Each question is worth 5 points. Choose the BEST answer for each question.

1.   The acetate ion is:

     a. CH_2COO^-

     b. CH_2COO^{2-}

     c. CH_3COO^-

     d. CH_3CO^-

     e. CH_3COO^{2-}

2.   Which of the following anions has a –1 charge?

     a.   cyanide ion

     b.   nitrate ion

     c.   carbonate ion

     d.   **a and b**

     e.   **all of the above**

3.   Cobalt (II) phosphide has the formula:

     a. $Co_3(PO_4)_2$

     b. Co_2PO_4

     c. CoP_2

     d. Co_2P_3

     e. Co_3P_2

4.   What is the oxidation number of phosphorus in P_4O_6?

     a.   –3

     b.   –2

     c.   +3

     d.   +5

     e.   +12

5.   Which of the following salts is **not soluble** in water?

     a.   KF

     b. $Ba(NO_3)_2$

     c.   silver nitrate

     d.   copper (II) fluoride

     e.   rubidium bicarbonate

6.   The total number of valence electrons in the nitrosyl ion, NO^+ is:

     a.   10

     b.   11

     c.   15

     d.   16

     e.   30

7.   Sulfurous acid, the acid that is related to the SO_3^{2-} ion, has the formula:

    a. HSO_4

    b. H_2SO_3

    c. H_2SO_4

    d. HSO_3

    e. H_3SO_3

8.   The molar mass of sodium oxide is about

    a.   19 g/mol.

    b.   30 g/mol.

    c.   39 g/mol.

    d.   62 g/mol.

    e.   85 g/mol.

9.   Which property **could** describe a covalent compound?

    a.   It is a gas at room temperature.

    b.   It conducts electricity when melted.

    c.   It is composed of a metal and a nonmetal.

    d.   It is a solid with a very high melting point.

    e.   **none of the above**

10.   Which of the following compounds is electron deficient?

    a. SO_2

    b. CCl_4

    c. PF_5

    d. PCl_3

    e. BCl_3

11.   One of the following compounds is incorrectly named. Which one is wrong?

    a. Cl_2O_7 dichlorine heptoxide

    b. $CaCl_2$ calcium chloride

    c. $FeSO_4$ iron (II) sulfate

    d. CuS copper (II) sulfide

    e. Cu_2CO_3 copper (II) carbonate

12.   How much $Ca(NO_3)_2$ should be weighed out to have 0.650 mol?

    a.   66.4 g

    b.   97.6 g

    c.   107 g

    d.   133 g

    e.   165 g

13. The combination of ions that will **NOT** produce a precipitate is:

    a. Sr^{2+} and phosphate ion

    b. Pb^{2+} and carbonate ion

    c.   silver ion and Br^-

    d.   barium ion and SO_4^{2-}

    e.   barium ion and bromide ion

14. How many single, covalent bonds are present in CH_2CH_2?

    a.   3

    b.   4

    c.   5

    d.   6

    e.   7

15. An element (valence shell configuration is ns^2np^4) forms a compound with a halogen. How many halogen atoms would be bonded to the element? Note: Assume that the central atom does **NOT** violate the octet rule.

    a.   7

    b.   6

    c.   4

    d.   2

    e.   1

16. In the following pairs of molecules, which group contains one molecule that is polar and one molecule that is non-polar?

    a. CS_2 and H_2S

    b. HF and H_2O

    c. CS_2 and CBr_4

    d. CH_4 and CF_4

    e. BI_3 and I_2

17. Which of the following equations is **NOT** correctly balanced?

    a. $2\ HI\ +\ FrOH\ \rightarrow\ H_2O\ +\ 2\ FrI$

    b. $3\ AgNO_3\ +\ (NH_4)_3PO_4\ \rightarrow 3\ NH_4NO_3\ +\ Ag_3PO_4$

    c. $V_2O_5\ +\ 2\ H_2 \rightarrow V_2O_3\ +\ 2\ H_2O$

    d. $CH_4\ +\ 2\ O_2\ \rightarrow\ CO_2\ +\ 2\ H_2O$

    e. $2\ SO_2\ +\ O_2\ \rightarrow\ 2\ SO_3$

18. Three moles of ethane (C_2H_6) and three moles of methane (CH_4)

 a.   have the same mass in grams.

 b.   contain the same number of molecules.

 c.   contain the same number of carbon atoms.

