MC 30pts   # 12 25pts
#11 25   # 13 20pts
100pts

AP Chemistry
Types of Reactions and Solutions

Name Key
Period________

* 15 mins for MC
Ap 1.5 / mc
* After 15 min, switch to FR

Multiple Choice: Write the letter of the best option in the space provided.

B 1) Of the species below, only __________ is not an electrolyte.
A) HCl   B) $C_6H_{12}O_6$ C) NaCl   D) KOH

D 2) What is the molarity of an aqueous solution containing 75.3 g of glucose ($C_6H_{12}O_6$) in 35.5 mL of solution?
A) 0.197   B) 2.12   C) 3.52   D) 11.8

$\left(\frac{75.3\text{ g sugar}}{}\right)\left(\frac{1\text{ mole sugar}}{180\text{ g sugar}}\right)\left(\frac{1}{0.0355\text{ L}}\right) = 11.78$

A 3) What is the molarity of sodium ions and sulfate ions in 500 mL of a 2.104 M solution of Na_2SO_4?
A) 4.208, 2.104   B) 1.052, 1.052   C) 2.104, 1.052   D) 2.104, 4.208

* Molarity is the same no matter how many mL you have
$[2Na^+] = 2 \times 2.104$ $[SO_4^{2-}] = 2.104$ M

C 4) What is the molarity of a solution prepared by diluting 43.72 mL of 1.005 M aqueous $K_2Cr_2O_7$ to 500 mL?
A) 0.870   B) 87.9   C) 0.0879   D) 0.0115

$M_1V_1 = M_2V_2$ (44 mL)(1.005 M) = (500 mL) ? M   M = .0879 $\frac{44\text{ mL}}{500\text{ mL}}$ 5 × 8 = 40

C 5) When aqueous solutions of __________ are mixed, precipitate forms.
A) NaI & KBr   B) Li_2CO_3 & KI   C) K_2SO_4 & $PbCl_2$ D) NaBr & $LiNO_3$

All Aq   LiI aq, KCO3 aq $PbSO_4$ ↓, KCl aq   All Aq

C 6) What are the spectator ions in the reaction between KOH (aq) and HNO_3 (aq)?
A) H^+ and NO_3^{-1} B) OH^- only   C) K^+ and NO_3^{-1} D) K^+ and H^+

→ K + NO_3 + H_2O

B 7) Lead ions can be precipitated from aqueous solutions by the addition of aqueous iodide:

$$Pb^{2+}(aq) + 2I^-(aq) \rightarrow PbI_2(s)$$

Lead iodide is virtually insoluble in water so that the reaction appears to go to completion. How many milliliters of 3.550 M $HI_{(aq)}$ must be added to a solution containing 0.400 mol of $Pb(NO_3)_{2\,(aq)}$ completely precipitate the lead?
A) 113   B) 225   C) 0.113   E) 0.225

$\left(\frac{.400\text{ mol Pb}}{1}\right)\left(\frac{2\text{ mole I}}{1\text{ mole Pb}}\right)\left(\frac{1\text{ L}}{3.500\text{ mole}}\right) = \frac{.8}{3.5}$ .2 × 1000   200

C 8) What mass in grams of potassium chloride is contained in 430 mL of a potassium chloride solution that has a chloride ion concentration of 0.193 M?
A) 0.0643   B) 0.386   C) 6.19   D) 12.37

$\left(\frac{.193\text{ moles KCl}}{1\text{ L}}\right)\left(\frac{.43\text{ L}}{1}\right)\left(\frac{74.6\text{ g KCl}}{1\text{ mole}}\right) = 6.19$

B 9) In a particular redox reaction, the oxidation number of phosphorus changed from -3 to 0. From this it may be concluded that phosphorus:

A) lost of 3 electrons and was reduced
B) lost of 3 electrons and was oxidized
C) gained 3 electrons and was reduced
D) gained 3 electrons and was oxidized

B 10) Which species is losing electrons in the following redox reaction?

