**BC SCIENCE 10 - Chapter 5 Practice Booklet**

**Matching**

***Match the solution/liquid with the appropriate description of indicator colours and likely pH. Each description may be used only once.***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Bromothymol Blue | Phenolphthalein | Methyl Red | pH Value |
| a. | yellow | colourless | red | 3 |
| b. | green | colourless | yellow | 7 |
| c. | blue | pink | yellow | 11 |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
|  |  |

\_\_\_\_ 1. NaOH(aq)

\_\_\_\_ 2. CH3COOH(aq)

\_\_\_\_ 3. H2O(l)

***Match the pH value with the appropriate description of H+ ion concentration. Each description may be used only once.***

|  |  |
| --- | --- |
| a. | H+ ion concentration is one million times less than pure water. |
| b. | H+ ion concentration is one million times greater than pure water. |
| c. | H+ ion concentration is one thousand times less than pure water. |
| d. | H+ ion concentration is one thousand times greater than pure water. |

\_\_\_\_ 4. pH = 1

\_\_\_\_ 5. pH = 4

\_\_\_\_ 6. pH = 10

\_\_\_\_ 7. pH = 13

***Match the acid name with the appropriate number of oxygen atoms contained in its formula. Each number may be used only once.***

|  |  |  |  |
| --- | --- | --- | --- |
| a. | zero oxygen atoms | d. | three oxygen atoms |
| b. | one oxygen atom | e. | four oxygen atoms |
| c. | two oxygen atoms |

\_\_\_\_ 8. hypochlorous acid

\_\_\_\_ 9. hydrosulfuric acid

\_\_\_\_ 10. phosphoric acid

\_\_\_\_ 11. nitrous acid

\_\_\_\_ 12. carbonic acid

***Match the formulas of the products* *with the appropriate pairs of reactants that would react to produce the products. Each set of formulas may be used only once.***

|  |  |  |  |
| --- | --- | --- | --- |
| a. | MgCl2(aq) + H2O(l) | c. | MgCl2(aq) + CO2(g) + H2O(l) |
| b. | MgCl2(aq) + H2(g) |

\_\_\_\_ 13. hydrochloric acid + magnesium metal  ?

\_\_\_\_ 14. hydrochloric acid + magnesium carbonate  ?

\_\_\_\_ 15. hydrochloric acid + magnesium hydroxide  ?

***Match each pair of reactant formulas with the best description of the results of that reaction. Each description may be used only once.***

|  |  |
| --- | --- |
| a. | will react together to produce an aqueous solution with a pH lower than 7 |
| b. | will react together to produce an aqueous solution with a pH higher than 7 |
| c. | will react together to produce a salt and water |
| d. | will react together to produce a salt and hydrogen gas |
| e. | will react together to produce a salt, carbon dioxide gas, and water |

\_\_\_\_ 16. H2SO4(aq) + Mg(s)  ?

\_\_\_\_ 17. Na2O(s) + H2O(l)  ?

\_\_\_\_ 18. HCl(aq) + CaCO3(s)  ?

\_\_\_\_ 19. SO3(g) + H2O(l)  ?

\_\_\_\_ 20. HNO3(aq) + KOH(aq)  ?

**Short Answer**

21. Two different aqueous solutions sit on a laboratory bench and appear identical. One is HCl(aq) and the other is NaOH(aq), but unfortunately the labels on the solutions have fallen off. Explain how a pH meter and the indicator bromothymol blue could be used to identify each solution.

22.

Complete the following table relating the pH to the acidity or basicity of some common substances compared to that of pure water.

|  |  |  |
| --- | --- | --- |
| Substance | pH Value | Relative Acidity/Basicity Compared to Pure Water |
| stomach acid | 1 | 106 or 1 000 000 times more acidic than pure water |
| apples | 3 | ? |
| black coffee | ? | 102 or 100 times more acidic than pure water |
| pure water | 7 | neutral |
| baking soda | 9 | ? |
| ammonia cleaner | ? | 104 or 10 000 times more basic than pure water |
| drain cleaner | 13 | 106 or 1 000 000 times more basic than pure water |

23. Explain how to recognize the chemical formula for an acid, a base, and a salt, and give an example of each.

24. Some names for acids begin with *hydro* and end with *ic*. Some names for acids have no prefix at all and simply end with *ic*, while others simply end with *ous*. Provide three naming rules for acids that explain when to employ each of these naming conventions. Give one example of an appropriate acid for each naming rule.

