

Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit.

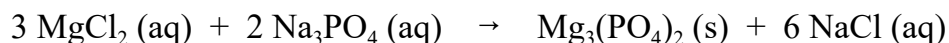
1. (4 pts) What is the correct **NET IONIC** equation from those given below to represent what happens when solutions of Na_3PO_4 and MgCl_2 are mixed.

This is an **exchange** (metathesis or double-replacement) reaction. Generally, when two soluble ionic compounds are the reactants it's an exchange reaction.

First exchange the partners and write the correct formulas. The charges don't change. Check the solubility table (rules) to see if anything is insoluble (forms a precipitate).

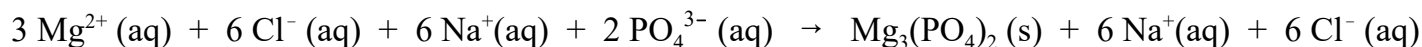


Formula Eqn: make sure it's balanced

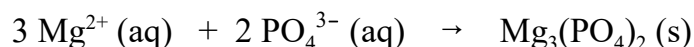


Write the ionic equation and cancel out everything that appears the same way on both sides of the equation.

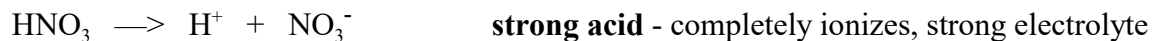
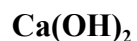
Ionic Eqn:



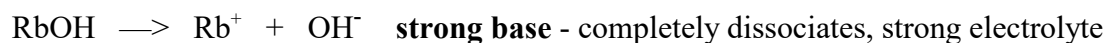
Net Ionic Eqn: (cancel "spectator ions" in ionic eqn.)



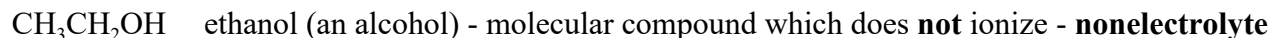
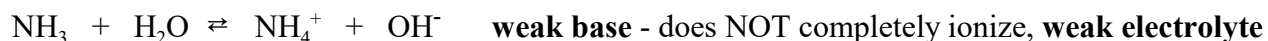
2. (2 pts) Which of the following are **strong** acids or **strong** bases? (Circle all that apply.)



The 7 strong acids are: HCl , HBr , HI , HNO_3 , HClO_3 , HClO_4 , H_2SO_4 (1st H^+ only)



Group 1 A and soluble group 2 A (Ca and below) hydroxides are strong bases.

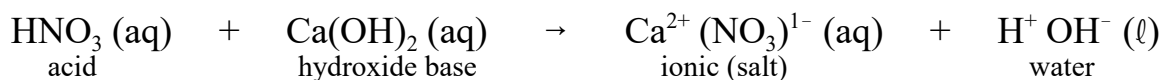


Most molecular compounds do not ionize and are nonelectrolytes. The molecular compounds which ionize or react with water are the strong acids (strong electrolytes), weak acids (weak electrolytes) and weak bases (like NH_3 , weak electrolyte).

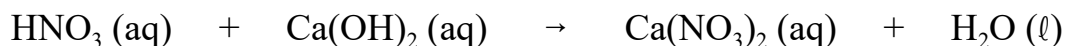
3. (4 pts) **Predict the products** of the following reaction. **Complete and balance** the equation. **Indicate the physical state** of reactants and products (i.e. (s), (g), (l), (aq)). **(Show all work.)**

A solution of nitric acid, HNO_3 , is combined with a solution of Ca(OH)_2 .

