ANSWER KEY

Density

You have a 23.6 g piece of gallium with a volume of 4.0 cm3. Calculate the density of gallium.

$D = \frac{m}{V}$

$D = \frac{23.6\,g}{4.0\,cm^3}$

$\boxed{D = 5.9\ g/cm^3}$

Density

You have a 3.6 g piece of nickel. What is the volume of your piece? (use Table S to find density)

$D = \frac{m}{V}$ $V = \frac{m}{D}$

$V = \frac{3.6\,g}{8.902\,g/cm^3}$

$\boxed{V = 0.4\,cm^3}$

Density

You have 12.4 ml of bromine. What is the mass of your sample? (use Table S to find density)

$D = \frac{m}{V}$ $m = D \cdot V$

$m = (3.122\,g/cm^3)(12.4\,ml)^*$

$\boxed{m = 38.7\,g}$

$^* 1\,ml = 1\,cm^3$

Percent Error

A student calculated the density of iron to be 7.204. What is the student's percent error? (use Table S to find density)

$\%\,err = \frac{meas.\ value - accep.\ value}{accep.\ value} \times 100$

$\%\,err = \frac{7.204\,g/cm^3 - 7.874\,g/cm^3}{7.874\,g/cm^3} \times 100$

$\boxed{\%\,err = -8.5\%}$

Temperature

A student heats water to a temperature of 69.8 °C. How many degrees Kelvin is this?

$K = °C + 273$

$K = 69.8°C + 273$

$\boxed{K = 342.8K}$

Temperature

A sample of gas is heated to 401K. How many degrees Celsius is this?

$K = °C + 273$

$401K = °C + 273$

$-273 \quad -273$

$\boxed{128°C = °C}$

% Composition by Mass

A penny has a total mass of 3.1g. Zinc makes up 2.9 g of the penny. What is the % by mass of zinc in the penny?

$\%\,comp. = \frac{mass\ part}{mass\ whole} \times 100$

$\%\,comp = \frac{2.9g}{3.1g} \times 100$

$\boxed{\%\,comp = 93.5\%}$

% Composition by Mass

C_3H_6 has a total mass of 42 g. What is the % composition by mass of carbon in the compound?

3 carbon atoms = $3 \times 12g = 36g$

$\%\,comp. = \frac{mass\ part}{mass\ whole} \times 100$

$\%\,comp. = \frac{36g}{42g} \times 100$

$\boxed{\%\,comp = 85.7\%}$

Parts Per Million

What is the concentration, in parts per million, of dissolved oxygen in a pond if a sample has 3.5 g of O_2 in every 147.1 g of pond water?

$ppm = \frac{grams\ solute}{grams\ solution} \times 1000000$

$ppm = \frac{3.5g}{147.1g} \times 1000000$

$\boxed{ppm = 23{,}793\ ppm}$

Combined Gas Law

A sample of gas has a volume of 12L at 273K and 187.5 kPa. What will be the new volume when the pressure is changed to 300kPa and the temp. is changed to 375K.

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{(187.5\,kPa)(12L)}{273K} = \frac{(300kPa)(V_1)}{375\,K}$

$\boxed{V_1 = 10.3L}$

Combined Gas Law

A sample of gas at 101.3 kPa has a volume of 4.5L and a temp. of 86.2 °C. If the pressure is increased to 116 kPa and the volume is decreased to 3.5L, what will the new temp. be?

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $(86.2°C = 359.2\,K)$

$\frac{(101.3kPa)(4.5L)}{359.2K} = \frac{(116kPa)(3.5L)}{T_2}$

$\boxed{T_2 = 319.9K}$

Combined Gas Law

A sample of gas has a volume of 6L and a pressure of 1.5atm. If the pressure is increased to 2.0 atm, what will the new volume be?

$P_1V_1 = P_2V_2$ (Temp. not changing, so take out of equation)

$\frac{(1.5atm)(6L)}{2.0atm} = \frac{(2.0atm)(V_2)}{2.0atm}$

$\boxed{4.5L = V_2}$

Weighted Atomic Mass

Boron has 2 natural isotopes: ^{10}B (10.013 amu) has 19.9% abundance, and ^{11}B (11.009 amu) has 80.1% abundance. Calculate the weighted atomic mass of Boron.

^{10}B $10.013 \times 0.199 = 1.993$

^{11}B $11.009 \times 0.801 = 8.818$ +

$\boxed{10.811\ amu}$

Empirical Formula

What is the empirical formula of a compound that is 40% sulfur and 60% oxygen by weight? (hint: use a 100g sample to calculate)

$40g\,S \times \left[\frac{1mol}{32g}\right] = 1.25mol\,S$

$60g\,O \times \left[\frac{1mol\,O}{16g\,O}\right] = 3.75mol\,O$

$1.25 : 3.75$

$1 : 3 \rightarrow \boxed{SO_3}$

Empirical Formula

A hydrocarbon has a gram formula mass of 86 g/mol. What is the molecular formula of this compound? And, what is the empirical formula?

