1. How many atoms are in 4 moles of iron?

$4 \times 6.02 \times 10^{23} = 2.4 \times 10^{24}$

2. What is the percentage by mass of oxygen in water? H_2O

$H_2 = 2 \times 1 = 2$

$O = 1 \times 16 = 16$

18

$\frac{16}{18} \times 100 = 89\%$

3. A compound is 57.5 % sodium, 40% oxygen and 2.5 % hydrogen. What is its empirical formula?

$57.5\text{g} \times \frac{1\text{mol}}{23\text{g Na}} = 2.5\text{mol Na}$

$2.5\text{g H} \times \frac{1\text{mol H}}{1\text{g H}} = 2.5\text{mol H}$

$40\text{g} \times \frac{1\text{mol O}}{16\text{g O}} = 2.5\text{mol O}$

1:1:1 ratio NaOH

4. A compound with an empirical formula of CH_2 has a molecular weight of 42. What is its molecular formula? C_3H_6

$C = 3 \times 12 = 36$

$H = 6 \times 1 = 6$

42

44.8

5. At STP ~~48~~ liters of neon would contain the same number of molecules as how many grams of Argon? What volume would the argon occupy?

$2\text{mol Ar} \times \frac{39.9\text{g Ar}}{1\text{mol Ar}} = 79.8\text{g Ar}$

$\cancel{48}\text{L Ne} \times \frac{1\text{mol Ne}}{22.4\text{L Ne}} = 2\text{mol Ne}$

44.8

Volume of Ar = 44.8L

6. Sodium and chlorine react to form sodium chloride. If 4 moles of chlorine react, how many moles of sodium chloride will form?

$2Na + Cl_2 \longrightarrow 2NaCl$

$4\text{mol } Cl_2 \times \frac{2\text{mol Na}}{1\text{mol } Cl_2} = 8\text{mol Na}$

7. How many liters of chlorine at STP would be needed to react with 92 grams of sodium?

$92\text{g Na} \times \frac{1\text{mol Na}}{23\text{g Na}} \times \frac{1\text{mol } Cl_2}{2\text{mol Na}} \times \frac{22.4\text{L}}{1\text{mol } Cl_2} = 44.8\text{L } Cl_2$

8. How many milliliters of chlorine were required in question 7?

$44.8\text{L} \times \frac{1000\text{mL}}{1\text{L}} = 44{,}800\text{mL } Cl_2$

9. Write and balance the equation for the combustion of butane.

$2C_4H_{10} + \cancel{6.5}\,^{13}O_2 \longrightarrow \cancel{4}\,^{8}CO_2 + \cancel{5}\,^{10}H_2O$

10. If 232.0 grams of butane are combined with 192 grams of oxygen and a reaction occurs, how many grams of water will form?

$232\text{g } C_4H_{10} \times \frac{1\text{mol } C_4H_{10}}{58\text{g } C_4H_{10}} \times \frac{10\text{ mol } H_2O}{2\text{mol } C_4H_{10}} \times \frac{18\text{g } H_2O}{1\text{ mol } H_2O} = 360\text{g } H_2O$

$192\text{g } O_2 \times \frac{1\text{mol } O_2}{32\text{g } O_2} \times \frac{10\text{mol } H_2O}{13\text{mol } O_2} \times \frac{18\text{g } H_2O}{1\text{mol } H_2O} = 83\text{g } H_2O$

11. If the reaction in number 9 was performed and 2 liters of carbon dioxide were produced at STP, what was the percent yield?

$2\text{L } CO_2 \times \frac{1\text{mol } CO_2}{22.4\text{L } CO_2} \times \frac{10\text{mol } H_2O}{8\text{mol } CO_2} \times \frac{18\text{g } H_2O}{1\text{mol } H_2O} = 2\text{g } H_2O$

$\frac{2\text{g } H_2O}{83\text{g } H_2O} \times 100 = 2.4\%$

12. Write and balance the equation for the reaction of aluminum with hydrochloric acid.

$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$

OR

$\frac{83\text{g } H_2O}{1} \times \frac{1\text{mol}}{18\text{g}} \times \frac{8\text{mol } CO_2}{10\text{mol } H_2O} \times \frac{22.4\text{L}}{1\text{mol}} = 83\text{L}$

$\frac{2\text{L}}{83\text{L}} \times 100 = 2.4\%$

13. If you are given 108 grams of aluminum to react with 146 grams of HCl, what will be the limiting reactant?

$108\text{g Al} \times \frac{1\text{mol Al}}{26.98\text{g Al}} \times \frac{3\text{mol } H_2}{2\text{mol Al}} \times \frac{2\text{g } H_2}{1\text{mol } H_2} = 12\text{g } H_2$

$146\text{g HCl} \times \frac{1\text{mol HCl}}{36.45\text{g HCl}} \times \frac{3\text{mol } H_2}{6\text{mol HCl}} \times \frac{2\text{g } H_2}{1\text{mol } H_2} = 4\text{g } H_2$