25. First, write out the word equation for a neutralization reaction. Then, write out the balanced formula equation for the neutralization that occurs when sulfuric acid reacts with calcium hydroxide.

26. Explain how the combustion of fossil fuels can contribute to acid precipitation.

27. A few drops of the indicator bromothymol blue are added to two flasks containing pure water. Into one flask, solid Na2O is dissolved, and into the other flask, gaseous SO3 is dissolved. Identify the compounds that now exist in each flask and the colour of each of these solutions.

28. First, state how the reactivity of metal elements is based on their positions in the periodic table. Then, rank the following metals in order from most to least reactive: gold, cesium, calcium, sodium, and iron.

29. Identify four properties of the element carbon that, collectively, are responsible for the huge variety of organic compounds that exist.

30. Draw structural diagrams for the following organic molecules:

a) methane: CH4

b) ethane: C2H6

c) methanol: CH3OH

d) ethanol: C2H5OH

**Problem**

31. Complete the following table:

|  |  |  |
| --- | --- | --- |
| Name of Anion Present  in Acid | Chemical Formula of Acid | Acid Name |
| Sulfite |  |  |
| Perchlorate |  |  |
| Nitrate |  |  |
| Iodide |  |  |
| Chromate |  |  |
| Hypochlorite |  |  |

32. Complete the word equations for the following neutralization reactions (acid name + base name  salt name + water):

a) sulfuric acid + aluminum hydroxide  ? + water

b) chlorous acid + tin(IV) hydroxide  ? + water

c) hydrofluoric acid + strontium hydroxide  ? + water

d) acetic acid + chromium(III) hydroxide  ? + water

33. Write balanced formula equations for the following neutralization reactions:

a) H2SO4 + Ca(OH)2 ?

b) H3PO4 + LiOH  ?

c) H2CrO4 + Al(OH)3  ?

34. Various oxides are dissolved in water. Complete the following table concerning these oxides and their resulting aqueous solutions.

|  |  |  |
| --- | --- | --- |
| Oxide Formula | pH of Aqueous Solution (above or below 7) | Colour of Bromothymol Blue in Aqueous Oxide Solution |
| K2O |  |  |
| NO2 |  |  |
| SrO |  |  |
| SO3 |  |  |

35. Each of the salts listed below were produced by an acid and a base in a neutralization reaction. Identify the acid and the base that would have reacted together to produce each of the salts.

|  |  |  |
| --- | --- | --- |
| Salt Formula | Acid Formula | Base Formula |
| CaSO4 |  |  |
| AlCl3 |  |  |
| Na3PO4 |  |  |
| Sr(ClO3)2 |  |  |

36. Define the term “organic chemistry,” and list three important properties of the element on which this branch of chemistry is based.

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**Answer Section**

**MATCHING**

1. ***C***

2. ***A***

3. ***B***

4. ***B***

5. ***D***

6. ***C***

7. ***A***

8. ***B***

9. ***A***

10. ***E***

11. ***C***

12. ***D***

13. ***B***

14. ***C***

15. ***A***

16. ***D***

17. ***B***

18. ***E***

19. ***A***

20. ***C***

**SHORT ANSWER**

21. HCl(aq) is hydrochloric acid. The pH of this acidic solution will be below 7, and the bromothymol blue will turn yellow in it. As NaOH(aq) (sodium hydroxide) is a basic solution, the pH will be above 7, and the bromothymol blue will remain blue.

22.

|  |  |  |
| --- | --- | --- |
| Substance | pH Value | Relative Acidity/Basicity Compared to Pure Water |
| stomach acid | 1 | 106 or 1 000 000 times more acidic than pure water |
| apples | 3 | 104 or 10 000 times more acidic than pure water |
| black coffee | 5 | 102 or 100 times more acidic than pure water |
| pure water | 7 | neutral |
| baking soda | 9 | 102 or 100 times more basic than pure water |
| ammonia cleaner | 11 | 104 or 10 000 times more basic than pure water |
| drain cleaner | 13 | 106 or 1 000 000 times more basic than pure water |
|  |  |  |

23. The chemical formula for an acid is usually written with an *H* on the left-hand side of the formula. An example of an acid is HCl. The chemical formula for a base is usually written with an *OH* on the right-hand side of the formula. An example of a base is NaOH. A salt is an ionic compound whose cation is an ion other than H+ and whose anion is an ion other than OH-. An example of a salt is NaCl.

