

Noteset 3F: Atomic Mass

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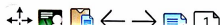
Atomic Mass

Mass of a single atom (isotope) of an element in kilograms (kg), grams (g), or atomic mass unit (amu)

Atomic Mass is based on the mass of the p^+ and n^0 (Mass #)

Atomic Mass: Actual mass (g, kg, or amu)

Mass #: # of $p^+ + n^0$



Calculating the atomic mass

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Subatomic Particle Mass

Ratio

$$p^+ = 1.672 \times 10^{-24} \text{ g}$$

$$\times 1836.15$$

$$n^0 = 1.675 \times 10^{-24} \text{ g}$$

$$\times 1838.15$$

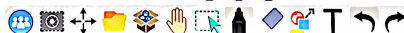
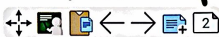
$$e^- = 9.109 \times 10^{-28} \text{ g}$$

$$\times 1$$

Mass e^- too small to actually make a difference to atomic mass

Because the mass of a p^+ or n^0 is so small we use amu

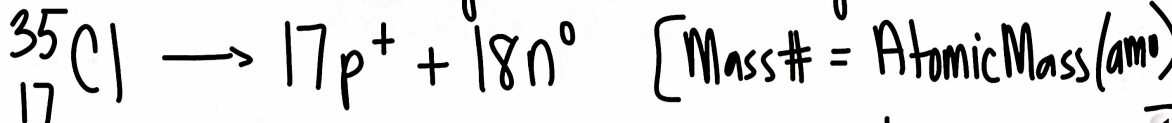
Mass $p^+ = \text{Mass } n^0 = 1 \text{ amu } (1.67 \times 10^{-24} \text{ g}) \text{ (atomic mass unit)}$



Comparing mass atom (g vs. amu)

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$$1 \text{ amu} = 1.67 \times 10^{-24} \text{ g} = 1.67 \times 10^{-27} \text{ kg}$$



$$17\text{p}^+ = 17 \cdot 1.67 \times 10^{-24} \text{ g} = 2.84 \times 10^{-23} \text{ g}$$

$$18\text{n}^0 = 18 \cdot 1.67 \times 10^{-24} \text{ g} = 3.01 \times 10^{-23} \text{ g}$$

$$\text{Atomic} = 5.85 \times 10^{-23} \text{ g}$$

$$17 \cdot 1 \text{ amu} = 17 \text{ amu}$$

$$18 \cdot 1 \text{ amu} = 18 \text{ amu}$$

$$\text{Atomic} = 35 \text{ amu}$$

Calculating atomic mass

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1. Find # p^+ and # n^0

$$[\text{n}^0 = \text{Mass\#} - \text{Atomic\#}]$$

2. Mass of p^+ and n^0 (amu)

$$[1\text{p}^+ \text{ or } 1\text{n}^0 = 1 \text{ amu}]$$

3. Add p^+ and n^0 mass = Atomic Mass (amu)

Atomic Mass ${}_{17}^{35}\text{Cl}$

17	Atomic #	(Chlorine - 35)
Cl		
35.45	Avg. Atomic mass	Mass #

$$\text{p}^+ = 17 \rightarrow 17 \text{ amu}$$

$$\text{n}^0 = 35 - 17 = 18 \rightarrow 18 \text{ amu}$$

$$\text{Mass\#} = 35 \rightarrow 35 \text{ amu} \quad (\text{Atomic Mass})$$

Isotope Stability

Every isotope of an atom has a chance to exist based on the $p^+ : n^0$ ratio. Closer to Ideal = More common.

Ideal $p^+ : n^0$ ratio

Small Atoms - $1p^+ : 1n^0$

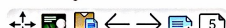
Medium Atoms - $1p^+ : 1.2n^0$

Large Atoms - $1p^+ : 1.5n^0$

2 Isotopes of Chlorine

$^{35}_{17}\text{Cl}$ (75%) $^{37}_{17}\text{Cl}$ (25%)

35 amu (17 p^+ :18 n^0) 37 amu (17 p^+ :20 n^0)



Average Atomic Mass

Atomic Mass based on all isotopes and their % abundance

% abundance

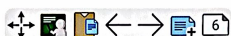
% of all isotopes a single isotope occupies
(# isotope out of 100)

EX: $^{35}_{17}\text{Cl}$: 75% (75 out of 100)

Single Iso. $^{37}_{17}\text{Cl}$: 25% (25 out of 100)

$^{35}_{17}\text{Cl}$: 35 amu $^{37}_{17}\text{Cl}$: 37 amu
atomic mass

Avg
Avg. = 35.45
Atomic amu
Based on % Abund



Finding Avg. Atomic Mass

$$A: \text{Amount}_A \times (\% \div 100)$$

$$B: \text{Amount}_B \times (\% \div 100)$$

$$C: \text{Amount}_C \times (\% \div 100)$$

$$\text{Add } A + B + C = \text{Avg. Amount}$$

Item Price	% Sold	Frac.
A:	$2.00 \times 8\% / 100 = 0.16$	
B:	$4.00 \times 72\% / 100 = 2.88$	
C:	$6.00 \times 20\% / 100 = 1.20$	
Avg:	$0.16 + 2.88 + 1.20$	
	$= 4.24$	(Avg. Cost)