

Formula Sheet

Order of Operations

$$ac + bc = c(a + b)$$

exponents

$$a^n a^m = a^{n+m}$$

$$(a^n)^m = a^{nm}$$

$$(ab)^n = a^n b^n$$

$$a^0 = 1$$

$$a^{-n} = \frac{1}{a^n}$$

radicals

$$a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

Unit Conversions

angles

$$2\pi = 6.28 \text{ rad} = 360^\circ$$

mass

$$1 \text{ kg} = 2.2 \text{ lbs.}$$

lengths

$$1 \text{ mile} = 1.6 \text{ km}$$

$$1 \text{ inch} = 2.54 \text{ cm}$$

$$1 \text{ m} = 3.3 \text{ ft}$$

volumes

$$1 \text{ gallon} = 3.78 \text{ Litres}$$

Concentrations (assume density of solvent water = 1 g/mL)

$$C = M/V = M/M = V/V$$

percentage (%)

$$x\%(w/v) = \frac{x[g]}{100[mL]} \quad x\%(v/v) = \frac{x[mL]}{100[mL]} \quad x\%(w/w) = \frac{x[g]}{100[g]}$$

parts

$$pph = x\%(w/v) \quad ppt = \frac{x[g]}{1[L]} \quad ppm = \frac{x[mg]}{1[L]} \quad ppb = \frac{x[\mu g]}{1[L]}$$

molarity

$$M = \text{molarity} \frac{[moles]}{[L]} \quad \text{FW} = \text{formula weight} \frac{[g]}{[mole]}$$

Dilutions

$$C_1 V_1 = C_2 V_2 \quad \text{dilution} = \frac{\text{solute volume}}{\text{total/final volume}} \quad \text{dilution factor (DF)} = \frac{1}{\text{dilution}}$$

Prepare 300 mL of a 5.0% (w/v) KCl solution.

Prepare a 2:1 alcohol:water solution using 100 mL of alcohol.

Prepare 750 mL of a 500 ppm nitrate solution.

Prepare a 0.9 M sucrose solution using 342 g/mol as the formula weight, and a total volume of 200 mL.

Prepare a 0.1% (w/w) hydrogen peroxide solution using 1.5 g of H_2O_2 . What is the total mass of the solution?

Determine the formula weight of $C_6H_{12}O_6$ (glucose).

Prepare a 1:3 oil:vinegar solution using 45 mL of vinegar.

Prepare 2.0 L of a 1.2% (w/v) calcium chloride solution.

Prepare a 1.5 M H_2SO_4 solution using 98.1 g/mol as the formula weight, and a total volume of 1.2 L.

You have 600 mL of a 3.0 M NaOH solution. What volume in L would give a 0.75 M solution?

Dissolve 29.25 g of KCl (FW = 74.5 g/mol) in 150 mL and dilute to 1.0 L. What is the final molarity?

Prepare a 2.5 pph potassium chloride solution using 0.5 kg of solute.

You dissolve 90 g of Na_2SO_4 (FW = 142 g/mol) in 300 mL of water and then dilute the solution to 1.5 L. What is the final molarity?

Prepare 300 mL of a 5.0% (w/v) KCl solution.

assume $300 \text{ mL} = 3.00 \times 10^2 \text{ mL}$

units:

$$C = 5.0\% \text{ (w/v)} = 5 \frac{\text{g}}{100 \text{ mL}} = \frac{5 \text{ g}}{100 \text{ mL}}$$

concentration:

$$C = \frac{m}{V_{\text{total}}}$$

$$\left[\frac{5 \text{ g}}{100 \text{ mL}} \right] = \frac{m}{[300 \text{ mL}]}$$

$$m = \frac{(5 \text{ g})(300 \text{ mL})}{100 \text{ mL}} = 15 \text{ g}$$

$$m_{\text{KCl}} = 15 \text{ g}$$

Prepare a 2:1 alcohol:water solution using 100 mL of alcohol.

$$\text{assume } 100 \text{ mL} = 1.00 \times 10^2 \text{ mL}$$

$$\text{total parts} = 2 + 1 = 3 \text{ parts}$$

concentration (alcohol):

$$C = \frac{V_{\text{alcohol}}}{V_{\text{total}}}$$

$$\frac{2 \text{ parts}}{3 \text{ parts}} = \frac{100 \text{ mL}}{V_{\text{total}}}$$

$$V_{\text{total}} = \frac{(3 \text{ parts})(100 \text{ mL})}{2 \text{ parts}} = 150 \text{ mL}$$

$$V_{\text{total}} = 1.50 \times 10^2 \text{ mL}$$

concentration (water):

$$C = \frac{V_{\text{water}}}{V_{\text{total}}}$$

$$\frac{1 \text{ part}}{3 \text{ parts}} = \frac{V_{\text{water}}}{150 \text{ mL}}$$

$$V_{\text{water}} = \frac{(1 \text{ part})(150 \text{ mL})}{3 \text{ parts}} = 50 \text{ mL}$$

$$V_{\text{water}} = 50.0 \text{ mL}$$

Prepare 750 mL of a 500 ppm nitrate solution.

assume: $500 \text{ ppm} = 5.00 \times 10^2 \text{ ppm}$ & $750 \text{ mL} = 7.50 \times 10^2 \text{ mL}$

units:

$$C = 500 \text{ ppm} = 500 \frac{\text{mg}}{\text{L}} = \frac{500 \text{ mg}}{1 \text{ L}}$$

concentration:

$$C = \frac{m}{V_{\text{total}}}$$

$$\left[\frac{500 \text{ mg}}{1 \text{ L}} \right] = \frac{m}{[750 \text{ mL}]}$$

$$m = \frac{(500 \text{ mg})(750 \text{ mL})}{1 \cancel{\text{L}}} \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) = 375 \text{ mg}$$

$$m_{\text{nitrate}} = 375 \text{ mg}$$

Prepare a 0.9 M sucrose solution using 342 g/mol as the formula weight, and a total volume of 200 mL.

