

Chapter 2: Atoms, Ions, and the Periodic Table

August 29, 2022

Chemistry Department, Cypress College

Lecture and Lab Weekly Agenda

Lab Section

- Lab lockers and safety quiz
- Start Exp 1 - Laboratory Techniques
- Using Bunsen burners

Lecture Section

- Finished Ch 1 - pg 1 – 55
- Go over Ch 2 - pg 56 – 88
- In-class Ch 2 worksheet

Bunsen Burner



- Each student will practice lighting a bunsen burner under supervision
- Safety goggles are available (free)
- Review proper use of bunsen burner - read the lab manual

Corrections to Lecture 3

- There is conservation of energy
- Amount of energy to do work is not 100%
- Scientific notation:

$$1.0 \times 10^{-2} \text{g} - 1.2 \times 10^{-3} \text{g} \quad (1)$$

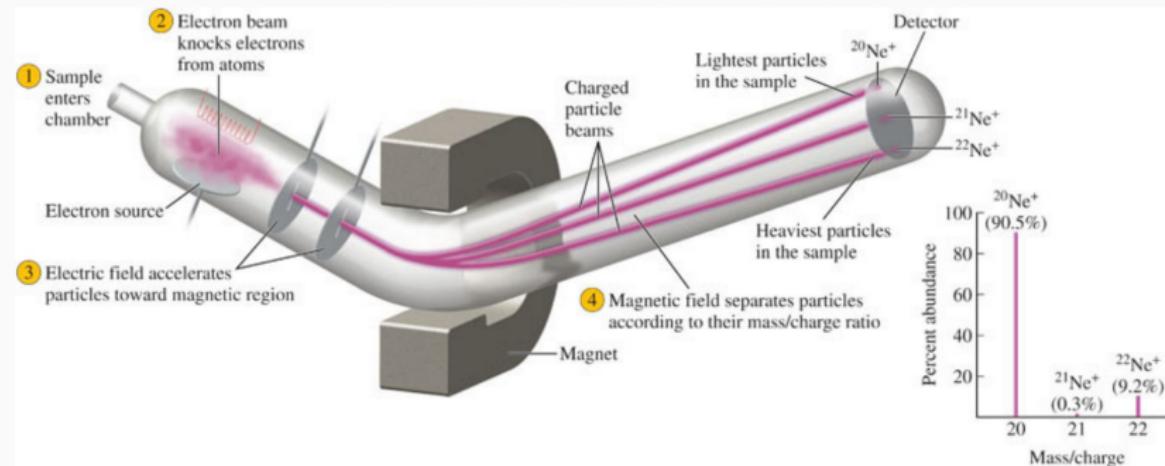
- Quiz - typos and mistakes on the quiz

Outline

Review: Relative Atomic Mass

Periodic Table - Grouped Elements

Experiment: Mass Spectroscopy



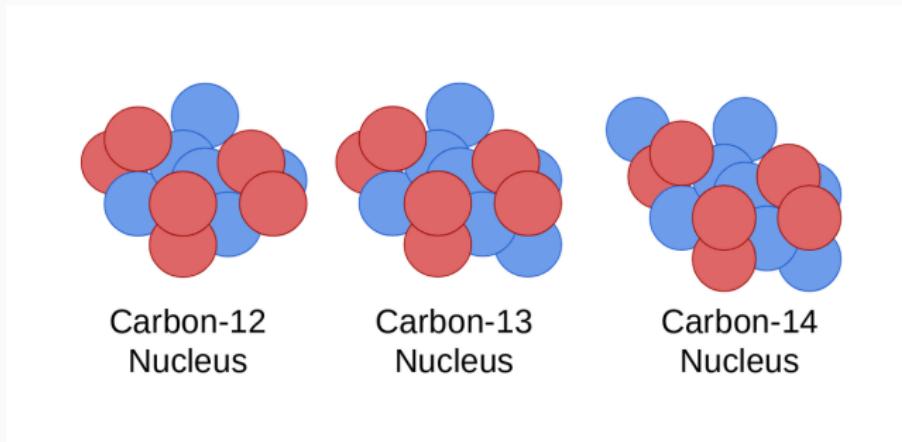
- Ionizes the atom and electric field accelerates atoms
- Time of flight - heavier atoms will travel slower than lighter ones
- Weighter average of atomic masses

Relative Atomic Mass

$$\text{Relative Atomic Mass} = (I_1 \times A_1) + (I_2 \times A_2) + \dots \quad (2)$$

where I is the mass of the isotope, and A is the relative abundance between 0 and 1

Carbon Isotopes



where red is the proton and blue is the neutron

Question: Given the carbon isotopes C-12, C-13, and C-14 that are naturally occurring. Can you make a statement about which isotope is the greatest in abundance?

