Answers at back

Quantitative Chemistry Review Worksheet

1. You should be able to classify reactions type, balance reaction equations, and write simple equations including states. Example questions below:

type:

____ ___$C_4H_{10}(g)$ + ___ $O_2(g)$ → ___ $CO_2(g)$ + ___ $H_2O(g)$

____ ___ $AgNO_3(aq)$ + ___ $CuSO_4(aq)$ → ___ $Ag_2SO_4(s)$ + ___ $Cu(NO_3)_2(aq)$

____ ___ $Cl_2(g)$ + ___ $Na_2S(aq)$ → ___ $NaCl(aq)$ + ___ $S_8(s)$

____ ___ $Ag(s)$ + ___ $O_2(g)$ + ___ $H_2(g)$→ ___ $AgOH(s)$

Lead (II) nitrate solution and potassium iodide solution react to produce a precipitate (and another product). Write (including states), balance, and state reaction type.

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2. Write non-ionic, total ionic and net ionic equations for the reaction of barium chlorate solution with sodium phosphate solution.

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3. A colourless solution has a red flame. It doesn't form a precipitate with the addition of NaOH(aq), but a fresh sample does form a precipitate with the addition of $Na_2SO_4(aq)$. What ion must be present in this solution? (Use the solubility table given at the end of the worksheet. This question won't work with the one in your *Data Booklet*.)

4. Gasoline {actually a mixture of compounds, but assume for the purposes of this question that it is pure $C_8H_{18}(l)$} underwent complete combustion in an experimental engine. What mass of $CO_2(g)$ would be produced during the combustion of 250 g of "gasoline"?

5. Nitric acid, HNO_3(aq), can be neutralized by reacting it with aqueous strontium hydroxide, $Sr(OH)_2$(aq). The *un*balanced reaction equation is:

____ $Sr(OH)_2$(aq) + ____ HNO_3(aq) $\rightarrow$ ____ $Sr(NO_3)_2$(aq) + ____ H_2O(l)

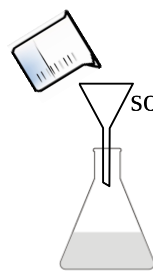
What volume of 0.676 mol/L HNO_3(aq) can be neutralized by 22.7 mL of 0.385 mol/L $Sr(OH)_2$(aq)?

6. Label the following diagram:

a)

b)

c)



solid that stays behind on filter paper a)

solution that goes through filter paper b)

type of flask used c)

7. In Investigation 7.B.1 you prepared 50 mL of $CuSO_4$(aq) in a 100 mL beaker and poured it into 50 mL of $Sr(NO_3)_2$(aq) prepared in a 250 mL beaker. Why did you do it this way rather than in the reverse direction? The lab handout is on my website if you've lost yours.

8. In the unbalanced reaction equation given below, 50.0 g of silver is reacted with 30.0 g of sulfur and more than enough oxygen.

____Ag(s) + ____S_8(s) + ____O_2(g) $\rightarrow$ ____Ag_2SO_4(s)

a) Which is the limiting reagent, Ag(s) or S_8(s)?

b) What is the expected mass of product, $Ag_2SO_4(s)$

9. List 5 factors that can limit or reduce the experimental yield of a product in a chemical reaction when compared to the predicted yield obtained using stoichiometry.

10. Xenon can be made to react with fluorine gas at about 400°C. The product that forms is xenon tetrafluoride(g). This reaction was first performed in the mid 1960's illustrating that under the right conditions some noble gases could be forced to react..

a) Write the balanced reaction equation.

b) How many grams of xenon tetrafluoride will form if 2.85 g of fluorine react with excess Xe(g)?

c) If the experimental yield was 6.31 g, what was the % yield of the reaction?

