**ATAR CHEMISTRY**

**Formative Assessment:**

**UNIT 1 Part B**

**2020**



Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Teacher: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# MATERIALS REQUIRED/RECOMMENDED FOR THIS PAPER

**To be provided by the supervisor:**

This Question/Answer Booklet

Multiple-choice Answer Sheet

Chemistry Data Book

**To be provided by the candidate:**

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener,

eraser, correction tape/fluid, ruler, highlighters

Special items: up to three non-programmable calculators approved for use in the WACE examinations

# IMPORTANT NOTE TO CANDIDATES

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

**Structure of this paper**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Suggested working time  (minutes) | Marks available |
| Section Two  Short answer | 5 | 5 | 30 | /30 |
| Section Three  Extended answer | 2 | 2 | 30 | /28 |

**Instructions to candidates**

1. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

2. Answer the questions according to the following instructions.

Sections Two and Three: Write your answers in this Question/Answer Booklet.

3. When calculating numerical answers, show your working or reasoning clearly. Your working should be in sufficient detail to allow your answer to be checked readily and for marks to be awarded for reasoning. Express numerical answers to the appropriate number of significant figures and include appropriate units where applicable.

4. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

5. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

6. The Chemistry Data booklet is not to be handed in with your Question/Answer booklet.

**Section Two: Short answer (30 marks)**

This section has five (5) questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 30 minutes.

**Question 26 (6 marks)**

Complete the following table by writing either the name or formula for each substance. Then state the type of bonding (i.e. ionic or covalent) present within each substance.

|  |  |  |
| --- | --- | --- |
| **Name** | **Formula** | **Type of bonding**  **(ionic / covalent)** |
| iron(III) oxide |  |  |
|  | N­2F4 |  |
| hydrogen peroxide |  |  |

**Question 27 (9 marks)**

A group of students were investigating temperature changes associated with various chemical reactions.

They began by measuring the initial temperature of the reagents with a thermometer. Then the reaction was allowed to proceed for 2 minutes, before the final temperature of the reagents was measured.

In a particular beaker, the students mixed 2 g of barium hydroxide pellets with 2 g of powdered ammonium thiocyanate (NH4SCN).

The measurements taken by the students are illustrated in the diagrams below.

**Initial Final**

25

20

15

10

5

0

-5

25

20

15

10

5

0

-5

(a) In the table below, record as accurately as possible, the data collected by the students for this reaction. Include a measure of the uncertainty or error associated with each of your recorded values. (3 marks)

|  |  |  |
| --- | --- | --- |
| **Initial temperature (°C)** | **Final temperature (°C)** | **Temperature change (°C)** |
|  |  |  |

(b) Classify this reaction as endothermic or exothermic. Justify your answer. (3 marks)

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As this reaction proceeded, the two solids were observed to form a cloudy white liquid mixture. The reaction also produced a very pungent smelling gas. The students’ teacher told them that the reaction had produced ammonia gas, water and the insoluble salt barium thiocyanate.

(c) Write a balanced ionic equation for this reaction, including the enthalpy change. (2 marks)

|  |
| --- |
|  |

**Question 28 (2 marks)**

Lawn and garden fertilisers will often contain the three (3) most important elements for plant growth; nitrogen (N), phosphorus (P) and potassium (K). Fertilisers will therefore often have an ‘N–P–K label’ written on the pack, to identify how much of each element is present in the fertiliser.

For example, if the N–P–K label was written as 16–4–8, the values would refer to the percent by mass of each element present, i.e. the fertiliser would contain 16% nitrogen by mass, 4% phosphorus by mass and 8% potassium by mass. The remaining mass of the fertiliser would consist of ‘fillers’ such as gypsum, lime and sand, which can be assumed to contain no nitrogen, phosphorus or potassium.

A particular sample of fertiliser was known to contain;

* 26.9 g of ammonium nitrate, NH4NO3
* 19.1 g of calcium dihydrogenphosphate, Ca(H2PO4)2
* 14.4 g of potassium chloride, KCl
* 22.6 g of additional ‘fillers’

(a) Calculate the percent composition respectively in each of the fertiliser ingredients named above. (2 marks)

|  |  |
| --- | --- |
| % N in NH4NO3 |  |
| % P in Ca(H2PO4)2 |  |

(b)

**Question 29 (9 marks)**

Consider the key below, which refers to three (3) common allotropes of carbon; graphite, diamond and buckyballs.

No

A

Is the substance a covalent network?

Yes

B

Is the substance an electrical conductor?

