

Instructor:
Course:
Date:

Frank Secretain
Math 150
June 18, 2025

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

Final
110 minutes
Pencil, pen, eraser, calculator
Be neat. Show your work where needed. Box final answers.

Marks allocated:
Percentage of final grade:

10 questions worth 30 marks
30% of final grade

The Periodic Table of the Elements

alkali metals

alkaline earth metals

other metals

transition metals

lanthanoids

actinoids

metalloids

nonmetals

halogens

noble gases

unknown elements

radioactive elements have
increases in parentheses

atomic number

electronegativity

oxidation states
most common and bold

group 1

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3

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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

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

(2 marks) Determine

- a) the total number of significant digits and
- b) re-write the number in scientific notation

for the following number:

200

a) significant digits = _____

b) scientific notation = _____

0.0200

a) significant digits = _____

b) scientific notation = _____

(4 marks) Solve for x in the following equation.

$$2ax + 14 = c$$

$$\frac{2a}{x} = \frac{w}{v}$$

(4 marks) Given the standard unit conversion table on the formula sheet (1st page), convert each of the numbers to the stated units.

$$12 \frac{\text{m}}{\text{gallon}} \rightarrow \frac{\text{ft}}{\text{L}}$$

$$74.3 \frac{\text{lbs.}}{\text{minute}} \rightarrow \frac{\text{kg}}{\text{day}}$$

$$12 \frac{\text{kg}}{\text{L}} \rightarrow \frac{\text{g}}{100 \text{ mL}}$$

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

(2 marks) Prepare a 3:2 water:alcohol solution using 84 mL of water.

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

(3 marks) Dilute 15 mL of a 6.0 M NaCl solution to 100 mL. Then take 25 mL of that and dilute it to 250 mL. What is the final concentration?

(3 marks) Dilute 7.0 mL of a 4.5 M CaCl_2 solution to 85 mL. Then take 15 mL and dilute it to 250 mL. What is the final concentration in molarity?

(4 marks) 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 concentration in % (w/v) and molarity?

(4 marks) Dilute 5.0 mL of a 1.2 % (w/v) CaCl_2 solution to 50 mL. Then take 10 mL and dilute it to 250 mL. What is the final concentration in % (w/v) and parts?

(2 marks) Determine

- the total number of significant digits and
- re-write the number in scientific notation

for the following number:

200

a) significant digits = 1

b) scientific notation = 2×10^2

0.0200

a) significant digits = 3

b) scientific notation = 2.00×10^{-2}

(4 marks) Solve for x in the following equation.

$$2ax + 14 = c$$

$$\frac{2ax = c - 14}{2a \quad 2a}$$

$$x = \frac{c - 14}{2a}$$

$$\cancel{v}x \left(\frac{2a}{\cancel{x}} \right) = \left(\frac{w}{\cancel{v}} \right) \cancel{x}$$

$$\frac{2av = wx}{w \quad w}$$

$$x = \frac{2av}{w}$$

(4 marks) Given the standard unit conversion table on the formula sheet (1st page), convert each of the numbers to the stated units.

$$12 \frac{\text{m}}{\text{gallon}} \rightarrow \frac{\text{ft}}{\text{L}}$$

$$12 \frac{\cancel{\text{m}}}{\cancel{\text{gal}}} \left(\frac{3.3 \cancel{\text{ft}}}{1 \cancel{\text{m}}} \right) \left(\frac{1 \cancel{\text{gal}}}{3.78 \text{L}} \right) = 10.476 \frac{\text{ft}}{\text{L}}$$

$$\boxed{1.0 \times 10^1 \frac{\text{ft}}{\text{L}}}$$

$$74.3 \frac{\text{lbs.}}{\text{minute}} \rightarrow \frac{\text{kg}}{\text{day}}$$

