Chemistry 141 Name

Dr. Cary Willard

Quiz 3a (20 points) February 20, 2013

1. (7 points) Titanium occurs in the magnetic mineral ilminite (FeTiO3), which is often found mixed up with sand. The ilmenite can be separated from the sand with magnets. The titanium can then be extracted from the ilmenite by the following set of reactions:

FeTiO3*(s)* + 3Cl2*(g)* + 3 C*(s)* 🡪 3CO*(g)* + FeCl2*(s)* + TiCl4*(g)*

TiCl4*(g)* + 2 Mg*(s)* 🡪 2MgCl2*(l)* + Ti*(s)*

Suppose that an ilmenite-sand mixture contains 22.8% ilmenite by mass and that the first reaction is carried out with a 90.8% yield. If the second reaction is carried out with an 85.9% yield, what mass (in grams) of titanium can be obtained from 3.50 kg of the ilmenite-sand mixture?

0.00526 kmol

0.798 kg

0.00410 kmol

1. (6 points) Calculate the molarity of sodium and phosphate ions in a solution formed by dissolving 42.8 g of sodium phosphate to a final volume of 750.0 mL?
2. (7 points) Iron(III) oxide reacts with carbon monoxide according to the equation

Fe2O3*(s)* + 3CO*(g)* 🡪 2Fe*(s)* + 3CO2*(g)*

A reaction mixture initially contains 35.23 g Fe2O3 and 17.94 g CO. Calculate the final mass of all reactants and products expected. Once the reaction has occurred as completely as possible, 19.44 g of metallic iron is formed. Calculate the percent yield for the reaction.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | x=0.2207 |  | x=0.2135 |  |  |  |  |
|  | Fe2O3 | + | 3CO | 🡪 | 2Fe | + | 3CO2 |
| I | 0.2207 mol |  | 0.6408 mol |  | 0 mol |  | 0 mol |
| D | -x |  | -3x |  | +2x |  | +3x |
| E | 0.2207-x  =0.2207-0.2135  =0.0072 mol |  | 0.6408-3x  =.6408-3(0.2135)  =0 mol |  | 2x  =2(0.2135)  =0.4270 mol |  | 3x  =3(0.2135)  =0.6408 mol |
|  |  |  |  |  |  |  |  |

Chemistry 141 Name

Dr. Cary Willard

Quiz 3b (20 points) February 20, 2013

1. (7 points) Titanium occurs in the magnetic mineral ilminite (FeTiO3), which is often found mixed up with sand. The ilmenite can be separated from the sand with magnets. The titanium can then be extracted from the ilmenite by the following set of reactions:

FeTiO3*(s)* + 3Cl2*(g)* + 3 C*(s)* 🡪 3CO*(g)* + FeCl2*(s)* + TiCl4*(g)*

TiCl4*(g)* + 2 Mg*(s)* 🡪 2MgCl2*(l)* + Ti*(s)*

Suppose that an ilmenite-sand mixture contains 26.8% ilmenite by mass and that the first reaction is carried out with a 90.8% yield. If the second reaction is carried out with an 85.9% yield, what mass (in grams) of titanium can be obtained from 4.50 kg of the ilmenite-sand mixture?

0.00795 kmol

1.21 kg

0.00620 kmol

1. (6 points) Calculate the molarity of sodium and phosphate ions in a solution formed by dissolving 68.3 g of sodium phosphate to a final volume of 750.0 mL?
2. (7 points) Iron(III) oxide reacts with carbon monoxide according to the equation

Fe2O3*(s)* + 3CO*(g)* 🡪 2Fe*(s)* + 3CO2*(g)*

A reaction mixture initially contains 42.69 g Fe2O3 and 19.38 g CO. Calculate the final mass of all reactants and products expected. Once the reaction has occurred as completely as possible, 21.84 g of metallic iron is formed. Calculate the percent yield for the reaction.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | x=0.2673 |  | x=0.2306 |  |  |  |  |
|  | Fe2O3 | + | 3CO | 🡪 | 2Fe | + | 3CO2 |
| I | 0.2673 mol |  | 0.6919 mol |  | 0 mol |  | 0 mol |
| D | -x |  | -3x |  | +2x |  | +3x |
| E | 0.2673-x  =0.2673-0.2306  =0.0367 mol |  | 0.6919-3x  =.6919-3(0.2306)  =0 mol |  | 2x  =2(0.2306)  =0.4613 mol |  | 3x  =3(0.2306)  =0.6919 mol |
|  |  |  |  |  |  |  |  |