

1. (6 pts.) What do acids release when dissolved in water?

1. \_\_\_\_\_

2. \_\_\_\_\_

2. (6 pts.) When bases dissolve in water, what ion forms?

3. \_\_\_\_\_

4. \_\_\_\_\_

3. (2 pts each) Identify the bases in the following table.

5. \_\_\_\_\_

KCl	Ca(OH) <sub>2</sub>	CH <sub>3</sub> OH
$\begin{array}{c} \text{H}-\ddot{\text{O}}-\text{H} \quad \text{H}-\ddot{\text{O}}-\text{H} \\   \quad   \quad   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\   \quad   \quad   \\ \text{H} \quad \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H}-\text{C} \quad \text{C}-\text{H} \\ \diagdown \quad \diagup \\ \text{C}=\text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \quad \text{H} \end{array}$	$\left[ \text{Mg} \right]^{2+} \left[ \begin{array}{c} \text{:}\ddot{\text{O}}-\text{H} \\ \text{:}\ddot{\text{O}}-\text{H} \end{array} \right]^{-}$
Li <sub>2</sub> CO <sub>3</sub>	NaOH	NaHCO <sub>3</sub>

6. \_\_\_\_\_

7. \_\_\_\_\_

8. \_\_\_\_\_

9. \_\_\_\_\_

10. \_\_\_\_\_

11. \_\_\_\_\_

12. \_\_\_\_\_

13. \_\_\_\_\_

4. (4 pts.) Briefly, explain why skin feels slippery when a base is spilled on it.

14. \_\_\_\_\_

5. (2 pts each) Identify the acids in the following table. Circle the acidic H on each acid.

$\text{H}-\ddot{\text{Br}}\text{:}$	$\text{H}-\ddot{\text{S}}-\text{H}$	$\text{:}\ddot{\text{Cl}}-\text{H}$
$\begin{array}{c} \text{:}\ddot{\text{O}}\text{:} \\   \\ \text{H}-\ddot{\text{O}}-\text{Br}-\ddot{\text{O}}\text{:} \\   \\ \text{:}\ddot{\text{O}}\text{:} \end{array}$	$\begin{array}{c} \text{:}\ddot{\text{O}}\text{:} \quad \text{H} \quad \text{:}\ddot{\text{O}}-\text{H} \\    \quad   \quad   \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{H} \quad \text{:}\ddot{\text{O}}\text{:} \\   \quad    \\ \text{:}\ddot{\text{Cl}}-\text{C}-\text{C}-\ddot{\text{O}}-\text{H} \\   \\ \text{:}\ddot{\text{Cl}}\text{:} \end{array}$
$\begin{array}{c} \text{H}-\ddot{\text{P}}-\text{H} \\   \\ \text{H} \end{array}$	$\begin{array}{c} \text{H}-\ddot{\text{O}}-\text{H} \\   \quad   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   \quad   \\ \text{H} \quad \text{H} \end{array}$	$\begin{array}{c} \text{:}\ddot{\text{O}}-\text{H} \\   \\ \text{:}\ddot{\text{O}}=\text{N}-\ddot{\text{O}}\text{:} \end{array}$

6. (8 pts) Limestone and marble are made from calcium carbonate ( $\text{CaCO}_3$ ). Explain why statues and buildings made from these building materials can be destroyed by acid rain.

7. a. (8 pts.) Write the balanced chemical equation for the reaction of the antacid  $\text{Mg}(\text{OH})_2$ —an ingredient in Maalox<sup>®</sup>—with  $\text{HCl}$  (stomach acid).

b. (8 pts.) Determine the mass (in grams) of  $\text{HCl}$  that can be neutralized by a 0.500 g tablet of  $\text{Mg}(\text{OH})_2$ .

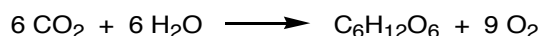
8. (8 pts.) Acids can react with metals. For example, hydrochloric acid reacts with iron according to the following equation. Is the reaction an acid-base reaction or an oxidation-reduction reaction? Explain your response.



9. (2 pts. each) Identify the following reactions as acid-base, oxidation-reduction, or *neither*.

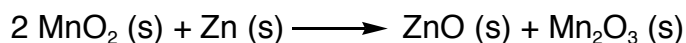
a. $2 \text{HNO}_3 + \text{Ba}(\text{OH})_2 \longrightarrow \text{Ba}(\text{NO}_3)_2 + 2 \text{H}_2\text{O}$
b. $6 \text{Li} + \text{N}_2 \longrightarrow 2 \text{Li}_3\text{N}$
c. $2 \text{C}_3\text{H}_6 + 9 \text{O}_2 \longrightarrow 6 \text{CO}_2 + 6 \text{H}_2\text{O}$
d. $2 \text{CH}_3\text{I} + \text{NaCl} \longrightarrow \text{CH}_3\text{Cl} + \text{NaI}$
e. $\text{CH}_3\text{CO}_2\text{H} + \text{NaHCO}_3 \longrightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{CH}_3\text{CO}_2\text{Na}$

10. (8 pts.) During photosynthesis, the energy in sunlight is captured and used to convert carbon dioxide ( $\text{CO}_2$ ) and water ( $\text{H}_2\text{O}$ ) to glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ) and oxygen ( $\text{O}_2$ ).



