This print-out should have 8 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Mlib 02 4043

08:12, general, multiple choice, > 1 min, fixed.

001

The electron configuration for the oxygen atom is

1. $1s^2\ 2s^6$.

2. $1s^8$.

3. $1s^2\ 2s^4\ 2p^2$.

4. $1s^2\ 2s^2\ 2p^3\ 3s^1$.

5. $1s^2\ 2s^2\ 2p^4$. **correct**

Explanation:

Brodbelt 05 10

08:13, general, multiple choice, > 1 min, fixed.

002

What is the electron configuration of Mg^{2+}?

1. $1s^2\ 2s^2\ 2p^6$ **correct**

2. $1s^2\ 2s^2\ 2p^6\ 3s^2$

3. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

4. $1s^2\ 2s^2\ 2p^6\ 3s^1$

5. $1s^2\ 2s^2\ 2p^5$

Explanation:

Mg^{2+} has lost two electrons, as indicated by the charge. It has only 10 electrons.

DAL 006 0006

09:02, general, multiple choice, < 1 min, fixed.

003

Rank the following in terms of decreasing ionic radii.

1. $N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}$ **correct**

2. $Mg^{2+}, Na^+, F^-, O^{2-}, N^{3-}$

3. $Na^+, Mg^{2+}, N^{3-}, O^{2-}, F^-$

4. $F^-, O^{2-}, N^{3-}, Na^+, Mg^{2+}$

5. $Na^+, Mg^{2+}, O^{2-}, N^{3-}, F^-$

Explanation:

We only consider ions that yield a Noble gas configuration (Na^+, Mg^{2+}, O^{2-}, N^{3-}, and F^-). We are comparing ions with the same number of electrons: 10 total and 8 valence in this case. The number of protons in the ion is the biggest determinate of the size when electron number is constant.

	# e^-	val.	inner	prot.	eff. charge
N^{3-}	10	8	2	7	+5
O^{2-}	10	8	2	8	+6
F^-	10	8	2	9	+7
Na^+	10	8	2	11	+9
Mg^{2+}	10	8	2	12	+10

The greater the effective nuclear charge, the stronger the attraction between the protons and the electrons, and thus the smaller the radii.

ChemPrin3e 01 82

09:01, general, multiple choice, > 1 min, wording-variable.

004

What is the order of increasing atomic radius?

1. chlorine, sulfur, silicon **correct**

2. silicon, sulfur, chlorine

3. chlorine, silicon, sulfur

4. silicon, chlorine, sulfur

5. sulfur, silicon, chlorine

6. sulfur, chlorine, silicon

Explanation:

chlorine (99 pm)
< sulfur (104 pm) < silicon (118 pm)

DAL 06 013

09:01, general, multiple choice, < 1 min, fixed.

005

What are the effective nuclear charges for a strontium atom valence electron and an $n = 2$ electron, respectively?

1. +2; +36 **correct**

2. +2; +38

3. +36; +38

4. +38; +38

5. +38; +2

Explanation:

The effective nuclear charge is

total protons − total inner shell electrons .

Neutral Sr has 38 protons and 38 electrons (obtain this number from the periodic table).

The $n = 2$ shell has 8 electrons. There are 2 electrons in the $n = 1$ shell that can shield them, so $+38 - 2 = +36$.

The valence electron is in the $n = 5$ shell. There are 4 shells between the valence electron and the nucleus that act to shield the nucleus. The total inner shell electrons are 36, so $+38 - 36 = +2$.

DAL 06 001

08:12, general, multiple choice, < 1 min, fixed.

006

Which of these elements, as a neutral atom, would have an electronic configuration influenced by the increased stability of a filled or half-filled subshell?

1. Zn only

2. Zn and Cr

3. Cr and Cu **correct**

4. Cr only

5. Cu only

Explanation:

Cr and Cu are exceptions to the rules for filling orbitals. The electron intended to fill the 4*s* orbital is added to the 3*d* orbital instead. Half-filling the Cr 3*d* orbital and fully filling the Cu 3*d* orbital is much more energetically stable for the electron than filling the 4*s* orbital.

ChemPrin3e T01 52

08:13, general, multiple choice, < 1 min, fixed.

007

All of the following can have the ground-state electron configuration [Xe] $4f^{14}\,5d^{10}$ except

1. Pb^{4+}

2. Hg^{2+}

3. Bi^{5+}

4. Tl^{+} **correct**

5. Au^{+}

Explanation:

Write the electron configurations for the ions listed to see which one matches the outer electron configuration given. The Aufbau order of electron filling is 1*s*, 2*s*, 2*p*, 3*s*, 3*p*, 4*s*, 3*d*, 4*p*, 5*s*, 4*d*, 5*p*, 6*s*, 4*f*, 5*d*, 6*p*, *etc.*

s orbitals can hold 2 electrons, *p* orbitals 6 electrons, and *d* orbitals 10 electrons. Note some exceptions do occur in the electron configuration of atoms (and ions) because of the stability of either a full or half-full outermost *d*-orbital, so you may need to account for this by 'shuffling' an electron from the $(n-1)\,s$ orbital. When electrons are removed from orbitals in a neutral atom to create a positive ion they are taken in this order: outermost (highest value of n) *p*, outermost *s*, then outermost *d*.

Msci 06 0323

09:03, general, multiple choice, > 1 min, fixed.

008

The first ionization potential of the elements B, C, and N (atomic numbers 5, 6, and 7) steadily increases, but that of O is less than that of N. The best interpretation of the lower value for O is that

1. the ionization potential of N is a maximum and the values decrease steadily for the elements O, F, and Ne.

2. the electron removed from O is farther from the nucleus and therefore less tightly bound than that in N.

3. the electron removed from O corresponds to a different value of the quantum number ℓ than that of the electron removed from B, C, or N.

4. there is more shielding of the nuclear charge in O than in B, C, or N.

5. the half-filled set of p orbitals in N makes it more difficult to remove an electron from N than from O. **correct**

Explanation:

The ionization potential is a measure of the ease with which electrons are lost by an atom. The ionization potential increases from left to right across the table. The outer electronic configuration of N atom is $2s^2 2p^3$ (half-filled orbital), which gives it extra stability. This increases the amount of energy needed to remove the first electron from N as compared to O.