$$74.3 \frac{\cancel{\text{lbs.}}}{\cancel{\text{min.}}} \left(\frac{1 \text{kg}}{2.2 \cancel{\text{lbs.}}} \right) \left(\frac{60 \cancel{\text{min}}}{1 \cancel{\text{hour}}} \right) \left(\frac{24 \cancel{\text{hours}}}{1 \text{day}} \right) = 48632.7 \frac{\text{kg}}{\text{day}}$$

$$\boxed{48600 \frac{\text{kg}}{\text{day}}}$$

$$12 \frac{\text{kg}}{\text{L}} \rightarrow \frac{\text{g}}{100 \text{mL}}$$

$$12 \frac{\cancel{\text{kg}}}{\cancel{\text{L}}} \left(\frac{1000 \text{g}}{1 \cancel{\text{kg}}} \right) \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) \left(\frac{100 \cancel{\text{mL}}}{100 \text{mL}} \right) = 1200 \frac{\text{g}}{100 \text{mL}}$$

$$\boxed{1200 \frac{\text{g}}{100 \text{mL}}}$$

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

units:

$$0.75\% (w/v) = 0.75 \frac{g}{100 mL} = \frac{0.75g}{100 mL}$$

concentration:

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

$$\left[\frac{0.75g}{100 mL} \right] = \frac{m}{[1.5L]}$$

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

$$m = 11.25 g$$

$$m = 11 g$$

(2 marks) Prepare a 3:2 water:alcohol solution using 84 mL of water.

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

concentration (water):

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

$$\left[\frac{3 \text{ parts}}{5 \text{ parts}} \right] = \frac{[84 \text{ mL}]}{V_{\text{total}}}$$

$$V_{\text{total}} = \frac{(5 \text{ parts})(84 \text{ mL})}{3 \text{ parts}} = 140 \text{ mL}$$

$$V_{\text{total}} = 140 \text{ mL}$$

concentration (alcohol):

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

$$\left[\frac{2 \text{ parts}}{5 \text{ parts}} \right] = \frac{V_{\text{alcohol}}}{[140 \text{ mL}]}$$

$$V_{\text{alcohol}} = \frac{(2 \text{ parts})(140 \text{ mL})}{5 \text{ parts}} = 56 \text{ mL}$$

$$V_{\text{alcohol}} = 56 \text{ mL}$$

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

units:

$$1.2 \text{ M} = 1.2 \frac{\cancel{\text{mol}}}{\text{L}} \left(\frac{180 \text{ g}}{\cancel{1 \text{ mol}}} \right) = 216 \frac{\text{g}}{\text{L}} = \frac{216 \text{ g}}{1 \text{ L}}$$

concentration:

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

$$\left[\frac{216 \text{ g}}{1 \text{ L}} \right] = \frac{m}{[150 \text{ mL}]}$$

$$m = \frac{(216 \text{ g})(150 \cancel{\text{ mL}})}{1 \cancel{\text{ L}}} \left(\frac{1 \cancel{\text{ L}}}{1000 \cancel{\text{ mL}}} \right) = 32.4 \text{ g}$$

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

(3 marks) Dilute 15 mL of a 6.0 M NaCl solution to 100 mL. Then take 25 mL of that and dilute it to 250 mL. What is the final concentration?

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

dilution 1:

$$C_1 V_1 = C_2 V_2$$

$$[6.0\text{M}][15\text{mL}] = C_2 [100\text{mL}]$$

$$C_2 = \frac{(6.0\text{M})(15\cancel{\text{mL}})}{100\cancel{\text{mL}}} = 0.9\text{M}$$

dilution 2:

$$C_2 V_2 = C_3 V_3$$

$$[0.9\text{M}][25\text{mL}] = C_3 [250\text{mL}]$$

$$C_3 = \frac{(0.9\text{M})(25\cancel{\text{mL}})}{250\cancel{\text{mL}}} = 0.09\text{M}$$

$$C_3 = 0.090\text{M}$$

(3 marks) Dilute 7.0 mL of a 4.5 M CaCl_2 solution to 85 mL. Then take 15 mL and dilute it to 250 mL. What is the final concentration in molarity?