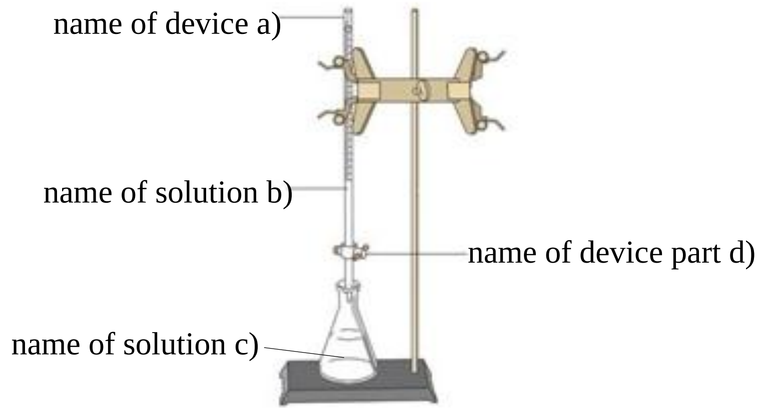
11. Label the following diagram and answer the associated questions.

    a)

    b)

    c)

    d)



- If I do the "titration of NaOH(aq) with HCl(aq)", which solution is NaOH, a) or c)?
- If I do a titration to find the concentration of solution b), what special name is given to this type of titration?
- The point in the titration where equivalent moles of acid and base are present is called?
- The colour change of an indicator during a titration is called?

12. Use the following titration data to find the concentration of HCl(aq):

titration of 10.00 mL of HCl with 0.125 mol/L $Sr(OH)_2(aq)$				
Trial	1	2	3	4
final Buret Reading (mL)	10.54	20.26	29.90	39.70
initial Buret Reading (mL)	0.24	10.54	20.26	29.90
titration volume (mL)				

it looks like there's not enough information, but there is

13. Sketch titration (pH) curves for

a) titration of a monoprotic strong acid with a monoprotic strong base

b) titration of a monoprotic strong base with a monoprotic strong acid

Ion → / Solubility ↓	H^+, Na^+, K^+, NH_4^+, NO_3^-, ClO_3^-, ClO_4^-, CH_3COO^-	F^-	Cl^-, I^-, Br^-	SO_4^{2-}	CO_3^{2-}, PO_4^{3-}, SO_3^{2-}	IO_3^-, $OOCCOO^{2-}$	S^{2-}	OH^-
Solubility $\geq$ 0.1 mol/L **(very soluble)**	most	most	most	most	H^+, Na^+, K^+, NH_4^+	Li^+, $Co(IO_3)_2$, $Fe_2(OOCCOO)_3$	Li^+, Mg^{2+}, Ca^{2+}	Li^+, Sr^{2+}
Solubility $\leq$ 0.1 mol/L **(slightly soluble)**	$RbClO_4$, $CsClO_4$, $AgCH_3COO$, $Hg_2(CH_3COO)_2$	Li^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Fe^{2+}, Hg_2^{2+}, Pb^{2+}	Cu^+, Ag^+, Hg_2^{2+}, Hg^{2+}, Pb^{2+}	Ca^{2+}, Sr^{2+}, Ba^{2+}, Hg_2^{2+}, Pb^{2+}, Ag^+	most	most	most	most

Answers

1. _C__ _2_$C_4H_{10}(g)$ + _13_ $O_2(g) \rightarrow$ _8_ $CO_2(g)$ + _10_ $H_2O(g)$

   _DR_ _2_ $AgNO_3(aq)$ + _1_ $CuSO_4(aq) \rightarrow$ _1_ $Ag_2SO_4(s)$ + _1_ $Cu(NO_3)_2(aq)$

   _SR_ _8_ $Cl_2(g)$ + _8_ $Na_2S(aq) \rightarrow$ _16_ $NaCl(aq)$ + _1_ $S_8(s)$

   _F__ _2_ $Ag(s)$ + _1_ $O_2(g)$ + _1_ $H_2(g) \rightarrow$ _2_ $AgOH(s)$

   Lead (II) nitrate solution and potassium iodide solution react to produce a precipitate (and another product). Write (including states), balance, and state reaction type.

