CP Chemistry
Chapter 8 Test

Name: Key

What is the molar mass of the following compounds? Be sure to include units! (4 points each)

1. NaCl Na 22.990 x 1 = 22.990
Cl 35.453 x 1 = 35.453
+
58.443 g/mol

2. $H_2S$ H 1.0079 x 2 = 2.0158
S 32.065 x 1 = 32.065
+
34.0808 g/mol

3. $Fe_3(PO_4)_2$
Fe 55.845 x 3 = 167.535
P 30.974 x 2 = 61.948
O 15.999 x 8 = 127.992
+
357.475 g/mol

4. $(NH_4)_2S$
N 14.007 x 2 = 28.014
H 1.0079 x 8 = 8.0632
S 32.065 x 1 = 32.065
68.1422 g/mol

What is the empirical formula for the following molecular formulas (3 points each)

5. $SO_2$ $SO_2$

6. $C_2H_4$ $CH_2$

7. $C_3H_8$ $C_3H_8$

8. $C_6H_{12}$ $CH_2$

Answer the following questions. Be sure to include units in your answer! (5 points each)

9. How many atoms are in 29.4 amu of calcuim? 40.078 amu = 1 atom Ca
$\frac{29.4 \text{ amu}}{40.078 \text{ amu}} \times \frac{1 \text{ atom}}{} = 0.734 \text{ atoms}$

10. How many atoms are in 489 amu of sulfur? 32.065 amu = 1 atom S
$\frac{489 \text{ amu}}{32.065 \text{ amu}} \times \frac{1 \text{ atom}}{} = 15.3 \text{ atoms}$

11. How many atoms in 12.9 moles of lithium? $6.022 \times 10^{23}$ atoms = 1 mole
$\frac{12.9 \text{ moles}}{1 \text{ mol}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{} = 7.77 \times 10^{24} \text{ atoms}$

12. How many atoms in 895 moles of lithium? $6.022 \times 10^{23}$ atoms = 1 mole
$\frac{895 \text{ moles}}{1 \text{ mole}} \times \frac{6.022 \times 10^{23} \text{ atoms}}{} = 5.39 \times 10^{26} \text{ atoms}$

13. How many moles are in 35.9 grams of zinc? $65.39\ g = 1\ mole$

$$35.9\ g\ Zn \left| \frac{1\ mole}{65.39\ g} \right. = 0.549\ mole\ Zn$$

14. How many moles are in 5.90 grams of helium? $4.0026\ g = 1\ mole$

$$5.90\ g\ He \left| \frac{1\ mole}{4.0026\ g} \right. = 1.47\ mole\ He$$

15. How many moles are present if there are $1.7 \times 10^{27}$ atoms of lithium? $6.022 \times 10^{23}\ atoms = 1\ mole$

$$1.7 \times 10^{27}\ atoms \left| \frac{1\ mole}{6.022 \times 10^{23}\ atoms} \right. = 2823\ moles\ Li$$

16. How many moles are present if there are $5.7 \times 10^{15}$ atoms of sodium? $6.022 \times 10^{23}\ atoms = 1\ mole$

$$5.7 \times 10^{15}\ atoms \left| \frac{1\ mole}{6.022 \times 10^{23}\ atoms} \right. = 9.465 \times 10^{-9}\ mole$$

17. How many grams are in 278 amu of carbon? $1.66 \times 10^{-24}\ g = 1\ amu$

$$278\ amu \left| \frac{1.66 \times 10^{-24}\ g}{1\ amu} \right. = 4.61 \times 10^{-22}\ g$$

$1.66 \times 10^{-24}\ g = 1\ amu$

18. How many grams are in 893 amu of sufur?

$$893\ amu \left| \frac{1.66 \times 10^{-24}\ g}{1\ amu} \right. = 1.48 \times 10^{-21}\ g$$

19. How many molecules of $CF_4$ are in 15 moles of $CF_4$? $6.022 \times 10^{23}\ molecules = 1\ mole$

$$15\ mole \left| \frac{6.022 \times 10^{23}\ molecules}{1\ mole} \right. = 9.033 \times 10^{24}\ molecules$$

20. How many molecules of $BaF_2$ are in 15 moles of $BaF_2$? $6.022 \times 10^{23}\ molecules = 1\ mole$

$$15\ moles \left| \frac{6.022 \times 10^{23}\ molecules}{1\ mole} \right. = 9.033 \times 10^{24}\ molecules$$