dilution 1:

$$C_1 V_1 = C_2 V_2$$

$$[4.5 \text{ M}][7.0 \text{ mL}] = C_2 [85 \text{ mL}]$$

$$C_2 = \frac{(4.5 \text{ M})(7.0 \text{ mL})}{85 \text{ mL}} = 0.3706 \text{ M}$$

dilution 2:

$$C_2 V_2 = C_3 V_3$$

$$[0.3706 \text{ M}][15 \text{ mL}] = C_3 [250 \text{ mL}]$$

$$C_3 = \frac{(0.3706 \text{ M})(15 \text{ mL})}{250 \text{ mL}} = 0.02224 \text{ M}$$

$$C_3 = 0.022 \text{ M}$$

(4 marks) 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 concentration in % (w/v) and molarity?

assume $400 \text{ mL} = 4.00 \times 10^2 \text{ mL}$

concentration:

$$C_1 = \frac{m}{V} = \frac{180 \text{ g}}{400 \text{ mL}} = 0.45 \frac{\text{g}}{\text{mL}} = \frac{0.45 \text{ g}}{1 \text{ mL}}$$

dilution:

$$C_1 V_1 = C_2 V_2$$

$$\left[\frac{0.45 \text{ g}}{1 \text{ mL}} \right] [400 \text{ mL}] = C_2 [2.0 \text{ L}]$$

$$C_2 = \frac{(0.45 \text{ g})(400 \text{ mL})}{(1 \text{ mL})(2.0 \text{ L})} = 90 \frac{\text{g}}{\text{L}}$$

units:

$$C_2 = 90 \frac{\text{g}}{\text{L}} \left(\frac{1 \text{ L}}{1000 \text{ mL}} \right) \left(\frac{100 \text{ mL}}{100 \text{ mL}} \right) = 9 \frac{\text{g}}{100 \text{ mL}} = 9\% (\text{w/v})$$

$$C_2 = 9.0\% (\text{w/v})$$

$$C_2 = 90 \frac{\text{g}}{\text{L}} \left(\frac{1 \text{ mol}}{180 \text{ g}} \right) = 0.5 \frac{\text{mol}}{\text{L}} = 0.5 \text{ M}$$

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

(4 marks) Dilute 5.0 mL of a 1.2 % (w/v) CaCl_2 solution to 50 mL. Then take 10 mL and dilute it to 250 mL. What is the final concentration in % (w/v) and parts?

assume: $50 \text{ mL} = 5.0 \times 10^1 \text{ mL}$ & $10 \text{ mL} = 1.0 \times 10^1 \text{ mL}$

dilution 1:

$$C_1 V_1 = C_2 V_2$$

$$[1.2\%][5 \text{ mL}] = C_2 [50 \text{ mL}]$$

$$C_2 = \frac{(1.2\%)(\cancel{5 \text{ mL}})}{\cancel{50 \text{ mL}}} = 0.12\% \text{ (w/v)}$$

dilution 2:

$$C_2 V_2 = C_3 V_3$$

$$[0.12\%][10 \text{ mL}] = C_3 [250 \text{ mL}]$$

$$C_3 = \frac{(0.12\%)(\cancel{10 \text{ mL}})}{\cancel{250 \text{ mL}}} = 0.0048\% \text{ (w/v)}$$

$$C_3 = 0.0048\% \text{ (w/v)}$$

units:

$$\begin{aligned} C_3 = 0.0048\% \text{ (w/v)} &= 0.0048 \frac{\cancel{\text{g}}}{\cancel{100 \text{ mL}}} \left(\frac{\cancel{1000 \text{ mL}}}{1 \text{ L}} \right) \left(\frac{1000 \text{ mg}}{\cancel{1 \text{ g}}} \right) \\ &= 48 \frac{\text{mg}}{\text{L}} = 48 \text{ ppm} \end{aligned}$$

$$C_3 = 48 \text{ ppm}$$