###### NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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#### STAGE 2 CHEMISTRY

BIRDWOOD HIGH SCHOOL **SEMESTER 1 EXAM**

Time : 120 minutes

*Approved dictionaries and calculators may be used.*

1 You will have 5 minutes to read the paper. You must not write in your question booklets during this reading time but you may make notes on the scribbling paper provided.

2 You will be expected to extract information such as atomic number and relative atomic mass from the periodic table supplied.

3 This paper consists of SEVEN questions.

4 There is no need to fill all of the space provided; clear well-expressed answers are required. If you delete part or all of an answer you should clearly indicate your final answer.

5 The total mark is 108. The seven questions are of approximately equal value.

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| --- | --- |
| For Markers’s Use Only |  |
| **1** |  | 15 |
| **2** |  | 17 |
| **3** |  | 15 |
| **4** |  | 17 |
| **5** |  | 21 |
| **6** |  | 15 |
| **7** |  | 8 |
| **Total** |  | 108 |

**QUESTION 1**

1. Glucose can be produced through the hydrolysis of starch
2. write an equation for the production of a glucose from starch

(2 marks)

1. Specific reaction conditions are needed for yeast to be effective, state *two* reaction conditions necessary for yeast to be effective.

(2 marks)

1. The anaerobic metabolism of glucose produces lactic acid

 O

 CH3 CH C OH

 OH

 *lactic acid*

1. Write the molecular formula of lactic acid

(1 mark)

1. Is lactic acid a carbohydrate? Explain the reasoning for your answer

(2 mark)

1. Would you expect lactic acid to be soluble in water? Highlight at least ***2*** structural features that support your choice

(3 marks)

1. Is the alcohol on lactic acid primary, secondary or tertiary?

(1 mark)

1. lactic acid can form a polymer

 O O O

 II II II

 - O – C – CH2 – O – C – CH2 – O – C – CH2 – O - -

 I I I

 CH3 CH3 CH3

1. Mark 1 repeating unit on the above diagram

(1 mark)

1. What is the special name given to this type of polymerisation

(1 mark)

1. Name the bond that is formed through this reaction

(1 mark)

1. What small molecule is a by-product of this reaction

(1 mark)

TOTAL: 15 marks

**QUESTION 2**

Esters can be produced from the reaction between an alcohol and a carboxylic acid

1. propyl ethanoate is a chemical responsible for a pears smell
2. draw the structure of propyl ethanoate

(2 marks)

1. Name the alcohol and the carboxylic acid from which this ester is derived

(2 marks)

1. Describe the reaction conditions necessary for the esterfication process

(2 marks)

1. 1-butanol is another alcohol that can be used to produce esters
2. Is 1-butanol a primary, secondary or tertiary alcohol?

(1 mark)

1. 1-butanol can be oxidised to an aldehyde. Draw the structure of this aldehyde.

(2 marks)

1. What reagent would be used for this oxidation?

(1 mark)

1. Why is it important that this oxidation is a controlled oxidation?

(2 marks)

1. Describe the observation that would indicate that the reaction has taken place

(2 marks)

1. Name the ketone isomer of this aldehyde

(1 mark)

1. Name the chemical and the observation that would allow you to distinguish between these two isomers

(2 marks)

TOTAL: 17 marks

**QUESTION 3**

1. The following structure is of an anti-inflammatory drug

1. Is the amine group primary, secondary or tertiary?

(1 mark)

1. This molecule can be prepared from the condensation of a carboxylic acid and a primary amine. What type of bond is formed by this reaction?

(1 mark)

1. Draw one of the reactants from this condensation reaction

(2 mark)

1. show that the molecular mass of this molecule is 246.3 (to four significant figures)

(3 marks)

1. The recommended dose of this drug is two 170mg capsules. Assuming the volume of bodily fluid is 35L what will be the concentration of the drug in the body fluid in mg L-1

(2 marks)

1. Express this concentration as ppm

(1 mark)

1. Convert this amount into mol L-1

(2 marks)

1. Complications can occur if the body fluid concentration reaches 0.3 mmol L-1. How many tablets would need to be consumed to reach this concentration?

(3 marks)

TOTAL : 15 marks

**QUESTION 4**

Triglycerides are made by the esterfication of three fatty acids and glycerol

1. Two common fatty acids are stearic acid and linoleic acid shown below

 CH3 (CH2)16 COOH Stearic acid

 CH3(CH2)4CH=CH CH2CH=CH(CH2)6 COOH Linoleic acid

1. Which of these two acids would form a triglyceride that is an oil? State a reason for your choice.

(2 marks)

1. Identify a reagent that would be suitable to distinguish between stearic acid and linoleic acid and describe what you would observe for each substance

 Reagent

 Observation with stearic acid

 Observation with linoleic acid

(4 marks)

1. Systematically name glycerol

(2 marks)

1. A triglyceride can be formed from stearic acid and glycerol
2. draw the triglyceride formed

(2 marks)

1. What small molecule is a by-product of this reaction?

(1 mark)

1. The triglyceride formed from linoleic acid can be converted into a saturated fat by reaction with hydrogen. What name is given to this process?

