Chem25, Spring 2014, SJCC, Test3 Name KEY

Please read all the questions VERY carefully before answering. Ask your instructor if you do not understand. No outside paper is allowed. The last page is a periodeic table with constants. Total points = 53 + (25 * 3 =) 75 = 128

**SHORT ANSWER. Please write the set-up equation first, then put the raw data with units before calculating. Write the word or phrase that best completes each statement or answers the question.**

1) In the reaction between $Fe_2O_3$ (s) and Al (s) to produce Fe (s) and $Al_2O_3$ (s), 23.5 g of $Fe_2O_3$ was reacted with 13.2 g of Al. (a) Show all your calculations to find out the limiting reagent (8 pts.)

1) $Fe_2O_3$

$$Fe_2O_{3(s)} + 2Al_{(s)} \rightarrow 2Fe_{(s)} + Al_2O_{3(s)}$$

Fe produced by Al $= 13.2\,g\,Al \times \frac{1\,mol\,Al}{27\,g\,Al} \times \frac{2\,mol\,Fe}{2\,mol\,Al} \times \frac{56\,g\,Fe}{1\,mol\,Fe} = 27.4\,g\,Fe$

Fe produced by $Fe_2O_3 = 23.5\,g\,Fe_2O_3 \times \frac{1\,mol\,Fe_2O_3}{(56\times2+16\times3)\,g\,Fe_2O_3} \times \frac{2\,mol\,Fe}{1\,mol\,Fe_2O_3} \times \frac{56\,g\,Fe}{1\,mol\,Fe} = 16.45\,g\,Fe$

→ $Fe_2O_3$ is the limiting reagent because it produces the smaller amount of Fe. ✓

(b) [EXTRA POINT QUESTION]
Calculate the amount (in grams) of the reagent that remained unreacted (6 pts.)

$$mol_{Al} = 13.2\,g\,Al \times \frac{1\,mol\,Al}{27\,g\,Al} = 0.489\,mol$$

$$mol\,Al\,react = 23.5\,g\,Fe_2O_3 \times \frac{1\,mol\,Fe_2O_3}{(56\times2+16\times3)\,g\,Fe_2O_3} \times \frac{2\,mol\,Al}{1\,mol\,Fe} = 0.294\,mol\,Al$$

+6

→ $mol\,Al\,remained = 0.489 - 0.294 = 0.195\,mol\,Al$

→ $Al_{remained} = 0.195\,mol\,Al \times \frac{27\,g\,Al}{1\,mol\,Al} = \boxed{5.265\,g\,Al}$

2) Iron, Fe(s) reacts with oxygen gas, $O_2(g)$ to produce $Fe_2O_3$ (s). Calculate how many grams of (a) Fe and (b) O are necessary to make 23.7 g of $Fe_2O_3$ (4 pts. each, total 8 pts)

2) 16.6 g Fe / 7.11 g $O_2$

$4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

$Fe(g) = 23.7\,g\,Fe_2O_3 \times \frac{1\,mol\,Fe_2O_3}{(56\times2+16\times3)\,g\,Fe_2O_3} \times \frac{4\,mol\,Fe}{2\,mol\,Fe_2O_3} \times \frac{56\,g\,Fe}{1\,mol\,Fe} = 16.59\,g\,Fe$ ✓

$O_2(g) = 23.7\,g\,Fe_2O_3 \times \frac{1\,mol\,Fe_2O_3}{(56\times2+16\times3)\,g\,Fe_2O_3} \times \frac{3\,mol\,O_2}{2\,mol\,Fe_2O_3} \times \frac{(16\times2)\,g\,O_2}{1\,mol\,O_2} = 7.11\,g\,O_2$ ✓

3) Write the net-ionic equation for the following reactions: **Include phase labels for both reactants and products. Also classify each reaction, giving its type.** (4 pts/each; 8 pts. tot)

3) _____

a. $2Na(s) + 2H_2O(l) \text{ -----> } 2NaOH(aq) + H_2(g)$

Net Ionic Equation:

Reaction Type: acid-base neutralization

$2Na + 2H^+ \rightarrow 2Na^+ + H_2$

$2Na(s) + 2H_2O(l) \rightarrow 2Na^+(aq) + 2OH^-(aq) + H_2(g)$ — 1

b. $2HC_2H_3O_2(aq) + Ba(OH)_2(aq) \text{ -----> } Ba(C_2H_3O_2)_2(aq) + 2H_2O(l)$

Net Ionic Equation:

Reaction Type: acid-base neutralization

$2H^+ + 2OH^- \rightarrow 2H_2O$ ✓

4) Draw the **complete** ground state electron configuration for (4 pts./each; Total = 8pts.)

4) _____

(a) Potassium (K; Z=19): $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^1$ ✓

(b) Cobalt (Co; Z=27) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^7$ ✓

5) Using only periodic table,

5) _____

(a) List atomic numbers 15, 16, 33 in order of increasing atomic size (6 pts.)

16 < 15 < 33 ✓

(b) List elements Be, N, F in order of increasing first ionic ionization energy (6 pts.)

Be < N < F ✓