21. How many moles of $CF_4$ do I have if I have $5.98 \times 10^{27}$ molecules of $CF_4$? $6.022 \times 10^{23}\ molecules = 1\ mole$

$$5.98 \times 10^{27}\ molecules \left| \frac{1\ mole}{6.022 \times 10^{23}\ molecules} \right. = 9.93 \times 10^{3}\ moles$$

22. How many moles of $BaF_2$ do I have if I have $3.67 \times 10^{5}$ molecules of $BaF_2$? $6.022 \times 10^{23}\ molecules = 1\ mole$

$$3.67 \times 10^{5}\ molecules \left| \frac{1\ mole}{6.022 \times 10^{23}\ molecules} \right. = 6.09 \times 10^{-19}\ moles$$

Answer the following questions. Be sure to include units in your answer! (6 points each)

23. What is the mass in grams of 23.5 moles of $CF_4$?

C 12.011 x 1 = 12.011
F 18.998 x 4 = 75.992
88.003

88.003 g = 1 mole

$23.5 \text{ moles} \left| \frac{88.003 \text{ g}}{1 \text{ mole}} \right. = 2068 \text{ g } CF_4$

24. What is the mass in grams of 8.90 moles of $BaF_2$?

175.326 g = 1 mole

Ba 137.33 x 1 = 137.33
F 18.998 x 2 = 37.996
175.326

$8.9 \text{ moles} \left| \frac{175.326 \text{ g}}{1 \text{ mole}} \right. = 1560 \text{ g } BaF_2$

25. How many atoms are in 14.0 grams of silver

107.87 g = 1 mole, 1 mole = $6.022 \times 10^{23}$ atoms

$14 \text{ g Ag} \left| \frac{1 \text{ mole}}{107.87 \text{ g}} \right. = 0.129785853 \text{ moles} \left| \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mole}} \right. = 7.82 \times 10^{22} \text{ atoms}$

26. How many atoms are in 289.9 grams of sodium?

22.990 g = 1 mole, 1 mole = $6.022 \times 10^{23}$ atoms

$289.9 \text{ g Na} \left| \frac{1 \text{ mole}}{22.99 \text{ g}} \right. = 12.60983036 \text{ moles} \left| \frac{6.022 \times 10^{23} \text{ atoms}}{1 \text{ mole}} \right. = 7.594 \times 10^{24} \text{ atoms}$

27. How many grams do $4.3 \times 10^{20}$ atoms of boron weigh?

$6.022 \times 10^{23}$ atoms = 1 mole 10.811 g = 1 mole

$4.3 \times 10^{20} \text{ atoms} \left| \frac{1 \text{ mole}}{6.022 \times 10^{23} \text{ atoms}} \right. = 0.000714048 \text{ mole} \left| \frac{10.811 \text{ g}}{1 \text{ mole}} \right. = 0.0077196 \text{ g}$

28. How many grams do $1.8 \times 10^{29}$ atoms of silicon weigh?

$6.022 \times 10^{23}$ atoms = 1 mole 28.086 g = 1 mole

$1.8 \times 10^{29} \text{ atoms} \left| \frac{1 \text{ mole}}{6.022 \times 10^{23} \text{ atoms}} \right. = 2.989 \times 10^{5} \text{ mole} \left| \frac{28.086 \text{ g}}{1 \text{ mole}} \right. = 8.395 \times 10^{6} \text{ g}$

Calculate the percent composition for each element in the compound (6 points each)

29. $BaCrO_4$

Ba 137.33 x 1 = 137.33 ÷ 253.322 = .5421
Cr 51.996 x 1 = 51.996 ÷ 253.322 = .2053
O 15.999 x 4 = 63.996 ÷ 253.322 = .2526
253.322

Ba 54.21 %
Cr 20.53 %
O 25.26 %

30. $(NH_4)_2S$

N 14.007 x 2 = 28.014 ÷ 68.1422 = .4111
H 1.0079 x 8 = 8.0632 ÷ 68.1422 = .1183
S 32.065 x 1 = 32.065 ÷ 68.1422 = .4706
68.1422