Carbon - $12g \times 6 = 72g$

Hydrogen - $1g \times 14 = 14g$ +

$86g$

Molecular = C_6H_{14}

Empirical = C_3H_7

Titration

A 25 mL solution of 0.5 M NaOH is titrated until neutralized into a 50 mL sample of HCl. What is the concentration of the HCl?

$M_A V_A = M_B V_B$

$\frac{(M_A)(50\,mL)}{50\,mL} = \frac{(0.5\,M)(25\,mL)}{50\,mL}$

$M_A = 0.25M$

Radioactive Decay

A sample of ^{14}C has a half life of 5730 years. How many half lives have elapsed after 14,000 years?

$\#\text{half lives} = \frac{t}{T}$

$\#\text{half lives} = \frac{14{,}000\,yrs}{5730\,yrs}$

#half lives = 2.44

Radioactive Decay

The half life of ^{233}U is 1.62×10^5 years. How much time has elapsed after 2.5 half lives?

$\#\text{half lives} = \frac{t}{T}$

$2.5\text{ half lives} = \frac{t}{1.62\times10^5\,yrs}$

$t = 405{,}000\,yrs$

or

$4.05 \times 10^5\,yrs$

Heat

How much heat is required to melt a 45.8 g sample of ice?

$Q = m H_f$

$Q = (45.8g)(334\,J/g)$

Q = 15,297 J

Heat

If 42,000 J is required to vaporize a sample of water, what was the mass of the water?

$Q = m H_v$

$\frac{42{,}000\,J}{2260\,J/g} = \frac{m(2260\,J/g)}{2260\,J/g}$

18.6g = m

Heat

How much heat is required to raise the temperature of 5.9 g of water from 50 °C to 80 °C?

$Q = mc\Delta T$

$Q = (5.9g)(4.18\,J/g\cdot{}^\circ C)(30^\circ C)$

Q = 739.9 J

Heat

If 9500 joules are added to 50g of liquid water at 20 °C, what will be the new temperature of the water?

$Q = mc\Delta T$

$9500\,J = (50g)(4.18\,J/g\cdot{}^\circ C)(\Delta T)$

$45.5^\circ C = \Delta T$

$20^\circ C + 45.5^\circ C = 65.5^\circ C$

Heat

How much heat will be liberated (given off) if 60g of water is cooled from 80 °C to 65 °C?

$Q = mc\Delta T$

$Q = (60g)(4.18\,J/g\cdot{}^\circ C)(15^\circ C)$

Q = 3762 J

Heat

If a piece of hot metal is put into a 100g sample of liquid water at 25 °C, and the temperature of the water rises until it reaches 32 °C, how much heat energy did the metal lose?

Heat gained = Heat lost

$Q = mc\Delta T$

$Q = (100g)(4.18\,J/g\cdot{}^\circ C)(7^\circ C)$

Q = 2926 J

Metric Conversion

A piece of glass tubing is 4.6m long. How many mm is this?

$4.6\,m \times \left[\frac{1000\,mm}{1\,m}\right] = 4600\,mm$

Express your answer in proper scientific notation:

$4.6 \times 10^3\,mm$

Metric Conversion

A liquid has a volume of 35.4 mL. How many liters is this?

$35.4\,mL \times \left[\frac{1\,L}{1000\,mL}\right] = 0.0354\,L$

Metric Conversion

A gardener buys a 2.50 kg bag of fertilizer. How many grams is this?

$2.50\,kg \times \left[\frac{1000\,g}{1\,kg}\right] = 2500\,g$

Metric Conversion

The pressure of a gas is recorded as 55,601 Pascals. How many kPa is this?

$55601\,Pa \times \left[\frac{1\,kPa}{1000\,Pa}\right] = 55.6\,kPa$

Metric Conversion

A chemist has 0.75 mg of mercury. How many grams is this?

$0.75\,mg \times \left[\frac{1\,g}{1000\,mg}\right] = 0.00075\,g$

Express your answer in proper scientific notation:

$7.5 \times 10^{-4}\,g$

Metric Conversion

If the density of liquid water is 1 g/cm^3, and 1ml = $1cm^3$, what is the mass of 200ml of water?

$200\,ml = 200\,cm^3$

$200\,cm^3 \times \left[\frac{1\,g}{1\,cm^3}\right] = 200\,g$

Pressure Conversion

A pressure of 154.7 kPa is equal to how many atmospheres?