24. Binary acids (those containing only two elements) are named by using the prefix *hydro* and the suffix *ic*. An example of a binary acid is HCl, whose name is “hydrochloric” acid. Oxyacids containing an anion ending in *ate* employ the suffix *ic* in their names. An example is HNO3. As the anion is the “nitrate” ion, the acid name is “nitric” acid. Oxyacids containing an anion ending in *ite* employ the suffix *ous* in their names. An example is HNO2. As the anion is the “nitrite” ion, the acid name is “nitrous” acid.

25. The word equation for a neutralization reaction is: Acid + Base  Salt + Water. The formula equation for the neutralization that occurs when sulfuric acid reacts with calcium hydroxide is: H2SO4 + Ca(OH)2  CaSO4 + 2 H2O.

26. When fuels such as coal and gasoline are burned, they combine with oxygen to release non-metal oxides into the atmosphere. When these oxides dissolve in rainwater, they produce acidic compounds that fall as precipitation.

27. As the solution containing the dissolved Na2O now contains NaOH, it is basic, and the solution will appear blue. As the solution containing the dissolved SO3 now contains H2SO4, it is acidic, and the solution will appear yellow.

28. The most reactive metals appear on the left side of the periodic table, and their reactivity increases as one moves down a chemical family on the table. The metals mentioned above are listed here from most to least reactive: cesium, sodium, calcium, iron, and gold.

29. Carbon has four valence electrons and usually uses all four of them to complete its octet. Carbon can form single, double, or triple bonds with other elements when satisfying its octet. Carbon has a seemingly endless ability to stick to itself in chains and branched chains. Carbon can form rings with itself of many different sizes.

30. a)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | H |  |  |
|  |  | | |  |  |
| H | — | C | — | H |
|  |  | | |  |  |
|  |  | H |  |  |

b)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | H |  | H |  |  |
|  |  | | |  | | |  |  |
| H | — | C | — | C | — | H |
|  |  | | |  | | |  |  |
|  |  | H |  | H |  |  |

c)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | H |  |  |  |  |
|  |  | | |  |  |  |  |
| H | — | C | — | O | — | H |
|  |  | | |  |  |  |  |
|  |  | H |  |  |  |  |

d)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | H |  | H |  |  |  |  |
|  |  | | |  | | |  |  |  |  |
| H | — | C | — | C | — | O | — | H |
|  |  | | |  | | |  |  |  |  |
|  |  | H |  | H |  |  |  |  |

**PROBLEM**

31.

|  |  |  |
| --- | --- | --- |
| Name of Anion Present in Acid | Chemical Formula of Acid | Acid Name |
| sulfite | H2SO3 | sulfurous acid |
| perchlorate | HClO4 | perchloric acid |
| nitrate | HNO3 | nitric acid |
| iodide | HI | hydroiodic acid |
| chromate | H2CrO4 | chromic acid |
| hypochlorite | HClO | hypochlorous acid |

32. a) sulfuric acid + aluminum hydroxide  aluminum sulfate+ water

b) chlorous acid + tin(IV) hydroxide  tin(IV) chlorite + water

c) hydrofluoric acid + strontium hydroxide  strontium fluoride + water

d) acetic acid + chromium(III) hydroxide  chromium(III) acetate + water

33. a) H2SO4 + Ca(OH)2  CaSO4 + 2 H2O

b) H3PO4 + 3 LiOH  Li3PO4 + 3 H2O

c) 3 H2CrO4 + 2 Al(OH)3  Al2(CrO4)3 + 6 H2O

34.

|  |  |  |
| --- | --- | --- |
| Oxide Formula | pH of Aqueous Solution (above or below 7) | Colour of Bromothymol Blue in Aqueous Oxide Solution |
| K2O | above 7 | blue |
| NO2 | below 7 | yellow |
| SrO | above 7 | blue |
| SO3 | below 7 | yellow |

35.

|  |  |  |
| --- | --- | --- |
| Salt Formula | Acid Formula | Base Formula |
| CaSO4 | H2SO4 | Ca(OH)2 |
| AlCl3 | HCl | Al(OH)3 |
| Na3PO4 | H3PO4 | NaOH |
| Sr(ClO3)2 | HClO3 | Sr(OH)2 |

36. Organic chemistry is the study of compounds containing carbon. Special properties of carbon can include:

i) the use of all available valence electrons to complete its octet

ii) the ability to complete its octet by forming single bonds, double bonds, triple bonds, or combinations of these bonds

iii) the ability to stick to itself in chains of virtually any length, both straight and branched

iv) the ability to form rings of carbon atoms of many sizes

v) the ability to form cage-like carbon structures