

Chapter 7 : 34, 40, 46, 58, 64, 72, 86, 88, 90, 92, 96, 104, 123, 125, 126

$$34. \quad E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.9979 \times 10^8 \text{ m/s})}{25 \text{ nm} \times \frac{1 \text{ nm}}{10^9 \text{ nm}}} = \mathbf{7.9 \times 10^{-18} \text{ J per photon}}$$

$$\frac{7.9 \times 10^{-18} \text{ J}}{\text{photon}} \times \frac{6.022 \times 10^{23} \text{ photons}}{1 \text{ mole}} \times \frac{1 \text{ kJ}}{1000 \text{ J}} = \mathbf{4.8 \times 10^3 \text{ kJ/mole}}$$

$$40. \quad \frac{208.4 \text{ kJ}}{\text{mole e}^-} \times \frac{1000 \text{ J}}{1 \text{ kJ}} \times \frac{1 \text{ mole e}^-}{6.022 \times 10^{23} \text{ e}^-} = \mathbf{3.461 \times 10^{-19} \text{ J/e}^-}$$

$$E = h\nu = \frac{hc}{\lambda}; \quad \lambda = \frac{hc}{E} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.9979 \times 10^8 \text{ m/s})}{3.461 \times 10^{-19} \text{ J}} = \mathbf{5.740 \times 10^{-7} \text{ m}} \\ = \mathbf{574.0 \text{ nm}}$$

$$46. \quad \text{a.} \quad E_n = -2.178 \times 10^{-18} \left(\frac{Z^2}{n^2} \right) \text{ J}$$

$$E_4 = -2.178 \times 10^{-18} \left(\frac{1^2}{4^2} \right) \text{ J} = -1.361 \times 10^{-19} \text{ J}$$

$$E_3 = -2.178 \times 10^{-18} \left(\frac{1^2}{3^2} \right) \text{ J} = -2.420 \times 10^{-19} \text{ J}$$

$$\Delta E = E_3 - E_4 = -1.059 \times 10^{-19} \text{ J (the negative means the radiation is emitted)}$$

$$\lambda = \frac{hc}{|\Delta E|} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.9979 \times 10^8 \text{ m/s})}{-1.059 \times 10^{-19} \text{ J}} = \mathbf{1.876 \times 10^{-6} \text{ m} = 1876 \text{ nm}}$$

$$\text{b.} \quad E_5 = -2.178 \times 10^{-18} \left(\frac{1^2}{5^2} \right) \text{ J} = -8.712 \times 10^{-20} \text{ J}$$

$$E_4 = -2.178 \times 10^{-18} \left(\frac{1^2}{4^2} \right) \text{ J} = -1.361 \times 10^{-19} \text{ J}$$

$$\Delta E = E_4 - E_5 = -4.901 \times 10^{-20} \text{ J (the negative means the radiation is emitted)}$$

$$\lambda = \frac{hc}{|\Delta E|} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.9979 \times 10^8 \text{ m/s})}{-4.901 \times 10^{-20} \text{ J}} = \mathbf{4.054 \times 10^{-6} \text{ m} = 4054 \text{ nm}}$$

$$c. \quad E_5 = -2.178 \times 10^{-18} \left(\frac{1^2}{5^2} \right) \text{J} = -8.712 \times 10^{-20} \text{J}$$

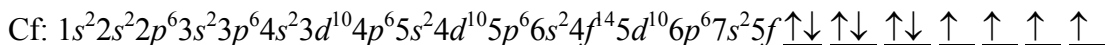
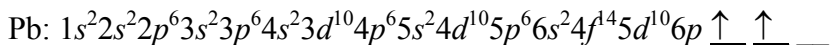
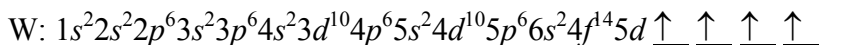
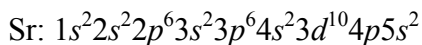
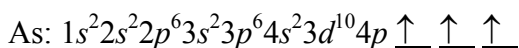
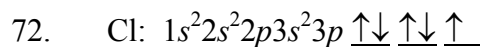
$$E_3 = -2.178 \times 10^{-18} \left(\frac{1^2}{3^2} \right) \text{J} = -2.420 \times 10^{-19} \text{J}$$

$$\Delta E = E_3 - E_4 = -1.549 \times 10^{-19} \text{J} \text{ (the negative means the radiation is emitted)}$$

$$\lambda = \frac{hc}{|\Delta E|} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.9979 \times 10^8 \text{ m/s})}{-1.549 \times 10^{-19} \text{ J}} = \mathbf{1.283 \times 10^{-6} \text{ m} = 1283 \text{ nm}}$$

58. $1p$ $3f$ $2d$ are **incorrect**
 $\ell = 1$ $\ell = 3$ $\ell = 2$
 $n = 1$ $n = 3$ $n = 2$ ℓ only can have values **up to** $n - 1$

