James Ruse Agricultural High School

Theory and Data Processing

Chemistry Assessment
Task 1   Term 4   2009

General Instructions

- **Reading Time**:   5 minutes
- **Working Time**:   85 minutes
- **Complete both Theory and Data Processing in the time, 85 minutes.**
- Write using black or blue pen
- Board approved calculators may be used
- Write your Student Number at the top of this page
- A Periodic Table and Data Sheet are attached to the back of the paper

Total Marks   50

Part A

Multiple Choice: 5 marks
Attempt Questions 1-5

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.
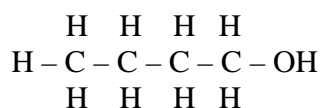
A ⬤   B ✖   C ⬭   D ⬭

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 – 5 in the Answer Box on page 8**

Theory Paper - 20 marks

1. What is the IUPAC name for the following alkanol?

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      H   H   H   H
    H – C – C – C – C – OH
      H   H   H   H
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(A) propanol

(B) 1-propanol

(C) butanol

(D) 1-butanol

2. The following represents the catalytic cracking of a hydrocarbon.

    $$C_{10}H_{22} \rightarrow C_8H_{18} + C_2H_4$$

    Which of the following correctly identifies a product of this reaction and the homologous series to which it belongs?

(A) octane   alkanes

(B) octene   alkenes

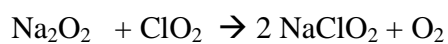(C) ethane   alkanes

(D) decane   alkanes

3. Which process could be used to describe the conversion of ethylene to ethanol?

(A) combustion

(B) addition

(C) dehydration

(D) fermentation

4.   Which of the following is a major component of biomass?

(A)   Ethene

(B)   Cellulose

(C)   Ethanol

(D)   Natural gas

5.   Given the following reaction:

$Na_2O_2 + ClO_2 \rightarrow 2 NaClO_2 + O_2$

Which of the following choices correctly describes the reactants and products of the reaction?

	oxidant	*reductant*	*reduced product*	*oxidised product*
(A)	ClO_2	Na_2O_2	$NaClO_2$	O_2
(B)	Na_2O_2	ClO_2	O_2	$NaClO_2$
(C)	Na_2O_2	ClO_2	$NaClO_2$	O_2
(D)	$NaClO_2$	O_2	ClO_2	Na_2O_2

Student No. ....

Part A: Answer grid for multiple choice questions

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 ⭘

Part B : Extended Response Questions (15 Marks)

Question 6 (4 marks)

During your study of Production of Materials you performed a first hand investigation to compare the reactivities of an alkane and an alkene.

Describe the experiment you performed and explain the results of your investigation.

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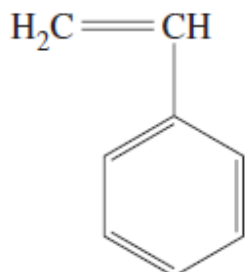
Question 7 (5 marks)

Below is the structure of a commercially significant monomer

$$H_2C = CH$$

(a)   Identify the common name of this monomer. (1 mark)

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(b)   Describe one use of the polymer made from this monomer in terms of its properties.
         (3 marks)

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(c)   Draw the structure of the polymer made from the above monomer. Use three monomers
         to show this structure. (1 mark)

Question 8   (5 marks)

The syllabus required you to study the structure and chemistry of either the lead acid cell or the dry cell. It also required you to be able to compare one of these cells with another one from a list: (*button cell, fuel cell, vanadium redox cell, lithium cell and the Gratzel cell)*
Choose one of these cells and compare it with the lead acid battery or the dry cell and evaluate them in terms of their chemistry and environmental impact.

