Problem Set #3 (NOT GRADED/NOT SCORED) - Moles, N_A, Compound Names
Chemistry 3A Fall 2025 (Secs 43957 & 43958)
3 pages

This is ungraded practice as a preliminary to a scored/graded homework assignment to follow. I suggest you do the problems quickly and submit them, and I will review and respond to them so that you know how to perform for the work to be scored.
YOU DON'T HAVE TO DO ALL OF THEM, although it is recommended. You can decide if you "know something enough" and skip it. I will only review what you respond to.

These problems focus on calculations only, which are often thought to be more difficult. The follow-up scored homework will include your knowledge of concepts.

NOTE: Avogadro's Number can refer to number of (i) particles, (ii) atoms, (iii) molecules, and also—adding this—(iv) formula units (!)

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1. Write the molecular or formula unit formulas for the following named compounds, and next to the formula, write if it is "ionic" or "not ionic":
   a. Diphosphorus pentoxide — P_2O_5
   b. Calcium chloride — $CaCl_2$
   c. Sulfur dioxide — SO_2
   d. Aluminum bromide — $AlBr_3$
   e. Nitrogen triiodide — NI_3
   f. Zinc sulfide — ZnS
   g. Carbon tetrachloride — CCl_4
   h. Dinitrogen monoxide — N_2O
   i. Silicon dioxide — SiO_2
   j. Phosphorus trichloride — PCl_3
   k. Sulfur hexafluoride — SF_6
   l. Magnesium nitride — Mg_3N_2
   m. Iron(III) oxide — Fe_2O_3
   n. Sodium sulfate — Na_2SO_4
   o. Potassium phosphate — K_3PO_4
   p. Ammonium carbonate — $(NH_4)_2CO_3$
2. Write the names of the following compounds:
   a. N_2O_4 — dinitrogen tetroxide
   b. PCl_3 — phosphorus trichloride
   c. Ca_3PO_4 — calcium phosphate
   d. MgO — magnesium oxide
   e. CCl_4 — carbon tetrachloride
   f. $(NH_4)_2SO_4$ — ammonium sulfate
   g. $CuCl_2$ — copper (II) chloride
   h. SO_2 — sulfur dioxide

i. Na_2CO_3 – sodium carbonate
j. N_2O_5 – dinitrogen pentoxide
k. LiI – lithium iodide
l. CO_2 – carbon dioxide
m. FeO – iron (II) oxide
n. P_2O_5 diphosphorus pentoxide
o. H_2O water → also dihydrogen monoxide

3. You have 3.011×10^{23} atoms of pure iron (Fe). How many moles of Fe do you have?

$$(3.011\times10^{23}\text{ atoms Fe})\times\left(\frac{1\text{ mol Fe}}{6.022\times10^{23}\text{ atoms Fe}}\right) = 0.5000\text{ mol Fe}$$

4. You have 3.011×10^{24} molecules of water (H_2O). How many moles of water do you have?

$$(3.011\times10^{24}\text{ molecules }H_2O)\times\left(\frac{1\text{ mol }H_2O}{6.022\times10^{23}\text{ molecules }H_2O}\right) = 5.000\text{ mol }H_2O$$

5. You have 0.254 mol calcium carbonate

a. write the structure (formula of the formula unit) of calcium carbonate

calcium → type I cation: Ca^{2+}
carbonate → polyatomic anion: CO_3^{2-}
Ca^{2+} + CO_3^{2-} criss-cross → $Ca_2(CO_3)_2$ → $CaCO_3$

b. calculate the number of formula units of calcium carbonate you have

$$(0.254\text{ mol }CaCO_3)\left(\frac{6.022\times10^{23}\text{ formula units }CaCO_3}{1\text{ mol }CaCO_3}\right) = 1.53\times10^{23}\text{ formula units }CaCO_3$$

c. using the Periodic Table, calculate the molar mass of calcium carbonate

Table:
Ca: 40.078 g/mol × 1 = 40.078 g/mol
C: 12.011 g/mol × 1 = 12.011 g/mol +
O: 16.00 g/mol × 3 = 48.00 g/mol +
= 100.09 g/mol $CaCO_3$

6. You have 9.50 mol of carbon dioxide

a. write the molecular formula of carbon dioxide ← non ionic!

O=C=O → CO_2

b. calculate the number of molecules of carbon dioxide you have

$$(9.50\text{ mol }CO_2)\times\left(\frac{6.022\times10^{23}\text{ molecules }CO_2}{1\text{ mol }CO_2}\right) = 5.72\times10^{24}\text{ molecules }CO_2$$

c. using the Periodic Table, calculate the molar mass of carbon dioxide

C: 12.011 g/mol × 1 = 12.011 g/mol
O: 16.00 g/mol × 2 = 32.00 g/mol + → = 44.01 g/mol CO_2