Yes

No

C

(a) Complete the key above, by writing the labels ‘graphite’, ‘diamond’ and ‘buckyballs’ in the appropriate boxes labelled A, B and C. (3 marks)

(b) Justify the choices you made in part (a), using your knowledge of the differences in structure and bonding of these 3 allotropes. (6 marks)

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**Question 30 (8 marks)**

Complete the data provided regarding species V, W, X, Y and Z in the table below. (8 marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species** | **Symbol** | **Number of protons** | **Number of neutrons** | **Electron configuration** |
| **V** | Mg2+  24  12 | 12 | 12 |  |
| **W** |  |  | 0 | 1 |
| **X** |  | 16 | 17 | 2, 8, 8 |
| **Y** | Ar  40  18 | 18 |  |  |
| **Z** | P  31  15 |  | 16 |  |

End of Section Two

**Section Three: Extended answer (28 Marks)**

This section contains **two (2)** questions. You must answer **all** questions. Write your answers in the spaces provided below.

Where questions require an explanation and/or description, marks are awarded for the relevant chemical content and also for coherence and clarity of expression. Lists or dot points are unlikely to gain full marks.

Final answers to calculations should be expressed to the appropriate number of significant figures.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 30 minutes.

**Question 31 (20 marks)**

Neon was discovered in 1898, as one of the previously unknown components of air. Scientists immediately knew it was a new element because it produced a distinctive bright red emission spectrum.

(a) Explain how an element can produce an emission spectrum and what would cause the emission spectrum for neon to be red. (5 marks)

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In 1913, J.J. Thompson fired a stream of neon ions through a magnetic and electric field and measured the deflections of the ions on a photographic plate. He observed 2 separate patches of light on the plate.

The instrument he used to perform this experiment was an early and very basic version of a mass spectrometer. This was the first discovery of isotopes of stable atoms, although Thompson did not realise this at the time.

(b) What is meant by the term ‘isotope’? (1 mark)

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(c) Briefly describe how mass spectrometry can be used to determine the isotopic composition of an element. (4 marks)

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We now know that neon in fact has 3 stable isotopes.

|  |  |  |
| --- | --- | --- |
| **Isotope** | **Atomic mass** | **Percentage abundance** |
| neon-20 | 19.992 | 90.48% |
| neon-21 | 20.994 | 0.27% |
| neon-22 | 21.991 | 9.25% |

(d) Justify which 2 isotopes were most likely discovered by Thompson. (2 marks)

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Thompson played an important role in our understanding of the nature of atoms. He discovered electrons and developed the ‘plum pudding model’ of atoms. However, we now have a greater understanding of the structure of an atom, and more accurate models have since been developed.

Using the information regarding the existence of a nucleus, gathered by Rutherford in his ‘gold leaf experiment’, as well as Bohr’s theory of electron shells;

(e) Draw a diagram showing the subatomic particle arrangement of the most abundant isotope of neon. Use the symbols provided in the key below. (3 marks)

|  |
| --- |
| **KEY**  p  n  e  proton  neutron  electron |

The industrial production of neon involves extracting it from a sample of air. In this process, the air is cooled under a high pressure, until it is in liquid form. When the liquid air is again warmed, the various components can be separated by fractional distillation.

(f) Describe how the process of fractional distillation works, and how this would allow isolation of neon. (3 marks)

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A sample of neon from an asteroid was analysed by mass spectrometry, to determine whether the isotopic composition was the same as that on Earth.

The results are shown in the graph below.

(g) Calculate the relative atomic mass of this sample of neon. (2 marks)

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**Question 32 (8 marks)**

One of the main uses of copper metal is for electrical wiring. For this purpose, copper needs to have a **high electrical conductivity** and be **ductile**.

(d) Explain, in terms of structure and bonding, why copper possesses both these properties. (4 marks)

Read this short extract on copper nanoparticles and answer the following questions.

*As early as the 9th century, copper nanoparticles were used as a component of pottery glaze. These copper nanoparticles were able to change the colour of the ceramic or glass on which they were painted, by the way they reflected light off the surface of the object.*

*In modern times, copper nanoparticles have been found to have antifungal and antibacterial properties that are not observed in commercially sourced copper. They are also finding use as catalysts in various reactions. In one case, the nanoparticle form of the copper catalyst provided an 88% conversion of reactants to products, compared to only a 43% conversion with commercially available copper catalyst.*

*There are several methods of producing copper nanoparticles. The starting materials, as well as the conditions used, can alter the size and shape of the copper nanoparticle produced.*

(e) Define a ‘nanomaterial’. (1 mark)

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(f) Give one example of how the properties of copper nanoparticles differ from those of the bulk form. (1 mark)

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A particular copper nanoparticle contained 64500 atoms of copper.

(g) Calculate the mass of this nanoparticle. (2 marks)

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**End of questions**