64. $1p$ 0 e- see problem 60
 $6d_{x^2-y^2}$ 2 e- 1 sub-orbital (+1/2, -1/2 m_s)
 $4f$ 14 e- f orbital has 7 sub-orbitals, each with 2 e- (see above)
 $7p_y$ 2 e- 1 sub-orbital
 $2s$ 2 e- only 1 sub-orbital in s
 $n = 3$ 18 e- $3s$ (2 e-), $3p$ (6 e-) and $3d$ (10 e-)



86. a. Be < Na < Rb
b. Ne < Se < Sr
c. O < P < Fe

88. a. Rb < Na < Be
b. Sr < Se < Ne
c. Fe < P < O

90. a. Ba
 b. Ga
 c. O (an anomaly because orbital becomes half-filled when 1 e⁻ removed)
 d. S²⁻
 e. Cs

92. 117

- a. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^{10} 7p \uparrow \downarrow \uparrow \downarrow \uparrow$
 b. At
 c. NaUs CUus₄
 MgUus₂ OUus₂
 d. UUsO⁻ UUsO₃⁻
 UUsO₂⁻ UUsO₄⁻

96. a. K, Cl
 b. Mg, F
 c. K, Cl

104. a. Li⁺ N³⁻ Li₃N lithium nitride
 b. Na⁺ Br⁻ Sodium bromide
 c. K⁺ S²⁻ K₂S potassium sulfide

123. **Sharp** increase at 3rd ionization energy - alkaline-earth metal.

125. a. $\text{Na(g)} \longrightarrow \text{Na}^{\text{+}}(\text{g}) + \text{e}^{-}$ IE₁ +496 kJ/mole
 $\text{Cl(g)} + \text{e}^{-} \longrightarrow \text{Cl}^{-}(\text{g})$ EA₁ -348.7 kJ/mole
 $\text{Na(g)} + \text{Cl(g)} \longrightarrow \text{Na}^{\text{+}}(\text{g}) + \text{Cl}^{-}(\text{g})$ ΔH **+146 kJ/mole**
- b. $\text{Mg(g)} \longrightarrow \text{Mg}^{\text{+}}(\text{g}) + \text{e}^{-}$ IE₁ +735 kJ/mole
 $\text{F(g)} + \text{e}^{-} \longrightarrow \text{F}^{-}(\text{g})$ EA₁ -327.8 kJ/mole
 $\text{Mg(g)} + \text{F(g)} \longrightarrow \text{Mg}^{\text{+}}(\text{g}) + \text{F}^{-}(\text{g})$ ΔH **+407 kJ/mole**
- c. $\text{Mg}^{\text{+}}(\text{g)} \longrightarrow \text{Mg}^{\text{2+}}(\text{g}) + \text{e}^{-}$ IE₂ +1445 kJ/mole
 $\text{F(g)} + \text{e}^{-} \longrightarrow \text{F}^{-}(\text{g})$ EA₁ -327.8 kJ/mole
 $\text{Mg}^{\text{+}}(\text{g)} + \text{F(g)} \longrightarrow \text{Mg}^{\text{2+}}(\text{g}) + \text{F}^{-}(\text{g})$ ΔH **+1117 kJ/mole**
- d. $\text{Mg(g)} \longrightarrow \text{Mg}^{\text{2+}}(\text{g}) + 2 \text{e}^{-}$ IE₁ + IE₂ +2180 kJ/mole
 $2 \text{F(g)} + 2 \text{e}^{-} \longrightarrow 2 \text{F}^{-}(\text{g})$ 2 x EA₁ -655.6 kJ/mole
 $\text{Mg(g)} + 2 \text{F(g)} \longrightarrow \text{Mg}^{\text{2+}}(\text{g}) + 2 \text{F}^{-}(\text{g})$ ΔH **+1524 kJ/mole**

$$126. \quad E_n = -2.178 \times 10^{-18} \left(\frac{Z^2}{n^2} \right) \text{J, for Be, } Z = 4$$

$$E_5 = -2.178 \times 10^{-18} \left(\frac{4^2}{5^2} \right) = -1.394 \times 10^{-18} \text{ J}$$

$$E = h\nu = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34} \text{ J}\cdot\text{s})(2.9979 \times 10^8 \text{ m/s})}{253.4 \text{ nm} \times \frac{1 \text{ m}}{10^9 \text{ nm}}} = 7.839 \times 10^{-19} \text{ J emitted}$$

$$\Delta E = E_n - E_5 = -7.839 \times 10^{-19} \text{ J}$$

$$E_n = \Delta E + E_5 = ((-7.839 \times 10^{-19} \text{ J}) + (-1.394 \times 10^{-18} \text{ J}))$$

$$E_n = -2.178 \times 10^{-18} \text{ J}$$

$$\mathbf{n = 4} \text{ because } E_4 = -2.18 \times 10^{-18} \left(\frac{4^2}{4^2} \right) = -2.178 \times 10^{-18} \text{ J}$$