units:

$$C = 0.9M = 0.9 \frac{\cancel{\text{mol}}}{\text{L}} \left(\frac{342 \text{ g}}{\cancel{\text{mol}}} \right) = 307.8 \frac{\text{g}}{\text{L}}$$

concentration:

$$C = \frac{M}{V_{\text{total}}}$$

$$\left[\frac{307.8 \text{ g}}{1 \text{ L}} \right] = \frac{M}{[200 \text{ mL}]}$$

$$M = \frac{(307.8 \text{ g})(200 \cancel{\text{mL}})}{\cancel{1 \text{ L}}} \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) = 61.56 \text{ g}$$

$$M_{\text{sucrose}} = 60 \text{ g}$$

Prepare a 0.1% (w/w) hydrogen peroxide solution using 1.5 g of H_2O_2 . What is the total mass of the solution?

units:

$$C = 0.1\%(\text{w/w}) = 0.1 \frac{\text{g}}{100\text{g}} = \frac{0.1 \text{ g}}{100 \text{ g}}$$

concentration:

$$C = \frac{m}{m_{\text{total}}}$$

$$\left[\frac{0.1 \text{ g}}{100 \text{ g}} \right] = \frac{[1.5 \text{ g}]}{m_{\text{total}}}$$

$$m_{\text{total}} = \frac{(100 \text{ g})(1.5 \text{ g})}{0.1 \text{ g}} = 1500 \text{ g}$$

units:

$$m_{\text{total}} = 1500 \text{ g} \left(\frac{1 \text{ kg}}{1000 \text{ g}} \right) = 1.5 \text{ kg}$$

$$m_{\text{total}} = 1.5 \text{ kg}$$

Determine the formula weight of $C_6H_{12}O_6$ (glucose).

$$\begin{aligned}C_6H_{12}O_6 &= 6(C) + 12(H) + 6(O) \\&= 6(12.0107) + 12(1.00794) + 6(15.9994) \\&= 180.15588\end{aligned}$$

$$FW_{C_6H_{12}O_6} = 180.1559 \frac{g}{mol}$$

Prepare a 1:3 oil:vinegar solution using 45 mL of vinegar.

$$\text{total parts} = 1 + 3 = 4 \text{ parts}$$

Concentration (vinegar):

$$C = \frac{V_{\text{vinegar}}}{V_{\text{total}}}$$

$$\frac{3 \text{ parts}}{4 \text{ parts}} = \frac{45 \text{ mL}}{V_{\text{total}}}$$

$$V_{\text{total}} = \frac{(\cancel{4 \text{ parts}})(45 \text{ mL})}{\cancel{3 \text{ parts}}} = 60 \text{ mL}$$

$$V_{\text{total}} = 6.0 \times 10^1 \text{ mL}$$

Concentration (oil):

$$C = \frac{V_{\text{oil}}}{V_{\text{total}}}$$

$$\frac{1 \text{ part}}{4 \text{ parts}} = \frac{V_{\text{oil}}}{60 \text{ mL}}$$

$$V_{\text{oil}} = \frac{(\cancel{1 \text{ part}})(60 \text{ mL})}{\cancel{4 \text{ parts}}} = 15 \text{ mL}$$

$$V_{\text{oil}} = 15 \text{ mL}$$

Prepare 2.0 L of a 1.2% (w/v) calcium chloride solution.

units:

$$C = 1.2\% \text{ (w/v)} = 1.2 \frac{\text{g}}{100\text{mL}} = \frac{1.2 \text{ g}}{100\text{mL}}$$

Concentration:

$$C = \frac{m}{V_{\text{total}}}$$

$$\left[\frac{1.2 \text{ g}}{100 \text{ mL}} \right] = \frac{m}{[2.0 \text{ L}]}$$

$$m = \frac{(1.2 \text{ g})(2.0 \text{ L})}{100 \text{ mL}} \left(\frac{1000 \text{ mL}}{1 \text{ L}} \right) = 24 \text{ g}$$

$$m_{\text{CaCl}_2} = 24 \text{ g}$$

Prepare a 1.5 M H_2SO_4 solution using 98.1 g/mol as the formula weight, and a total volume of 1.2 L.

units:

$$C = 1.5 \text{ M} = 1.5 \frac{\cancel{\text{mol}}}{\text{L}} \left(\frac{98.1 \text{ g}}{\cancel{\text{mol}}} \right) = 147.15 \frac{\text{g}}{\text{L}}$$

Concentration:

$$C = \frac{m}{V_{\text{total}}}$$

$$\left[\frac{147.15 \text{ g}}{1 \text{ L}} \right] = \frac{m}{1.2 \text{ L}}$$

$$m = \frac{(147.15 \text{ g})(1.2 \text{ L})}{1} = 176.58 \text{ g}$$

$$m_{\text{H}_2\text{SO}_4} = 180 \text{ g}$$

You have 600 mL of a 3.0 M NaOH solution. What volume in L would give a 0.75 M solution?

assume: $600 \text{ mL} = 6.00 \times 10^2 \text{ mL}$

dilution:

$$C_1 V_1 = C_2 V_2$$

$$[3.0 \text{ M}][600 \text{ mL}] = [0.75 \text{ M}]V_2$$

$$V_2 = \frac{(3 \text{ M})(600 \text{ mL})}{0.75 \text{ M}} = 2400 \text{ mL}$$

units:

$$V_2 = 2400 \text{ mL} \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) = 2.4 \text{ L}$$

$$V_2 = 2.4 \text{ L}$$

Dissolve 29.25 g of KCl (FW = 74.5 g/mol) in 150 mL and dilute to 1.0 L. What is the final molarity?

