Problem Set 3: Atoms & Moles



 $N_A = 0.022 \times 10^{23}$ units

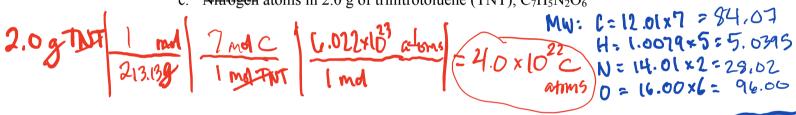
- 1. How many entities are present in each of the following:
 - a. 3.21 mol argon atoms

b. 1.3×10^{-12} mol marbles

1.3×10 mol marbles
$$(1.022 \times 10^{23})$$
 marbles = 7.8×10^{11} marble

Carbon

c. Nitrogen atoms in 2.0 g of trinitrotoluene (TNT), C₇H₅N₂O₆



213.133/

2. Fill in the blanks in the table (one column per element or ion)

Symbol	⁵⁸ Ni	⁵⁹ Co ²⁺	2º Ne	\ /
# protons	28	27	10	
# neutrons	98-28 = 30	59-27= 32	10	X
# electrons	28	25	10	

3. Naturally occurring uranium consists of two isotopes, whose masses and abundances are shown below.

Isotope	Abundance	Mass
²³⁵ U	0.720%	235.044 amu
²³⁸ U	99.275%	238.051 amu

Only ²³⁵U can be used as fuel in a nuclear reactor, so uranium for use in the nuclear industry must be enriched in this isotope. If a sample of enriched uranium has an average atomic mass of 235.684 amu, what percentage of ²³⁵U is present?

Atomic Mass:
$$2(isotope mass)(abundance)$$

235.684 amu = $(235.044 \text{ amu})(x) + (238.051 \text{ amu})(y)$
235.684 amu = $235.044x + 236.051(-x)$
235.684 amu = $235.044x + 236.051 - 236.051x$
 $-2.367 \text{ am} = -3.007x$
 $x = 0.79$ (797.025)

4. I have two pennies—one dated 1977 and the other dated 1999. I was asked if each penny contained the same number of copper atoms. The logical answer is yes (you would at least expect it to be close). The real answer is no. They look the same, but the 1977 penny weighs 3.11 g and the 1999 penny weighs 2.5 g. I looked into this and found out that the penny underwent a change in ~1982. Prior to 1982 the penny was roughly 95% copper and now it is only 2.5% copper (the rest is zinc). How many copper atoms are there in each of my pennies?

$$2.59 \times 0.025 = 0.06259 \% \left[\frac{1 \text{ mod Cu}}{63.559 \%} \frac{1.022 \times 10^{23} \text{ orbital}}{1 \text{ mod Cu}} \right] = 5.9 \times 10^{20}$$