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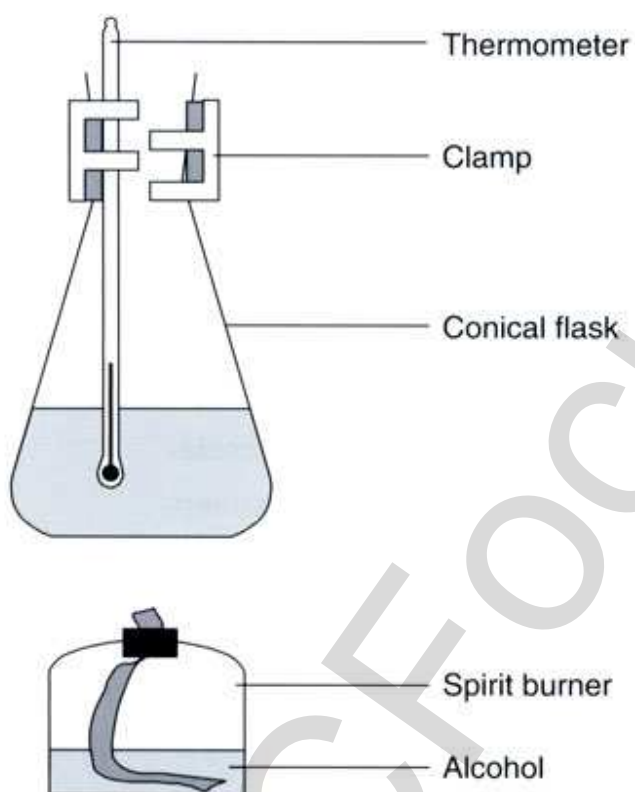
Data Processing Paper - 30 marks

Question 1   20 marks

Aim: To determine and compare the heats of combustion of three liquid alkanols per gram and per mole.

Method:

Methanol, ethanol and 1-propanol were burned in separate spirit burners and used to heat a container of water. The volume of water heated by each alkanol was 100.0 ml.

(a)   Complete the results table below. (1 mark)

Alkanol burning	Methanol	Ethanol	1-propanol
Initial mass of burner (g)	250.0	250.0	250.0
Final mass of burner (g)	248.8	249.1	249.0
Mass of alkanol burnt (g)			
Initial temperature of water (ºC)	23	23	23
Final temperature of water (ºC)	36	36	36
Rise in temperature of water (ºC)			
Mass of water heated (g)	100	100	100

(b)   Complete the calculations table below (5 marks)

Name of alkanol used	methanol	ethanol	1-propanol
Heat released by burning fuel in experiment (J)			
Heat released by burning 1 g of fuel (J)			
Molecular formula of the fuel			
Molar mass of fuel (g)			
Heat released by burning the molar mass of fuel (kJ mol^{-1})			

(c)   Which fuel releases the most heat   (i) per gram …………………………

                                           (ii) per mole burned?........................

                                           (1 mark)

(d)   Assuming complete combustion, write an equation for the combustion of
        1-propanol, including the enthalpy value as determined in (b).   (2 marks)

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(e)   Explain why your calculated values are well below the value given in data books
        (2 marks)

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(f)   If the data value for the molar heat of combustion for petrol (assume this consists of
        octane) is 5460 kJ mol^{-1} and for ethanol is 1370 kJ mol^{-1}, which fuel would release the
        most energy per kg of fuel? Show all working   (2 marks)

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(g)   Which of the fuels in (f) requires more oxygen for complete combustion? Show the
        equations for each fuel in your answer. (2 marks)

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(h) Explain with reference to your answer to question (f) & (g) whether these are advantages or disadvantages for using ethanol as an alternative car fuel. (4 marks)

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Question 2   (4 marks)

A student studying the mass change that occurs during fermentation added glucose, water and yeast to a flask and stoppered the flask with some cotton wool.
The student measured the mass of the flask daily for seven days. The table shows the data collected.

Day	Mass(g)
1	381.05
2	376.96
3	373.42
4	370.44
5	370.42
6	370.40
7	370.39

(a) Calculate the total moles of CO_2 released from day 1 to day 7. (1 mark)

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(b) Calculate the mass of glucose that underwent fermentation between days 1 and 7.
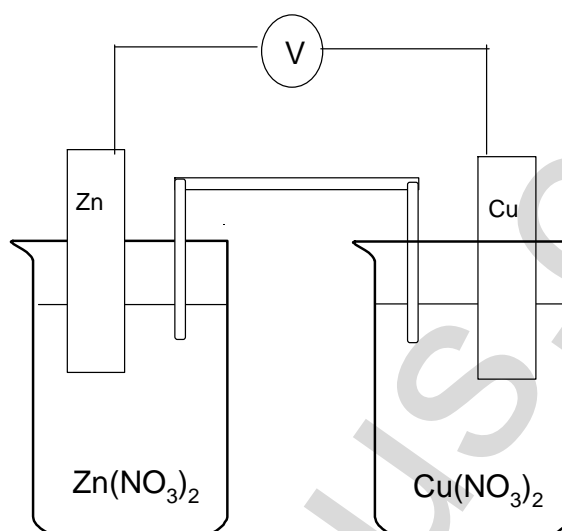Include a balanced chemical equation in your answer. (3 marks)

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Question 3   (6 marks)

A group of students wanted to study the effect of concentration and temperature on the potential of a galvanic cell consisting of copper ions/copper electrode and zinc ions and zinc electrode: The set-up they used is shown below:


Two experiments were performed.

Experiment 1. Keeping the temperature and the $[Zn^{2+}]$ constant, the students measured the potential of the cell at various Cu^{2+} concentrations.

Experiment 2. The concentration of the Cu^{2+} ion and the Zn^{2+} were kept constant and the change in potential was monitored with the change in temperature. The result of both experiments are given in the table below:

Experiment	$molL^{-1} Zn^{2+}$	$molL^{-1} Cu^{2+}$	Temperature (^oC)	Cell voltage (V)
1	0.01	0.001	25	1.07
1	0.01	0.010	25	1.10
1	0.01	0.100	25	1.13
1	0.01	1.00	25	1.17
2	10^{-5}	0.1	5	1.21
2	10^{-5}	0.1	25	1.22
2	10^{-5}	0.1	50	1.23

(a)   Use the grid below to graph the temperature and voltages in **Experiment 2** . Label your
       graph. (3 marks)
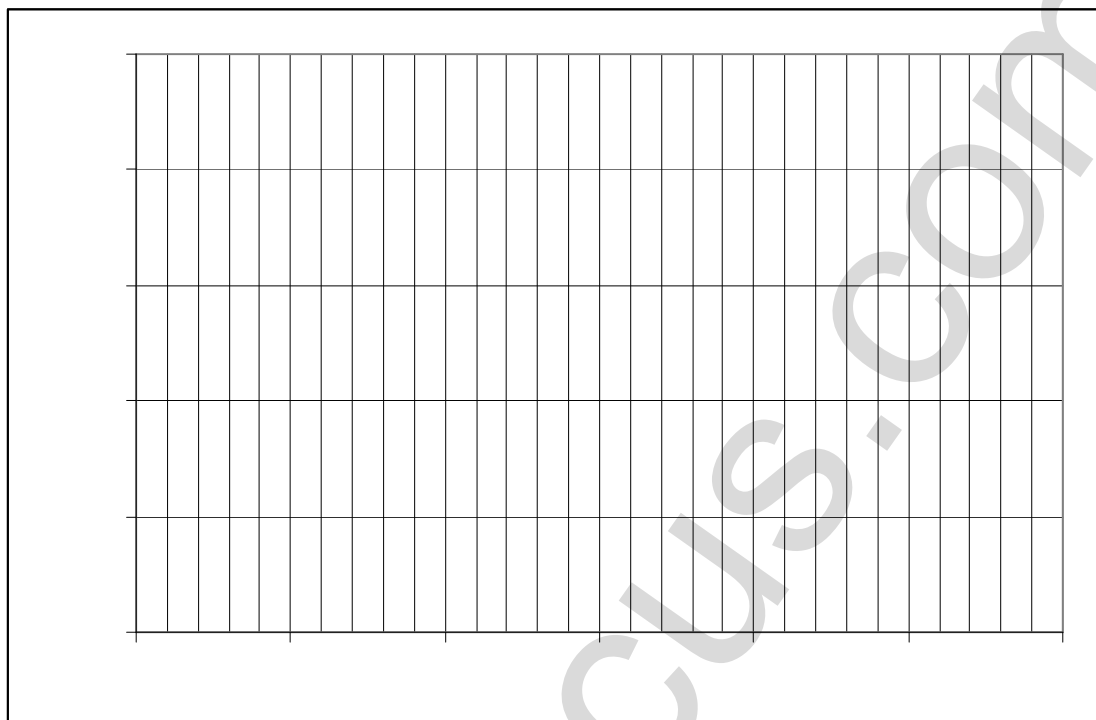
(b)   Identify the trend in cell voltages measured in Experiment 2.   (1 mark)

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(c)   Use the results of Experiment 1 to describe the variation of the voltage with
       concentration. (2 marks)

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End of Test