units:

$$C_1 = \frac{29.25 \cancel{\text{g}}}{150 \cancel{\text{mL}}} \left(\frac{1 \cancel{\text{mol}}}{74.5 \cancel{\text{g}}} \right) \left(\frac{1000 \cancel{\text{mL}}}{1 \text{L}} \right) = 2.62 \frac{\text{mol}}{\text{L}}$$

dilution:

$$C_1 V_1 = C_2 V_2$$

$$\left[2.62 \frac{\text{mol}}{\text{L}} \right] [150 \text{mL}] = C_2 [1 \text{L}]$$

$$C_2 = \frac{(2.62 \text{ mol})(150 \cancel{\text{mL}})}{(1 \text{L})(1 \cancel{\text{L}})} \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) = 0.393 \frac{\text{mol}}{\text{L}}$$

$$C_2 = 0.39 \text{ M}$$

Prepare a 2.5 ppm potassium chloride solution using 0.5 kg of solute.

units:

$$2.5 \text{ ppm} = 2.5 \frac{\text{g}}{100 \text{ mL}} = \frac{2.5 \text{ g}}{100 \text{ mL}}$$

concentration:

$$C = \frac{m}{V_{\text{total}}}$$

$$\left[\frac{2.5 \text{ g}}{100 \text{ mL}} \right] = \frac{[0.5 \text{ kg}]}{V_{\text{total}}}$$

$$V_{\text{total}} = \frac{(100 \text{ mL})(0.5 \text{ kg})}{2.5 \text{ g}} \left(\frac{1000 \text{ g}}{1 \text{ kg}} \right) \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) = 20 \text{ L}$$

$$V_{\text{total}} = 20 \text{ L}$$

You dissolve 90 g of Na_2SO_4 (FW = 142 g/mol) in 300 mL of water and then dilute the solution to 1.5 L. What is the final molarity?

assume: $90 \text{ g} = 9.0 \times 10^1 \text{ g}$ & $300 \text{ mL} = 3.00 \times 10^2 \text{ mL}$

concentration:

$$C_1 = \frac{m}{V} = \frac{90 \cancel{\text{g}}}{300 \cancel{\text{mL}}} \left(\frac{1 \cancel{\text{mol}}}{142 \cancel{\text{g}}} \right) \left(\frac{1000 \cancel{\text{mL}}}{1 \text{ L}} \right) = 2.11 \frac{\text{mol}}{\text{L}}$$

dilution:

$$C_1 V_1 = C_2 V_2$$

$$[2.11 \text{ M}][300 \text{ mL}] = C_2 [1.5 \text{ L}]$$

$$C_2 = \frac{(2.11 \text{ M})(300 \cancel{\text{mL}})}{1.5 \cancel{\text{L}}} \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) = 0.4225 \text{ M}$$

$$\boxed{C_2 = 0.42 \text{ M}}$$

Instructor:
 Course:
 Date:

Frank Secretain
 Math 150
 June 11, 2025

Assessment:
 Time allowed:
 Devices allowed:
 Notes from instructor:

Test 2 (practice)
 110 minutes
 Pencil, pen, eraser, calculator
 Be neat. Show your work where needed. Box final answers.

Marks allocated:
 Percentage of final grade:

13 questions worth 25 marks
 25% of final grade

The Periodic Table of the Elements

atomic mass

atomic number

electronegativity

oxidation states
most common and bold

electron configuration

name

chemical symbol

1st ionization energy
in kJ/mol

or most stable ion
in kJ/mol

alkali metals

alkaline earth metals

other metals

transition metals

lanthanoids

actinoids

metalloids

nonmetals

halogens

noble gases

unknown elements

radioactive elements have
increases in parentheses

group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																																																																																																																																																																																																																																																																				
period 1	1.00794 H Hydrogen	4.002602 He Helium																																																																																																																																																																																																																																																																																				
2	6.941 Li Lithium	9.012182 Be Beryllium	22.98976928 B Boron	12.0107 C Carbon	14.003074 N Nitrogen	15.9994 O Oxygen	18.99840325 F Fluorine	20.1797 Ne Neon																																																																																																																																																																																																																																																																														
3	22.98976928 Na Sodium	24.30409 Mg Magnesium	44.9559125 Al Aluminum	50.9415 Si Silicon	55.845 P Phosphorus	63.546 S Sulfur	69.723 Cl Chlorine	72.64 Ar Argon	78.96 K Potassium	89.904 Ca Calcium	91.224 Sc Scandium	92.90638 Ti Titanium	95.94 V Vanadium	98.906 Cr Chromium	101.07 Mn Manganese	102.9055 Fe Iron	106.42 Co Cobalt	107.8682 Ni Nickel	112.411 Cu Copper	114.818 Zn Zinc	118.710 Ga Gallium	121.760 Ge Germanium	127.60 As Arsenic	132.905 Se Selenium	137.47 Br Bromine	139.904 Kr Krypton																																																																																																																																																																																																																																																												
4	39.0983 K Potassium	40.078 Ca Calcium	44.9559125 Sc Scandium	47.867 Ti Titanium	50.9415 V Vanadium	54.9380425 Cr Chromium	55.845 Mn Manganese	58.931325 Fe Iron	58.931325 Co Cobalt	58.931325 Ni Nickel	63.546 Cu Copper	65.38 Zn Zinc	69.723 Ga Gallium	72.64 Ge Germanium	74.92160 As Arsenic	78.96 Se Selenium	79.904 Br Bromine	83.798 Kr Krypton	86.90918 Rb Rubidium	88.90585 Sr Strontium	91.224 Y Yttrium	92.90638 Zr Zirconium	95.94 Nb Niobium	98.906 Mo Molybdenum	101.07 Tc Technetium	102.9055 Ru Ruthenium	106.42 Rh Rhodium	107.8682 Pd Palladium	112.411 Ag Silver	114.818 Cd Cadmium	118.710 In Indium	121.760 Sn Tin	127.60 Sb Antimony	132.905 Te Tellurium	137.47 I Iodine	139.904 Xe Xenon																																																																																																																																																																																																																																																		
5	85.4678 Rb Rubidium	87.62 Sr Strontium	88.90585 Y Yttrium	91.224 Zr Zirconium	92.90638 Nb Niobium	95.94 Mo Molybdenum	98.906 Tc Technetium	101.07 Ru Ruthenium	102.9055 Rh Rhodium	106.42 Pd Palladium	107.8682 Ag Silver	112.411 Cd Cadmium	114.818 In Indium	118.710 Sn Tin	121.760 Sb Antimony	127.60 Te Tellurium	132.905 I Iodine	137.47 Xe Xenon	139.904 Ba Barium	140.9076 La Lanthanum	144.242 Ce Cerium	147.07 Pr Praseodymium	150.36 Nd Neodymium	151.964 Pm Promethium	157.25 Sm Samarium	158.9253 Eu Europium	162.5023 Gd Gadolinium	164.9303 Tb Terbium	167.259 Dy Dysprosium	170.253 Ho Holmium	173.054 Er Erbium	176.255 Tm Thulium	178.49 Yb Ytterbium	180.9478 Lu Lutetium	183.84 Hf Hafnium	186.207 Ta Tantalum	188.905 W Tungsten	191.224 Re Rhenium	195.084 Os Osmium	197.023 Ir Iridium	200.59 Pt Platinum	204.3833 Au Gold	208.9804 Hg Mercury	210.236 Tl Thallium	216.23 Pb Lead	223.019 Bi Bismuth	227.028 Po Polonium	238.02891 At Astatine	238.02891 Rn Radon																																																																																																																																																																																																																																					
6	132.9054 Cs Cesium	137.47 Ba Barium	140.9076 La Lanthanum	144.242 Ce Cerium	147.07 Pr Praseodymium	150.36 Nd Neodymium	151.964 Pm Promethium	157.25 Sm Samarium	158.9253 Eu Europium	162.5023 Gd Gadolinium	164.9303 Tb Terbium	167.259 Dy Dysprosium	170.253 Ho Holmium	173.054 Er Erbium	176.255 Tm Thulium	178.49 Yb Ytterbium	180.9478 Lu Lutetium	183.84 Hf Hafnium	186.207 Ta Tantalum	188.905 W Tungsten	191.224 Re Rhenium	195.084 Os Osmium	197.023 Ir Iridium	200.59 Pt Platinum	204.3833 Au Gold	208.9804 Hg Mercury	210.236 Tl Thallium	216.23 Pb Lead	223.019 Bi Bismuth	227.028 Po Polonium	238.02891 At Astatine	238.02891 Rn Radon	244.06422 Fr Francium	247.02748 Ra Radium	250.1076 Ac Actinium	252.083223 Th Thorium	257.10372 Pa Protactinium	261.1088823 U Uranium	265.1010923 Np Neptunium	269.1015439 Pu Plutonium	273.1036315 Am Americium	277.1043703 Cm Curium	281.1061254 Bk Berkelium	285.1072898 Cf Californium	289.1084883 Es Einsteinium	293.1095865 Fm Fermium	297.1013175 Md Mendelevium	301.10270823 No Nobelium	305.1041823 Lr Lawrencium																																																																																																																																																																																																																																					
7	223.019 Fr Francium	227.028 Ra Radium	252.083223 Th Thorium	257.10372 Pa Protactinium	261.1088823 U Uranium	265.1010923 Np Neptunium	269.1015439 Pu Plutonium	273.1036315 Am Americium	277.1043703 Cm Curium	281.1061254 Bk Berkelium	285.1072898 Cf Californium	289.1084883 Es Einsteinium	293.1095865 Fm Fermium	297.1013175 Md Mendelevium	301.10270823 No Nobelium	305.1041823 Lr Lawrencium	309.10566823 Uut Ununtrium	313.10715103 Uuq Ununquadium	317.10863523 Uup Ununpentium	321.11011933 Uuq Ununquadium	325.11160353 Uuh Ununhexium	329.11308823 Uuq Ununquadium	333.11457293 Uuh Ununhexium	337.11605763 Uup Ununpentium	341.11754233 Uuh Ununhexium	345.11902703 Uuq Ununquadium	349.12051173 Uuh Ununhexium	353.12199643 Uuh Ununhexium	357.12348113 Uuh Ununhexium	361.12496583 Uuh Ununhexium	365.12645053 Uuh Ununhexium	369.12793523 Uuh Ununhexium	373.12941993 Uuh Ununhexium	377.13090463 Uuh Ununhexium	381.13238933 Uuh Ununhexium	385.13387403 Uuh Ununhexium	389.13535873 Uuh Ununhexium	393.13684343 Uuh Ununhexium	397.13832813 Uuh Ununhexium	401.13981283 Uuh Ununhexium	