

Chemistry 11
Atomic Theory Review

Name: Key
Date:
Block:

1. Give the atomic number and the number of protons, neutrons and electrons in the following:

Ion	Atomic #	Atomic Mass	Protons	Neutrons	Electrons
Hf^{3+}	72	178	72	106	69
Po^{2+}	84	209	84	125	82
At	85	210	85	125	86

2. Give the nuclear symbol of the following isotopes:

Nuclear Symbol	Protons	Neutrons	Electrons
${}_{42}^{96}Mo^{3+}$	42	54	39
${}_{32}^{74}Ge$	32	42	32
${}_{108}^{265}Hs^{3+}$	108	157	105

3. What is the average atomic mass of element X given the following proportions?

${}^{192}X = 35.5\%$, ${}^{194}X = 34.9\%$, ${}^{198}X = 20.3\%$, ${}^{209}X = 9.3\%$

$$(192 \times 0.355) + (194 \times 0.349) + (198 \times 0.203) + (209 \times 0.093)$$

$$= 195.497 \text{ amu}$$

4. Each single orbital can hold a maximum of 2 electrons.
5. An "s" subshell (1 orbital) can hold a maximum of 2 electrons
 A "p" subshell (3 orbitals) can hold a maximum of 6 electrons
 A "d" subshell (5 orbitals) can hold a maximum of 10 electrons
 An "f" subshell (7 orbitals) can hold a maximum of 14 electrons
- When electrons in an atom are filling energy levels, they fill the lowest possible energy levels first.

6. Give the electron configuration and orbital diagram for each of the following atoms and ions:

(You may use core notation)

Si [Ne] 3s ² 3p ² [Ne] $\frac{1\downarrow}{3s} \quad 2\downarrow \quad 1\downarrow$ 3p	Cr [Ar] 4s ¹ 3d ⁵ [Ar] $\frac{1}{4s} \quad 2\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ 3d
Br [Ar] 4s ² 3d ¹⁰ 4p ⁵ [Ar] $\frac{1\downarrow}{4s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ $\frac{1\downarrow}{4p} \quad 1\downarrow \quad 1\downarrow$	Ce [Xe] 6s ² 4f ² [Xe] $\frac{1\downarrow}{6s} \quad 1\downarrow \quad 1\downarrow$ ----- 4f
K [Ar] 4s ¹ [Ar] $\frac{1}{4s}$	Cu [Ar] 4s ¹ 3d ¹⁰ [Ar] $\frac{1}{4s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ 3d
Na ⁺ [He] 2s ² 2p ⁶ [He] $\frac{1\downarrow}{2s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ 2p	Zr ⁴⁺ [Ar] 4s ² 3d ¹⁰ 4p ⁶ [Ar] $\frac{1\downarrow}{4s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ $\frac{1\downarrow}{4p} \quad 1\downarrow \quad 1\downarrow$
Mn ²⁺ [Ar] 3d ⁵ [Ar] $1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ 3d	Ag ⁺ [Kr] 4d ¹⁰ [Kr] $1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ 4d
Br [Ar] 4s ² 3d ¹⁰ 4p ⁶ [Ar] $\frac{1\downarrow}{4s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ $\frac{1\downarrow}{4p} \quad 1\downarrow \quad 1\downarrow$	As ³⁻ [Ar] 4s ² 3d ¹⁰ 4p ⁶ [Ar] $\frac{1\downarrow}{4s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ $\frac{1\downarrow}{4p} \quad 1\downarrow \quad 1\downarrow$
O ²⁻ [He] 2s ² 2p ⁶ [He] $\frac{1\downarrow}{2s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ 2p	Te ²⁻ [Kr] 5s ² 4d ¹⁰ 5p ⁶ [Kr] $\frac{1\downarrow}{5s} \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow \quad 1\downarrow$ $\frac{1\downarrow}{5p} \quad 1\downarrow \quad 1\downarrow$

7. Write the configuration and then find the number of valence electrons for the following atoms:

N (configuration) $1s^2 2s^2 2p^3$ (# of valence e-'s) 5

Si (configuration) $1s^2 2s^2 2p^6 3s^2 3p^2$ (# of valence e-'s) 4

Ca (configuration) $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$ (# of valence e-'s) 2

P (configuration) $1s^2 2s^2 2p^6 3s^2 3p^3$ (# of valence e-'s) 5

Al (configuration) $1s^2 2s^2 2p^6 3s^2 3p^1$ (# of valence e-'s) 3

8. In order to become stable,

an atom of Ca will give 2 electrons and become the ion Ca^{2+}

an atom of Se will gain 2 electrons and become the ion Se^{2-}

an atom of K will donate 1 electrons and become the ion K^+

an atom of Br will gain 1 electrons and become the ion Br^-

an atom of N will gain 3 electrons and become the ion N^{3-}

an atom of As will gain 3 electrons and become the ion As^{3-}

an atom of Al will donate 3 electrons and become the ion Al^{3+}

an atom of Te will gain 2 electrons and become the ion Te^{2-}

9. What is the general trend in atomic radius (size of atoms) as you move from left to right across any period? (increase/decrease) decrease

10. As you move from Li to Ne, electrons are filling (the same/different) the same energy levels(s).

11. As you move across from Li to Ne, what is happening to the number of protons in the nucleus?

increase. What do the protons do to the electrons? attract them.