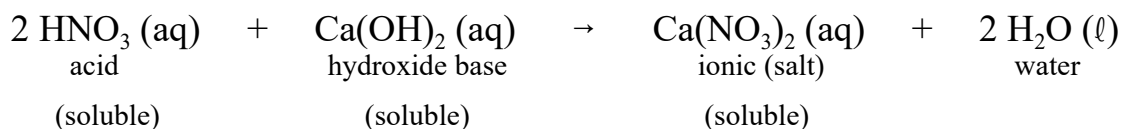
Neutralization Rxn: Treat as an exchange rxn. - switch partners



charges on ions do not change when they switch partners in double replacement rxns

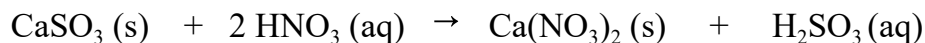
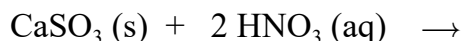


Bal: (start w. NO_3^- - there's two of them on the right and it's on the left like a poly atomic ion. You generally want to balance polyatomic ions as a unit after balancing other things, but before H and O)



Look in solubility table to see if substances are soluble (aq) or a precipitate (solid) or determine if one of the products breaks down to give a gas (CO_2 , SO_2 or H_2S).

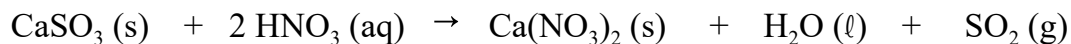
4. (3 pts) What are the expected products of the following reaction?



Sulfurous acid is unstable and decomposes



Overall final equation:



Exchange (double-replacement) with the formation of a **gas**.

Carbonates (CO_3^{2-}) and bicarbonates (HCO_3^-) react with acids to give $\text{H}_2\text{O} (\ell)$ & $\text{CO}_2 (\text{g})$.

Sulfites (SO_3^{2-}) and bisulfites (HSO_3^-) react with acids to give $\text{H}_2\text{O} (\ell)$ & $\text{SO}_2 (\text{g})$.

Sulfides (S^{2-}) react with acids to give $\text{H}_2\text{S} (\text{g})$.

5. (4 pts) Determine the oxidation number of the underlined element in the following compound. (Must show all work.)

Chg. on Cr₂O₇²⁻ is -2

a) (2 pts) Cr₂O₇²⁻ $2X_{Cr} + 7(-2)_O = -2$; $2X_{Cr} - 14 = -2$; $2X_{Cr} = +12$; $X_{Cr} = +6$

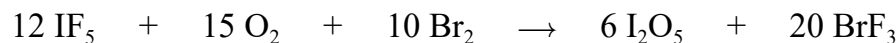
The ox. no. on chromium is +6.

Chg. on P₄O₆ is 0

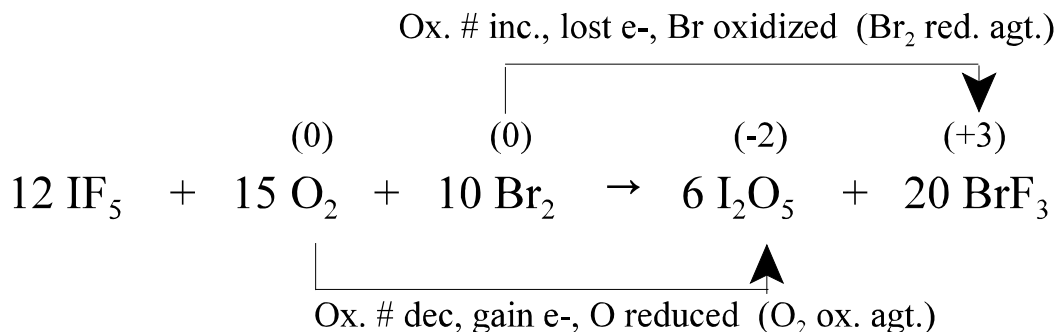
b) (2 pts) P₄O₆ $4X_P + 6(-2)_O = 0$; $4X_P - 12 = 0$; $4X_P = +12$; $X_P = +3$

The ox. no. on phosphorous is +3.

6. (5 pts) Examine the reaction below and the statements concerning the reaction. Select an answer which includes ALL of the CORRECT statements given below.



- 1) Br has been oxidized.
- 2) F is reduced.
- 3) The oxidation number of Br changed from 0 to +3.
- 4) O has been oxidized.
- 5) The oxidation number of O changed from 0 to -2.