$\overset{+4}{Sn}\overset{-4}{O_2} + 4\overset{-1}{Cl^-} + 4\overset{+1}{H^+} \rightarrow \overset{+2}{Sn}\overset{-1}{Cl_2} + \overset{0}{Cl_2} + 2\overset{+1}{H}\overset{-2}{_2}0$

A) H^+ B) Cl^- C) O D) Sn

Free Response:

11. For each of the following equations, predict the products and write a molecular equation (in first box) and a net ionic equation (in second box) with NO spectators. Be sure and include the states of matter of the reactants and products.

a. solutions of nickel (II) nitrate and sodium sulfide are mixed

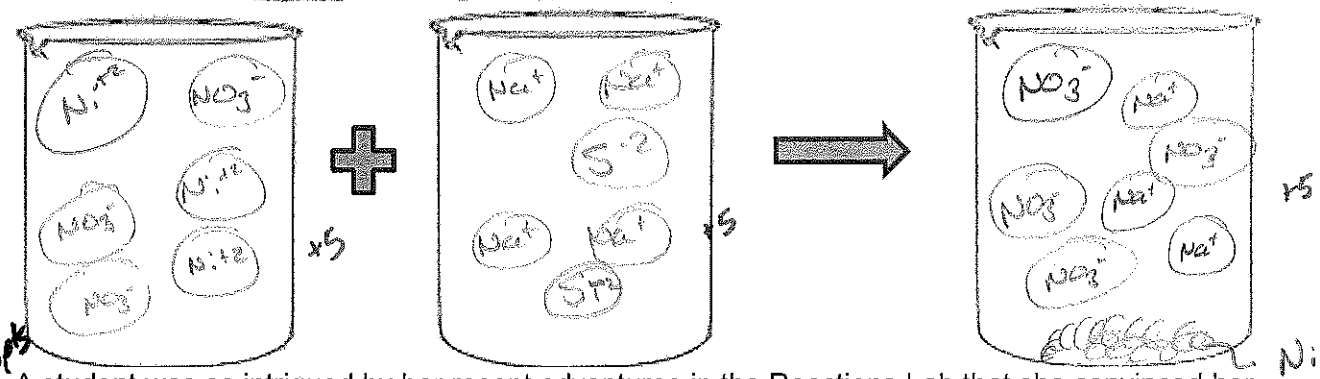
molecular eqn

$Ni(NO_3)_{2(aq)} + Na_2S_{(aq)} \rightarrow NiS_{(s)} + 2NaNO_{3(aq)}$

Net

$Ni^{+2}_{(aq)} + S^{-2}_{(aq)} \rightarrow NiS_{(s)}$

b. Draw the particulate diagram of the above reaction putting each reactant in it's own beaker and all final products in the the last beaker. You do not have to include the water molecules.



12. A student was so intrigued by her recent adventures in the Reactions Lab that she convinced her chemistry teacher to recreate the experience using a different compound. Her teacher chose to use potassium chlorate, $KClO_3$.

a) The student determined there were three possible reactions. Write the balanced chemical equation for each reaction below. You do not need to include states of matter.

i) Potassium chlorate → potassium chlorite + oxygen

$2KClO_3 \rightarrow 2KClO_2 + O_2$

ii) potassium chlorate → potassium chloride + oxygen

$2KClO_3 \rightarrow 2KCl + 3O_2$

iii) potassium chlorate → potassium oxide + chlorine + oxygen

$4KClO_3 \rightarrow 2K_2O + 2Cl_2 + 5O_2$

b) The student's data table is below – complete it for her.