405.14129753 Uuh Ununhexium	409.14278223 Uuh Ununhexium	413.14426693 Uuh Ununhexium	417.14575163 Uuh Ununhexium	421.14723633 Uuh Ununhexium	425.14872103 Uuh Ununhexium	429.15020573 Uuh Ununhexium	433.15169043 Uuh Ununhexium	437.15317513 Uuh Ununhexium	441.15465983 Uuh Ununhexium	445.15614453 Uuh Ununhexium	449.15762923 Uuh Ununhexium	453.15911393 Uuh Ununhexium	457.16059863 Uuh Ununhexium	461.16208333 Uuh Ununhexium	465.16356803 Uuh Ununhexium	469.16505273 Uuh Ununhexium	473.16653743 Uuh Ununhexium	477.16802213 Uuh Ununhexium	481.16950683 Uuh Ununhexium	485.17099153 Uuh Ununhexium	489.17247623 Uuh Ununhexium	493.17396093 Uuh Ununhexium	497.17544563 Uuh Ununhexium	501.17693033 Uuh Ununhexium	505.17841503 Uuh Ununhexium	509.17989973 Uuh Ununhexium	513.18138443 Uuh Ununhexium	517.18286913 Uuh Ununhexium	521.18435383 Uuh Ununhexium	525.18583853 Uuh Ununhexium	529.18732323 Uuh Ununhexium	533.18880793 Uuh Ununhexium	537.19029263 Uuh Ununhexium	541.19177733 Uuh Ununhexium	545.19326203 Uuh Ununhexium	549.19474673 Uuh Ununhexium	553.19623143 Uuh Ununhexium	557.19771613 Uuh Ununhexium	561.19920083 Uuh Ununhexium	565.20068553 Uuh Ununhexium	569.20217023 Uuh Ununhexium	573.20365493 Uuh Ununhexium	577.20513963 Uuh Ununhexium	581.20662433 Uuh Ununhexium	585.20810903 Uuh Ununhexium	589.20959373 Uuh Ununhexium	593.21107843 Uuh Ununhexium	597.21256313 Uuh Ununhexium	601.21404783 Uuh Ununhexium	605.21553253 Uuh Ununhexium	609.21701723 Uuh Ununhexium	613.21850193 Uuh Ununhexium	617.21998663 Uuh Ununhexium	621.22147133 Uuh Ununhexium	625.22295603 Uuh Ununhexium	629.22444073 Uuh Ununhexium	633.22592543 Uuh Ununhexium	637.22741013 Uuh Ununhexium	641.22889483 Uuh Ununhexium	645.23037953 Uuh Ununhexium	649.23186423 Uuh Ununhexium	653.23334893 Uuh Ununhexium	657.23483363 Uuh Ununhexium	661.23631833 Uuh Ununhexium	665.23780303 Uuh Ununhexium	669.23928773 Uuh Ununhexium	673.24077243 Uuh Ununhexium	677.24225713 Uuh Ununhexium	681.24374183 Uuh Ununhexium	685.24522653 Uuh Ununhexium	689.24671123 Uuh Ununhexium	693.24819593 Uuh Ununhexium	697.24968063 Uuh Ununhexium	701.25116533 Uuh Ununhexium	705.25265003 Uuh Ununhexium	709.25413473 Uuh Ununhexium	713.25561943 Uuh Ununhexium	717.25710413 Uuh Ununhexium	721.25858883 Uuh Ununhexium	725.26007353 Uuh Ununhexium	729.26155823 Uuh Ununhexium	733.26304293 Uuh Ununhexium	737.26452763 Uuh Ununhexium	741.26601233 Uuh Ununhexium	745.26749703 Uuh Ununhexium	749.26898173 Uuh Ununhexium	753.27046643 Uuh Ununhexium	757.27195113 Uuh Ununhexium	761.27343583 Uuh Ununhexium	765.27492053 Uuh Ununhexium	769.27640523 Uuh Ununhexium	773.27788993 Uuh Ununhexium	777.27937463 Uuh Ununhexium	781.28085933 Uuh Ununhexium	785.28234403 Uuh Ununhexium	789.28382873 Uuh Ununhexium	793.28531343 Uuh Ununhexium	797.28679813 Uuh Ununhexium	801.28828283 Uuh Ununhexium	805.28976753 Uuh Ununhexium	809.29125223 Uuh Ununhexium	813.29273693 Uuh Ununhexium	817.29422163 Uuh Ununhexium	821.29570633 Uuh Ununhexium	825.29719103 Uuh Ununhexium	829.29867573 Uuh Ununhexium	833.30016043 Uuh Ununhexium	837.30164513 Uuh Ununhexium	841.30312983 Uuh Ununhexium	845.30461453 Uuh Ununhexium	849.30609923 Uuh Ununhexium	853.30758393 Uuh Ununhexium	857.30906863 Uuh Ununhexium	861.31055333 Uuh Ununhexium	865.31203803 Uuh Ununhexium	869.31352273 Uuh Ununhexium	873.31500743 Uuh Ununhexium	877.31649213 Uuh Ununhexium	881.31797683 Uuh Ununhexium	885.31946153 Uuh Ununhexium	889.32094623 Uuh Ununhexium	893.32243093 Uuh Ununhexium	897.32391563 Uuh Ununhexium	901.32540033 Uuh Ununhexium	905.32688503 Uuh Ununhexium	909.32836973 Uuh Ununhexium	913.32985443 Uuh Ununhexium	917.33133913 Uuh Ununhexium	921.33282383 Uuh Ununhexium	925.33430853 Uuh Ununhexium	929.33579323 Uuh Ununhexium	933.33727793 Uuh Ununhexium	937.33876263 Uuh Ununhexium	941.34024733 Uuh Ununhexium	945.34173203 Uuh Ununhexium	949.34321673 Uuh Ununhexium	953.34470143 Uuh Ununhexium	957.34618613 Uuh Ununhexium	961.34767083 Uuh Ununhexium	965.34915553 Uuh Ununhexium	969.35064023 Uuh Ununhexium	973.35212493 Uuh Ununhexium	977.35360963 Uuh Ununhexium	981.35509433 Uuh Ununhexium	985.35657903 Uuh Ununhexium	989.35806373 Uuh Ununhexium	993.35954843 Uuh Ununhexium	997.36103313 Uuh Ununhexium	1001.36251783 Uuh Ununhexium	1005.36400253 Uuh Ununhexium	1009.36548723 Uuh Ununhexium	1013.36697193 Uuh Ununhexium	1017.36845663 Uuh Ununhexium	1021.36994133 Uuh Ununhexium	1025.37142603 Uuh Ununhexium	1029.37291073 Uuh Ununhexium	1033.37439543 Uuh Ununhexium	1037.37588013 Uuh Ununhexium	1041.37736483 Uuh Ununhexium	1045.37884953 Uuh Ununhexium	1049.38033423 Uuh Ununhexium	1053.38181893 Uuh Ununhexium	1057.38330363 Uuh Ununhexium	1061.38478833 Uuh Ununhexium	1065.38627303 Uuh Ununhexium	1069.38775773 Uuh Ununhexium	1073.38924243 Uuh Ununhexium	1077.39072713 Uuh Ununhexium	1081.39221183 Uuh Ununhexium	1085.39369653 Uuh Ununhexium	1089.39518123 Uuh Ununhexium	1093.39666593 Uuh Ununhexium	1097.39815063 Uuh Ununhexium	1101.39963533 Uuh Ununhexium	1105.40112003 Uuh Ununhexium	1109.40260473 Uuh Ununhexium	1113.40408943 Uuh Ununhexium	1117.40557413 Uuh Ununhexium	1121.40705883 Uuh Ununhexium	1125.40854353 Uuh Ununhexium	1129.41002823 Uuh Ununhexium	1133.41151293 Uuh Ununhexium	1137.41299763 Uuh Ununhexium	1141.41448233 Uuh Ununhexium	1145.41596703 Uuh Ununhexium	1149.41745173 Uuh Ununhexium	1153.41893643 Uuh Ununhexium	1157.42042113 Uuh Ununhexium	1161.42190583 Uuh Ununhexium	1165.42339053 Uuh Ununhexium	1169.42487523 Uuh Ununhexium	1173.42635993 Uuh Ununhexium	1177.42784463 Uuh Ununhexium	1181.42932933 Uuh Ununhexium	1185.43081403 Uuh Ununhexium	1189.43229873 Uuh Ununhexium	1193.43378343 Uuh Ununhexium	1197.43526813 Uuh Ununhexium	1201.43675283 Uuh Ununhexium	1205.43823753 Uuh Ununhexium	1209.43972223 Uuh Ununhexium	1213.44120693 Uuh Ununhexium	1217.44269163 Uuh Ununhexium	1221.44417633 Uuh Ununhexium	1225.44566103 Uuh Ununhexium	1229.44714573 Uuh Ununhexium	1233.44863043 Uuh Ununhexium	1237.45011513 Uuh Ununhexium	1241.45159983 Uuh Ununhexium	1245.45308453 Uuh Ununhexium	1249.45456923 Uuh Ununhexium	1253.45605393 Uuh Ununhexium	1257.45753863 Uuh Ununhexium	1261.45902333 Uuh Ununhexium	1265.46050803 Uuh Ununhexium	1269.46199273 Uuh Ununhexium	1273.46347743 Uuh Ununhexium	1277.46496213 Uuh Ununhexium	1281.46644683 Uuh Ununhexium	1285.46793153 Uuh Ununhexium	1289.46941623 Uuh Ununhexium	1293.47090093 Uuh Ununhexium	1297.47238563 Uuh Ununhexium	1301.47387033 Uuh Ununhexium	1305.47535503 Uuh Ununhexium	1309.47683973 Uuh Ununhexium	1313.47832443 Uuh Ununhexium	1317.47980913 Uuh Ununhexium	1321.48129383 Uuh Ununhexium	1325.48277853 Uuh Ununhexium	1329.48426323 Uuh Ununhexium	1333.48574793 Uuh Ununhexium	1337.48723263 Uuh Ununhexium	1341.48871733 Uuh Ununhexium	1345.49020203 Uuh Ununhexium	1349.49168673 Uuh Ununhexium	1353.49317143 Uuh