HCl is limiting reactant

760 mm Hg = 101.325 kPa

14. Convert 350 kPa to mm Hg.

$350\ kPa \times \frac{760\ mm Hg}{101.325\ kPa} = 2625.2\ mm Hg$

15. A sample of gas occupies 4 liters at 25 C and 200 kPa. What will its volume be at STP?

Standard
T = 0°C
P = 101.325 kPa

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ (V_1, T_1, P_1, V_2)

$\frac{4L \cdot 200kPa}{25°C+273K} = \frac{101.325kPa \cdot V_2}{0°C+273K}$

$2.7\frac{L\,kPa}{K} = 0.37\frac{kPa}{K} V_2$

$V_2 = 7.30\ L$

16. What is the volume of a 4 mole sample of He at 200 K and 102 kPa.

$R = 0.0821 \frac{L \cdot atm}{mol \cdot K}$ (n, T, P)

$PV = nRT$

$102\ kPa \times \frac{1\ atm}{101.325\ kPa} = 1\ atm$

$1\ atm\ (V) = (4\ mol)(0.0821\frac{L \cdot atm}{mol \cdot K})(200\ K)$

$V = 65.68\ L$

17. What is the mass of 2 liters of ammonia at 222 kPa and 125 C?

(? , V, P, T)

$PV = nRT$

$222\ kPa \times \frac{1\ atm}{101.325\ kPa} = 2.19\ atm$

$125 + 273 = 398$

$(2.19\ atm)(2L) = n\,(0.0821\frac{L \cdot atm}{mol \cdot K})(398\ K)$

$n = 0.13\ moles \times \frac{17g\ NH_3}{1\ mol\ NH_3} = 2.21g\ NH_3$

N - 14
H_3 - 3x1
17g

18. How does the volume of at gas relate to temperature? to Pressure?

V↑, T↑ V↑, P↓

19. How is temperature related to average kinetic energy?

Temperature is a measurement of average kinetic energy
kinetic energy is the average movement of molecules

20. What phase change does solid carbon dioxide (dry ice) undergo at 1 atm and 25 C?

sublimation -- change from a solid to a gas

21. Why do your ears "pop" when you go up a mountain?

air pressure decreases at higher altitudes -- if high pressure is inside the ear and low pressure outside the ear, air will tend to move out of the ear

22. Does a gas diffuse faster, or slower at a high temperature

faster - molecules move faster at higher temps

23. What is Boyle's law?

$P_1V_1 = P_2V_2$ P and V are inversely related

24. What is the molecular weight of a gas that has a mass of .5 grams in a volume of 1 liter at STP?

$PV=nRT$ $\quad \frac{PV}{RT}=n$ $\quad \frac{1atm \times 1L}{.0821\frac{Latm}{molK}\cdot 273K} = .045mol$ $\quad \frac{.5g}{.045mol} = 11.1g/mol$

25. If you dissolve salt in a beaker of water and the temperature goes up, was the solution process exothermic or endothermic? exothermic heat exits the system

26. How many joules of energy are released when 40 grams of water cool from 40 C to 20 C?

$Q=mC\Delta T$

$40g \times 4.18 J/g°C \times 20°C = 3344 J$

27. How many joules of energy are needed to melt 20 grams of water (ice) at its melting point. The heat of fusion of water is 80 cal/gram and 4.18 joules = 1 calorie.

$Q=mH_f$ $\quad \frac{80cal}{gram} \times \frac{4.18J}{1cal} = 334.4 J/g$

$20g \times 334.4 J/g$

$= \boxed{6688 J}$

28. 25 grams of a metal at 98 C are put into a container of 50.0 grams of water at 18 C. The temp. of the water rises to 25 C. What was the specific heat capacity of the metal? Cp water = 4.18 J/gC

Q_{water}

$Q=mC\Delta T$

$Q = 50g \times 4.18 \frac{J}{g°C} \times (25°C-18°C)$

$Q_w = 1463 J$

$Q_{water} = Q_{metal}$ $\quad Q=mC\Delta T$

$\frac{Q}{m\Delta T} = C$

$\frac{1463 J}{25g \times (25°C-98°C)}$ $\quad \boxed{C = .082 J/g°C}$

29. The ΔH for the combustion of ethane is –3120 kJ. If 100.0 grams are burned, what quantity of heat is released? $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O \quad \Delta H = -3120 kJ$

