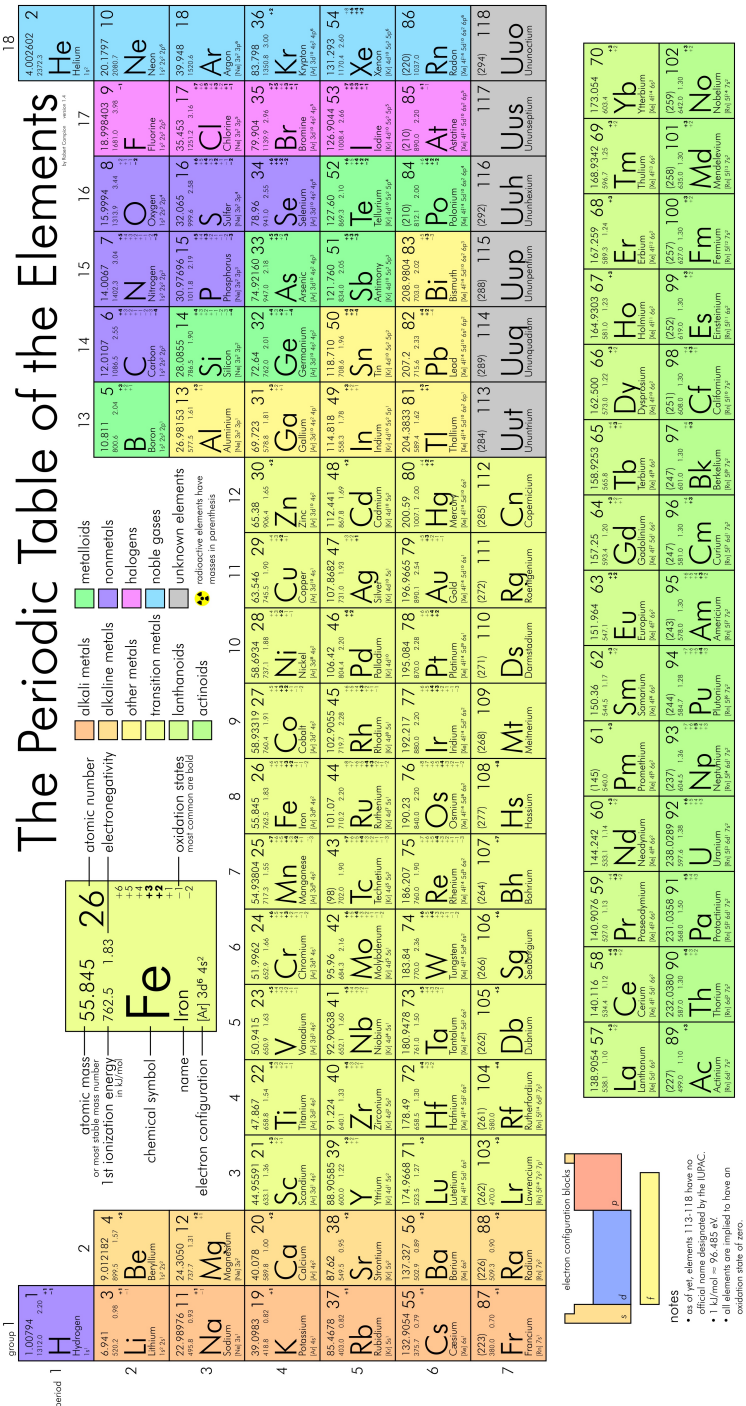
Instructor:	Frank Secretain
Course:	Math 150
Date:	June 12, 2026
Assessment:	Test 2
Time allowed:	110 minutes
Devices allowed:	Pencil, pen, eraser, calculator
Notes from instructor:	Be neat. Show your work where needed. Box final answers.
Marks allocated:	10 questions worth 25 marks
Percentage of final grade:	25% of final grade



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

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

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 (%)

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

parts

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

molarity

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

Dilutions

$$C_1V_1 = C_2V_2$$

dilution = $\frac{\text{solute volume}}{\text{total/final volume}}$ dilution factor (DF) = $\frac{1}{\text{dilution}}$

Prepare 320 mL of a 2.2% (w/v) KCl solution.

Prepare a 3:1 alcohol:water solution using 130 mL of alcohol.

Prepare 250 mL of a 350 ppm nitrate solution.

Prepare a 1.9 M sucrose solution using 320 g/mol as the formula weight, and a total volume of 100 mL.

Prepare a 0.2% (w/w) hydrogen peroxide solution using 1.7 g of H_2O_2. What is the total mass of the solution?

Determine the formula weight of $NaHCO_3$ (baking soda).

Prepare a 1:4 oil:vinegar solution using 50 mL of oil.

Prepare 1.2 L of a 1.6% (w/v) calcium chloride solution.

Prepare a 1.2 M H_2SO_4 solution using 98.1 g/mol as the formula weight, and a total volume of 1.0 L.

Prepare a 3.5 pph potassium chloride solution using 0.2 kg of solute.

Prepare 320 mL of a 2.2% (w/v) KCl solution.

$$C = 2.2\%\,(w/v) = \frac{2.2\ g}{100\ mL}$$

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

$$320\ mL\left(\frac{2.2\ g}{100\ mL}\right) = \left(\frac{m}{320\ mL}\right)320\ mL$$

$$m = \frac{(320\ mL)(2.2\ g)}{100\ mL} = 7.04\ g$$

$$\boxed{m = 7.0\ g}$$

Prepare a 3:1 alcohol:water solution using 130 mL of alcohol.

total parts = 3 + 1 = 4

alcohol:

$$C = \frac{\forall}{\forall_{total}}$$

$$\frac{3 \text{ parts}}{4 \text{ parts}} = \frac{130 \text{ mL}}{\forall_{total}}$$

$$\forall_{total} = \frac{(130 \text{ mL})(4 \text{ parts})}{3 \text{ parts}} = 173.3 \text{ mL}$$

water:

$$C = \frac{\forall}{\forall_{total}}$$

$$\frac{1 \text{ parts}}{4 \text{ parts}} = \frac{\forall}{173.3 \text{ mL}}$$

$$\forall_{water} = \frac{(1 \text{ part})(173.3 \text{ mL})}{4 \text{ parts}} = 43.3 \text{ mL}$$

Prepare 250 mL of a 350 ppm nitrate solution.

$$C = 350 \text{ ppm} = \frac{350 \text{ mg}}{1 \text{ L}}$$

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

$$\frac{350 \text{ mg}}{1 \text{ L}} = \frac{m}{250 \text{ mL}}$$

$$m = \frac{(350 \text{ mg})(250 \cancel{\text{mL}})}{1 \cancel{\text{L}}} \left(\frac{1 \cancel{\text{L}}}{1000 \cancel{\text{mL}}} \right) = 87.5 \text{ mg}$$

$$\boxed{m = 87.5 \text{ mg}}$$

Prepare a 1.9 M sucrose solution using 320 g/mol as the formula weight, and a total volume of 100 mL.

$$C = 1.9\,M = 1.9\,\frac{\cancel{mol}}{L}\left(\frac{320\,g}{\cancel{mol}}\right) = 608\,\frac{g}{L}$$

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

$$\frac{608\,g}{1\,L} = \frac{m}{100\,mL}$$

$$m = \frac{(608\,g)(100\,\cancel{mL})}{1\,\cancel{L}}\left(\frac{1\,\cancel{L}}{1000\,\cancel{mL}}\right) = 60.8\,g$$

$$\boxed{m = 60.8\,g}$$

Prepare a 0.2% (w/w) hydrogen peroxide solution using 1.7 g of H_2O_2. What is the total mass of the solution?

$$C = 0.2\%\,(w/w) = \frac{0.2\ g}{100\ g}$$

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

$$\frac{0.2\ g}{100\ g} = \frac{1.7\ g}{m_{total}}$$

$$m_{total} = \frac{(1.7\ g)(100\ g)}{0.2\ g} = 850\ g$$

$$\boxed{m_{total} = 850\ g}$$

Determine the formula weight of $NaHCO_3$ (baking soda).

Formula weight:

$$
\begin{aligned}
Na: \quad & 22.98976 = 22.98976 \\
H: \quad & 1.00794 = 1.00794 \\
C: \quad & 12.0107 = 12.0107 \\
O_3: \quad & 3(15.9994) = 47.9982 \\
& \qquad\qquad\qquad\quad 84.0066
\end{aligned}
$$

$$FW_{NaHCO_3} = 84.0 \ g/mol$$

Prepare a 1:4 oil:vinegar solution using 50 mL of oil.

total parts = 1 + 4 = 5 parts

concentration (oil):

$$C = \frac{V}{V_{total}}$$

$$\frac{1 \text{ part}}{5 \text{ parts}} = \frac{50 \text{ mL}}{V_{total}}$$

$$V_{total} = \frac{(50 \text{ mL})(5 \text{ parts})}{1 \text{ part}} = 250 \text{ mL}$$

concentration (vinegar):

$$C = \frac{V}{V_{total}}$$

$$\frac{4 \text{ parts}}{5 \text{ parts}} = \frac{V}{250 \text{ mL}}$$

$$V = \frac{(4 \text{ parts})(250 \text{ mL})}{5 \text{ parts}} = 200 \text{ mL}$$

Prepare 1.2 L of a 1.6% (w/v) calcium chloride solution.

$$C = 1.6\%\left(\frac{w}{v}\right) = \frac{1.6\ g}{100\ mL}$$

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

$$\frac{1.6\ g}{100\ mL} = \frac{m}{1.2\ L}$$

$$m = \frac{(1.6\ g)(1.2\ \cancel{L})}{100\ \cancel{mL}}\left(\frac{1000\ \cancel{mL}}{1\ \cancel{L}}\right) = 19.2\ g$$

$$\boxed{m = 19.2\ g}$$

Prepare a 1.2 M H_2SO_4 solution using 98.1 g/mol as the formula weight, and a total volume of 1.0 L.

$$C = 1.2\ M = \frac{1.2\ \cancel{mol}}{1\ L}\left(\frac{98.1\ g}{\cancel{mol}}\right) = 117.72\ \frac{g}{L}$$

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

$$\frac{117.72\ g}{1\ L} = \frac{m}{1\ L}$$

$$m = \frac{(117.72\ g)(1\ \cancel{L})}{1\ \cancel{L}} = 117.72\ g$$

$$\boxed{m = 118\ g}$$

Prepare a 3.5 pph potassium chloride solution using 0.2 kg of solute.

$$C = 3.5 \text{ pph} = 3.5\% (w/v) = \frac{3.5 \text{ g}}{100 \text{ mL}}$$

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

$$\frac{3.5 \text{ g}}{100 \text{ mL}} = \frac{0.2 \text{ kg}}{V}$$

$$V = \frac{(0.2 \text{ kg})(100 \text{ mL})}{3.5 \text{ g}} \left(\frac{1000 \text{ g}}{1 \text{ kg}}\right) = 5714.29 \text{ mL} \left(\frac{1 \text{ L}}{1000 \text{ mL}}\right)$$

$$= 5.714 \text{ L}$$

$$\boxed{V = 5.71 \text{ L}}$$