$154.7\,kPa \times \left[\frac{1\,atm}{101.3\,kPa}\right] = 1.53\,atm$

* Table A

Pressure Conversion

A pressure of 3.6 atm is equal to how many kPa?

$3.6\,atm \times \left[\frac{101.3\,kPa}{1\,atm}\right] = 364.7\,kPa$

Molar Mass/Gram Formula Mass

Calculate the gram formula mass of H_2SO_4.

H: $2 \times 1g = 2g$

S: $1 \times 32g = 32g$

O: $4 \times 16g = 64g$ +

$98\,g/mole$

Molar Mass/Gram Formula Mass

How many grams are in one mole of $Ca(NO_3)_2$?

Ca: $1 \times 40 = 40\,g$

N: $2 \times 14 = 28\,g$

O: $6 \times 16 = 96\,g$ +

$164\,g/mole$

Gram → Mole Conversions

If you have 372.6 grams of C_2H_8N, how many moles is this?

Gram Form. Mass $C_2H_8N = 46\,g/mole$

$372.6\,g\,C_2H_8N \times \left[\frac{1\,mole\,C_2H_8N}{46\,g\,C_2H_8N}\right] = 8.1\,mol\,C_2H_8N$

Gram → Mole Conversions

How many moles is a 43.9 gram sample of $Al_2(SO_4)_3$?

Gram Form. Mass $Al_2(SO_4)_3 = 342\,g/mol$

$43.9\,g\,Al_2(SO_4)_3 \times \left[\frac{1\,mol}{342\,g}\right] = 0.128\,mol\,Al_2(SO_4)_3$

Mole → Gram Conversions

A chemist wants to measure out exactly 5 moles of Magnesium. How many grams is this?

$5\,mol\,Mg \times \left[\frac{24.3\,g\,Mg}{1\,mol\,Mg}\right] = 121.5\,g\,Mg$

Mole → Gram Conversions

If I want exactly 1.567 moles of Fe_2O_3, how many grams would I measure out on a balance?

Gram Form. Mass $Fe_2O_3 = 160\,g/mol$

$1.567\,mol\,Fe_2O_3 \times \left[\frac{160\,g}{1\,mol}\right] = 250.7\,g\,Fe_2O_3$

Mole → Mole Ratios

How many moles of oxygen react with 2.4 moles of iron in this reaction?

$4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

$2.4\,mol\,Fe \times \left[\frac{3\,mol\,O_2}{4\,mol\,Fe}\right] = 1.8\,mol\,O_2$

Mole → Mole Ratios

In this reaction, what is the ratio of moles of oxygen used to moles of CO2 produced?

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{2(g)}$

$1\,mol\,O_2 : 2\,mol\,CO_2$

1:2

Mole → Mole Ratios

How many moles of aluminum are needed to react completely with 1.2 mole of FeO?

$2Al_{(s)} + 3FeO_{(s)} \rightarrow 3Fe_{(s)} + Al_2O_{3(s)}$

$1.2\,mol\,FeO \times \left[\frac{2\,mol\,Al}{3\,mol\,FeO}\right] = 0.8\,mol\,Al$

Mole → Mole Ratios

How many *grams* of hydrogen are needed to react with 3.2 moles of P_4?

$P_{4(g)} + 6H_{2(g)} \rightarrow 4PH_{3(g)}$

$3.2\,mol\,P_4 \times \left[\frac{6\,mol\,H_2}{1\,mol\,P_4}\right] = 19.2\,mol\,H_2$

$19.2\,mol\,H_2 \times \left[\frac{2\,g\,H_2}{1\,mol\,H_2}\right] = 38.4\,g\,H_2$

Molarity

What is the molarity of a solution that has 4.5 moles of NaCl dissolved into water to make 500ml of solution?

$M = \frac{moles\,solute}{liters\,solution}$

$M = \frac{4.5\,mol\,NaCl}{0.5\,L}$

$M = 9\,\frac{mol}{L}$ or 9M

Molarity

How many moles of KCl will we need to make 2L of a 3.0M solution?

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

$3.0\,M = \frac{moles}{2\,L}$

6 moles

How many grams of KCl is this?

$6\,mol\,KCl \times \left[\frac{74.5\,g\,KCl}{1\,mol\,KCl}\right] = 447\,g\,KCl$

Molarity

What is the volume of a 4.0M solution of HCl made with 35.8 g of HCl?

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

$4.0\,M = \frac{0.98\,mol}{L}$

0.245 L

$35.8\,g\,HCl \times \left[\frac{1\,mol\,HCl}{36.5\,g\,HCl}\right] = 0.98\,mol\,HCl$