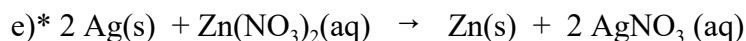
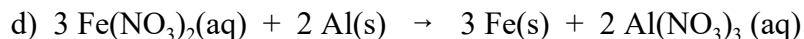
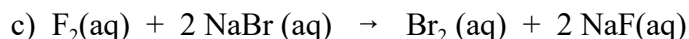
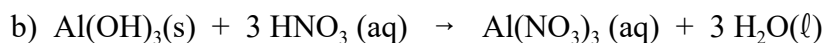
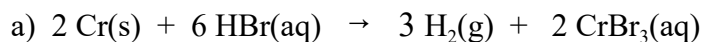


O: reduced (ox. num. chgs from 0 to -2)
O₂ : oxidizing agent

Br: oxidized (ox. num. chgs from 0 to +3)
Br₂ : reducing agent

1, 3 & 5 are Correct

7. (3 pts) Which of the following reactions will **NOT** occur as written?



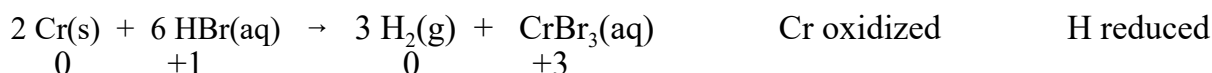
The reactions are redox (oxidation-reduction) reactions. To be a redox (oxidation-reduction) reaction the oxidation numbers must change. More specifically the reactions are all displacement (single replacement) reactions. You need to figure out what's being oxidized and reduced. Then you use the activity series. Remember, ease of oxidation increases from bottom to top in the series. The more easily oxidized substance is higher in the table.

Remember (OIL RIG):

oxidation: loss of e⁻, inc. in oxidation #

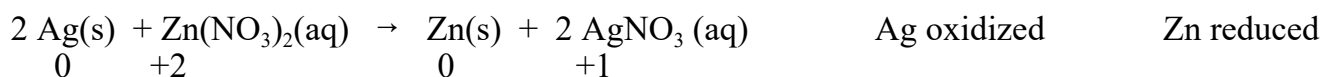
reduction: gain of e⁻, dec. in oxidation #

reaction (a):



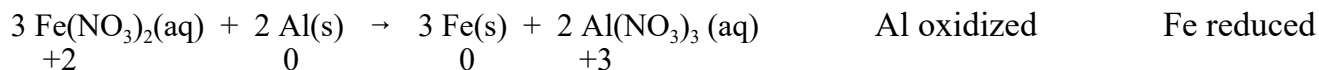
In the activity series table aluminum is higher than hydrogen meaning aluminum is more easily oxidized. Since Cr is being oxidized this reaction will occur as written going left to right. Thus the Cr replaces H⁺ in solution.

Proceeding in this way you find reaction (e) can't occur as written:



However, from the table Zn is more easily oxidized than Ag. This reaction won't occur spontaneously left to right but instead the reverse reaction would occur.

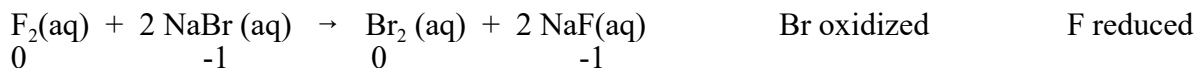
Reaction (d) is also a redox reaction. Aluminum is above Fe in the activity series meaning it will be oxidized more easily than Fe and that's what is occurring in the reaction as written.



***** continued on next page *****

7. (Cont.)

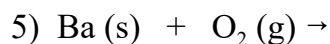
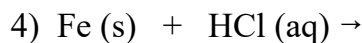
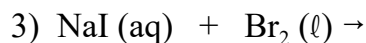
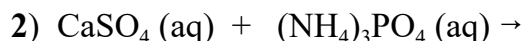
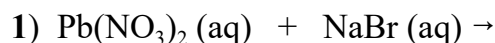
Reaction (c) is a redox reaction involving the replacement of one halogen in solution with another. The order of reactivity for halogens (ease of reduction) is $I < Br < Cl < F$. This reaction will occur as written and F will replace Br⁻ in solution.