N 41.11 %
H 11.83 %
S 47.06 %

31. $Ca_3(PO_4)_2$

Ca 32.13%
P 16.56%
O 51.31%

Ca 40.078 x 3 = 120.234 ÷ 374.17 = .3213
P 30.974 x 2 = 61.948 ÷ 374.17 = .1656
O 15.999 x 12 = 191.988 ÷ 374.17 = .5131

32. $Al_2(Cr_2O_7)_3$

Al 7.69%
Cr 44.45%
O 47.87%

Al 26.982 x 2 = 53.964 ÷ 701.919 = .07688
Cr 51.996 x 6 = 311.976 ÷ 701.919 = .4445
O 15.999 x 21 = 335.979 ÷ 701.919 = .4787

Solve the following problems: (10 points each)

33. If a compound contains 0.0938 grams of carbon and 0.00625 grams of hydrogen?

a. What is the empirical formula of the compound?

$\frac{.0938\text{ g C}}{12.011\text{ g/mole}} = \frac{0.0078095}{.006201} = 1.25 \times 4 = 5$

$\frac{.00625\text{ g H}}{1.00794\text{ g/mole}} = \frac{0.006201}{.006201} = 1 \times 4 = 4$

$C_5H_4$

b. If the molar mass of the compound is approximately 128 grams/mole, what's the molecular formula?

C 12.011 x 5 = 60.055
H 1.0079 x 4 = 4.0316
64.0866

$\frac{128}{64.0866} = 1.997 = 2$

$C_{10}H_8$

34. If a compound contains 7.908 grams of carbon, 0.554 grams of hydrogen and 1.538 grams of nitrogen ?

a. What is the empirical formula of the compound?

$\frac{7.908\text{ g C}}{12.011\text{ g/mole}} = \frac{0.6584}{.1098} = 5.996 = 6$

$\frac{.554\text{ g H}}{1.0079\text{ g/mole}} = \frac{0.5497}{.1098} = 5$

$\frac{1.538\text{ g N}}{14.007\text{ g/mole}} = \frac{0.1098}{.1098} = 1$

$C_6H_5N$

b. If the molar mass of the compound is approximately 273 grams/mole, what's the molecular formula?

C 12.011 x 6 = 72.066
H 1.0079 x 5 = 5.0395
N 14.007 x 1 = 14.007
91.1125

$\frac{273}{91.1125} = 2.996 = 3$

$C_{18}H_{15}N_3$

35. If a compound contains 40.00% carbon, 6.713% hydrogen, and 53.28% oxygen:

a. What is the empirical formula of the compound?

$\frac{40\text{ g C}}{12.011\text{ g}/1\text{ mole}} = \frac{3.330}{3.330} = 1$

$\frac{6.713\text{ g H}}{1.0079\text{ g}/1\text{ mole}} = \frac{6.660}{3.330} = 2$

$\frac{53.28\text{ g O}}{15.999\text{ g}/1\text{ mole}} = \frac{3.330}{3.330} = 1$

$CH_2O$

b. If the molar mass of the compound is approximately 180 grams/mole, what's the molecular formula?

C $12.011 \times 1 = 12.011$

H $1.0079 \times 2 = 2.0158$

O $15.999 \times 1 = 15.999$

$30.0258$

$\frac{180}{30.0258} = 5.99 = 6$

$C_6H_{12}O_6$

36. If a compound contains 49.99% carbon, 5.61% hydrogen, and 44.4% oxygen:

c. What is the empirical formula of the compound?

$\frac{49.99\text{ g C}}{12.011\text{ g}/1\text{ mole}} = \frac{4.162}{2.775} = 1.4998 = 1.5 \times 2 = 3$

$\frac{5.61\text{ g H}}{1.0079\text{ g}/1\text{ mole}} = \frac{5.566}{2.775} = 2 \times 2 = 4$

$\frac{44.4\text{ g O}}{15.999\text{ g}/1\text{ mole}} = \frac{2.775}{2.775} = 1 \times 2 = 2$

$C_3H_4O_2$

d. If the molar mass of the compound is approximately 72 grams/mole, what's the molecular formula?

C $12.011 \times 3 = 36.033$

H $1.0079 \times 4 = 4.0316$

O $15.999 \times 2 = 31.998$

$72.0626$

$\frac{72}{72.0626} = 0.999 = 1$

$C_3H_4O_2$