Outline

Review: Relative Atomic Mass

Periodic Table - Grouped Elements

Review: Modern Periodic Table

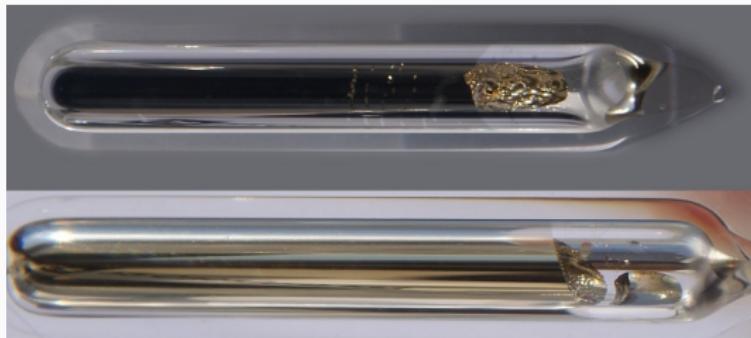
Temperature: 0 °C 32 °F 273 K

32	2	8	18	4																
Ge																				
Germanium	72.630																			
Series	Metalloids																			
Write-up	Germanium	Wikipedia																		
State at	0 °C	Solid																		
Weight	72.63	u																		
Energy levels	2, 8, 18, 4																			
Electronegativity	2.01																			
Melting point	938.25 °C	v																		
Boiling point	2,820 °C	v																		
Electron affinity	119 kJ/mol	v																		
Ionization, 1st	762 kJ/mol	v																		
Radius, calculated	125 pm	v																		
Hardness, Brinell	N/A MPa	v																		
Modulus, bulk	N/A GPa	v																		
Density, STP	5,323 kg/m³	v																		
Conductivity, thermal	0.013 W/mK	v																		

For elements with no stable isotopes, the mass number of the isotope with the longest half-life is in parentheses.

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71				
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu				
Lanthanum (138.91)	Cerium (140.12)	Neodymium (140.91)	Praseodymium (144.24)	Neptunium (145)	Samarium (150.96)	Europium (151.96)	Terbium (157.29)	Dysprosium (158.93)	Holmium (163.93)	Thulium (168.93)	Erbium (167.26)	Terbium (168.93)	Ytterbium (173.05)	Lucentium (174.57)				
69	90	91	92	93	94	95	96	97	98	99	100	101	102	103				
Ac	Th	Protactinium (231.04)	Uranium (238.03)	Neptunium (237)	Plutonium (244)	Americium (243)	Curium (247)	Berkelium (247)	Californium (251)	Einstenium (252)	Fermium (257)	Mendelevium (258)	No邦ium (259)	Lawrencium (266)				

Alkali Metal



- Lower densities than other metals
- Extremely soft metals
- Highly reactive e.g. forming H_2 when in contact with water
- Prefer to lose an electron

Alkaline Earth Metal



- Fairly reactive metals
- Can form solutions with a pH greater than 7 (more basic or alkaline)
- Calcium and magnesium important for life
- Prefer to lose 2 electrons

Transition Metals



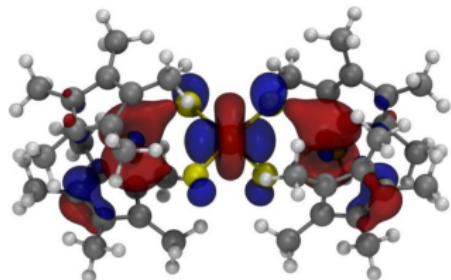
- Easily malleable and great conductors of heat and electricity
- High melting points except mercury (liquid at Room temperature)
- High densities
- Oxidation states (ability to gain/lose electrons) can vary between 1+ to 6+

Actinides and Lanthanides

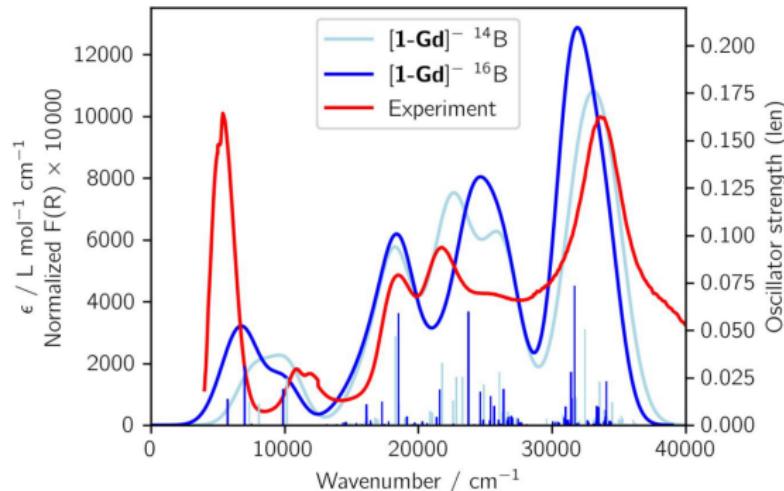


- Radioactive due to instability
- Silvery/silvery-white luster in metallic form
- Potential application to quantum computers and nuclear power
- Oxidation states can range from 2+ to 7+