Formula Sheet

Order of Operations

$$ac + bc = c(a + b)$$

exponents

$$a^n a^m = a^{n+m}$$

$$(a^n)^m = a^{nm}$$

$$(ab)^n = a^n b^n$$

$$a^0 = 1$$

$$a^{-n} = \frac{1}{a^n}$$

radicals

$$a^{\frac{n}{m}} = \sqrt[m]{a^n}$$

Unit Conversions

angles

$$2\pi = 6.28 \text{ rad} = 360^\circ$$

mass

$$1 \text{ kg} = 2.2 \text{ lbs.}$$

lengths

$$1 \text{ mile} = 1.6 \text{ km}$$

$$1 \text{ inch} = 2.54 \text{ cm}$$

$$1 \text{ m} = 3.3 \text{ ft}$$

volumes

$$1 \text{ gallon} = 3.78 \text{ Litres}$$

Concentrations (assume density of solvent water = 1 g/mL)

$$C = M/V = M/M = V/V$$

percentage (%)

$$x\%(w/v) = \frac{x[g]}{100[mL]} \quad x\%(v/v) = \frac{x[mL]}{100[mL]} \quad x\%(w/w) = \frac{x[g]}{100[g]}$$

parts

$$pph = x\%(w/v) \quad ppt = \frac{x[g]}{1[L]} \quad ppm = \frac{x[mg]}{1[L]} \quad ppb = \frac{x[\mu g]}{1[L]}$$

molarity

$$M = \text{molarity} \frac{[moles]}{[L]} \quad FW = \text{formula weight} \frac{[g]}{[mole]}$$

Dilutions

$$C_1 V_1 = C_2 V_2 \quad \text{dilution} = \frac{\text{solute volume}}{\text{total/final volume}} \quad \text{dilution factor (DF)} = \frac{1}{\text{dilution}}$$

Prepare 250 mL of a 6.5% (w/v) NaCl solution.

Prepare a 3:1 water:alcohol solution using 72 mL of water.

Prepare 500 mL of a 300 ppm fluoride solution.

Prepare a 1.2 M glucose solution using 180 g/mol as the formula weight, and a total volume of 150 mL.

Prepare a 0.25% (w/w) potassium permanganate solution using 2.5 g of KMnO_4 . What is the total mass of the solution?

Determine the formula weight of CaCl_2 (calcium chloride).

