groepnommer / group number: .

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4de Vraag / 4th Question [20]

1) Elementanalise van 'n ioniese verbinding toon dat die mangaan (58.86% per massa) en suurstof bevat. Die oksidasietoestand van die katioon kan enige van +2, +3, +4, +6 of +7 wees. Die lading van die anioon is ook nie bekend nie, maar ons weet dat die anioon mangaan en suurstof in die verhouding van 1:4 bevat.

Gebruik hierdie inligting om die

a) empiriese formule van die binêre ioniese verbinding op 'n sinvolle en oortuigende manier te bepaal en

b) Benaam die ioniese verbinding

The elemental analysis of an ionic compound shows it to contain manganese (58.86 % by mass) and oxygen. The oxidation state of the cation can be any one of +2, +3, +4, +6 or +7. The charge of the anion is also not known, but we do know that the anion contains manganese and oxygen in a 1:4 mole ratio.

Use this information to deduce:

a) the empirical formula of the binary ionic compound in a sensible and conclusive manner; and

b) name the ionic compound [10]

2) Twee waterige oplossings, wat onderskeidelik lood(II)nitraat en natriumchloried bevat, word gemeng waarna 'n lood(II)chloried neerslag vorm (sien die ongebalanseerde vergelyking hieronder). Die produk word gefilter en geweeg en 37.0 g lood(II)chloried word herwin. 'n Opbrengs van 89.0% word bereken. Hoeveel lood(II)nitraat is oorspronklik gebruik?

Two aqueous solutions, respectively containing lead(II) nitrate and sodium chloride, are mixed upon which a lead(II) chloride precipitate forms (see unbalanced equation below). The product is filtered, dried and weighed and 37.0 g lead(II) chloride is recovered. An 89.0% yield is calculated. How much lead(II) nitrate was originally used? [10]

$$Pb(NO_3)_2(aq) + NaC\ell(aq) \rightarrow PbC\ell_2(s) + NaNO_3(aq)$$

Fourth Question (1)

calculate number of moles each of Mn and O from mass% data

assuming 100 g of the compound

mass O = mass compound − mass Mn = 100 g − 58.86 g Mn = 41.14 g O

$$\text{amount Mn (mol)}: \frac{58.86\ \text{g Mn}}{} \cdot \frac{\text{mol Mn}}{54.94\ \text{g Mn}} = 1.07135\ \text{mol Mn}$$

$$\text{amount O (mol)}: \frac{41.14\ \text{g O}}{} \cdot \frac{\text{mol O}}{16.00\ \text{g O}} = 2.5713\ \text{mol O}$$

smallest whole number mole ratio : $\text{Mn}_{1.07135}\ \text{O}_{2.5713}$

$$\text{Mn}_{\frac{1.07135}{1.07135}}\ \text{O}_{\frac{2.5713}{1.07135}}$$

$$\text{Mn}\ \ \text{O}_{2.4000}$$

$\times 5)$ $\text{Mn}_5\ \text{O}_{12}$

the anion could either be permanganate (MnO_4^-) or manganate (MnO_4^{2-})

$Mn_2(MnO_4)_3$ the compound can only be manganese(III) manganate for

the charges to balance : $Mn_2^{3+}(MnO_4^{2-})_3$

Fourth Question (2)

actual yield is 37.0 g $PbCl_2$

percentage yield is 89.0%

$$\text{theoretical yield } PbCl_2\ \text{(g)}: \frac{37.0\ \text{g } PbCl_2\ \text{(actual)}}{} \cdot \frac{100\ \text{g } PbCl_2\ \text{(theoretical)}}{89.0\ \text{g } PbCl_2\ \text{(actual)}} = 41.573\ \text{g } PbCl_2$$

$$\text{mass } Pb(NO_3)_2\ \text{(g)}: \frac{41.573\ \text{g } PbCl_2}{} \cdot \frac{\text{mol } PbCl_2}{278.1\ \text{g } PbCl_2} \cdot \frac{1\ \text{mol } Pb(NO_3)_2}{1\ \text{mol } PbCl_2} \cdot \frac{331.2\ \text{g } Pb(NO_3)_2}{\text{mol } Pb(NO_3)_2} = 49.5\ \text{g } Pb(NO_3)_2\ \text{(3 s.f.)}$$