DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION Department for Curriculum Management and eLearning **Educational Assessment Unit Annual Examinations for Secondary Schools 2011**

StudentBounts.com **CHEMISTRY** FORM 3

Name: _____

Class: _____

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

| | | _ | | | | | PER | RIODI | C TAI | BLE | | | | | | | |
|------------------------|------------------------------------|------------------------|--------------------------------------|------------------------|-----------------------|------------------------|---|------------------------|------------------------|-------------------------|--|----------------------------|------------------------|------------------------|------------------------|-------------------------|--|
| 1 | 2 | | | | | | | | | | 3 | 4 | 5 | 6 | 7 | 0 | |
| | | \mathbf{H}_{1} | | | | | | | | | | 4 He 2 | | | | | |
| 7 Li 3 | 9 Be 4 | | | | | | | - | | | | 11 B 5 | 12 C 6 | 14 N 7 | 16 O 8 | 19 F 9 | ${\overset{20}{{ m Ne}}}_{10}$ |
| 23 Na 11 | 24 Mg 12 | | | | | | | | | | | 27 Al 13 | 28 Si 14 | 31 P 15 | 32 S 16 | 35.5 Cl 17 | ${}^{40}_{18}$ |
| 39 K 19 | ${\overset{40}{{f Ca}}}_{20}^{40}$ | 45 Sc 21 | 48 Ti 22 | 51 V 23 | 52 Cr 24 | 55 Mn 25 | 56 Fe 26 | 59 Co 27 | 59 Ni 28 | 63.5 Cu 29 | ${\overset{65}{{ m Zn}}}_{30}$ | 70 Ga 31 | 73 Ge 32 | 75 As 33 | 79 Se 34 | 80 Br 35 | ⁸⁴ Kr ₃₆ |
| 85 Rb 37 | 88 Sr 38 | 89 Y 39 | ${\mathop{\rm Zr}\limits_{40}}^{91}$ | 93 Nb 41 | 96 Mo 42 | 99 Tc 43 | $\overset{101}{\underset{44}{\mathbf{Ru}}}$ | 103 Rh 45 | 106 Pd 46 | 108 Ag 47 | $\overset{112}{\underset{48}{\overset{12}{}}}$ | 115 In 49 | 119 Sn 50 | 122 Sb 51 | 128 Te 52 | 127 I 53 | ¹³¹ Xe ₅₄ |
| 133 Cs 55 | 137 Ba 56 | 139 La 57 | 178 Hf 72 | 181 Ta 73 | 184 W 74 | 186 Re 75 | 190 Os 76 | 192 Ir 77 | 195 Pt 78 | 197 Au 79 | 201 Hg 80 | 204 Tl 81 | 207 Pb 82 | 209 Bi 83 | 210 Po 84 | 210 At 85 | 222 Rn 86 |



relative atomic mass symbol atomic number

Marks Grid [For Examiners use only]

| Question | | | Secti | ion A | | | 5 | Section | B |] | |
|----------------|----|----|-------|-------|----|----|----|---------|----|-----------------|--|
| Nº. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| Max Mark | 10 | 10 | 10 | 10 | 10 | 10 | 20 | 20 | 20 | Theory Total | |
| Actual Mark | | | | | | | | | | | |

| Theory Paper: 85% | Practical: 15% | Final Score: 100% |
|-------------------|----------------|-------------------|
| | | |

SECTION A – Answer ALL questions. This section carries 60 marks.

- 1 + A dry grey mixture consists of equal volumes of aluminium powder and iron powder.
- sugentBounts.com + A dry red mixture consists of equal volumes of anhydrous chromium (III) chloride (CrCl₃) and chromium (III) oxide (Cr_2O_3) .

The following table with some of the properties of the named substances may be useful:

| | Solubility in water | Magnetic properties |
|-------------------------|---------------------|---------------------|
| Aluminium powder | Insoluble | Non-magnetic |
| Iron powder | Insoluble | Magnetic |
| Chromium (III) chloride | Readily soluble | Non-magnetic |
| Chromium (III) oxide | Insoluble | Non-magnetic |

a. (i) Give the name of a method suitable to separate the constituents of the dry grey mixture.

