

TOPIC: 1.8 VALENCE ELECTRONS AND IONIC COMPOUNDS

ENDURING UNDERSTANDING:

SPQ-2 The periodic table shows patterns in electronic structure and trends in atomic properties.

LEARNING OBJECTIVE:

SPQ-2.B Explain the relationship between trends in the reactivity of elements and periodicity.

ESSENTIAL KNOWLEDGE:

SPQ-2.B.1 The likelihood that two elements will form a chemical bond is determined by the interactions between the valence electrons and nuclei of elements.

SPQ - 2.B.2 Elements in the same column of the periodic table tend to form analogous compounds

SPQ - 2.B.3 Typical charges of atoms in ionic compounds are governed by their location on the periodic table and the number of valence electrons.

EQUATION(S):

N/A

NOTES:

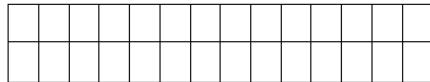
An ionic bond always involves the transfer of electrons from the least electronegative species to the most electronegative. Traditionally, ionic compounds are described as being between a metal and a nonmetal. Based on electron configuration, elements will either lose or gain electrons in order to have a complete s^2p^6 outer valence shell. This loss or gain of electrons leads to the formation of positive or negative ions. Ionic compounds are held together by an electrostatic force.

In order to maintain neutrality, the number of electrons lost must equal the number of electrons gained. Because the number of electrons lost or gained is based on electron configurations, elements in the same group will form the same M_nNn analogous compounds. For example, all group I metals (Lithium – Cesium) will have the following format when combined with any group VII halogen (Fluorine – Astatine): LiF or LiCl. Any group II metal, when combined with a group VII halogen would be CaF₂ or MgCl₂. Again, these analogous structures are because of the need to maintain neutrality. Nonmetals only want to gain enough electrons to fill their octet. Metals only want to give away enough electrons to have a pseudo-noble gas configuration.

<http://kinga2.weebly.com/unit-3-periodic-table.html>

Valence Electrons in Each Group

1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8



I DO:

Calcium reacts with a certain element to form a compound with the general formula CaX₂. What would be the most likely formula for a compound formed between sodium and element X?

- A) NaX₂
- B) Na₂X
- C) Na₂X₂
- D) NaX

WE DO:

Element 117 was recently discovered and is named Tennessine. Assuming that periodic trends are followed, write the noble gas electron configuration and predict the formula when it forms an ionic compound with Mg.

1	IA	IIA	III	IVB	V	VB	VIIB	VIB	VIB	IB	IB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	H Hydrogen 1s ¹	2	Be Beryllium 1s ² 2s ²	3 Li Lithium 1s ² 2s ¹	4 Be Beryllium 1s ² 2s ²	5	6 VIB	7	8 VIB	9	10 VIB	11 IB	12 IB	13	14	15	16
19 K Potassium 1s ² 2s ² 2p ⁶ 3s ¹	20 Ca Calcium 1s ² 2s ² 2p ⁶ 3s ²	21 Sc Scandium 1s ² 2s ² 2p ⁶ 3s ² 3p ¹	22 Ti Titanium 1s ² 2s ² 2p ⁶ 3s ² 3p ²	23 V Vanadium 1s ² 2s ² 2p ⁶ 3s ² 3p ³	24 Cr Chromium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁴	25 Mn Manganese 1s ² 2s ² 2p ⁶ 3s ² 3p ⁵	26 Fe Iron 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶	27 Co Cobalt 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ¹	28 Ni Nickel 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ²	29 Cu Copper 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ¹	30 Zn Zinc 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ²	31 Ga Gallium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4p ¹	32 Ge Germanium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4p ²	33 As Arsenic 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4p ³	34 Se Selenium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4p ⁴	35 Br Bromine 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4p ⁵	36 Kr Krypton 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4p ⁶
37 Rb Rubidium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ¹	38 Sr Strontium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ²	39 Y Yttrium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4f ¹	40 Zr Zirconium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ²	41 Nb Molybdenum 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ³	42 Mo Technetium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ⁴	43 Tc Ruthenium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ⁵	44 Ru Rhodium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ⁶	45 Rh Rhodium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ⁷	46 Pd Palladium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ⁸	47 Ag Silver 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ⁹	48 Cd Cadmium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁰	49 In Indium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹¹	50 Sb Antimony 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹²	51 Te Tellurium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹³	52 Po Polonium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁴	53 At Astatine 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁵	54 Xe Xenon 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 4s ² 4d ¹⁶
55 Cs Cesium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹	56 Ba Barium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ²	57 - 71 Lanthanoids 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ^{1 - 14}	72 Hf Hafnium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴	73 Ta Tantalum 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ¹	74 W Tungsten 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ²	75 Re Rhenium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ³	76 Os Osmium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ⁴	77 Ir Iridium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ⁵	78 Pt Platinum 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ⁶	79 Au Gold 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ⁷	80 Hg Mercury 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ⁸	81 Tl Thallium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ⁹	82 Pb Lead 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ¹⁰	83 Bi Bismuth 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ¹¹	84 Po Polonium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ¹²	85 At Astatine 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ¹³	86 Rn Radium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ¹⁴
87 Fr Francium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹	88 Ra Radium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ²	89 - 103 Actinoids 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2}	104 Rf Rutherfordium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ¹	105 Db Dubnium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ¹ 8s ¹	106 Sg Seaborgium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2}	107 Bh Bohrium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ¹	108 Hs Hassium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2}	109 Mt Meitnerium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ¹	110 Ds Darmstadtium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2}	111 Rg Roentgenium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ¹	112 Cn Copernicium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2}	113 Nh Nhastium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2} 11s ¹	114 Fl Florium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2} 11s ^{1 - 2}	115 Mc Meitnerium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2} 11s ^{1 - 2}	116 Lv Livermorium 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2} 11s ^{1 - 2} 12s ¹	117 Ts Tsingizi 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2} 11s ^{1 - 2} 12s ^{1 - 2}	118 Og Oganesson 1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ 3d ¹⁰ 4f ¹⁴ 5d ^{1 - 2} 6s ^{1 - 2} 7s ^{1 - 2} 8s ^{1 - 2} 9s ^{1 - 2} 10s ^{1 - 2} 11s ^{1 - 2} 12s ^{1 - 2}

**YOU DO:**

- 1) Which of the following has the same number of electrons as Cl⁻¹?
- F⁻¹
 - S
 - Al³⁺
 - K⁺
- 2) KCl dissolves in water, forming a solution able to conduct electricity. Which of the following would behave similarly?
- PbCl₂
 - LiK
 - LiCl
 - SrCl₂
- 3) The complete photoelectron spectrum for an element is shown. What oxide compound would it most likely form?
- Relative Number of Electrons
- Energy
- 10 1 0.1
-
- 4) Identify the correct electron configuration for the aluminum ion.
- 1s²2s²2p⁶
 - 1s²2s²2p⁶3s²3p¹
 - 1s²2s²2p⁶3s²3p⁶
 - 1s²2s²2p⁶3s²