Materials for Quantum Computing: Lanthanide Complexes

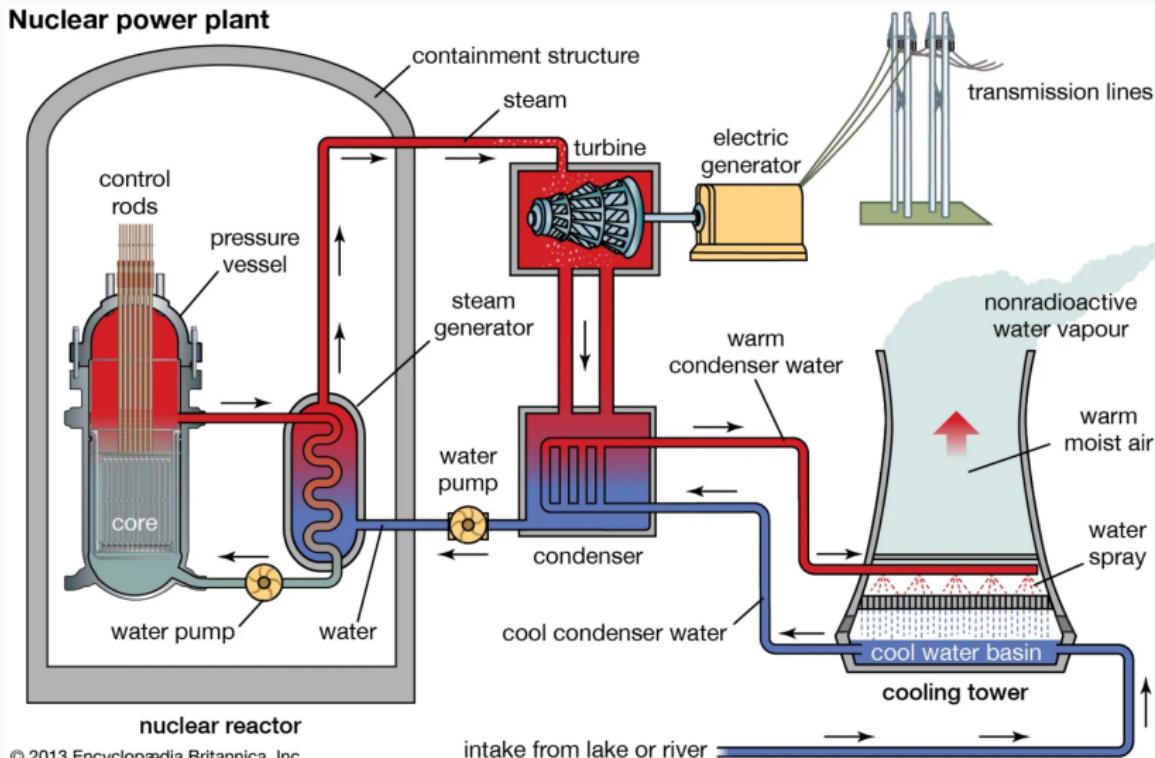


[1-Gd]⁻¹ HOMO



- Understanding the electronic structure
- Hysteresis - electronic spin memory
- Lanthanide MoS₄ research article

Nuclear Power Plants



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Halogens

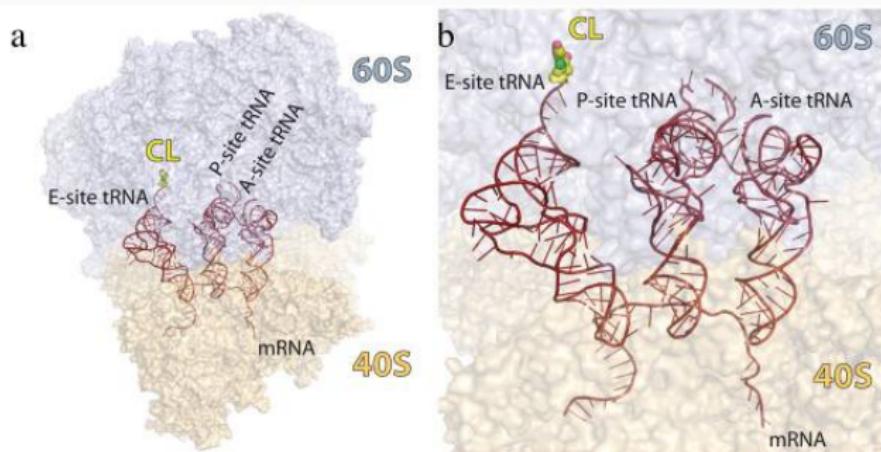
- Fairly toxic and form acids when combined with hydrogen
- Readily react with metals to form salts e.g. NaCl
- Important for drug development due to their “sticky” nature
- Prefers to gain an electron

Cancer Therapeutics



- Chlorolissoclimide is a potent cancer drug that is naturally found in sea squirts
- Understanding the structure–activity relationships e.g. interactions between drug and ribosome

My Research Project: Chlorolissoclimide



- Chlorolissoclimide research article

Noble Gases



- Colorless, odorless, tasteless, and non-flammable under standard conditions
- Extremely non-reactive and most stable elements
- Do not like to gain or lose electrons

Practice: Periodic Table

Group the elements into the following groups

- Br
- K
- Mg
- Al
- Mn
- Ar
- U

Practice

What is the charge of the ions for each of the following elements?

- Al
- P
- Br
- S