   _DR_ $Pb(NO_3)_2(aq) + 2\ KI(aq) \rightarrow PbI_2(s) + 2\ KNO_3(aq)$

2. $3\ Ba(ClO_3)_2 + 2\ Na_3PO_4(aq) \rightarrow 1\ Ba_3(PO_4)_2(s) + 6\ NaClO_3(aq)$

$3\ Ba^{2+}(aq) + 6\ ClO_3^-(aq) + 6\ Na^+(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ba_3(PO_4)_2(s) + 6\ Na^+(aq) + 6\ ClO_3^-(aq)$

   $3\ Ba^{2+}(aq) + 2\ PO_4^{3-}(aq) \rightarrow Ba_3(PO_4)_2(s)$

3. See attached Solubility Chart.

4. $2\ C_8H_{18}(l) + 25\ O_2(g) \rightarrow 16\ CO_2(g) + 18\ H_2O(g)$

   n_1 — 250 g; n_2 — m=?

   $$n_1 = 250\ g \times \frac{1}{114.26}\frac{mol}{g} = 2.19\ mol$$

   $$n_2 = \frac{16}{2} \times 2.19\ mol = 17.5\ mol$$

   $$m = 17.5\ mol \times 44.01\ g/mol = 770\ g$$

5. $1\ Sr(OH)_2(aq) + 2\ HNO_3(aq) \rightarrow 1\ Sr(NO_3)_2(aq) + 2\ H_2O(l)$

   n_1 — 0.385 mol/L, 22.7 mL; n_2 — 0.676 mol/L, v=?

   $$n_1 = 0.385\ mol/L \times 0.0227 L = 8.74 \times 10^{-3} mol$$

   $$n_2 = \frac{2}{1} \times 8.74 \times 10^{-3} mol = 0.0175\ mol$$

   $$v = 0.0175\ mol \times \frac{1}{0.676}\frac{L}{mol} = 0.0259 L = 25.9\ mL$$

6. a) precipitate
   b) filtrate
   c) erlenmeyer flask

7. The $CuSO_4$ in solution was the excess reagent. It could be poured into the $Sr(NO_3)_2$ without any need of rinsing to make sure that all of it went into the reaction.

8. $16\ Ag(s) + 1\ S_8(s) + 16\ O_2(g) \rightarrow 8\ Ag_2SO_4(s)$ find which one makes least moles, n_3, of product

   n_1 n_2 n_3

   50 g 30 g

$$n_1 = 50\ g \times \frac{1}{107.87}\frac{mol}{g} = 0.464\,mol \qquad n_2 = 30\ g \times \frac{1}{256.56}\frac{mol}{g} = 0.117\,mol$$

$$n_3 = \frac{8}{16} \times 0.464\,mol = 0.232\,mol \qquad n_3 = \frac{8}{1} \times 0.117\,mol = 0.935\,mol$$

Ag is limiting since it makes fewer moles of product

b) $m = 0.232\,mol \times 311.81\,{}^{g}\!/\!{}_{mol} = 72.3\,g$ of $Ag_2SO_4(s)$

9. list given on page 306 of text

10. a) $Xe(g) + 2\ F_2(g) \rightarrow XeF_4(g)$

b) $Xe(g) + 2\ F_2(g) \rightarrow XeF_4(g)$

   n_1 n_2

   2.85 g m=?

$$n_1 = \frac{2.85\,g}{38.00\,{}^{g}\!/\!{}_{mol}} = 0.0750\,mol$$

$$n_2 = \frac{1}{2} \times 0.0750\,mol = 0.0375\,mol$$

$$m = 0.0375\,mol \times 207.29\,{}^{g}\!/\!{}_{mol} = 7.77\,g$$

c) $$\frac{6.31\,g}{7.77\,g} \times 100\% = 81.2\%$$

11. p. 312 and notes

12. Average titration volume: 10.30 mL (omit, out of range)

$$\frac{9.72\,mL + 9.64\,mL + 9.80\,mL}{3} = 9.72\,mL$$

$2\ HCl(aq) + 1\ Sr(OH)_2(aq) \rightarrow 1\ SrCl_2(aq) + 2\ HOH(l)$

n_2	n_1
c=?	0.125 mol/L
10.00 mL	9.72 mL

$$n_1 = 0.125\,{}^{mol}\!/\!_{L} \times 0.00972\,L = 0.00122\,mol$$

$$n_2 = \frac{2}{1} \times 0.00122\,mol = 0.00243\,mol$$

$$[HCl] = 0.00243\ mol \times \frac{1}{0.01000}\frac{1}{L} = 0.243\,{}^{mol}\!/\!_{L}$$

13. p. 318