Name: _________________________            Class: _______________

Useful Data: Atomic numbers and relative atomic masses are shown in the periodic table printed below.

One mole of any gas occupies 22.4 dm$^3$ at standard temperature and pressure

Faraday constant = 96500 C mol$^{-1}$  Q = It

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | H |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | He |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Key:

- $a$ relative atomic mass
- $b$ symbol
- X atomic number

Marks Grid [ For Examiner’s use only ]

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Section A</th>
<th>Section B</th>
<th>Theory Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Max Mark</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Actual Mark

<table>
<thead>
<tr>
<th>Theory Paper: 85%</th>
<th>Practical: 15%</th>
<th>Final Score: 100%</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SECTION A – Answer ALL questions. This section carries 60 marks.

1a. Use the given periodic table to find the name of:
   (i) an alkali metal __________________________ [1]
   (ii) the element whose atoms contain 6 protons __________________________ [1]
   (iii) a transition metal which is in period 4 __________________________ [1]
   (iv) an element which exists as a liquid at room temperature __________________________ [1]
   (v) the most reactive non-metal __________________________ [1]

1b. Use the given periodic table to find the symbol of:
   (i) the most reactive metal __________________________ [1]
   (ii) the element whose atoms contain 4 electrons __________________________ [1]
   (iii) an element which is magnetic __________________________ [1]
   (iv) a very reactive metal which has to be stored under oil __________________________ [1]
   (v) a very good electrical conductor commonly used in wires __________________________ [1]

2. State the colour of:
   a. solid iodine __________________________ [1]
   b. iodine vapour __________________________ [1]
   c. universal indicator in dilute hydrochloric acid __________________________ [1]
   d. Cu^{2+} (aq) __________________________ [1]
   e. the Bunsen flame in which a crystal of sodium chloride is placed __________________________ [1]
   f. the substance which results when water is removed from hydrated copper (II) sulfate __________________________ [1]
   g. the solution which results when chlorine gas is bubbled through a solution of potassium iodide __________________________ [1]
   h. the precipitate which forms when acidified silver nitrate is added to a chloride solution __________________________ [1]
   i. the precipitate which forms when NaOH solution is added to iron (II) chloride solution __________________________ [1]
   j. the solid which forms when the precipitate formed in 2 (i) above is left to stand in air __________________________ [1]
3 This question is about the reactivity of different substances.

a. (i) Arrange the following metals in order of their chemical reactivity, placing the most reactive metal first.

\[
\text{copper, sodium, iron, zinc, magnesium}
\]

___________________________________________________________________

(ii) Between which two metals should hydrogen be placed?
___________________________________________________________________

(iii) Zinc is used in galvanising. Explain what this means and why it is done.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

b. (i) Arrange the following halogens in order of their chemical reactivity, placing the most reactive first.

\[
bromine, chlorine, fluorine, iodine
\]

___________________________________________________________________

(ii) Give one reason why these elements are classified as non-metals.
___________________________________________________________________

(iii) Considering the positions of chlorine and bromine in the Periodic Table, give two reasons why chlorine is more reactive than bromine.
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(iv) Why would you expect potassium fluoride to be soluble in water?
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
4. Last year Johann went to Germany on a student exchange visit. Whilst there, he visited an ammonia producing factory.

a. Fill in:
Ammonia is manufactured by the _______________ process in which the two elements ______________ and ______________ are combined directly together. The two gases are compressed at a pressure of ______________ atmospheres and passed over a catalyst made of ______________ at ______________ °C. [3]

b. Write a balanced chemical equation for the reaction.


[2]

c. Describe a simple test which could be carried out in the laboratory to identify ammonia and state the result you would expect.


[2]

d. The guide who took them round the factory said that most of the ammonia produced is reacted with an acid to produce ammonium nitrate. Ammonium nitrate is a powerful explosive. A tremendous explosion occurred in 1921 which killed all the workers involved in the process.

(i) Write a balanced chemical equation for the production of ammonium nitrate from ammonia and an acid.


[2]

(ii) State one important use of ammonium nitrate besides explosives.


[1]
5 This question is about Period 3 of the Periodic Table.

| Na | Mg | Al | Si | P | S | Cl | Ar |

a. (i) Write the electronic configuration of Sodium.
______________________________________________________________________ [1]

(ii) How does the number of the group in the Periodic Table in which they are found relate to the electronic configuration of each element?
______________________________________________________________________ [1]

(iii) How does the metallic character of the elements change across Period 3?
______________________________________________________________________ [1]

(iv) Explain why Al is an amphoteric metal.
______________________________________________________________________ [1]

b. Complete the following table:

<table>
<thead>
<tr>
<th>Element</th>
<th>Formula of an oxide</th>
<th>Formula of a chloride</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silicon</td>
<td>SiO₂</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td></td>
<td>NaCl</td>
</tr>
<tr>
<td>Sulfur</td>
<td>SO₂</td>
<td></td>
</tr>
</tbody>
</table>

[3]

c. Sulfur dioxide is one of the gases causing acid rain.