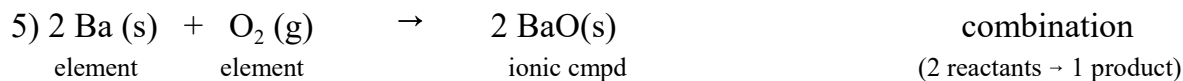
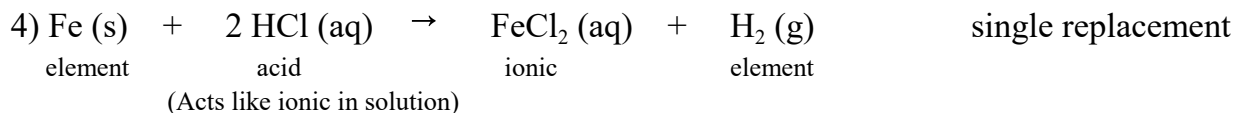
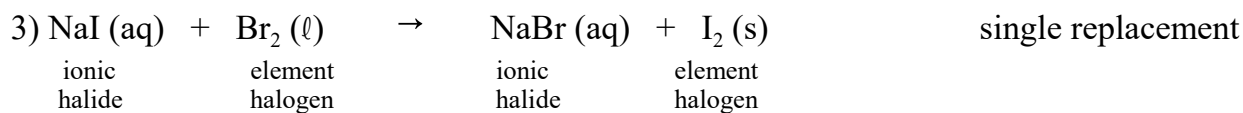
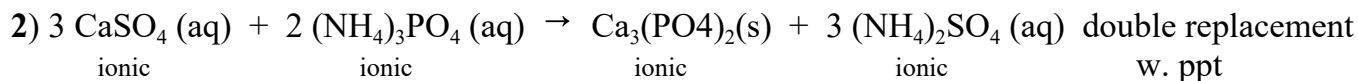
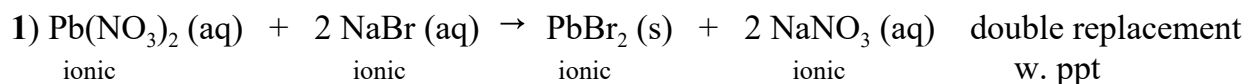
Reaction (b) is an acid-base neutralization reaction between a strong acid, HNO_3 , and a hydroxide base. An acid-base neutralization involving a strong acid and/or a strong base go to completion.

E

8. (5 pts) Which of the following is (are) an example(s) of an **exchange** (**double-replacement** or **metathesis**) reaction (assume all reactions occur to give products and write the products)?



1 and 2 are **exchange** (double replacement or metathesis) reactions



9. (2 pts) Which reaction(s) in question 8 is (are) an example(s) of a **redox** reaction (assume all reactions occur to give products)?

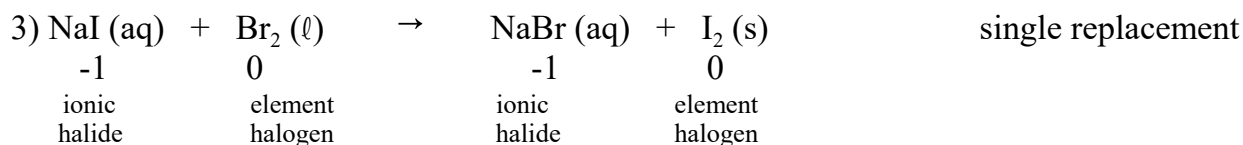
Oxidation-Reduction (Redox) reactions involve the transfer of electrons (and associated change in oxidation numbers)..

