Ch. 2, 7 & 22 Review

Answers

17 protons 18 protons

1)Which of the following correctly identifies which has the higher first-ionization energy, Cl or Ar, and supplies the best justification?
(A) Cl, because of its higher electronegativity
(B) Cl, because of its higher electron affinity
(C) Ar, because of its completely filled valence shell
(D) Ar, because of its higher effective nuclear charge

2) Which of the following species is smallest is size?
(A) Cl ← 3p orbital
(B) I ← 6p orbital
(C) Cl^-
(D) I^-

3) Which atom has the lowest second ionization energy?
(A) Mg [Ne] $3s^2$
(B) Na [Ne] $3s^1$
(C) K [Ar] $4s^1$
(D) Ar [Ne] $3s^2 3p^6$

need to find where 2nd e⁻ is coming from
Both e⁻ can come from the 3s orbital in all others 2nd e⁻ is much harder to remove

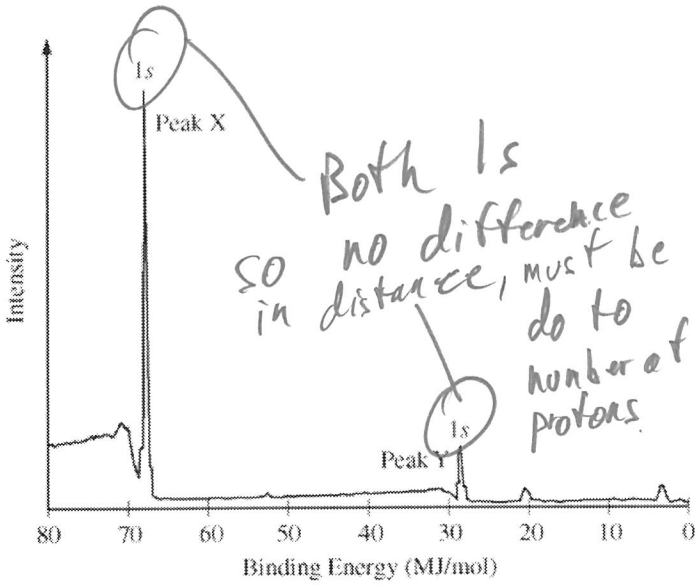
4) There are two stable isotopes of carbon. They differ with respect to
(A) atomic mass
(B) number of protons
(C) atomic number
(D) electron configuration

isotopes have different number of neutrons so different atomic mass

Element	First Ionization Energy (kJ/mol)	Atomic Radius (pm)
$2s^1$ Li	520	145
$2s^2$ Be	899	105
$2s^2 2p^1$ B	801	85
Switch $2s^2 2p^2$ to 2p C	1086	77
N	1400	75
O	1314	73
F	1680	72
Ne	2080	70

lower

5)The table above shows the first ionization energy and atomic radius of several elements. Which of the following best helps to explain the deviation of the first ionization energy of boron from the overall trend?
(A) The atomic radius of boron is greater than the atomic radius of carbon.
(B) The atomic radius of boron is less than the atomic radius of beryllium.
(C) The outermost electron in boron is in the 2p orbital which has weaker attraction to the nucleus.
(D) The outermost electron in boron is in the 2p orbital which has stronger attraction to the nucleus.



6) A sample containing atoms of C and F was analyzed using x-ray photoelectron spectroscopy. The portion of the spectrum showing the 1s peaks for atoms of the two elements is shown above. Which of the following correctly identifies the 1s peak for the F atoms and provides an appropriate explanation?

(A) Peak X, because F has a smaller first ionization energy than C has.

(B) Peak X, because F has a greater nuclear charge than C has.

(C) Peak Y, because F is more electronegative than C is.

(D) Peak Y, because F has a smaller atomic radius than C has.

lost 2 e^-

7) One $^{40}Ca^{2+}$ ion contains

(A) 2 protons

(B) 18 electrons

(C) 21 neutrons

(D) 2 electrons

8) Which statement about the electron configuration of electrons in the Cs atom is correct?

(A) The outermost two electrons are paired in the same atomic orbital.

(B) The 4f shell is completely full.

(C) Only one of the 55 electrons is involved in most interactions of Cs with other atoms.

(D) The 4f shell is only partially filled.

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^1$

Valence electrons drive chemistry

~~(10)~~ 9

A) The outermost electrons in all the elements from Li to Ne are in the second energy level but the number of protons goes from 3 for Li to 10 for Ne. The more protons for an atom the greater the ionization energy, in general.

b) The first electron removed from a B atom would come from a 2p orbital which is slightly higher in energy than the 2s orbital which is where the electron from a Be atom would come from. The 2p is slightly further away and this would offset the additional attractive force of the proton.

c) Both oxygen and nitrogen would have electrons in the 2p orbital. Oxygen with one more proton would be expected to have a higher ionization energy but it is actually lower. This is due to the doubling up of electrons in the same orbital, in nitrogen each electron in the 2p orbital is in it's own orbital but in oxygen there are 2 electrons that are in the same orbital. This causes increased $e^- - e^-$ repulsion with offset the additional p^+.

d) Sodium would have a lower 1st ionization energy than either Li or Ne. The outermost e^- would be in the 3s orbital this is further from the nucleous and experiences more electron shielding making it's ionization lower.

~~2~~ 10

a) The outer most electron for Mg is in the 3s while the outer most electron for Calcium is in the 4s orbital. The 4s orbital is further from the nucleous and experiences more electron shielding so even though the Ca atom has more protons, the 4s electrons are more weakly attracted to the nucleous.

b) Calcium has an electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$ the first two electrons removed come from the 4s orbital, while the third electron comes from the 3p orbital the 3p orbital is closer to the nucleous and experiences less electron shielding than the 4s orbital so electrons in the 3p are much harder to remove.

c) The general trend for electron affinity is to increase from left to right across a period but nitrogen is lower than carbon. This is is due to nitrogen have an electron in each of the 2p orbitals, so that any added electron would need to go into an orbital that already has an electron. This doubling of electrons in the same orbital means that the two electrons repele each other lowering the electron affinity

~~21d~~ 10

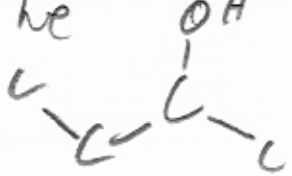
Sodium has only 1 electron in it's 3s orbital while magnesium has 2. This means that the second electron removed from sodium has to come from the 2p orbital which is much closer to the nucleus and experiences much less electron shielding, meaning it is much harder to remove.

~~22a~~ 11

$$E = \frac{hc}{\lambda} \qquad \lambda = \frac{hc}{E} = \frac{6.63 \cdot 10^{-34}\ J \cdot s \ \ 3.0 \cdot 10^{8}\ m \cdot s^{-1}}{7.04 \cdot 10^{-19}\ J}$$

$$\lambda = 282.5 \cdot 10^{-7}\ m \cdot \frac{1\ nm}{10^{-9}\ m} = 282\ nm$$

~~22b~~ 11

The  is an alcohol with four carbons this is butan-2-ol or 2-butanol.