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*
$^{96}_{42}Mo^{3+}$	42	54	39
$^{74}_{32}Ge$	32	42	32
$^{265}_{108}Hs^{3+}$	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%

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

195.5 amu (atomic mass unit)

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)

$[Ne]\,3s^2 3p^2$ Si $[Ne]$ 3s: ↿⇂ 3p: ↿ ↿ _	$[Ar]\,4s^1 3d^5$ Cr $[Ar]$ 4s: ↿ 3d: ↿ ↿ ↿ ↿ ↿
$[Ar]\,4s^2 3d^{10} 4p^5$ Br $[Ar]$ 4s: ↿⇂ 3d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ 4p: ↿⇂ ↿⇂ ↿	$[Xe]\,6s^2 4f^2$ Ce $[Xe]$ 6s: ↿⇂ 4f: ↿ ↿ _ _ _ _ _ _ _
$[Ar]\,4s^1$ K $[Ar]$ 4s: ↿	$[Ar]\,4s^1 3d^{10}$ Cu $[Ar]$ 4s: ↿⇂ 3d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ ↿⇂
$[He]\,2s^2 2p^6$ Na^+ $[He]$ 2s: ↿⇂ 2p: ↿⇂ ↿⇂ ↿⇂	$[Ar]\,4s^2 3d^{10} 4p^6$ Zr^{4+} $[Ar]$ 4s: ↿⇂ 3d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ ↿⇂ 4p: ↿⇂ ↿⇂ ↿⇂
$[Ar]\,3d^5$ Mn^{2+} $[Ar]$ 3d: ↿ ↿ ↿ ↿ ↿	$[Kr]\,4d^{10}$ Ag^+ $[Kr]$ 4d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ ↿⇂
$[Ar]\,4s^2 3d^{10} 4p^6$ Br^- $[Ar]$ 4s: ↿⇂ 3d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ ↿⇂ 4p: ↿⇂ ↿⇂ ↿⇂	$[Ar]\,4s^2 3d^{10} 4p^6$ As^{3-} $[Ar]$ 4s: ↿⇂ 3d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ ↿⇂ 4p: ↿⇂ ↿⇂ ↿⇂
$[He]\,2s^2 2p^6$ O^{2-} $[He]$ 2s: ↿⇂ 2p: ↿⇂ ↿⇂ ↿⇂	$[Kr]\,5s^2 4d^{10} 5p^6$ Te^{2-} $[Kr]$ 5s: ↿⇂ 4d: ↿⇂ ↿⇂ ↿⇂ ↿⇂ ↿⇂ 5p: ↿⇂ ↿⇂ ↿⇂

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

N (configuration) $[He]2s^2 2p^3$ (# of valence e⁻'s) 5

Si (configuration) $[Ne]3s^2 3p^2$ (# of valence e⁻'s) 4

Ca (configuration) $[Ar]4s^2$ (# of valence e⁻'s) 2

P (configuration) $[Ne]3s^2 3p^3$ (# of valence e⁻'s) 5

Al (configuration) $[Ne]3s^2 3p^1$ (# 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 take 2 electrons and become the ion Se^{2-}

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

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

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

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

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

an atom of Te will take 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 <u>*smaller*</u> as you move from left to right.

The more protons, the more positive pull the nucleus has, the more tightly the electron shells are being held 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.

More electron shells are being added.

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.

The electrons are held tighter in smaller atoms, making it more difficult (requiring more energy) to remove an electron.

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 because the electrons aren't held as tightly due to the shielding effect.

19. Compare the following particles:

Sodium Ion	Oxygen Ion	Neon	Magnesium Atom	Fluorine Ion

Arrange the particles using chemical formulas from smallest atomic radii to largest atomic radii:

Smallest Largest

$Na^+ < Ne < F^- < O^{2-} < Mg$

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

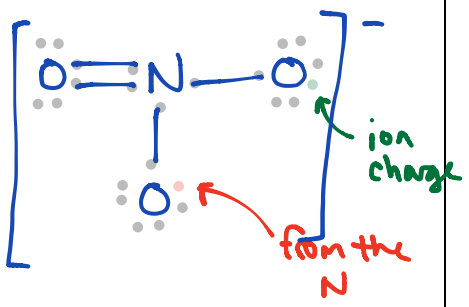
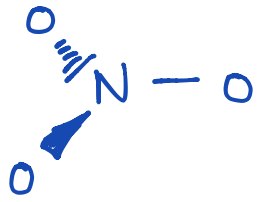
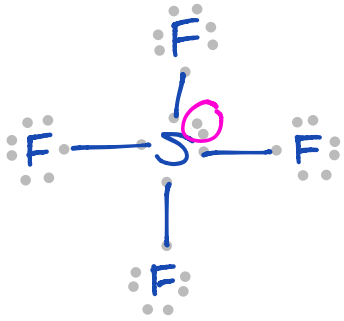
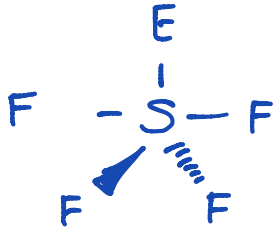
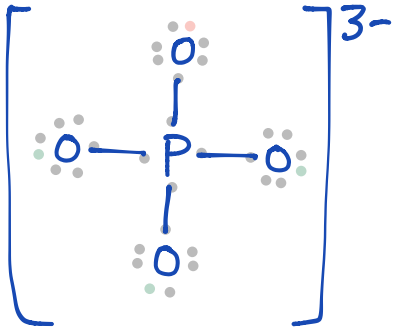
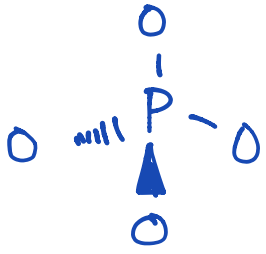
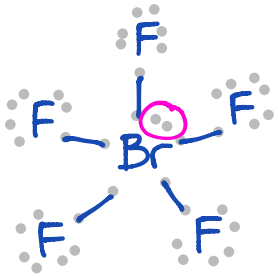
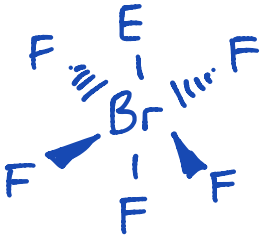
c) K and Br 2.8 - 0.8 = 2.0 ionic

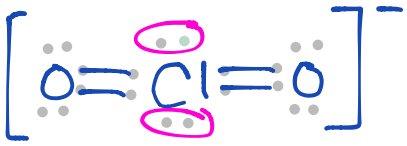
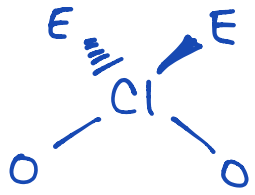
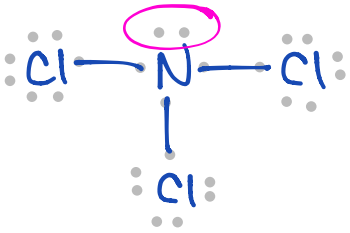
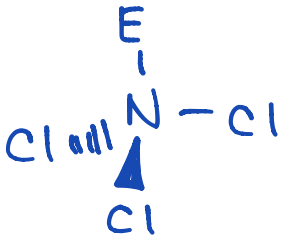
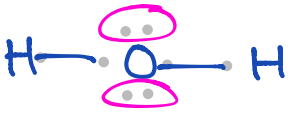
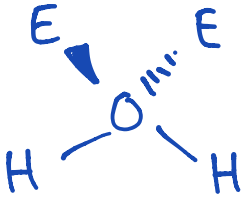
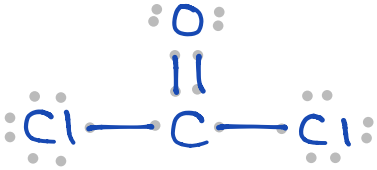
d) C and H 2.5 - 2.1 = 0.4 polar covalent

e) Cu and F 4.0 - 1.9 = 2.1 ionic

f) Cl and Cl 3.0 - 3.0 = 0 nonpolar covalent

21. Fill in the table below.

Compound	Lewis Structure	AXE Notation	Shape
NO_3^-		AX_3	Name: trigonal planar Diagram: 
SF_4		AX_4E	Name: Seesaw Diagram: 
PO_4^{3-}		AX_4	Name: tetrahedral Diagram: 
BrF_5		AX_5E	Name: Square pyramidal Diagram: 

ClO_2^-		AX_2E_2	Name: Bent Diagram: 
NCl_3		AX_3E	Name: trigonal pyramidal Diagram: 
H_2O		AX_2E_2	Name: bent Diagram: 
$COCl_2$ (C is central atom)		AX_3	Name: trigonal planar Diagram: