

INNOVA JUNIOR COLLEGE JC 2 PRELIMINARY EXAMINATIONS 2 in preparation for General Certificate of Education Advanced Level **Higher 2**

CANDIDATE NAME		
CLASS	INDEX NUMBER	

CHEMISTRY

Paper 2 Structured

Candidates answer on the Question Paper

Additional Materials: Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your index number, name and civics group on all the work you hand in.

Write in dark blue or black pen.

You may use pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **<u>all</u>** questions in the space provided. A Data Booklet is provided.

You are advised to show all working in calculations. You are reminded of the need for good English and clear presentation in your answers. You are reminded of the need for good handwriting. Your final answers should be in 3 significant figures.

You may use a calculator.

The number of marks is given in brackets [] at the end of each question or part question.

At the end of the examination, fasten all your work securely together.

For Examiner's Use	
Sect	ion A
1	13
2	11
3	8
4	12
5	16
Significant Figures	
Handwriting	
Total	60

9746/02

1 hour 30 min

15 September 2008

This document consists of **15** printed pages and **1** blank page.



Answer <u>ALL</u> questions on the space provided

2

1 Aspirin, or acetylsalicylic acid is used as an anti-inflammatory medication. It has been established that low doses of aspirin may be given immediately after a heart attack to reduce the risk of another heart attack or of the death of cardiac tissue. Aspirin has the structural formula:



(a) Paracetamol and aspirin are commonly used for the relief of fever, headaches, and other minor aches and pains.

Median lethal dose, LD_{50} of a toxic substance or radiation is the dose required to kill half the members of a tested population. LD_{50} figures are frequently used as a general indicator of a substance's acute toxicity.

The LD_{50} of Aspirin is 1100 mg kg⁻¹ of body mass and of paracetamol is 338 mg kg⁻¹ of body mass.

(i) Suggest and explain whether aspirin or paracetamol is more toxic.

.....

 (ii) Calculate the minimum number of 325 mg aspirin tablets that will be toxic to a 50 kg person.

[2]

(b) The synthesis of aspirin is classified as an esterification reaction, where the alcohol group from the salicylic acid reacts with an acid derivative (acetic anhydride), yielding aspirin and acetic acid as a by-product. Small amounts of sulphuric acid are often used as a catalyst.

3



(i) Why is aspirin kept in dry conditions?

[1]

(ii) Suggest a method (include all reagents and conditions) to re-form salicylic acid from aspirin. Write an equation for this conversion.

Method:	
Reagent(s) and condition(s):	

Equation:

(iii)	Suggest a simple chemical test to differentiate salicylic acid from aspirin.	
	Reagent(s) and condition(s):	
	Observations for	
	salicylic acid:	
	aspirin:	 [2]

[2]

(iv) Predict, with reasons, whether aspirin is a stronger or weaker acid than acetic acid.

4

[2]

(c) A large shipment of salicylic acid is contaminated with boric oxide, B(OH)₃. It looks like salicylic acid which is a white powder.

The heat of combustion of salicylic acid at constant volume is known to be $-3.00 \times 10^3 \text{ kJ mol}^{-1}$.

Boric oxide does not burn because it is fully oxidized. When a 3.56 g sample of contaminated salicylic acid is burned in a bomb calorimeter, the temperature increases by 2.5 °C.

From previous measurements, the heat capacity of the calorimeter is known to be 13.62 kJ $\rm K^{-1}.$

(i) Define standard enthalpy change of combustion of salicylic acid.

[1]

(ii) Calculate the percentage by mass of boric oxide in the sample of contaminated salicylic acid.

[3]

[Total: 13]

2 Hydrazine is a chemical compound with the formula N₂H₄. It has an ammonia-like odour, and is derived from the same industrial chemistry processes that manufacture ammonia. However, hydrazine has physical properties that are more similar to those of water. Hydrazine is used as rocket fuel and to prepare the gas precursors used in air bags.

5

(a) Draw the Lewis structure for the hydrazine molecule. State its shape and indicate the H–N–H bond angle.

Shape:

- [2]
- (b) (i) Calculate the volume occupied by 1 mole of ideal gas at a pressure of 1.5 atm and 300 K.

- [1]
- (ii) At a pressure of 1.5 atm and 300K, 1 mole of gaseous hydrazine occupies a volume 20.0 dm³. Explain the difference in the volume occupied by hydrazine and the volume calculated in (i).

