CHEM 1210 (Rowley)
Exam 1 (Chapters 1-2) Fall 2025

Formulas

$$T_K = T_{\circ C} + 273.15$$

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

$$A.W. = \sum_{i=isotope} mass_i \frac{\%abundance_i}{100\%}$$

Constants

$$R = 8.314 \frac{J}{mol\ K}$$

$$R = 0.08206 \frac{L\ atm}{mol\ K}$$

Feel free to use this page as scratch paper, but final work for questions must be shown *in the question's section* to count for credit.

Periodic Table of the Elements

1 IA 1A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 **H** Hydrogen 1.008																	2 **He** Helium 4.003
3 **Li** Lithium 6.941	4 **Be** Beryllium 9.012											5 **B** Boron 10.811	6 **C** Carbon 12.011	7 **N** Nitrogen 14.007	8 **O** Oxygen 15.999	9 **F** Fluorine 18.998	10 **Ne** Neon 20.180
11 **Na** Sodium 22.990	12 **Mg** Magnesium 24.305											13 **Al** Aluminum 26.982	14 **Si** Silicon 28.086	15 **P** Phosphorus 30.974	16 **S** Sulfur 32.066	17 **Cl** Chlorine 35.453	18 **Ar** Argon 39.948
19 **K** Potassium 39.098	20 **Ca** Calcium 40.078	21 **Sc** Scandium 44.956	22 **Ti** Titanium 47.867	23 **V** Vanadium 50.942	24 **Cr** Chromium 51.996	25 **Mn** Manganese 54.938	26 **Fe** Iron 55.845	27 **Co** Cobalt 58.933	28 **Ni** Nickel 58.693	29 **Cu** Copper 63.546	30 **Zn** Zinc 65.38	31 **Ga** Gallium 69.723	32 **Ge** Germanium 72.631	33 **As** Arsenic 74.922	34 **Se** Selenium 78.971	35 **Br** Bromine 79.904	36 **Kr** Krypton 83.798
37 **Rb** Rubidium 85.468	38 **Sr** Strontium 87.62	39 **Y** Yttrium 88.906	40 **Zr** Zirconium 91.224	41 **Nb** Niobium 92.906	42 **Mo** Molybdenum 95.95	43 **Tc** Technetium 98.907	44 **Ru** Ruthenium 101.07	45 **Rh** Rhodium 102.906	46 **Pd** Palladium 106.42	47 **Ag** Silver 107.868	48 **Cd** Cadmium 112.414	49 **In** Indium 114.818	50 **Sn** Tin 118.711	51 **Sb** Antimony 121.760	52 **Te** Tellurium 127.6	53 **I** Iodine 126.904	54 **Xe** Xenon 131.294
55 **Cs** Cesium 132.905	56 **Ba** Barium 137.328	57 **La** Lanthanum 138.905	72 **Hf** Hafnium 178.49	73 **Ta** Tantalum 180.948	74 **W** Tungsten 183.84	75 **Re** Rhenium 186.207	76 **Os** Osmium 190.23	77 **Ir** Iridium 192.217	78 **Pt** Platinum 195.085	79 **Au** Gold 196.967	80 **Hg** Mercury 200.592	81 **Tl** Thallium 204.383	82 **Pb** Lead 207.2	83 **Bi** Bismuth 208.980	84 **Po** Polonium [208.982]	85 **At** Astatine 209.987	86 **Rn** Radon 222.018
87 **Fr** Francium 223.020	88 **Ra** Radium 226.025	89 **Ac** Actinium 227.028	104 **Rf** Rutherfordium [261]	105 **Db** Dubnium [262]	106 **Sg** Seaborgium [266]	107 **Bh** Bohrium [264]	108 **Hs** Hassium [269]	109 **Mt** Meitnerium [278]	110 **Ds** Darmstadtium [281]	111 **Rg** Roentgenium [280]	112 **Cn** Copernicium [285]	113 **Nh** Nihonium [286]	114 **Fl** Flerovium [289]	115 **Mc** Moscovium [289]	116 **Lv** Livermorium [293]	117 **Ts** Tennessine [294]	118 **Og** Oganesson [294]

