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| |  | | --- | | **Empirical Formula**  **Practice** | |  | | | |  |  | | --- | --- | | Name: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | Class: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | | Date: | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | |
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|  | | |
| Time: | **15 minutes** | |
| Marks: | **14 marks** | |
| Comments: |  | |
|  | | |

**Q1.** An alkane contains 30 hydrogen atoms per molecule. Its empirical formula is

**A**       C6H15

**B**       C7H15

**C**       C14H30

**D**       C15H30

**(Total 1 mark)**

**Q2.** CH2O is the empirical formula of

**A**       methanol

**B**       methyl methanoate

**C**       ethane-1,2-diol

**D**       butanal

**(Total 1 mark)**

**Q3.** When TiCI4 is reduced with hydrogen under certain conditions, a new compound is produced which contains 68.9% chlorine by mass. Which one of the following could be the formula of the new compound?

**A**       TiH2Cl2

**B**       TiCl

**C**       TiCl2

**D**       TiCl3

**(Total 1 mark)**

**Q4.** The pigment ’Cobalt Yellow’ contains an octahedral complex of cobalt(III) and nitrate(III) ions (NO2–). Analysis shows that Cobalt Yellow contains 13.0% of cobalt, 18.6% of nitrogen and 25.9% of potassium by mass. The remainder is oxygen.

(a)     Use these data to calculate the empirical formula of Cobalt Yellow. Show your working.

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**(3)**

(b)     Deduce the structural formula of the cobalt-containing ion in Cobalt Yellow.

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**(1)**

**(Total 4 marks)**

**Q5.**Compounds containing Cu2+, OH– and CO32− ions are sometimes described as basic copper carbonates.

(a)     Solid Cu2(OH)2CO3 is added to an excess of dilute hydrochloric acid.

A solution of copper(II) chloride is formed, together with two other products.

(i)      Write an equation for the reaction.

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**(2)**

(ii)     Suggest **one** observation that could be made during the reaction.

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**(1)**

(b)     A 5.000 g sample of a different basic copper carbonate contains 0.348 g of carbon, 0.029 g of hydrogen and 1.858 g of oxygen.

(i)      State what is meant by the term empirical formula.

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**(1)**

(ii)     Calculate the empirical formula of this basic copper carbonate.

Show your working.

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**(3)**

**(Total 7 marks)**

**M1.**B

**[1]**

**M2.**B

**[1]**

**M3.**D

**[1]**

**M4.**(a)     Percentage of oxygen is 42.5% **(M1)**

*Allow if shown clearly in the calculation.*

**1**

Co 13.0 / 58.9 = 0.221, N 18.6 / 14 = 1.329,

K 25.9 / 39.1 = 0.662, O 42.5 / 16 = 2.656 **(M2)**

*Allow alternative method if chemically correct.*

*If Ar has been divided by the percentage, chemical error, lose* ***M2*** *and* ***M3****.*

**1**

CoN6K3O12 **(M3)**

*Allow in any order.*

*Correct answer without working scores this mark only.*

**1**

(b)     Co(NO2)63−

*Allow a correct diagram bonding through N or O*

*Do not allow CoN6O123−*

*Must have correct overall charge.*

*Allow consequential answer from part(a) if the charge on the anion is correct.*

**1**

**[4]**

**M5.** (a)     (i)     H2O + CO2 (as products in any equation)

*Allow H2O + H2CO3*

**1**

Cu2(OH)2CO3 + 4HCl → 2CuCl2 + 3H2O + CO2

*Allow multiples*

*Ignore states*

**1**

(ii)     Bubbles or fizzing or effervescence

Or solid disappears

Or blue(-green) solution

*Do not allow dissolves*

*Ignore CO2 gas or gas evolved*

**1**

(b)     (i)      Simplest (whole-number) ratio of atoms of each element in a compound

*Allow atoms of Cu, H & O in this compound*

**1**

(ii)     Mass of copper = 2.765

Dividing masses by *Ar*

**1**

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**1**

Correct whole number ratio of integers

or

Cu:C:H:O

3:2:2:8

or

Correct empirical formula Cu3C2H2O8

*Any order*

*Ignore Cu3(OH)2(CO3)2*

**1**

**[7]**