7. Convert:

a. 1.02 *nmol* to *mol*. Use scientific notation

$$(1.02\text{ nmol})\times\left(\frac{10^{-9}\text{ mol}}{1\text{ nmol}}\right) = 1.02\times10^{-9}\text{ mol}$$

b. 2.34×10^{-6} *mol* to *mmol*

$$(2.34\times10^{-6}\text{ mol})\times\left(\frac{10^{3}\text{ mmol}}{1\text{ mol}}\right) = 2.34\times10^{-3}\text{ mmol} = 0.00234\text{ mmol}$$

c. 0.0092 *mol* to *mmol*

$$(0.0092\text{ mol})\cdot\left(\frac{10^{3}\text{ mmol}}{1\text{ mol}}\right) = 0.0092\times10^{3}\text{ mmol} = 9.2\text{ mmol}$$

d. 1.0×10^6 *nmol* to *mol* $(1.0\times10^6\ \text{nmol})\times\left(\frac{1\ \text{mol}}{10^9\ \text{nmol}}\right)=1.0\times10^{-3}\ \text{mol}$
$=0.0010\ \text{mol}$

8. You have 3 nmol of Fe_2O_3

a. What is the name of the compound?
O has −2 charge fixed $3\times O^{2-}=6-$ total $2Fe^{3+}$ balances 6−
iron(III) chloride

b. How many moles do you have? Use scientific notation if the numbers is greater than 100 or less than 0.01
$(3\ \text{nmol}\ Fe_2O_3)\cdot\left(\frac{1\ \text{mol}\ Fe_2O_3}{10^9\ \text{nmol}\ Fe_2O_3}\right)=3\times10^{-9}\ \text{mol}\ Fe_2O_3$

c. How many formula units do you have?
$(3\times10^{-9}\ \text{mol}\ Fe_2O_3)\cdot\left(\frac{6.022\times10^{23}\ \text{formula units}\ Fe_2O_3}{1\ \text{mol}\ Fe_2O_3}\right)=1.8066\times10^{15}$ FU
$=2\times10^{15}$ formula units Fe_2O_3

d. What is the molar mass of the compound?
Fe: $55.845\ \text{g/mol}\times2=111.69\ \text{g/mol}$
O: $16.00\ \text{g/mol}\times3=48.00\ \text{g/mol}+\rightarrow 159.69\ \text{g/mol}\ Fe_2O_3$

e. How many grams of Fe_2O_3 do you have?
$(3\ \text{nmol}\ Fe_2O_3)\times\left(\frac{159.69\ \text{g}\ Fe_2O_3}{1\ \text{mol}\ Fe_2O_3}\right)\left(\frac{10^{-9}\ \text{mol}\ Fe_2O_3}{1\ \text{nmol}\ Fe_2O_3}\right)=4.7907\times10^{-7}\ \text{g}\ Fe_2O_3$
$=5\times10^{-7}\ \text{g}\ Fe_2O_3$

f. How many micrograms (µg) of Fe_2O_3 do you have?
$(4.7907\times10^{-7}\ \text{g}\ Fe_2O_3)\times\frac{10^6\ \mu\text{g}\ Fe_2O_3}{1\ \text{g}\ Fe_2O_3}=0.47907\ \mu\text{g}\Rightarrow 0.5\ \mu\text{g}\ Fe_2O_3$

9. You have 100.0 g of dichlorine heptaoxide

a. What is the molecular formula of this compound?
Cl_2O_7 di = 2, hepta = 7 chlorine = Cl oxide → oxygen = O

b. What is the molar mass of this compound?
$Cl = 35.453\ \text{g/mol}\times2=70.906\ \text{g/mol}$
$O = 16.00\ \text{g/mol}\times7=112.0\ \text{g/mol}+\rightarrow 182.9\ \text{g/mol}\ Cl_2O_7$

c. What is the number of millimoles of this compound?
$(100.0\ \text{g}\ Cl_2O_7)\times\left(\frac{1\ \text{mol}\ Cl_2O_7}{182.9\ \text{g}\ Cl_2O_7}\right)\times\left(\frac{10^3\ \text{mmol}\ Cl_2O_7}{1\ \text{mol}\ Cl_2O_7}\right)=546.7\ \text{mmol}\ Cl_2O_7$

10. You have 2×10^{20} molecules of PCl_5

a. What is the name of this compound?
1P = phosphorus (not monophosphorus) 5Cl = penta chlorine → chloride
phosphorus pentachloride

b. What is the molar mass of this compound?
$P = 30.974\ \text{g/mol}\times1=30.974\ \text{g/mol}$
$Cl = 35.45\ \text{g/mol}\times5=177.25\ \text{g/mol}+\rightarrow 208.224\ \text{g/mol}\ PCl_5$

c. What is the number of moles of this compound?
$(2\times10^{20}\ \text{molecules}\ PCl_5)\cdot\left(\frac{1\ \text{mol}\ PCl_5}{6.022\times10^{23}\ \text{molecules}\ PCl_5}\right)=3.321\times10^{-4}\ \text{mol}\ PCl_5$ ← ok
$\rightarrow 3\times10^{-4}\ \text{mol}\ PCl_5$

d. How many grams of PCl_5 do you have?
$(3.321\times10^{-4}\ \text{mol}\ PCl_5)\cdot\left(\frac{208.224\ \text{g}\ PCl_5}{1\ \text{mol}\ PCl_5}\right)=0.0615\ \text{g}\ PCl_5\rightarrow 0.07\ \text{g}\ PCl_5$

*8f: I used intermediate calculation, not the rounded final answer