Lanthanide Series	58 **Ce** Cerium 140.116	59 **Pr** Praseodymium 140.908	60 **Nd** Neodymium 144.243	61 **Pm** Promethium 144.913	62 **Sm** Samarium 150.36	63 **Eu** Europium 151.964	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.925	66 **Dy** Dysprosium 162.500	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.259	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.055	71 **Lu** Lutetium 174.967
Actinide Series	90 **Th** Thorium 232.038	91 **Pa** Protactinium 231.036	92 **U** Uranium 238.029	93 **Np** Neptunium 237.048	94 **Pu** Plutonium 244.064	95 **Am** Americium 243.061	96 **Cm** Curium 247.070	97 **Bk** Berkelium 247.070	98 **Cf** Californium 251.080	99 **Es** Einsteinium [254]	100 **Fm** Fermium 257.095	101 **Md** Mendelevium 258.1	102 **No** Nobelium 259.101	103 **Lr** Lawrencium [262]

Name _____ Points: ____
100

Problem 1: (4 points)

A runner in a race runs $100.0m$ with a time of $12.54s$. What is their running speed in mph? ($1km = 0.621371miles$)

Problem 2: (4 points)

For each number below, give the quantity of significant figures, and the position of the least significant figure as a power of 10

$12.004g$ $0.00240m$ $3.20 \times 10^{-6}s$ $9.2 \times 10^{5}m$

Problem 3: (4 points)

For each of the 19th century scientists below, briefly describe what major feature of atomic theory was demonstrated through their work

- Rutherford:
- Thompson:
- Millikan:

Problem 4: (4 points)

For each of the substances below, categorize them as an element, compound, heterogeneous mixture, or homogeneous mixture

- Titanium
- Ethanol
- Tears (from your eyes)
- Chicken casserole
- Granola
- Table salt (NaCl)
- Carbon monoxide
- Silver

Problem 5: (4 points)

State whether each change or property is physical or chemical (just write "P" or "C")

Changes

- A gram of sugar dissolves in hot water
- Eaten food is metabolized
- Iron is reshaped by a blacksmith
- A river carves a canyon through erosion

Properties

- Density
- Flammability
- Melting Point
- Electrical Conductivity

Problem 6: (4 points)

For each compound below, list how many atoms of each element are present.

$(NH_4)_3PO_4$ $CH_3CH_2COCH_3$ $MgSO_4 \cdot 7\,H_2O$

Problem 7: (4 points)

Use your own words to briefly describe *two* of the four postulates of Dalton's atomic theory

Problem 8: (4 points)

Oxygen will condense from the gas phase into a liquid at $-183^{\circ}C$. This temperature is called the normal boiling point. Give the normal boiling point for oxygen using the Kelvin temperature scale

Problem 9: (4 points)

Rubidium has 2 stable isotopes with the following properties:

Isotope	^{85}Rb	^{87}Rb
Mass (amu)	84.911789	86.909183
% Abundance	72.17	27.83

Based on these measurements, what atomic mass should we find on the periodic table?

Problem 10: (4 points)

Atoms are composed of electrons, protons, and neutrons. Interestingly, among these particles two of them account for most of the mass but virtually none of the volume, and one of them accounts for most of the volume but virtually none of the mass. Which subatomic particles belong to which categories?

Large volume, low mass:

Large mass, low volume:

Problem 11: (4 points)

Match each prefix to its appropriate power of 10

nano-	_____	A) 10^{-2}
centi-	_____	B) 10^{3}
kilo-	_____	C) 10^{-3}
micro-	_____	D) 10^{-6}
milli-	_____	E) 10^{-9}

Problem 12: (8 points)

Fill in the blank portions of the following table

Symbol	# of Protons	# of Neutrons	# of Electrons	Mass #	Charge
	12	13	12		
$^{85}Rb^{+}$					
	50		50	119	
$^{79}Se^{2-}$					

Problem 13: (4 points)

The following table gives the density of several common metals.

Metal	Density (g/cm^3)
Gold	19.32
Rhodium	12.4
Copper	8.96
Niobium	8.57
Iron	7.87
Vanadium	6.11
Zirconium	6.51

A cube of metal measures 2.56 mm on each side, and has a mass of 150.3 mg.