(1 mark)

1. This reaction would be extremely slow at room temperature so 3 reaction conditions are used to increase the rate. Identify them (in qualitative terms).

(3 marks)

1. Explain the reason for one of your answers to part iv in terms of collision theory

(2 marks)

TOTAL: 17 marks

**QUESTION 5**

Ammonia, NH3, is a toxic gas, commonly available as aqueous solutions that are used as household cleaning agents.

The concentration of ammonia in these solutions can be determined by titration.

1. In one titration, 25.0 ml samples of the household ammonia solution was reacted with 50.00mL of a standard HCl solution
2. Name the glassware used to deliver the HCl solution.

(1 mark)

1. Describe the rinsing procedure for this piece of glassware

(2 marks)

1. A titration was performed using the following procedure

 **Step 1** A volume of 25.0 mL of the household ammonia solution was made up to 250.00 mL.

 **Step 2** A 20.00 mL aliquot was taken and immediately added to 50.00 mL of 0.2000 mol L-1 HCl solution. An equation for the reaction that occurred is shown below:

 NH3 + HCl → NH4Cl

 **Step 3** The unreacted acid was titrated with sodium hydroxide solution. A volume of 18.9 mL of 0.1501 mol L-1 sodium hydroxide solution was required. An equation for the reaction that occurred is shown below.

 HCl + NaOH → NaCI + H2O

1. Calculate the number of moles of HCl that were added to the diluted ammonia solution in Step 2.

(2 marks)

1. Calculate the number of moles of the sodium hydroxide standard solution that was required in Step 3

(1 mark)

1. Hence calculate the number of moles of HCl that reacted with sodium hydroxide standard solution in Step 3.

(1 marks)

1. Calculate the number of moles of HCl that reacted with ammonia in Step 2.

(2 mark)

1. Calculate the number of moles of ammonia in the 20.00 mL aliquot that was titrated in Step 2.

(1 mark)

1. Calculate the concentration of ammonia (mol L-1) in the 20.00mL aliquot and hence the 250.0 mL of diluted ammonia solution.

(2 marks)

1. Hence calculate the %w/v of ammonia in the household ammonia solution.

(3 marks)

1. The correct use of significant figures for part b

(1 mark)

c) i) Draw the molecular structure of ammonia

(2 marks)

ii) Highlight on your diagram and describe the feature that allows ammonia to act as a base

(3 marks)

TOTAL: 21

**QUESTION 6**

Arsenic is an element that can be toxic in groundwater. As a metalloid arsenic can form both positive and negative ions.

* 1. i) Write the electronic configuration for arsenic 3+ using subshell notation

(2 marks)

ii) Calculate the oxidation number of arsenic in As2O5

(2 marks)

* 1. Concentrations of arsenic may be determined using atomic absorption spectroscopy (AAS). The first step in this process involves calibrating the equipment. The table below shows the absorbance of a number of solutions with known concentrations of arsenic:

|  |  |
| --- | --- |
| Concentration of Arsenic (µg L-1) | Absorbance |
| 0 | 0 |
| 50 | 0.15 |
| 100 | 0.31 |
| 200 | 0.59 |

* + 1. using the data above construct a calibration graph for measuring concentration of arsenic

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(5 marks)

* + 1. Is AAS a quantitative or qualitative technique

(1 mark)

* + 1. The world health organisation recommends that the concentration of arsenic in drinking water should not exceed 10 µg L-1

Measurements of a sample of ground water were analysed before and after a new filtration technique was used

|  |  |
| --- | --- |
| Sample | Absorbance |
| Before treatment | 0.32 |
| After treatment | 0.13 |

 Discuss the effectiveness of this new filtration method in making the ground water fit for drinking

(3 marks)

* 1. When analysing the water sample, a check for mercury was also made. What features of the AAS would need to be changed to analyse the sample for mercury?

(2 marks)

TOTAL: 15 marks

**QUESTION 7**

Hydrogen bonds form between some side chains on a section of protein when they are close to each other. The diagram below shows the structural formula of sections of a protein chain

With reference to the sections of protein chain shown in the diagram above, explain:

* how a hydrogen bond forms between two groups
* the effect that increasing the pH has on the hydrogen bonding in the protein, and hence on its function
* In your answer you may refer to annotations you make on the diagram above

(8 marks)