Shedding Light on Acids and Bases Episode 5: Advanced Acid-Base Chemistry

Name: _____

Part A

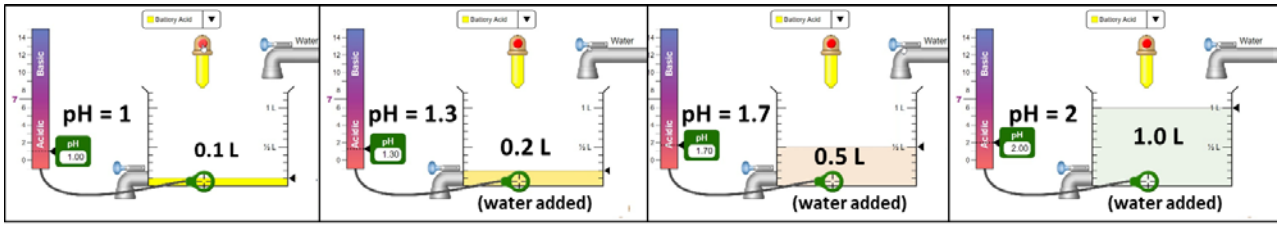
1. When HCl, which is a gas, dissolves in water, _____ ions and _____ ions are formed.
2. Complete the following general equations:
   acid + metal → _____ + _____
   acid + base → _____ + _____
3. When a base dissolves in water, _____ ions are produced.
4. A strong acid contains lots of/relatively few H^+ ions while a weaker acid contains lots of/relatively few H^+ ions. (circle the correct answers)

Part B

5. A change of 1 on the pH scale means an increase (or decrease) in the concentration of H^+ ions in a solution by a factor of _____.
6. An acid with a pH of 3 has _____ times as many H^+ ions as an acid with a pH of 4, and _____ times as many H^+ ions as an acid with a pH of 5 (assuming you have the same amount of the acid).
7. 200 mL of an acid with a pH of 2 has _____ times as many H^+ ions as 200 mL of an acid with a pH of 6.
8. Acid A has a pH of 1 and has 100,000 times as many H+ ions as Acid B. What is Acid B's pH?

   _____

   _____



9. A certain acid has a pH of 1. If it is watered down by an equal amount of water (so that it is only half as concentrated), its pH rises to _____, which is a change of _____.
10. A certain acid has a pH of 1.7. If it is watered down by an equal amount of water (so that it is only half as concentrated), its pH rises to _____, which is a change of _____.
11. The pH of any acid that is watered down by half (so that its concentration halves) will rise by _____ on the pH scale.

Part C

12. Fill in the table.

pH	example	Concentration: grams (g) of H^+ ions per litre (L)
6	clean rain water	
5	coffee	
4	orange juice	
3	grape juice	
2	lemon juice	
1	stomach juices	
0	hydrochloric acid	

13. Pure water has a pH of 7. It contains tiny tiny amounts of both H^+ ions and OH^- ions in equal number. Where do the ions come from? _____

_____

_____

14. A basic solution of pH 11 has the same number of OH^- ions as an acid of pH _____ has H+ ions.
15. A basic solution of pH 9.5 has the same number of OH^- ions as an acid of pH _____ has H+ ions.

Part D

16. Complete the following equations (and include the states) for the reaction between HCl and NaOH.
    (a) $HCl_{(aq)} + NaOH_{(aq)} \rightarrow$ _____( ) + _____( )
    (b) $H^+_{(aq)} + Cl^-_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightarrow$ _____( ) + _____( ) + _____( )
17. Why are the Na^+ and the Cl^- ions called "spectator" ions in the above reaction? _____

_____

_____

_____

18. Write the equation for the reaction in Q16 above, but leave out the spectator ions.

_____

19. When magnesium reacts with hydrochloric acid, hydrogen gas and magnesium chloride are formed. Complete the equations below.
    (a) (standard) $Mg_{(s)} + 2HCl_{(aq)} \rightarrow$ _____( ) + _____( )
    (b) (ionic) $Mg_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)} + \rightarrow$ _____( ) + _____( ) + _____( )
20. Which ion acts as a spectator ion? _____
21. Complete the ionic equation from Q19 without the spectator ions.

_____

22. Describe what actually happens at the atomic level when magnesium atoms react with hydrochloric acid. _____

_____

_____

Skill-Builders:

23. Hydrochloric acid reacts with calcium in a very similar way to the way it reacts with magnesium (magnesium and calcium are both in Group 2 of the Periodic Table and both have 2 electrons in their outer shells).
    In the reaction, calcium chloride ($CaCl_2$) and hydrogen gas are produced. Write out the equations for the reactions below using your answers to Q19 and Q21 a guide:
    (standard, like Q19a above) $Ca_{(s)} + 2HCl_{(aq)} \rightarrow$ _____( ) + _____( )
    (ionic, like Q19b above) _____
    (ionic, without the spectator ions, like Q21) _____

24. Lithium is in the same group as sodium on the periodic table (Group 1) so they both react in a similar way with other substances. Likewise, fluorine and chlorine are in the same group (Group 17) so they also react in a similar way to each other.
    Hydrofluoric acid (HF) reacts with lithium hydroxide (LiOH) to produce water and a type of salt called lithium fluoride (LiF). Write the standard chemical equation and the ionic equations for this reaction (using Q16 and Q18 above as a guide).
    (standard, like Q16a) $HF_{(aq)} + LiOH_{(aq)} \rightarrow$ _____( ) + _____( )
    (ionic, like Q16b) _____
    (ionic, without the spectator ions (like Q18) _____