Mass of test tube	18.621 g
Mass of test tube + $KClO_3$	21.149 g
Mass of $KClO_3$	2.528g +2
Mass of test tube + final product	20.145 g − 18.621
Mass of final product	1.524g +2

K 1×39.10 = 39.10
Cl 1× 35.45 = 35.45
O 3×16.00 = 48.00
122.55

c) Use stoichiometry to determine the theoretical amount of product the student should obtain based on each of the three reactions above. Circle the equation that matches with the data the best

i) $\left(\frac{2.528\text{g } KClO_3}{1}\right)\left(\frac{1\text{ mole } KClO_3}{122.55\text{ g } KClO_3}\right)\left(\frac{2\text{ mole } KClO_2}{2\text{ mole } KClO_3}\right)\left(\frac{106.55\text{ g } KClO_2}{1\text{ mole } KClO_2}\right) =$ 2.198 g $KClO_2$ +3

ii) $\left(\frac{2.528\text{g } KClO_3}{1}\right)\left(\frac{1\text{ mole } KClO_3}{122.55\text{g } KClO_3}\right)\left(\frac{2\text{ mole } KCl}{2\text{ mole } KClO_3}\right)\left(\frac{74.55\text{ g } KCl}{1\text{ mole } KCl}\right) =$ 1.538 g KCl +5

iii) $\left(\frac{2.528\text{g } KClO_3}{1}\right)\left(\frac{1\text{ mole } KClO_3}{122.55\text{g } KClO_3}\right)\left(\frac{2\text{ mole } K_2O}{4\text{ mole } KClO_3}\right)\left(\frac{94.20\text{g } K_2O}{1\text{ mole } K_2O}\right) =$ .9716 g K_2O +5

d) Calculate the percent yield for the student's experiment. $\frac{\text{Actual}}{\text{Theoretical}} \times 100$

$\frac{1.524\text{g}}{1.538\text{g}} \times 100 = 99.09\%$ +2

20pts 13. A chemist mixed 50.0 mL of 1.25 M Na_3PO_4 with 35.0 mL of 0.750 M $Ba(NO_3)_2$. Use this information to answer the following questions.

a) Write balanced chemical equation:

$2Na_3PO_{4(aq)} + 3Ba(NO_3)_{2(aq)} \rightarrow 6NaNO_{3(aq)} + Ba_3^{2+}(PO_4^{3-})_{2(s)}$ +3

50.0 mL = .0500L, 1.25 M; .750 M, 35.0 mL = 0.0350L

b) Identify the precipitate formed in the reaction

$Ba_3(PO_4)_2$ +2

c) Identify the limiting reactant. Show all work

$\left(\frac{1.25 \text{ moles } Na_3PO_4}{1\text{ L}}\right)\left(\frac{0.0500\text{ L}}{1}\right) = 0.0625 \text{ moles } Na_3PO_4$

$\left(\frac{0.750 \text{ moles } Ba(NO_3)_2}{1\text{ L}}\right)\left(\frac{0.0350\text{ L}}{1}\right) = 0.0263 \text{ moles } Ba(NO_3)_2$

$Ba(NO_3)_2$ +5

	$2Na_2PO_4$	$3Ba(NO_3)_2$	$\rightarrow$	$6NO_3^-$	$Ba_3(PO_4)_2(s)$	
I	0.0625 m	0.0263		0	0	$2x = .0625$ $x = 0.0313$
C	$-2x$ $-2(.00877)$ -0.0175	$-3x$ $-3(.00877)$ -0.0263		$6x$ $6(.00877)$	x 0.00877	$3x = 0.0263$ $x = 0.00877$
E	0.045 m	Ø Limiting		0.0526 m	.00877 m	

d) Determine the mass of the precipitate formed. Show all work

$\left(\frac{.00877 \text{ moles } Ba_3(PO_4)_2}{1}\right)\left(\frac{601.93\text{ g } Ba_3(PO_4)_2}{1 \text{ mole } Ba_3(PO_4)_2}\right) =$ 5.28 g $Ba_3(PO_4)_2$ +5

Ba $3 \times 137.33 = 411.99$
P $2 \times 30.97 = 61.94$
O $8 \times 16.00 = 128.00$

e) Find the concentration of nitrate ions after mixing. Show all work.

Molarity $= \frac{\text{moles}}{\text{L}}$

Total volume $= 0.0350\text{ L} + 0.0500\text{ L} = 0.0850\text{ L}$

0.619 M NO_3^- +5

$\frac{0.0526 \text{ moles } NO_3^-}{0.0850\text{ L}} = 0.619 \text{ M } NO_3^-$