Suggest a reason why the atoms in a period actually get *smaller* as you move from left to right.

The more protons (positive charged), the more the electrons shells are being held in tighter to the nucleus

12. What is the general trend in atomic radius (size of atoms) as you move *down* a vertical column (group)? (increase/decrease) increase

13. Suggest a reason for this trend.

increased # of shells

14. What is meant by ionization energy?

The energy required to remove an electron from a neutral atom

15. What is the general trend in first ionization energy as you move from left to right across any Period? (eg. from Li→Ne or from Na→Ar) (increase/decrease) increase

16. Keeping in mind the trend in atomic radius as you move from left to right across a period, suggest a reason for this trend in ionization energies.

electrons are held tighter together

17. What is the trend in ionization energy as you move down a vertical column, like from Li→Na→K or from He→Ne→Ar→Kr? (increase/decrease) decrease

18. Suggest a reason for this trend based on atomic radius (size) and the distance and force of attraction between the nucleus and the outer electron.

it is easier to remove an electron from a larger atom... shielding effect. because the electrons aren't held as tight.

19. Compare the following particles:

Sodium Ion	Oxygen Ion	Neon	Magnesium Atom	Fluorine Ion
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Arrange the particles using chemical formulas from smallest atomic radii to largest atomic radii:

Smallest $\text{Na}^+ < \text{Ne} < \text{F}^- < \text{O}^{2-} < \text{Mg}$ largest

20. Determine the type of bond that forms between the following atoms:

a) N and O $3.5 - 3.0 = 0.5$ - polar covalent

b) Ca and P $2.1 - 1.0 = 1.1$ - polar covalent

c) K and Br $2.8 - 0.8 = 2.0$ - Ionic

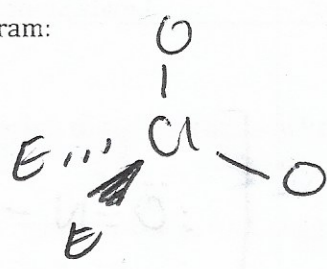
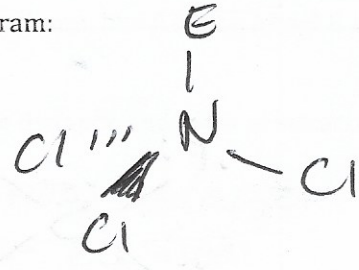
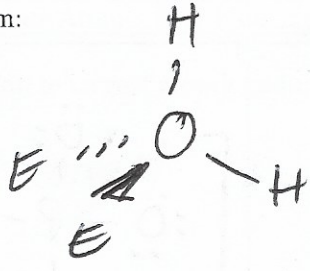
d) C and H $2.5 - 2.1 = 0.4$ - polar covalent

e) Cu and F $4.0 - 1.9 = 2.1$ - Ionic

f) Cl and Cl $3.0 - 3.0 = 0$ - non-polar covalent

21. Fill in the table below.

Compound	Lewis Structure	AXE Notation	Shape
NO ₃ ⁻		AX ₃	Name: Trigonal planar Diagram:
SF ₄		AX ₄ E	Name: seesaw Diagram:
PO ₄ ³⁻		AX ₄	Name: Tetrahedral Diagram:
BrF ₅		AX ₅ E	Name: Square pyramidal Diagram:

ClO ₂ ⁻	$\left[\begin{array}{c} \ddot{\text{O}} \\ \\ \text{---} \ddot{\text{Cl}} \text{---} \\ \\ \ddot{\text{O}} \end{array} \right]^{-}$	AX ₂ E ₂	Name: bent Diagram: 
NCl ₃	$\begin{array}{c} \ddot{\text{Cl}} \text{---} \ddot{\text{N}} \text{---} \ddot{\text{Cl}} \\ \\ \ddot{\text{Cl}} \end{array}$	AX ₃ E	Name: trigonal pyramidal Diagram: 
H ₂ O	$\text{H} \text{---} \ddot{\text{O}} \text{---} \text{H}$	AX ₂ E ₂	Name: bent Diagram: 
COCl ₂ (C is central atom)	$\begin{array}{c} \ddot{\text{Cl}} \\ \\ \ddot{\text{O}} = \text{C} \\ \\ \ddot{\text{Cl}} \end{array}$	AX ₃	Name: trigonal planar Diagram: 