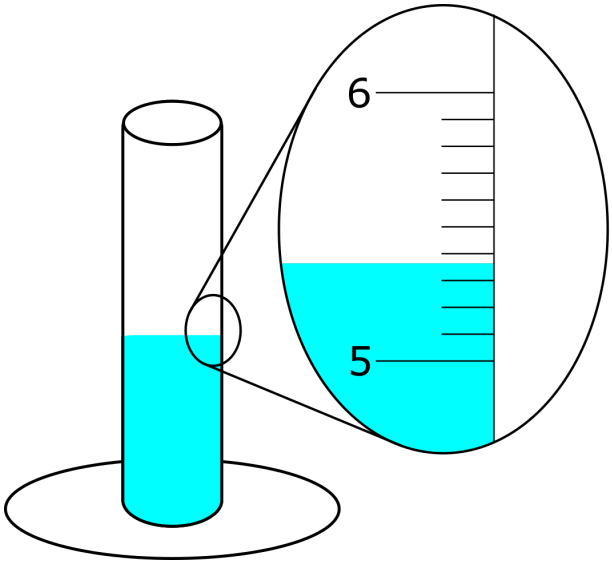
- Find the volume of the cube in cm^3.
- Find the density of the metal cube, and identify it based on the above table of densities.

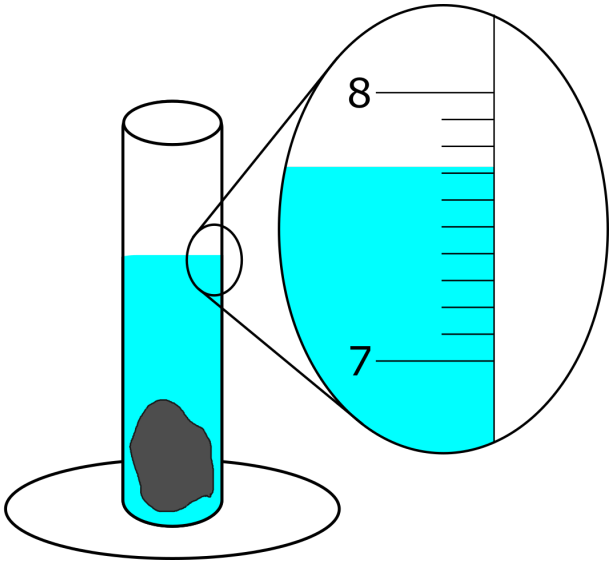
Problem 14: (4 points)

Tungsten (W) has a density of $19.28 g/cm^3$. Find the volume (in cm^3) of $2.68 g$ of tungsten

Problem 15: (4 points)

A rock is measured to weigh $5.456\ g$, then placed in a graduated cylinder of water. Below are images of the cylinder before and after the rock is added:





○ Find the density of the rock in $\frac{g}{ml}$ (take care with significant figures!)

○ Give the density in $\frac{kg}{m^3}$ (you will need the relation: $1\ ml = 1\ cm^3$)

Problem 16: (8 points)

Classify each of the following elements as a *Halogen*, *Alkali Metal*, *Transition Metal*, *Inner Transition Metal*, *Chalcogen*, *Noble Gas*, *Metalloid*, or *Alkaline Earth Metal*

Ne	_____	Ca	_____
Li	_____	S	_____
Cl	_____	Br	_____
Au	_____	Zn	_____
Si	_____	Kr	_____

Problem 17: (4 points)

A scientific *hypothesis* only becomes a *theory* after it has been supported by many experiments and accepted as highly reliable by a consensus in the scientific community

True False

Problem 18: (4 points)

List the name of your *favorite* element, its atomic symbol, and the reason you love it!

Problem 19: (4 points)

Give the name or the chemical formula for each compound below:

Formula	Name
W_2O	_____
$Ca(ClO_2)_2$	_____
_____	Iron(III) hydrogen sulfate
_____	Lithium bicarbonate

Problem 20: (4 points)

Give the name or the chemical formula for each compound below:

Formula	Name
XeF_4	_____
P_2Cl_5	_____
_____	Sulfur difluoride
_____	Triphosphorous disulfide

Problem 21: (4 points)

Give the name or the chemical formula for each compound below:

Formula	Name
H_2SO_4	_____
$CuSO_4 \cdot 5\, H_2O$	_____
_____	Nitrous acid
_____	Calcium chloride dihydrate

Problem 22: (4 points)

Give the answer to the problems below, with units and the correct number of significant figures:

$$x = \frac{1.50g + 9.13g}{12.34ml}$$

$$3.45cm \times 8.64cm - 2.93cm \times 9.01cm$$

Problem 23: (4 points)

In the space below, draw arrows which represent all possible phase changes and label the arrows, giving the names of the phase changes.

Gas

Liquid

Solid