Prepare a 3:2 salt:water solution using 60 mL of salt.

Prepare 1.5 L of a 0.75% (w/v) magnesium chloride solution.

Prepare a 0.6 M NaOH solution using 40.0 g/mol as the formula weight, and a total volume of 0.75 L.

You have 0.50 L of a 4.0 M HCl solution. What volume in mL would give a 1.0 M solution?

Dissolve 17.55 g of NaCl (FW = 58.5 g/mol) in 250 mL and dilute to 1.0 L. What is the final concentration in % (w/v) and molarity?

Dilute 5.0 mL of a 6.0 M CaCl_2 solution to 50 mL. Then take 10 mL and dilute it to 250 mL. What is the final concentration in parts and molarity?

You dissolve 180 g of glucose (FW = 180 g/mol) in 400 mL of water and then dilute the solution to 2.0 L. What is the final molarity?

Prepare 250 mL of a 6.5% (w/v) NaCl solution.

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

$$6.5 \frac{\text{g}}{100 \text{ mL}} = \frac{m}{250 \text{ mL}}$$

$$\frac{6.5 \text{ g}}{100 \text{ mL}} = \frac{m}{250 \text{ mL}}$$

$$m = \frac{(6.5 \text{ g})(250 \text{ mL})}{100 \text{ mL}} = 16.25 \text{ g}$$

$$m = 16 \text{ g}$$

Prepare a 3:1 water:alcohol solution using 72 mL of water.

$$\text{total parts} = 3 + 1 = 4 \text{ parts}$$

$$C_{\text{H}_2\text{O}} = \frac{V_{\text{H}_2\text{O}}}{V_{\text{total}}}$$

$$\frac{3 \text{ parts}}{4 \text{ parts}} = \frac{72 \text{ mL}}{V_{\text{total}}}, \quad V_{\text{total}} = \frac{(72 \text{ mL})(4 \text{ parts})}{3 \text{ parts}} = 96 \text{ mL}$$

$$V_{\text{total}} = 96 \text{ mL}$$

$$C_{\text{alcohol}} = \frac{V_{\text{alcohol}}}{V_{\text{total}}}$$

$$\frac{1 \text{ part}}{4 \text{ parts}} = \frac{V_{\text{alcohol}}}{96 \text{ mL}}, \quad V_{\text{alcohol}} = \frac{(1 \text{ part})(96 \text{ mL})}{4 \text{ parts}} = 24 \text{ mL}$$

$$V_{\text{alcohol}} = 24 \text{ mL}$$

Prepare 500 mL of a 300 ppm fluoride solution.

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

$$300 \frac{\text{mg}}{\text{L}} = \frac{m}{500 \text{ mL}}$$

$$\frac{300 \text{ mg}}{1 \text{ L}} = \frac{m}{500 \text{ mL}}$$

$$m = \frac{(300 \text{ mg})(500 \text{ mL})}{1 \text{ L}} \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) = 150 \text{ mg}$$

$$m = 200 \text{ mg}$$

Prepare a 1.2 M glucose solution using 180 g/mol as the formula weight, and a total volume of 150 mL.

$$1.2 \text{ M} = 1.2 \frac{\cancel{\text{mol}}}{\cancel{\text{L}}} \left(180 \frac{\text{g}}{\cancel{\text{mol}}} \right) \left(\frac{\cancel{1\text{L}}}{1000\text{mL}} \right) = 0.216 \frac{\text{g}}{\text{mL}}$$

$$C = \frac{m}{V_{\text{total}}}$$

$$0.216 \frac{\text{g}}{\text{mL}} = \frac{m}{150 \text{ mL}}$$

$$\frac{0.216 \text{ g}}{1 \text{ mL}} = \frac{m}{150 \text{ mL}}$$

$$m = \frac{(0.216 \text{ g})(150 \cancel{\text{mL}})}{\cancel{1 \text{ mL}}} = 32.4 \text{ g}$$

$$m = 32 \text{ g}$$

Prepare a 0.25% (w/w) potassium permanganate solution using 2.5 g of KMnO_4 . What is the total mass of the solution?

$$C = \frac{m}{m_{\text{total}}}$$

$$0.25 \frac{\text{g}}{100\text{g}} = \frac{2.5\text{g}}{m_{\text{total}}}$$

$$\frac{0.25\text{g}}{100\text{g}} = \frac{2.5\text{g}}{m_{\text{total}}}$$

$$m_{\text{total}} = \frac{(100\text{g})(2.5\text{g})}{0.25\text{g}} = 1000\text{g} \left(\frac{1\text{kg}}{1000\text{g}} \right)$$

$$m_{\text{total}} = 1.0\text{kg}$$

Determine the formula weight of CaCl_2 (calcium chloride).

$$\text{Ca} + 2\text{Cl} = (40.078) + 2(35.453)$$
$$= 110.984$$

$$= 110.984 \frac{\text{g}}{\text{mol}}$$

Prepare a 3:2 salt:water solution using 60 mL of salt.

$$\text{total parts} = 3 + 2 = 5 \text{ parts}$$

$$C_{\text{salt}} = \frac{V_{\text{salt}}}{V_{\text{total}}}$$

$$\frac{3 \text{ parts}}{5 \text{ parts}} = \frac{60 \text{ mL}}{V_{\text{total}}}$$

$$V_{\text{total}} = \frac{(\cancel{5 \text{ parts}})(60 \text{ mL})}{\cancel{3 \text{ parts}}} = 100 \text{ mL}$$

$$V_{\text{total}} = 100 \text{ mL}$$

$$C_{\text{H}_2\text{O}} = \frac{V_{\text{H}_2\text{O}}}{V_{\text{total}}}$$

$$\frac{2 \text{ parts}}{5 \text{ parts}} = \frac{V_{\text{H}_2\text{O}}}{100 \text{ mL}}$$

$$V_{\text{H}_2\text{O}} = \frac{(2 \text{ parts})(100 \text{ mL})}{5 \text{ parts}} = 40 \text{ mL}$$

$$V_{\text{H}_2\text{O}} = 40 \text{ mL}$$

Prepare 1.5 L of a 0.75% (w/v) magnesium chloride solution.