(i) Name one other gas which increases the acidity of rain water.
______________________________________________________________________ [1]

(ii) Give a likely pH for acid rain.
______________________________________________________________________ [1]

(iii) Give one undesirable effect of acid rain.
______________________________________________________________________ [1]
6 Two scientists Deborah and Maria, decided to carry out qualitative analysis on a green compound.

These were their observations:

When the green powder A was heated strongly it decomposed to form a black compound B, and a colourless gas which turned limewater milky.

When this black compound B was mixed with dilute nitric acid, a blue solution C formed.

On adding NaOH solution to solution C a blue precipitate D formed.

<table>
<thead>
<tr>
<th>a. Name the substances A to D:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A=</td>
</tr>
<tr>
<td>B=</td>
</tr>
<tr>
<td>C=</td>
</tr>
</tbody>
</table>
| D=                            | [4]

<table>
<thead>
<tr>
<th>b. Write balanced chemical equations, including state symbols, for:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) the decomposition of compound A</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>(ii) the reaction of solution C with NaOH solution</td>
</tr>
</tbody>
</table>
|                                                                 | [3]
SECTION B – Answer TWO questions only on the foolscap provided. This section carries 40 marks.

7a. Charles, a technician in a school chemistry laboratory found a 1-litre bottle of sodium hydroxide solution of unknown concentration. He had a standard solution of 0.5 mol dm\(^{-3}\) sulfuric acid and so he decided to carry out a titration to find the concentration of the alkali. He measured four 25 cm\(^3\) aliquots (portions) of the sulfuric acid and placed each in a conical flask. He used phenolphthalein as an indicator for this titration.

(i) Write a balanced chemical equation for the reaction between H\(_2\)SO\(_4\) and NaOH. [2]

(ii) Describe how you can carry out this titration. [5]

(iii) Draw a labelled diagram of how the apparatus should be set up. [4]

(iv) How would Charles know that the end point has been reached? [1]

b. The results of the titration were put in the following table:

<table>
<thead>
<tr>
<th>Titration</th>
<th>Titration 1</th>
<th>Titration 2</th>
<th>Titration 3</th>
<th>Titration 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final burette reading (cm(^3))</td>
<td>19.55</td>
<td>39.40</td>
<td>19.30</td>
<td>40.35</td>
</tr>
<tr>
<td>Initial burette reading (cm(^3))</td>
<td>0.00</td>
<td>20.00</td>
<td>0.00</td>
<td>21.00</td>
</tr>
<tr>
<td>Titre value (cm(^3))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(i) Work out the titre values for each titration. [2]

(ii) Calculate the average titre value. [2]

(iii) Use the average titre value to calculate the concentration of the NaOH solution. [4]

8a. During a school experiment Kurt set up the apparatus shown on the right in order to cover an iron spoon with silver.

(i) What is this process called? [1]

(ii) Explain why the spoon must be connected as the cathode. [3]

(iii) Conduction in copper wires occurs due to a flow of electrons. In the solution there are no free electrons. Therefore how does conduction take place? [1]

(iv) What ions are present in silver nitrate solution? [2]
b. Use half equations to **explain** what is happening:

(i) at the **anode**

(ii) at the **cathode**

[4] [4]

c. The cell is left on for 1.5 hours with a current of 0.5 Amps flowing through it.

(i) Calculate the amount of charge which has passed through the cell. [2]

(ii) At the end of 1.5 hours, what mass of silver would have been deposited on the iron spoon? [3]

[4]

9a. Redox reactions occur when two substances undergo a particular change at the same time.

Ritienne decided to investigate one such reaction by burning a piece of magnesium.

(i) What did Ritienne observe when the piece of magnesium was burned in air? [1]

(ii) Give one important safety precaution related to this experiment. [1]

(iii) Write a balanced chemical equation for this reaction (include state symbols). [3]

(iv) Explain which element is being oxidized and which is reduced in **terms of electron transfer**. [4]

b. Ritienne collected the magnesium oxide on the watch-glass. It was found to weigh 8 g.

(i) Explain how Ritienne could weigh, as accurately as possible, the magnesium oxide. [3]

(ii) Calculate the mass of the original magnesium which was burnt. [3]

(iii) What volume of oxygen (at s.t.p.) was used in this experiment? [2]

(iv) Calculate the volume of oxygen that would be needed if the experiment were carried out at 60 °C instead of at s.t.p. [3]

**End of paper.**