Remember (OIL RIG):

oxidation: loss of e⁻, inc. in oxidation #

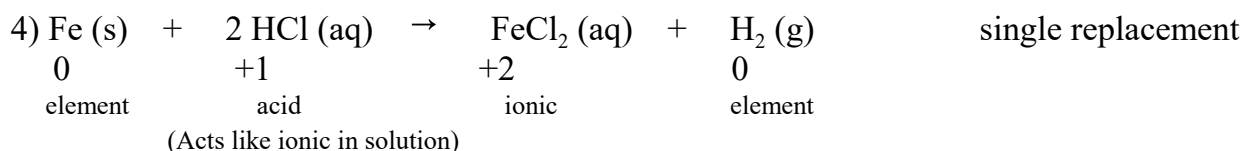
reduction: gain of e⁻, dec. in oxidation #

See above answers in #8. **Displacement** (single-replacement) and **combination** rxns are some examples of redox rxns.



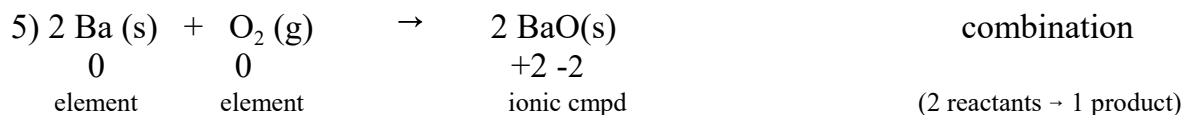
I oxidized
(NaI reducing agent)

Br reduced
(Br₂ oxidizing agent)



Fe oxidized
(Fe reducing agent)

H reduced
(HCl oxidizing agent)



Ba oxidized
(reducing agent)

O reduced
(O₂ oxidizing agent)

(3, 4, 5)

10. (3 pts) Calculate the molarity of Na^+ when 0.832 g of Na_3PO_4 is dissolved in enough water to make 26.8 mL of solution. (Atomic weights: Na = 22.99, P = 30.97, O = 16.00)

$$\begin{aligned} \frac{? \text{ mol Na}^+}{1 \text{ L soln}} &= \frac{0.832 \text{ g of Na}_3\text{PO}_4}{26.8 \text{ mL soln}} \times \frac{10^3 \text{ mL soln}}{1 \text{ L soln}} \times \frac{1 \text{ mol Na}_3\text{PO}_4}{163.94 \text{ g Na}_3\text{PO}_4} \times \frac{3 \text{ mol Na}^+}{1 \text{ mol Na}_3\text{PO}_4} \\ &= 0.5681 \text{ M Na}^+ \\ &= 0.568 \text{ M Na}^+ \end{aligned}$$

Another way to do this is to first calculate the molarity of the Na_3PO_4 and then calculate the molarity of the Na^+ ions. To get the molarity of the Na_3PO_4 that's just the first 3 steps above. That gives:

$$0.18936 \text{ M Na}_3\text{PO}_4$$

Then there's 3 Na^+ ions per one formula unit of Na_3PO_4 so the molarity of Na^+ would be 3 times the molarity of the Na_3PO_4

$$\text{molarity of Na}^+ = 3 * 0.18936 = 0.5681 \text{ M Na}^+$$

Could also use a BCA table (in molarity):

	Na_3PO_4	---->	3 Na^+	+	PO_4^{3-}
B	0.1893		0		0
C	- 0.1893		+ 3(0.1893)		+ 0.1893
<hr/>					
A	0		0.5679		0.1893

11. (2 pts) Calculate the molarity of an H_2SO_4 solution that results when 45.0 mL of 18.0 M H_2SO_4 is diluted with 90.0 mL of H_2O assuming the volumes are additive.

Dilution problem $M_2V_2 = M_1V_1$

Remember, V_1 is the initial volume of soln. and V_2 is the final volume of soln.

$$\begin{array}{ll} M_1 = 18.0 \text{ M} & M_2 = ? \\ V_1 = 45.0 \text{ mL} & V_2 = 45.0 \text{ mL H}_2\text{SO}_4 + 90.0 \text{ mL H}_2\text{O} = 135.0 \text{ mL final solution} \end{array}$$

$$M_2 = \frac{M_1V_1}{V_2} = \frac{(18.0 \text{ M})(45.0 \text{ mL})}{135.0 \text{ mL}} = 6.00 \text{ M H}_2\text{SO}_4$$