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

$$0.75 \frac{\text{g}}{100\text{mL}} = \frac{m}{1.5\text{L}}$$

$$\frac{0.75\text{g}}{100\text{ mL}} = \frac{m}{1.5\text{L}}$$

$$m = \frac{(0.75\text{g})(1.5\cancel{\text{L}})}{100\cancel{\text{mL}}} \left(\frac{1000\cancel{\text{mL}}}{1\cancel{\text{L}}} \right)$$

$$m = 11.25 \text{ g}$$

$$m = 11 \text{ g}$$

Prepare a 0.6 M NaOH solution using 40.0 g/mol as the formula weight, and a total volume of 0.75 L.

$$0.6 \text{ M} = 0.6 \frac{\cancel{\text{mol}}}{\text{L}} \left(40 \frac{\text{g}}{\cancel{\text{mol}}} \right) = 24 \frac{\text{g}}{\text{L}}$$

$$C = \frac{m}{V_{\text{total}}}$$

$$24 \frac{\text{g}}{\text{L}} = \frac{m}{0.75 \text{ L}}$$

$$\frac{24 \text{ g}}{1 \text{ L}} = \frac{m}{0.75 \text{ L}}$$

$$m = \frac{(24 \text{ g})(0.75 \cancel{\text{L}})}{\cancel{1 \text{ L}}} = 18 \text{ g}$$

$$m_{\text{NaOH}} = 20 \text{ g}$$

You have 0.50 L of a 4.0 M HCl solution. What volume in mL would give a 1.0 M solution?

$$C_1 V_1 = C_2 V_2$$

$$[4.0 \text{ M}][0.50 \text{ L}] = [1.0 \text{ M}] V_2$$

$$V_2 = \frac{(4.0 \text{ M})(0.50 \text{ L})}{(1.0 \text{ M})} = 2 \text{ L} \left(\frac{1000 \text{ mL}}{1 \text{ L}} \right) = 2000 \text{ mL}$$

$$V_2 = 2.0 \times 10^3 \text{ mL}$$

Dissolve 17.55 g of NaCl (FW = 58.5 g/mol) in 250 mL and dilute to 1.0 L. What is the final concentration in % (w/v) and molarity?

$$C_1 = \frac{m}{V}$$

$$C_1 = \frac{17.55 \text{ g}}{250 \text{ mL}} = 0.0702 \frac{\text{g}}{\text{mL}} \left(\frac{100 \text{ mL}}{100 \text{ mL}} \right) = 7.02 \frac{\text{g}}{100 \text{ mL}} = 7.02 \%$$

$$C_1 V_1 = C_2 V_2$$

$$(7.02 \%) (250 \text{ mL}) = C_2 (1 \text{ L})$$

$$C_2 = \frac{(7.02 \%) (250 \text{ mL})}{1 \text{ L}} \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) = 1.755 \%$$

$$C_2 = 1.8 \%$$

$$C_2 = 1.755 \% = 1.755 \frac{\text{g}}{100 \text{ mL}} \left(\frac{\text{mol}}{58.5 \text{ g}} \right) \left(\frac{1000 \text{ mL}}{1 \text{ L}} \right)$$

$$= 0.3 \frac{\text{mol}}{\text{L}} = 0.3 \text{ M}$$

$$C_2 = 0.30 \text{ M}$$

Dilute 5.0 mL of a 6.0 M CaCl_2 solution to 50 mL. Then take 10 mL and dilute it to 250 mL. What is the final concentration in parts and molarity?

$$C_1 V_1 = C_2 V_2$$

$$(6\text{M})(5\text{mL}) = C_2(50\text{mL})$$

$$C_2 = \frac{(6\text{M})(5\text{mL})}{50\text{mL}} = 0.6\text{M}$$

$$C_2 V_2 = C_3 V_3$$

$$(0.6\text{M})(10\text{mL}) = C_3(250\text{mL})$$

$$C_3 = \frac{(0.6\text{M})(10\text{mL})}{250\text{mL}} = 0.024\text{M}$$

$$C_3 = 0.024\text{M}$$

$$\text{CaCl}_2 = \text{Ca} + 2\text{Cl} = (40.078) + 2(35.453) = 110.984 \frac{\text{g}}{\text{mol}}$$

$$C_3 = 0.024\text{M} = 0.024 \frac{\text{mol}}{\text{L}} \left(110.984 \frac{\text{g}}{\text{mol}} \right) = 2.663 \frac{\text{g}}{\text{L}}$$

$$C_3 = 2.663 \text{ ppt}$$

$$C_3 = 3 \text{ ppt}$$

You dissolve 180 g of glucose (FW = 180 g/mol) in 400 mL of water and then dilute the solution to 2.0 L. What is the final molarity?

$$C_1 = \frac{m}{V} = \frac{180 \cancel{\text{g}}}{400 \cancel{\text{mL}}} \left(\frac{\cancel{\text{mol}}}{180 \cancel{\text{g}}} \right) \left(\frac{1000 \cancel{\text{mL}}}{1 \cancel{\text{L}}} \right) = 2.5 \frac{\text{mol}}{\text{L}} = 2.5 \text{ M}$$

$$C_1 V_1 = C_2 V_2$$

$$(2.5 \text{ M})(400 \text{ mL}) = C_2 (2.0 \text{ L})$$

$$C_2 = \frac{(2.5 \text{ M})(400 \cancel{\text{mL}})}{2.0 \cancel{\text{L}}} \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) = 0.5 \text{ M}$$

$$C_2 = 0.5 \text{ M}$$