$\frac{100g\ C_2H_6}{1} \times \frac{1mol\ C_2H_6}{30g\ C_2H_6} \times \frac{-3120kJ}{2mol\ C_2H_6} = 5200 kJ$ heat released

or $-5200 kJ$

30. Was the reaction endothermic or exothermic?

exothermic

31. If 400.0 kJ of energy are put into 50 grams of water at 25 C, what will be the final temperature of the water?

make J

$Q = mC\Delta T$

$\Delta T = \frac{Q}{mC}$

$\Delta T = \frac{400000\,J}{50 \cdot 4.183\,J/g^{\circ}C} = 19.14$

$\Delta T = T_F - T_i$

$\Delta T + T_i = T_F$

$19.14 + 25 = 44.14\,K$

32. How do you determine whether a bond is ionic, polar covalent or non polar covalent?

e-transfer — e-sharing unequally (diff electroneg.) — e-sharing equally (similar electroneg)

33. What type of bond involves equal sharing of electrons?

non-polar covalent bond

34. How do the electronegativities of the atoms in a non-polar bond compare to each other?

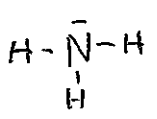
they are nearly the same

35. What is the formula of an ionic compound between magnesium and nitrogen? Mg_3N_2

36. How many double bonds are in the Lewis dot diagram of carbon dioxide?

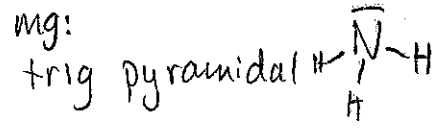
2 double bonds $\bar{O}=C=\bar{O}$

37. What is the electron domain geometry of ammonia (NH_3)?

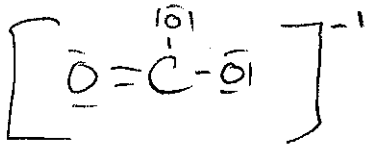


edg: Tetrahedral

mg: trig pyramidal



38. How many double bonds are in the carbonate ion (CO_3^{-2})



One

valence e⁻s

C - 4 x 1 = 4

O - 3 x 6 = 18

22

+ 2

24

39. If two molecules are similar in size, would a polar or a non-polar molecule evaporate faster?

polar molecules stick together more, non-polar molecules evaporate faster

40. Between non-polar molecules, do big molecules or small molecules stick together better?

big molecules stick together better, more LDFs.

41. What is an unsaturated hydrocarbon?

A hydrocarbon with a double or triple bond

42. What four elements would you expect to find in an amine?

C, H, N

43. What functional group would you expect to find in propanol?

"ol" OH

44. Differentiate between alkanes, alkenes and alkynes.

alkane - all single bonds
alkene - one double bond between 2 carbons
alkyne - one triple bond between 2 carbons

45. How many moles are in 4 liters of 4 M NaOH?

$\text{Molarity (M)} = \frac{\text{moles}}{\text{volume}}$ $4\,M = \frac{\text{moles}}{4L}$ moles = 16 moles NaOH

46. What is the molarity of a solution containing 120 grams of NaOH in 4 liters of solution?

$120\,g\,NaOH \times \frac{1\,mol\,NaOH}{40\,g\,NaOH} = 3\,mol\,NaOH$

$M = \frac{3\,mol\,NaOH}{4L}$

M = 0.75 M NaOH

47. What is the pH range of a base?

7 > 14

48. What is the pH of a solution with a hydronium ion concentration of .0001 M?

$pH = -\log[H_3O^+]$ $pH = -\log[.0001]$ pH = 4

49. How do you identify a base by looking at a chemical formula?

OH hydroxide ions!

example NaOH

50. If 25 ml of acid HA are required to neutralize 35 ml of .2 M NaOH, what was the molarity of the acid?

$HA + NaOH \rightarrow NaA + HOH$

$M = \frac{moles}{volume}$

$0.2M\ NaOH = \frac{moles}{0.035L}$ moles = 0.007 mol NaOH also 0.007 mol HA

$M = \frac{0.007 mol\ HA}{0.025\ L}$

$M = 0.28M\ HA$

51. What do acids donate to bases?

a proton

52. What is an electrolyte?

A solution that contains ions

53. What is equilibrium?

Two processes occuring in opposite directions at equal rates

54. How do equilibrium systems differ from the chemical reactions that we studied for most of the year?

equilibrium reactions don't completely react

55. For the reaction A + B <-> C, What effect will an increase in B have on A and C?

↑ → more C and less of A

move away from an increase

56. When metals combine with oxygen, what does their charge go up, or down?

metals lose e^- so they have a positive charge

charge goes up

57. In the reaction between chlorine and sodium iodide, what reactant is oxidized? OIL RIG

$\underset{0}{Cl_2} + \underset{+1\ -1}{NaI} \rightarrow \underset{+1\ -1}{NaCl} + \underset{0}{I_2}$

Iodine is oxidized - loses an electron - charge goes up

58. What type particle can be accelerated in a magnetic field?

a charged particle

59. When salt is put into water, what effect does it have on the liquid range of the water?

freezing/melting point is lowered and boiling point is raised

60. What is the difference between nuclear fusion and nuclear fission?

fusion - two atoms become one

fission - splitting of atoms