 d.   **a and b**

 e.   **b and c**

19. Write and balance the equation for the combustion of $C_{11}H_{18}O_4$.
     When correctly balanced, the sum of all of the coefficients is:

 a.   34
 b.   39
 c.   48
 d.   49
 e.   69

20. Which are spectator ions in the reaction shown here?

$$RbOH \ (aq) \ + \ HBr \ (aq) \ \rightarrow \ RbBr \ (aq) \ + \ H_2O \ (l)$$
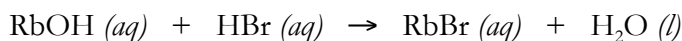
 a. Br^- only
 b. Rb^+ only
 c. H^+ only
 d. OH^- **and** Rb^+
 e. Br^- **and** Rb^+

21. How many oxygen atoms are there in 2.0 moles dinitrogen trioxide?

 a. 1.2×10^{24}
 b. 1.8×10^{24}
 c. 3.0×10^{24}
 d. 3.6×10^{24}
 e. 6.0×10^{25}

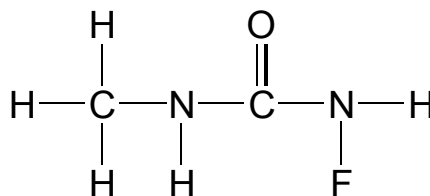22. SCl_5Br has sulfur as the central atom. This molecule is

 a.   an octahedral molecule with $\mu = 0$.

 b.   an octahedral molecule with $\mu \neq 0$.

 c.   a trigonal bipyramidal molecule with $\mu = 0$.

 d.   a trigonal bipyramidal molecule with $\mu \neq 0$.

 e.   a classic example of a nonpolar AB_6 molecule.

23. In addition to water, which of the following is the correct formula for a product of the reaction of perchloric acid, $HClO_4$, with sodium hydroxide?

 a. $NaCl$
 b. $NaClO_3$
 c. $NaClO_4$
 d. Na_2HClO_4
 e. $Na_2H_2ClO_5$

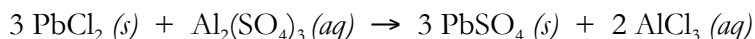24. What is the approximate nitrogen–carbon–nitrogen bond angle in the molecule shown here?

a. 60°
b. 90°
c. 109°
d. 120°
e. 180°

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-N-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{}{\underset{\underset{\displaystyle F}{|}}{N}}-H$$

25. What is the approximate fluorine-nitrogen-carbon bond angle in the molecule shown in **question 24**?

a. 60°
b. 90°
c. 109°
d. 120°
e. 180°

Refer to the reaction shown below for questions 26 - 28.

$$3\ PbCl_2\ (s)\ +\ Al_2(SO_4)_3\ (aq)\ \rightarrow\ 3\ PbSO_4\ (s)\ +\ 2\ AlCl_3\ (aq)$$

26. Assuming excess aluminum sulfate is available, how many moles of aluminum chloride can be formed from 4.5 moles of $PbCl_2$?

a. 0.33 mol

b. 1.5 mol

c. 3.0 mol

d. 6.8 mol

e. 9.0 mol
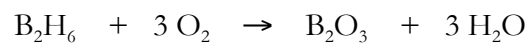
27. How many moles of aluminum sulfate are needed to produce 2.4 moles of $PbSO_4$?

a. 0.80 mol

b. 1.2 mol

c. 1.3 mol

d. 1.9 mol

e. 7.2 mol

28. How many moles of $Al_2(SO_4)_3$ are needed to completely react with 100.7 g of lead (II) chloride?

a. 0.12 mol

b. 1.1 mol

c. 33.6 mol

d. 0.36 mol

e. 3.2 mol

29.   The reaction shown here is an example of which type of reaction?

$$B_2H_6 \ + \ 3\,O_2 \ \rightarrow \ B_2O_3 \ + \ 3\,H_2O$$

a.   combustion reaction

b.   redox reaction

c.   acid-base neutralization reaction

d.   **a and b**

e.   **all of the above**

30.   In the chemical equation shown here, how many moles of phosphoric acid can be produced if 10.0 g of water and 0.350 mol of P_4O_{10} are combined?

$$6\,H_2O \ (l) \ + \ P_4O_{10} \ (s) \rightarrow \ 4\,H_3PO_4 \ (aq)$$
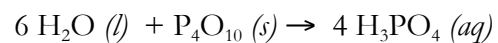
a.   0.233 mol

b.   0.370 mol

c.   1.40 mol

d.   2.22 mol

e.   6.67 mol