- (ii) Aluminium has a relative atomic mass of 27; iron has a relative atomic mass of 56. So, once separated, the two powders have equal volumes but different [2]
- b. (i) Before separating the dry red mixture, one has to add a common reagent. Give the name of this reagent.
 - (ii) Give the name of the method suitable to separate the constituents of the **red** mixture after the reagent in question b. (i) was added.
 - (iii) Give the name of two other substances that when mixed together can be separated by the method used in question b. (i) and (ii).
 - + + [3]

c. Relative atomic masses: Cr = 52, O = 16, Cl = 35.5.

- (i) Work out the formula mass of:
 - + chromium (III) chloride:
 - + chromium (III) oxide:
- (ii) Once separated and dried, anhydrous chromium (III) chloride and chromium (III) oxide have equal volumes but chromium (III) chloride has a _____ mass than chromium (III) oxide. [5]

| S. | |
|---|-----------|
| iden. | |
| 2 Rainwater collected and stored in large reservoirs is initially routed through corridors c coarse gravel and then through beds of fine gravel and sand. A measured dose of chlorine added before the remaining water becomes drinkable and can be supplied to homes and in- | County-co |
| a. The process of passing rainwater through gravel and sand is one form of: | SITS) |
| evaporation filtration distillation | [1] |
| b. Give one reason why chlorine is added before water becomes drinkable. | - |
| | [1] |
| Name one main source of pollution resulting from: (i) water falling on agricultural land. (ii) water passing through urban roads. | [2] |
| d. Rainwater passing through porous rocks becomes gradually hard. | |
| (i) What is hard water? | |
| (ii) Name one substance present in temporary hard water. | [2] |
| e. Various water purification processes are being used nowadays to produce drinkable water from seawater but only distillation can remove all pollutants. | |
| (i) Give one reason why distillation is rarely used for water purification. | |
| (ii) Give the name of another water purification process that is used extensively in countri | es |
| like Malta where rainwater is scarce. | [2] |
| f. A simple laboratory test is used to confirm the presence of water. | |
| (i) Which chemical must be used for this test? | |
| (ii) What colour change is observed if water is present? | [2] |

- StudentBounts.com 3 The element selenium is isotopic and five different atoms of selenium are known to exist. of these isotopes have symbols: ${}_{34}\text{Se}^{78}$ and ${}_{34}\text{Se}^{80}$.
- a. (i) Fill in the empty spaces in the table below:

b.

c.

d.

| | No. of protons per atom | No of neutrons per atom |
|--------------------------------|-------------------------|-------------------------|
| ₃₄ Se ⁷⁸ | | |
| ₃₄ Se ⁸⁰ | | |

(ii) Isotopes are atoms of the same element that contain an unequal number of :

| protons electrons neutrons | [5] |
|---|-----|
| The element selenium forms two chlorides, selenium (I) chloride and selenium (IV) chloride | |
| Write down the formulae of: | |
| + selenium (I) chloride | |
| + selenium (IV) chloride | [2] |
| Selenium (IV) chloride sublimes when heated. Explain what sublimes means. | |
| | [1] |
| Selenium (IV) chloride reacts with water to form selenium (IV) oxide and hydrogen chloride. | |
| For this reaction, write down: | |
| (i) a word equation. | |
| (ii) a balanced chemical equation. (No need to include state symbols) | |

[2]

4 a. Fill in the empty spaces in the table below:

| in the empty spaces in | the table | e below: | Studente | aounty.c. |
|------------------------|-----------|-------------------|----------------------------------|-----------|
| Name | Basic | Solubility | Colour of aqueous solution after | |
| of | or | in | drops of universal indicator | |
| oxide | Acidic | Water | were added. | |
| Calcium oxide | | sparingly soluble | | |
| Carbon dioxide | | | orange red | |
| Phosphorus (V) oxide | acidic | | | |
| Copper (II) oxide | | insoluble | | |
| | • | • | | [7] |

b. Fill in the blanks in the statement below:

Basic oxides that are soluble in water form ______ solutions that can be reacted with acidic solutions to form a _____ and _ [3] .

