

Test bank chapter (8)

Choose the most correct answer

1. Elements in the modern version of the periodic table are arranged in order of increasing \_\_\_\_\_.
- oxidation number
  - atomic mass
  - average atomic mass
  - atomic number**

**Explanation:** The older version of the periodic table had the elements arranged in order of increasing atomic mass, but the modern version of the periodic table is based on the increasing order of atomic number.

2. The first ionization energies of the elements \_\_\_\_\_ as you go from left to right across a period of the periodic table, and \_\_\_\_\_ as you go from the bottom to the top of a group in the table. Shaped like four-leaf clovers.

- increase, increase**
- increase, decrease
- decrease, increase
- decrease, decrease



**Explanation:** The ionization energies (IE s) of elements increase to the right in a row since larger amounts of energy need to be supplied to remove an electron. The elements become more non-metallic making it harder to remove an electron.

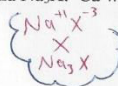
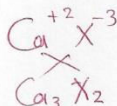
3. The \_\_\_\_\_ have the most negative electron affinities

- alkaline earth metals
- alkali metals
- halogens**
- transition metals

**Explanation:** The electron affinity of an element is defined as the energy change that occurs when an electron is added to a gaseous atom. The halogens have the most negative electron affinities indicating that they are most comfortable accepting an electron. The formation of an anion essentially gives the halogen atom the electron configuration of the nearest noble gas. The negative sign here indicates that the addition of an electron to the halogens results in energy being released by the halogen atom.

4. Na reacts with element X to form an ionic compound with the formula  $Na_3X$ . Ca will react with X to form \_\_\_\_\_.

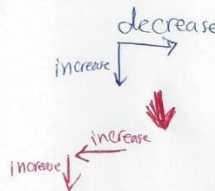
- $CaX_2$
- $CaX$
- $Ca_2X_3$
- $Ca_3X_2$**



**Explanation:** The element X must have 3 negative charges for it to form the compound  $Na_3X$ , since each Ca has 2 positive charges, the formula of the compound formed by the reaction of Ca and X would have to be  $Ca_3X_2$ .

5. 16. Atomic radius generally increases as we move \_\_\_\_\_.

- down a group and from right to left across a period**
- up a group and from left to right across a period
- down a group and from left to right across a period
- there is no trend



6. 18. The atomic radius of main-group elements generally increases down a group because \_\_\_\_\_.

- a) effective nuclear charge increases down a group
- b) effective nuclear charge decreases down a group
- c) both effective nuclear charge increases down a group and the principal quantum number of the valence orbitals increases
- d) **the principal quantum number of the valence orbitals increases**

7. Which of the following correctly lists the five atoms in order of increasing size (smallest to largest)?

- a)  $O < F < S < Mg < Ba$
- b)  **$F < O < S < Mg < Ba$**
- c)  $F < O < S < Ba < Mg$
- d)  $O < F < S < Ba < Mg$

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**Explanation:** Fluorine and oxygen are in the same period (#2) and next to each other with F being the smallest of these 5 atoms. Ba is in group 2A and in row 6 (farthest "down" a group) and is the largest of the atoms. Mg is in group 2A and in the third period and hence will be bigger than F, O and S. Even though S is in the same period as Mg it is in group 6A making it smaller than Mg.

8. Which of the following correctly lists the five atoms in order of increasing size (smallest to largest)?

- a)  $F < K < Ge < Br < Rb$
- b)  $F < Ge < Br < K < Rb$
- c)  $F < K < Br < Ge < Rb$
- d)  **$F < Br < Ge < K < Rb$**

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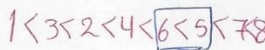


**Explanation:** Fluorine is in group 7A and period 2 making it the smallest of the 5 atoms here. Br is also in group 7A but is in period 4 making it larger than F, Ge is in group 4A and also in period 4 but is to the left of Br making it larger than Br. K and Rb are both in group 1A but K is in period 4 and Rb is in period 5, making the Rb atom the largest of all the 5 atoms.

9. Of the following atoms, which has the largest first ionization energy?

- a) Br
- b) **O**
- c) C
- d) P

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**Explanation:** The ionization energy (IE) typically increases from left to right in a period and decreases from top to bottom in a group. Thus for C and O which are in the same period, O will have the larger IE. Br is in period #4 and will have the lowest IE out of these 4 elements.

10. Of the following elements, which has the largest first ionization energy?

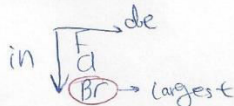
- a) Na
- b) Al
- c) Se
- d) **Cl**

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**Explanation:** The ionization energy (IE) typically increases from left to right in a period and decreases from top to bottom in a group. Na, Al and Cl are all in period 3 with the chlorine atom to the farthest right and will have the highest IE.

11. Which ion below has the largest radius?

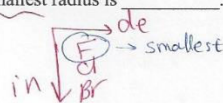
- a)  $\text{Cl}^-$
- b)  $\text{K}^+$
- c)  $\text{Br}^-$
- d)  $\text{F}^-$



**Explanation:** Typically cations are smaller than their parent atoms while anions are larger than the parent atoms. Of the atoms here, the Br atom would be the largest as it is farthest down the group and hence its anion also will be the largest ion.

12. The ion with the smallest radius is \_\_\_\_\_.

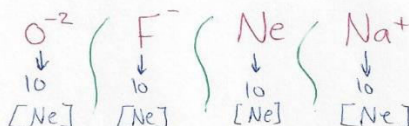
- a)  $\text{Br}^-$
- b)  $\text{Cl}^-$
- c)  $\text{O}^{2-}$
- d)  $\text{F}^-$



**Explanation:** Typically anions are larger than the parent atoms. Of the atoms here, the F atom would be the smallest as it is farthest down the group and hence its anion also will be the smallest ion.

13. Which of the following is an isoelectronic series?

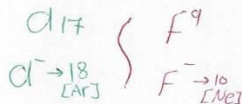
- a)  $\text{B}^{5-}$ ,  $\text{Si}^{4+}$ ,  $\text{As}^{3-}$ ,  $\text{Te}^{2-}$
- b)  $\text{O}^{2-}$ ,  $\text{F}^-$ ,  $\text{Ne}$ ,  $\text{Na}^+$
- c) S, Cl, Ar, K
- d) None of the above



**Explanation:** Isoelectronic series contain a combination of atoms and ions or only ions with the same number of electrons. Here the series containing the  $\text{O}^{2-}$ ,  $\text{F}^-$ ,  $\text{Ne}$  and  $\text{Na}^+$  is the only one where all atoms/ions contain 10 electrons.

14. \_\_\_\_\_ is isoelectronic with argon and \_\_\_\_\_ is isoelectronic with neon.

- a)  $\text{Cl}^-$ ,  $\text{F}^-$
- b)  $\text{Cl}^-$ ,  $\text{Cl}^+$
- c)  $\text{F}^+$ ,  $\text{F}^-$
- d)  $\text{Ne}$ ,  $\text{Kr}^+$



**Explanation:** The  $\text{Cl}^-$  ion has 18 electrons and is isoelectronic with argon while the  $\text{F}^-$  ion has 10 electrons making it isoelectronic with neon.

15. Chlorine is much more apt to exist as an anion than is sodium. This is because \_\_\_\_\_.

- a) chlorine is bigger than sodium
- b) chlorine has a greater ionization energy than sodium does
- c) **chlorine has a greater electron affinity than sodium does**
- d) chlorine is a gas and sodium is a solid

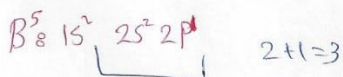


16. The alkaline earth metals are found in \_\_\_\_\_ of the periodic table.

- a) Group 1A
- b) **Group 2A**
- c) Group 7A
- d) Group 8A

17. How many *valence electrons* does a boron atom (B) have?

- a) 1
- b) 3
- c) 5
- d) 7

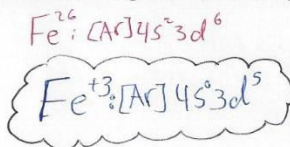


18. Which ion is *isoelectronic* with Ar?

- a)  $Ni^{2+} \rightarrow [Ar]_{18} 4s^0 3d^8$
- b)  $F^- \rightarrow [Ne]$
- c)  $Br^- \rightarrow [Kr]$
- d)  $K^+ \rightarrow [Ar]$  ✓

19. Which of these choices is the electron configuration of the iron (III) ion ( $Fe^{3+}$ )?

- a)  $[Ar]4s^2 3d^5$
- b)  $[Ar]4s^1 3d^5$
- c)  $[Ar]3d^5$
- d)  $[Ar]3d^6$



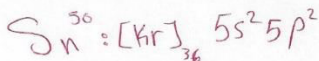
20. In what group of the periodic table is the element with the electron configuration  $[Ar]4s^2 3d^{10} 4p^1$ ?

- a) 1A
- b) 2A
- c) 3A
- d) 4A

group:  $2+1=3A$

21. How many *valence electrons* does a tin (Sn) atom have?

- a) 2
- b) 4
- c) 14
- d) 36



22. Which of these ground-state ions has unpaired electrons?

- a)  $P^{3-} \rightarrow [Ar]$
- b)  $V^{5+} \rightarrow [Ar]$
- c)  $S^{2-} \rightarrow [Ar]$
- d)  $Sc^{2+} \rightarrow 8[Ar]_{18} 4s^0 3d^1 \rightarrow$  unpaired

23. Consider the element with the electron configuration  $[Xe]6s^2 4f^7$ . This element is

- a) a representative element.
- b) a lanthanide element.
- c) a nonmetal.
- d) an actinide element

Period: 4  
block: f

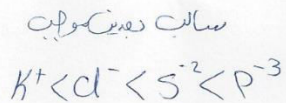
24. If the radius of atom X is greater than the radius of atom Y, then it is also likely that

- a) X has a larger electron affinity than Y does.
- b) X has a larger first ionization energy than Y does.
- c) X has greater metallic character than Y does.

25. Arrange these ions in order of increasing ionic radius:  $K^+$ ,  $P^{3-}$ ,  $S^{2-}$ ,  $Cl^-$ .

Increasing radius  $\rightarrow$

- Row 1  $K^+ < Cl^- < S^{2-} < P^{3-}$   
Row 2  $K^+ < P^{3-} < S^{2-} < Cl^-$   
Row 3  $P^{3-} < S^{2-} < Cl^- < K^+$   
Row 4  $Cl^- < S^{2-} < P^{3-} < K^+$   
Row 5  $Cl^- < S^{2-} < K^+ < P^{3-}$



- a) Row 1  
b) Row 2  
c) Row 3  
d) Row 4

26. - Selenium ( ${}_{34}Se$ ) element is

- a) a nonmetal  
b) found in group 6A  
c) found in period 2  
d) **both a and b**

28. The outer electron configuration of the noble gases is

- a)  $ns^2 np^6$   
b)  $ns^2 nd^{10}$   
c)  $ns^2 np^4$   
d)  $ns^2 np^8$

29. Which of the following species is isoelectronic with  $Cl^- \rightarrow [Ar]_{18}$

- a)  $K^+ \rightarrow [Ar]_{18}$   
b)  $Na^+ \rightarrow [Ne]_6$   
c)  $O^{2-}$   
d)  $2^-$

30. Gallium (Ga) element is found in the periodic table in

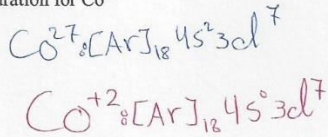
- a) period 3, group 1B  
b) period 3A, group 4  
c) period 4, group 1A  
d) **period 4, group 3A**

31. Titanium (Ti) element is found in the periodic table in

- a) s-block  
b) p-block  
c) **d-block**  
d) f-block

32. Write the electronic configuration for  $\text{Co}^{+2}$

- a)  $[\text{Ar}] 4s^2 3d^5$
- b)  $[\text{Ar}] 4s^2 3d^7$
- c)  $[\text{Ar}] 4s^1 3d^6$
- d)  $[\text{Ar}] 4s^1 3d^5$



33. Select the correct order of radius of the two ions

- a)  $A^+ > A^-$  ✗
- b)  $A^- < A^+$  ✗
- c)  $A^{2+} > A^+$  ✗
- d)  $A^{2+} < A^+$  ✓

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34. Two ions are referred to as isoelectronic if they have the same number of

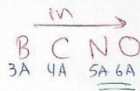
- a) **electrons.**
- b) protons.
- c) atoms.
- d) neutrons.

35. The energy required to remove an electron from an atom in its ground state is known as the

- a) potential energy.
- b) activation energy.
- c) electron affinity.
- d) **ionization energy.**

36. Which will have the highest ionization energy?

- a) C
- b) N
- c) O
- d) B



Exception  $6A < 5A$

37. Order the following ( $\text{N}^{3-}$ ,  $\text{Li}^+$ ,  $\text{C}$ ,  $\text{O}^{2-}$ ) according to increasing atomic/ionic radius.

- a)  $\text{C} < \text{Li}^+ < \text{O}^{2-} < \text{N}^{3-}$
- b)  $\text{N}^{3-} < \text{O}^{2-} < \text{C} < \text{Li}^+$
- c)  $\text{Li}^+ < \text{C} < \text{N}^{3-} < \text{O}^{2-}$
- d)  **$\text{Li}^+ < \text{C} < \text{O}^{2-} < \text{N}^{3-}$**

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