DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION
Department of Curriculum Management
Educational Assessment Unit

Annual Examinations for Secondary Schools 2014

FORM 3 CHEMISTRY TIME: 1h 30min

Name: _________________________ Class: _______________

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

PERIODIC TABLE

Key: \( a \) relative atomic mass symbol \( b \) atomic number

Marks Grid [ For Examiner’s use only ]

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Section A</th>
<th>Section B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Max Mark</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Actual Mark</td>
<td></td>
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</tr>
</tbody>
</table>
SECTION A – Answer ALL questions. This section carries 60 marks.

1a. Give the formula of the following substances:
   (i) Magnesium __________
   (ii) Iron __________
   (iii) Potassium chloride __________
   (iv) Calcium sulfate __________
   (v) Aluminium nitrate __________

1b. Give the name of the following laboratory equipment:
   (i)

   ____________________________
   ____________________________
   ____________________________
   ____________________________
   ____________________________

   [5]
2 The diagram below shows the changes in the state of matter.

Using the words provided below, fill in the following sentences about changes of state:

<table>
<thead>
<tr>
<th>state</th>
<th>rise</th>
<th>melting</th>
<th>random</th>
<th>liquid</th>
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<tr>
<td>boiling</td>
<td>fixed</td>
<td>solid</td>
<td>vibrate</td>
<td>gaseous</td>
</tr>
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</table>

a. When a solid substance is heated its particles vibrate in their _________ positions at a faster rate. [1]
b. The temperature of the _________ increases until its _________ point is reached. [2]
c. At this point the heat provided to the substance causes a change of _________ and the solid changes to a _______. [2]
d. In the liquid state the particles not only _________ but they can also move around. [1]
e. As more heat is given to the liquid its temperature continues to _________ until its _________ point is reached. [2]
f. Any heat energy that is supplied to the substance goes to change the state of the substance from the liquid to the _________ state. [1]
g. Now the particles break free from the liquid and travel at high speed in _________ motion in the space above the liquid. [1]
3 Tom was out with his family enjoying a barbeque. The barbeque set was made of iron. After being used for some time it became covered with a reddish-brown flaky material.

a. What is the reddish-brown flaky material called? __________________________________ [1]

b. Apart from iron, what other substances need to be present for this flaky material to form?
   (i) _______________________________  (ii) _______________________________ [1]

c. Tom could remember the day that his family bought the brand new barbeque set. It was cheap. On using it for the first time some of the paint, especially where the flames touched the metal, peeled off. After a while the barbeque set started to corrode.

   (i) What kind of rust protection was used by the manufacturer to protect the barbeque set against corrosion? ______________________________________________________ [1]

   (ii) Suggest a better rust protection method for this barbeque set so that it would not rust during its lifetime. ______________________________________________________ [1]

   (iii) Explain why you chose this particular rust protection method. ______________________________________________________ [1]

d. Charcoal is a material that is made of carbon. It burns in air to produce heat. Give a balanced chemical equation to show what happens when carbon is burnt in a plentiful supply of oxygen.

   ______________________________________________________________________ [2]

e. Tom’s little brother insisted that next time round, they should do the barbeque indoors. Would this be a good idea? Yes [ ] No [ ] [1]

f. Explain your answer to e).

   ______________________________________________________________________ [2]
4a. During an experiment, hydrogen chloride and ammonia gases were released at opposite ends of a glass tube as shown in the diagram. Both gases travelled inside the tube until they met together somewhere along the tube.

(i) What is the process of the movement of gases in air called? _____________________ [1]

(ii) On the diagram, mark with a cross (X) where you would expect the gases to meet. [1]

(iii) Explain why you chose this particular position.

______________________________________________________________________
______________________________________________________________________ [2]

(iv) What would be observed where the two gases meet each other?

______________________________________________________________________ [1]

b. Matter is made of atoms.

(i) Draw a diagram showing all electron shells of a lithium atom and label all the subatomic particles. [2]

(ii) Most elements have isotopes. What does the word isotope mean?

______________________________________________________________________ [1]

(iii) Magnesium has three isotopes, magnesium-24, magnesium-25 and magnesium-26. In a sample of this metal, the percentage by mass of these isotopes is 78.99 %, 10.00 % and 11.01 % respectively. Calculate the relative atomic mass of magnesium.

______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________ [2]
5a. John bought a new aquarium. He filled it with tap water and was about to add his newly bought goldfish. His friend Rita, an aquarium enthusiast, called by to check on his new purchase. Rita told John that his goldfish needed water to be in a pH range between 7 and 8.

(i) From the values of pH mentioned above, could you say that the goldfish like acidic environments? __________________________________________________________ [1]

(ii) What should John do to check the pH of the water in his aquarium without contaminating the water?

______________________________________________________________________ [1]

(iii) The water turned out to be slightly acidic. Which one of the following substances could John use to change the pH to the required level? (Tick the right answer.)

- conc. NaOH solution
- dil. H$_2$SO$_4$ solution
- limestone, CaCO$_3$ [1]

(iv) Explain why you chose this particular substance.

- ........................................................................................................ [2]
- ........................................................................................................ [2]

b. John and Rita then started talking about what is happening in the water. Rita explains that certain materials neutralise acids.

(i) What is neutralisation?

______________________________________________________________________ [1]

(ii) Give a balanced chemical equation showing the reaction between the substance chosen in a. iii) and HCl (aq).

