Ionization Energy Questions

1. * see glossary *

2. a) O^{2-} $1s^2 2s^2 2p^6$ $^{-2}$
   b) F^{-1} $1s^2 2s^2 2p^6$ $^{-1}$
   c) Ne $1s^2 2s^2 2p^6$
   d) Na^{+1} $1s^2 2s^2 2p^6$
   e) Mg^{+2} $1s^2 2s^2 2p^6$ $^{+2}$

3. isoelectric

4. stable ion is isoelectric w/ a noble gas. You can recognize this by a <u>full</u> s & p orbital (He $1s^2$)

5. stable ions include Ca^{2+}, P^{3-}, Na^{+1}, Cl^-

6. noble gas have the ↑est I.E. b/c they are already in a stable e^- arrangement & ∴ do <u>NOT</u> want to become unstable so their pull on valence e^- is strong.

7. Noble gases are stable ∴ they do not need to gain (anions) or lose (cations) e^-.

8. The most stable ion would have a charge of +2 so that it could be isoelectric with Ne full s & p orbitals.

9. # of p^+ ↑ as you move left to right across a period & ∴ the Zeff ↑ causing valence e^- to be held more tightly which will require more E to remove them.

10. Be [He] $2s^2$ vs. Li [He] $2s^1$. Be has a full 2s orbital which is a more stable e^- arrangement

than a half-full s orbital. So more E would be required to remove an e^- from a full orbital than to remove an e^- from a half-full orbital. (2)

11. a) lowest IE = ii) $1s^2 2s^2 2p^6 3s^1$ } n=3 i half-full
b) inert gas = vi $1s^2 2s^2 2p^6$ } valence has full s & p
c) increasing 1st IE = ii, i, iv, iii, v
d) highest 2nd IE = ii } 1st IE results in [Ne]
e) lowest 2nd IE = iii } 2nd IE results in half-full p ($2p^3$)

Atomic Radius Questions

1. Size of an atom is determined by first the principal quantum number (n), and second by Z_{eff}.

2. a) Across a period atomic radius ↓
b) Down a group atomic radius ↑

3. a) An atom with n=2 will be smaller than an atom with n=3
b) Z_{eff} is used to determine differences in size
c) When determining the size of an atom you need to know n and Z_{eff} (i.e. sub-level info s^1 vs s^2 etc)

4. a) Mg is larger b/c its Z_{eff} is less than Al so its valence e^- will be located further from the nucleus than Al.
b) Mg is larger than Be b/c Mg valence e^- are located in the 3s orbit vs Be which is in the 2s. As n ↑ A.R. ↑

5. Cations are smaller than their neutral atom b/c cations will have a greater Z_{eff} as they have lost e^- but not p^+ so the ratio $\uparrow p^+ : \downarrow e^-$ causing valence e^- to be pulled closer to the nucleus (i.e. smaller) 3

6. Anions are larger than their neutral atom b/c anions will have a smaller Z_{eff} as they have gained e^- but not p^+ so the ratio is $\downarrow p^+ : \uparrow e^-$ causing valence e^- to move further away from the nucleus (i.e. larger)

7. a) Na is larger than Li b/c Na = [Ne] $3s^1$ vs Li = [He]
b) Both Na & Mg are $n=3$ but Na has $11p^+$ vs Mg has $12p^+$. ∴ Na has a lower Z_{eff} so it will be larger.
c) Na will be larger than Na^+ b/c Na^+ valence e^- is now $2p^6$ w Na $3s^1$

8. a) Ne smaller than Na b/c Ne $n=2$ vs Na $n=3$
A.R. ↑ as n ↑
b) Ne would be larger than Na^{+1} b/c they both have e^- in the same energy level ($n=2$) but Na^{+1} would have more p^+ in its nucleus & ∴ its Z_{eff} would be higher causing Na^{+1} to be slightly smaller than Ne.