

Academic Chemistry – Unit 2 Review

KEY

Chapter 4 – Atomic Structure

1. Complete the chart for a **NEUTRAL** atom. Remember that isotopes of the same element are neutral as well.

Element	Atomic Number	# of Protons	# of Electrons	# of Neutrons	Mass Number	Isotope Symbol	Nuclear Symbol
Si	14	14	14	15	29	Si-29	$^{29}_{14}\text{Si}$
B	5	5	5	5	10	B-10	$^{10}_5\text{B}$
F	9	9	9	10	19	F-19	$^{19}_9\text{F}$
U	92	92	92	143	235	U-235	$^{235}_{92}\text{U}$
Kr	36	36	36	48	84	Kr-84	$^{84}_{36}\text{Kr}$
U	92	92	92	146	238	U-238	$^{238}_{92}\text{U}$
Xe	54	54	54	77	131	Xe-131	$^{131}_{54}\text{Xe}$

2. Lead has 4 stable isotopes that occur in nature. Using the following data, calculate the average atomic mass of lead:
Pb-204 (1.4%), Pb-206 (24.1%), Pb-207 (22.1%), Pb-208 (52.4%)

$$(204 \times 0.014) + (206 \times 0.241) + (207 \times 0.221) + (208 \times 0.524) = \boxed{207.24 \text{ amu}}$$

Chapter 5 – Electrons in Atoms

- What is an orbital? How many orbitals are possible at each sublevel (s, p, d, f)?
 A shape (derived out of math formula) that holds the electrons. s-1, p-3, d-5, f-7
(indicating highest probability)
- How many electrons can exist in the third energy level? $2n^2$
 \rightarrow energy level $\Rightarrow 2 \cdot (3^2) = \boxed{18e^- \text{ total}}$
- Of these sublevels, 3p, 4s, (5d), 6s, which has the highest energy?
- How many electrons can be held in a 5d orbital? In a 3p? In a 2s?
 $10e^-$ $6e^-$ $2e^-$
- What elements are composed of atoms having the following electron configurations?:
 a. $1s^2 2s^2 2p^6 3s^2 3p^4$ S
 b. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^4$ Mo — But e^- configuration is incorrect b/c Mo is an exception & should end with $5s^1 4d^5$
- Write the electron configuration (longhand & shorthand) for:
 a. Titanium $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2 3d^2$ [Ar] $4s^2 3d^2$
 b. Gallium $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2 3d^{10} 4p^1$ [Ar] $4s^2 3d^{10} 4p^1$
- Write the orbital notation for:
 a. Boron $\uparrow\downarrow$ $\uparrow\downarrow$ \uparrow — —
1s 2s 2p
 b. Fluorine $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ \uparrow
1s 2s 2p
 c. Phosphorus $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ \uparrow \uparrow \uparrow
1s 2s 2p 3s 3p
 d. Germanium $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$
1s 2s 2p 3s 3p 4s 4p
 e. Krypton $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$ $\uparrow\downarrow$
1s 2s 2p 3s 3p 4s 4p
- Explain how electrons can go to a higher energy level. After they are at this higher energy level, what happens?
 They gain a quantum of energy (heat, light, etc.). At higher EL they are unstable so they release a photon of light going back to a lower EL
- Using the equation, $c = \lambda f$ answer the following:
 a. What is the value for the speed of light (c)? $3.00 \times 10^8 \text{ m/s}$
 b. What is the relationship between wavelength (λ) and frequency (f)? λ is inversely related to f
 c. If the wavelength of blue light is $4.00 \times 10^7 \text{ nm}$, calculate its frequency. $S = \lambda f$
 $3.00 \times 10^8 \text{ m/s} = 4.00 \times 10^7 \text{ m} \cdot f$ $f = \boxed{7.5 \times 10^{14} \text{ Hz}}$

Chapter 6 – The Periodic Table

Read the following description to determine which element of the periodic table fits.

- Si 1. In the 3rd period with 4 valence electrons.
Fr 2. The representative element with the lowest ionization energy.
Rb 3. Alkali element in period 5.
Ca 4. Neutral atom with 20 electrons.
Na, Mg, Al 5. Good conductor of electricity in period 3.
Be 6. In the 2nd period with 2 valence electrons
He 7. Representative element with the highest ionization energy
Br 8. Halogen in period 4.
Zn 9. Neutral atom with 30 electrons
I, Xe 10. Poor conductor of electricity in period 5
Ne 11. Noble gas in period 2
Sr 12. Alkaline earth metal from period 5
F 13. Halogen from period 2
Si 14. Metalloid from group 4A
N, P 15. Non-metal from group 5A
Sn, Pb 16. Metal from group 4A
Be 17. 2+ ion from period 2
S 18. 2- ion from period 3
K 19. 1+ ion from period 4
Fr 20. 1+ ion with the largest radius
F 21. 1- ion with the smallest radius
Rn 22. Nobel gas with largest radius
P 23. In period 3 with 5 valence electrons
Bi 24. Metal in period 6 with 5 valence electrons

25. Element "X" has an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$.

- What is the element? Se
- What period is it in? 4
- What group is it in? 6A
- Is it a metal, nonmetal, or metalloid? nonmetal
- Draw the Lewis dot structure for the atom. •Se•
- List two other elements that would exhibit similar chemical behavior. O, S, Te, Po (possible choices)
- Does it need to gain or lose electrons to become stable? gain
- How many electrons does it need to gain or lose? 2e⁻
- When it becomes stable (an ion) what would be its charge? 2⁻ ⇒ Se²⁻

26. An atom's electron configuration ends in $5s^2 4d^{10} 5p^4$. Identify the element and draw its Lewis dot structure.

27. Why is group 8A unique?

Te •Te•
 It has all 8e⁻ ∴ its stable

Atomic Radius Trend

28. Rank the following elements by increasing atomic radius: carbon, aluminum, oxygen, potassium

O, C, Al, K

29. Which atom is larger: astatine (At) or tellurium (Te)... why? more energy levels

30. Circle the atom in each pair that has the largest atomic radius.

- a) Al B b) S O c) Br Cl
 d) Na Al e) O F f) Mg Ca

Ionization Energy Trend

31. Which has the greater first ionization energy:

- a. Na or K b. Li or Be c. Sn or As

32. Rank the following element by decreasing ionization energy: polonium, oxygen, sulfur, selenium

O, S, Se, Po

Electronegativity Trend

33. Rank the following elements by increasing electronegativity: sulfur, oxygen, neon, aluminum.

EN = 0
Ne, Al, S, O

34. Arrange oxygen, fluorine, and beryllium in order of increasing electronegativity.

Be, O, F

35. Circle which element of the following pairs is the most electronegative:

- a. Ca, Ga b. Li, O c. Cl, S d. Br, As

Ion Size Trend

36. Would you expect a Cl⁻ ion to be larger or smaller than an Mg²⁺ ion? Explain. All anions larger

37. Explain why the sulfide ion (S²⁻) is larger than the chloride ion (Cl⁻). It has an additional e⁻ competing for space

38. Circle which atom/ion has the larger ionic size:

- a. Li, Li⁺ b. O²⁻, O⁻¹ c. Al³⁺, Al d. Zr²⁺, Zr³⁺