[1]

(iii) Under what conditions of temperature and pressure would you expect gaseous hydrazine to occupy the same volume as that calculated in (i)?

.....

(iv) Assuming that gaseous hydrazine is placed under the conditions specified in(iii), sketch the graph of pressure against the reciprocal of volume for a given amount of hydrazine at constant temperature.

6



(d) A student wishes to make a buffer solution using the above 0.20 moldm⁻³ of hydrazine and its salt, hydrazine chloride. Calculate the concentration of the salt in the buffer solution of pH 10 at 25°C.

[1] [Total: 11]

3 The use of the Data Booklet is relevant to this question.

- (a) The ⁶⁸Ge isotope of the Group IV element Germanium is medically useful because it undergoes a natural radioactive process to give a Gallium isotope, ⁶⁸Ga, which can be used to detect tumours. This transformation of Germanium occurs when an electron enters the nucleus, changing a proton into a neutron.
 - (i) State the number of protons and neutrons in the ⁶⁸Ga isotope formed.

Number of protons :

[1]

(ii) While undergoing radioactive decay, the isotope will give out an alpha particle, α which is the nucleus of helium atom.

The angle of deflection of the alpha particle, α , is 3°.

I. Draw the path for which the alpha particle will take when placed in an electric field shown below.

Source	
II. Give reasons and suggest the angle of deflection of the deuterium ion, ${}_{1}^{2}D^{+}$.	
[2]	

- (b) Gallium is placed below aluminium in Group III in the Periodic Table. It exhibits the same chemical properties as aluminium.
 - (i) Predict how the melting point of gallium chloride will differ from gallium oxide, explaining the type of structure and bonding present.

(ii)

4 Optimum amino acid balance is important to maximize growth and efficiency in pigs. Diets are routinely formulated to meet the threonine:lysine and tryptophan:lysine ratio requirement in pig fed. Research is done to formulate the diets to optimize growth performance.

9

Amino Acid	Formula of side chain (R' in R'CH(NH ₂)CO ₂ H)	Isoelectric Points
Threonine (Thr)	Н ——С——ОН ——СН ₃	5.60
Lysine (Lys)	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	9.60
Tryptophan (Trp)	H-O-H H	5.89

Information of the three amino acids in the pig fed is listed below.

(a) Draw the structural formula of a dipeptide, Lys-Trp

[1]

(b) Draw the structure of threonine at pH = 5.60

(c) The technique known as electrophoresis can be used to separate the amino acids. This technique involves placing a solution of different amino acids at the centre of an agarose gel placed in an aqueous solution of a known pH. An electric potential is then applied through electrodes which are connected to the two ends of the gel strip. An electrophoresis experiment is run on a solution containing the 3 amino acids mentioned above at pH 7.00 and the relative positions of the amino acids are obtained as shown in the diagram.



Original position of sample

(i) Draw the structural formulae of the species found at positions A, B and C at the end of the experiment.

A	
В	
С	



5 When Compound **Y** is heated, a migration known as aromatic Claisen rearrangement occurs. Compound **X** is formed.

12



- (a) Give the structural formula of the organic products formed when Compound X is reacted with the following reagents.
 - (i) KMnO₄, dilute H_2SO_4 , reflux

(ii) NaOH(aq), reflux

(iii) Aqueous chlorine

[2]

(b) Describe one simple chemical test you could use to distinguish Compound Y from Compound X. State the reagents, conditions and observations that can be seen.

Note: The simple chemical test should not involve heating as it will convert Compound \mathbf{Y} into Compound \mathbf{X} .

Reagent(s) and Condition(s): Observations for : Compound Y: Compound X:

(c) A student found a bottle of Compound W in the laboratory and decided to synthesise Compound X using it. He devised the following synthesis pathway to synthesize Compound X.



There is one significant error in the proposed synthesis. Identify the step in which the error occur and provide an explanation.

Step

planation:
[2]

(d) Phenylacetone is used as an intermediate to produce pesticides and anticoagulants. It is also used as an intermediate to used in the clandestine synthesis of MDMA (3,4-methylenedioxymethamphetamine), commonly known as ecstasy.



Describe the mechanism when phenylacetone is reacted with HCN in trace amount of NaOH.

Note: You may use $R - C - CH_3$ to represent phenylacetone in the mechanism.

[3]

For Examiner's Use



15