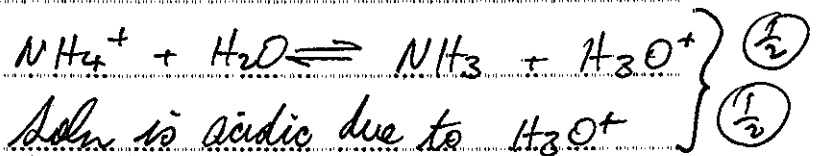
1. (a) calibrate the probe/meter using a buffer solutions pH 4, 7, 10.
(b) Rinse with distilled water after calibrating.
2. Place approx 50 mls of salt soln in a beaker
3. Place the calibrated probe/meter in the soln until a constant pH is reached. Record result. (1)
4. Rinse well with distilled water before testing each soln.

Precautions

- Rinsing well with distilled water (2) (1)
- Calibrate with buffers pH 4, 7, 10.
- Waited for a constant reading

Equations

* Must have eqns



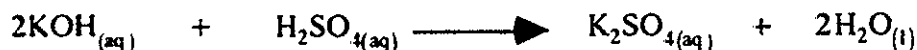
{ NaHCO_3 - formed from strong base & weak acid
 HCO_3^- is a weak acid \rightarrow a conjugate strong base. $\therefore \text{pH} > 7.0$

{ same for NH_4^+
No equations with H_2O^{16} (1 mark only)

Question 26 (5 marks)

Show ALL working.

The equation for the reaction between potassium hydroxide and sulfuric acid is



A chemist carries out a titration to find the concentration of a sulfuric acid solution. In the titration, the acid is in the burette. These are the details of the titration:

- concentration of potassium hydroxide solution: $0.0671 \text{ mol L}^{-1}$
- volume of potassium hydroxide solution used in each titration: 20.0 mL
- average volume of sulfuric acid used to just react with the base: 27.5 mL

(a) Calculate the number of moles of KOH used in each titration.

1

$$n = cV$$

$$n = (0.0671)(20.0 \times 10^{-3})$$

$$n = \underline{1.34 \times 10^{-3} \text{ mol}}$$

$\frac{1}{2}$ if no UNIT.

(b) Calculate the concentration of the sulfuric acid solution in mol L^{-1}

2

FROM THE EQUATION WE SEE

2 moles KOH REACT WITH 1 mole H_2SO_4 $\therefore \frac{1}{2}$ AS MUCH ACID NEEDED

$$\text{Moles ACID} = 6.71 \times 10^{-4} \text{ mol.}$$

$$[\text{H}_2\text{SO}_4] = \frac{n}{V}$$

$$[\text{H}_2\text{SO}_4] = \frac{6.71 \times 10^{-4}}{27.5 \times 10^{-3}} = \underline{2.44 \times 10^{-2} \text{ mol. L}^{-1}}$$

(c) Outline TWO possible sources of error when carrying out a titration

2

Burette not RINSED WITH solution to be delivered.

PIPETTE " " " " " " " " " " " "

Conical flask not rinsed with DISTILLED WATER.

NOT READING FROM the bottom of the MENISCUS when taking readings from the burette or pipette.

ERROR OF PARALLAX when reading burette or pipette.

NOT: EQUIPMENT NOT RINSED PROPERLY.

ANY TWO.
ONE SHOULD BE A RINSING TECHNIQUE.

MARK POSITIVELY.

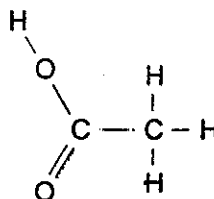
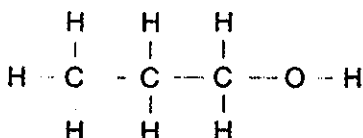
Question 27 (5 marks)

Esters are fruity organic compounds made by reacting an alcohol (alkanol) with a carboxylic acid (alkanoic acid).

- (a) Describe the purpose of using concentrated acid in esterification and name the acid used. 2

✓
 CONCENTRATED SULFURIC ACID: USED AS A CATALYST ✓
 OR DEHYDRATING AGENT

- (b) Identify the IUPAC nomenclature for describing the ester produced from the following reactants i.e. name the ester produced when the reactants below are refluxed. 1



Name of ester produced: PROPYL ETHANOATE.

- (c) Explain the need for refluxing during esterification. 2

Esterification is a slow reaction at room temperature so heat is needed to speed up the reaction. However, the ester product is volatile (as are the reactants) so refluxing is used to condense these volatile reactants/products. Also safer as flammable alcohol vapour will not reach any naked flames in the laboratory.

End of Paper