Are the C atoms in this reaction being oxidized or reduced? Explain your response.

11. The reaction that occurs in an alkaline battery is written below.

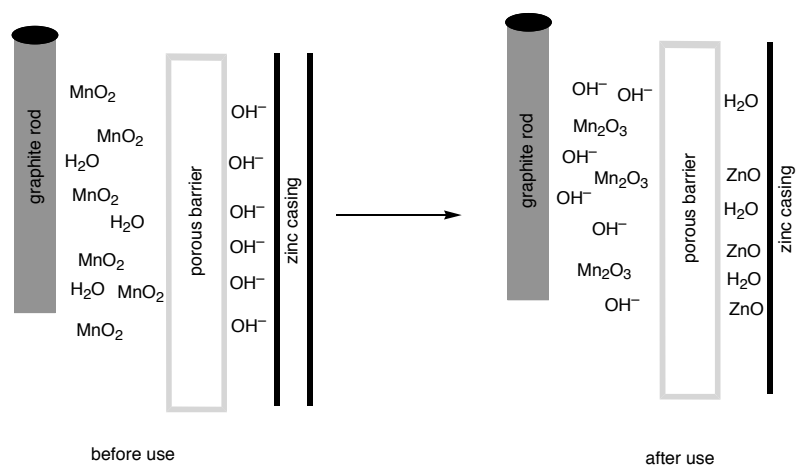


In this reaction, the Mn in the  $\text{MnO}_2$  starts with a charge of +4, the O atoms and the Zn atoms start with charges of  $-2$  and  $0$  respectively. At the end of the reaction, the Mn atoms are each +3, and the O and Zn atoms are  $-2$  and +2 respectively.

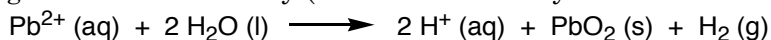
a. (4 pts.) From the Zn's point of view, what happens; does the Zn gain or lose electrons?

b. (4 pts.) If the Zn in part a. is losing electrons where do the electrons in go (If the Zn in part a. is gaining electrons, where do they come from)?

c. (4 pts.) On the left side of the diagram drawn below (a schematic for an alkaline battery), draw a wire and an arrow that shows how the electrons would move when the circuit is completed.



12. (2 pts. each) The reaction shown below is an undesirable side reaction that can occur while attempting to charge a lead acid battery (the kind of battery that is used to start your car.)



a. What is the charge of the lead (the Pb) at the beginning of the reaction?	b. What is the charge of the lead in the $\text{PbO}_2$ ?
c. What is the charge (oxidation number) of the H atoms in the water molecules?	d. What is the charge (oxidation number) of the H atoms in the $\text{H}_2$ molecule?
e. What is the charge (oxidation number) of the O atoms in the water molecules?	f. What is the charge (oxidation number) of the O atoms in the $\text{PbO}_2$ ?

g. Are the O atoms gaining electrons, losing electrons, or doing neither?

h. Are the Pb atoms gaining electrons, losing electrons, or doing neither?

i. Are the H atoms that are becoming part of the  $\text{H}_2$  molecule gaining electrons, losing electrons, or doing neither?

j. Why is this reaction considered undesirable, especially in a location where sparks can be generated?

13. Show work for the following questions. Consider a typical automobile that achieves a mileage rating of 25 miles per gallon.

a. (4 pts.) If the vehicle travels 36 miles each day, how many gallons of gas are consumed per day? b. Per year?

b. (4 pts.) The combustion of  $\text{C}_8\text{H}_{18}$  can be used to describe the reaction that occurs in an internal combustion engine. Write the balanced chemical equation for the combustion of  $\text{C}_8\text{H}_{18}$ .

c. (4 pts.) One gallon of gasoline weighs approximately 2700 g. Determine the mass of carbon dioxide released into the atmosphere each day by the car in part a.

14. Various groups talk about the coming “Hydrogen Economy”. One of the claimed benefits of the use of hydrogen as a fuel is that the combustion of hydrogen produced no pollution.

a. (4 pts.) Write a balanced chemical equation for the combustion of hydrogen ( $H_2$ ).

b. (4 pts.) Can hydrogen be used in a fuel cell to generate electricity? Explain your response.

c. (4 pts.) From where is hydrogen obtained?

d. (8 pts.) Is the use of hydrogen as a fuel for automobiles truly pollution free? Explain your response.