5 Fill in the empty spaces in the table below. The first row has been filled for you.

| Description of Substance | Example of a substance that fits the description | | | | |
|--------------------------|--|--------------------------------|--|--|--|
| | Chemical Name | Formula | | | |
| Amphoteric oxide | aluminium oxide | Al ₂ O ₃ | | | |
| Weak acid | | | | | |
| Efflorescent solid | | | | | |
| Catalyst | | | | | |
| Neutral oxide | | | | | |
| Acid salt | | | | | |

[10]

| | Stude | |
|----|--|--------|
| 6 | Give a reason why each of the following occurs: | Bount |
| a. | A steel hammer rusts when placed partly in seawater but it does not rust when placed on seabed, 20 metres below the surface. | the |
| | | _ [2] |
| b. | A solid silver candlestick turns gradually black if left standing without protection. | |
| - | | [2] |
| c. | Stalagmites and stalactites are rock structures formed when hard water evaporates and mi are left behind. | nerals |
| - | | [2] |
| d. | The composition of the air is not homogeneous but varies slightly from one place to anoth | ner. |
| - | | [2] |
| e. | An excess quantity of carbon dioxide in the air is one cause of climate change. | |
| - | | [2] |

SECTION B – Answer TWO questions only on the foolscap provided. This section carries 40 marks.

SUGENBOUNES.com 7 In an experiment to determine the empirical formula of magnesium oxide, some magnesium granules were heated strongly in a closed crucible. Every now and then, the lid was lifted slightly for a few seconds. When the reaction was concluded, the crucible and contents were allowed to cool and then weighed. The following results were obtained:

| Mass of crucible and lid: | 15.0 g |
|---|--------|
| Mass of crucible, lid and magnesium granules: | 16.2 g |
| Mass of crucible, lid and magnesium oxide: | 17.0 g |

- a. Give a reason for the following experimental steps:
 - (i) The crucible lid had to be lifted from time to time.
 - (ii) On each occasion, the lid was only lifted slightly.
- b. From the results, calculate the mass of:

[2]

- c. Convert your answer to question b. (i) to moles of magnesium atoms and your answer to question b. (ii) to moles of oxygen atoms. (Relative Atomic Masses: O = 16; Mg = 24) [4]
- d. Give the empirical formula of magnesium oxide, showing how you arrived at your answer. [2]
- e. Magnesium oxide is an ionic compound.
 - (i) Draw dot-and-cross diagrams, showing all electron shells, to show the structure of a magnesium ion and an oxygen ion. Include the charge on each ion. (Oxygen has an atomic number of 8; magnesium has an atomic number of 12)
 - (ii) Give three general properties of ionic compounds.
 - (iii) The properties of magnesium and oxygen as elements are totally different from those of the compound magnesium oxide. Give two properties of magnesium which show that it is a metal and **two** properties of oxygen which show that it is a non-metal. [10]

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- StudentBounty.com 8 a. Describe how you can prepare a sample of pure, dry hydrogen in the laboratory. Your answer should include a clear, well-labelled diagram of the apparatus, a short description of the method used, any observations and a balanced chemical equation.
 - b. (i) Draw dot-and-cross diagrams, showing outer electrons only, to illustrate the bonding in:
 - + a molecule of hydrogen.
 - + a molecule of ammonia. (Ammonia is a compound composed of nitrogen and hydrogen; hydrogen has an atomic number of 1 and nitrogen has an atomic number of 7)

[6]

[4]

- (ii) Give one general property of covalent substances.
- 9 a. Give balanced chemical equations, including state symbols, to show how copper (II) sulfate solution can be prepared using as starting materials:
 - (i) copper (II) oxide and an appropriate acid
 - (ii) copper (II) carbonate and an appropriate acid
 - b. (i) Describe how you would prepare copper (II) sulfate solution in the laboratory using: either copper (II) oxide or copper (II) carbonate.

Your answer should include details of the practical steps required to conduct the experiment and a labelled diagram of the apparatus used.

(ii) The technique of evaporation to dryness is unsuitable to obtain crystals of hydrated copper (II) sulfate (copper (II) sulfate 5-water) from the solution obtained in question b. (i). Give a reason for this. [11]

c. Someone has accidentally dropped crystals of copper (II) sulfate into an open glass container full of distilled water. Draw a clear, well-labelled diagram of the apparatus needed to obtain distilled water from the resulting copper (II) sulfate solution. [5]