______________________________________________________________________ [2]

c. Sodium carbonate is used in the lab to neutralise acid spills. During the reaction bubbles of a gas are produced.

(i) How would you know that enough carbonate has been added to the affected area?

______________________________________________________________________ [1]

(ii) What is the name of the gas that is produced when a carbonate reacts with an acid?

______________________________________________________________________ [1]
Emma sets out to perform an experiment to determine the chemical formula of the oxide which copper forms when it reacts with the oxygen present in air. She uses the equipment shown in the diagram.

a. Emma starts by weighing 1 g of copper powder using a digital weighing balance.

(i) In order for Emma to weigh the metal, she needs to follow steps which her teacher had given her. Unfortunately, she is confused. Arrange these steps in order, so that she can weigh the copper properly. Put the correct numbers (1, 2 and 3) in the spaces provided.

_ Press the tare button.
_ Put the crucible on the digital balance.
_ Add copper powder until the balance reads 1 g.

(ii) Calculate the amount, in moles, present in 1 g of copper.

______________________________________________________________________
______________________________________________________________________

b. Why did Emma choose to use a crucible instead of a beaker?

______________________________________________________________________

[1]

[1]

c. She heated the crucible until the copper turned black. She stopped heating and allowed the crucible to cool before taking it to the weighing balance. She repeated this cycle of heating and weighing until the copper oxide reached a constant mass of 1.252 g.

(i) Why did Emma need to heat the copper until constant mass is reached?

______________________________________________________________________

[1]

(ii) Calculate the mass of oxygen that reacted with copper in the crucible.

______________________________________________________________________

[1]

(iii) From the information gathered so far, calculate the empirical formula of copper oxide.

______________________________________________________________________
______________________________________________________________________

[2]

d. If the molar mass of copper oxide is 79.5 g, what is the chemical formula of copper oxide?

______________________________________________________________________
______________________________________________________________________

[1]

e. Calculate the percentage by mass of oxygen in this compound.

______________________________________________________________________
______________________________________________________________________

[1]
7 In the laboratory oxygen gas is produced by the action of manganese (IV) oxide on hydrogen peroxide.

a. What is the function of manganese (IV) oxide in this reaction? [1]

b. Copy and complete the following chemical reaction:

\[
\_ \text{H}_2\text{O}_2(\text{l}) \rightarrow 2\text{H}_2\text{O}(\_\_) + \text{O}(\_\_\_) (\text{g})
\] [3]

c. List two uses of oxygen. [2]

d. Redraw the following diagram on your foolscap.

![Diagram of oxygen production equipment]

Label the items indicated on the diagram that show the equipment and materials used to produce dry oxygen. [8]

e. The equipment used above is set up of three sections; the purification system, the collection system and the generator system. On your diagram in part d, draw 2 dotted lines to separate the three different parts and label each part accordingly. [4]

f. Give a chemical test for oxygen and state what is observed. [2]
8 Peter was given two salts mixed together. On heating, one of the substances changes from solid to gas while the other is heat resistant.

a. What separation technique could he use to separate these salts? [1]

b. Describe how you would perform this separation technique. Your description should include:
   (i) The equipment needed [Hint: Mention at least four items.] [2]
   (ii) A brief method [3]
   (iii) The expected outcome [2]

c. Peter was also given a mixture of two liquids, water and ethanoic acid, which are miscible. The boiling point of ethanoic acid is 118 °C. His task was to separate and collect the two liquids.
   (i) What does the word “miscible” mean? [1]
   (ii) Name another pair of liquids which are miscible. [1]
   (iii) What is the name of the separation technique that could be used to separate miscible liquids? [1]
   (iv) Label the parts and materials indicated by the letters A to F. [6]

   (v) Which part of the apparatus is responsible for the separation of the two liquids? [1]
   (vi) Which substance would be collected first in the conical flask? [1]
   (vii) What is the function of apparatus E? [1]
9a. Baking powder is a common material that is used to bake cakes. Its main ingredient is sodium hydrogen carbonate (also known as sodium bicarbonate) which is a white solid that is **soluble** in water and decomposes on heating to form sodium carbonate and carbon dioxide. An **insoluble** drying agent, also known as an anti-caking agent, is added to the baking powder to prevent it from forming a solid mass.

(i) What substance present in air will cause pure baking powder to form a solid mass? [1]

(ii) How does the anti-caking agent prevent baking powder from forming a solid mass? [1]

(iii) Can any anti-caking agent be used as foodstuff? Why? [2]

b. A particular brand of baking powder declares that its product has 95 % baking powder and 5 % anti-caking agent by mass. Janet decides to investigate this claim by separating the **insoluble** material from the baking soda. She then goes to calculate the actual percentages and compare the values with those declared on the product.

(i) What is the name of the separating technique she should use? [1]

(ii) Label the parts indicated by the letters A to F. [6]

![Diagram of filtration setup]

Complete the missing steps in the following method (write them on the foolscap):

- Weigh a sample of the mixture and a dry filter paper separately. [1]

(iii) Filter the undissolved anti-caking agent using a filter funnel and filter paper. [1]

(iv) Allow the anti-caking agent and filter paper to dry completely. [1]

(vi) Mention the measurements that she should take. [2]
c. From a sample of 2 g of this baking powder, 0.09 g was anti-caking agent.

(i) Calculate the percentage by mass of the anti-caking agent. [2]

(ii) Excluding the possibility that the amount of anti-caking agent is not right, suggest a reason why the percentage of anti-caking agent is found to be different than that declared on the product. [2]