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

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

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

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

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

$$= \mathbf{574.0\ nm}$$

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

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

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

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

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

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

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

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

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

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

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

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

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

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-	3*s* (2 e-), 3*p* (6 e-) and 3*d* (10 e-)

72. Cl: $1s^22s^22p3s^23p$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow\ }$

As: $1s^22s^22p^63s^23p^64s^23d^{10}4p$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$

Sr: $1s^22s^22p^63s^23p^64s^23d^{10}4p5s^2$

W: $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^66s^24f^{14}5d$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\ \ \ }$

Pb: $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^66s^24f^{14}5d^{10}6p$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\ \ \ }$

Cf: $1s^22s^22p^63s^23p^64s^23d^{10}4p^65s^24d^{10}5p^66s^24f^{14}5d^{10}6p^67s^25f$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow\downarrow}$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$ $\underline{\uparrow\ }$

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. S^{2-}
e. Cs

92. 117

a. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2 5f^{14} 6d^{10} 7p$ ↑↓ ↑↓ ↑
b. At
c. NaUus, $CUus_4$, $MgUus_2$, $OUus_2$
d. $UUsO^-$, $UUsO_3^-$, $UUsO_2^-$, $UUsO_4^-$

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

104. a. Li^+ N^{3-} Li_3N lithium nitride
b. Na^+ Br^- Sodium bromide
c. K^+ S^{2-} K_2S potassium sulfide

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

125. a.

$Na(g) \longrightarrow Na^+(g) + e^-$	IE_1	+496 kJ/mole
$Cl(g) + e^- \longrightarrow Cl^-(g)$	EA_1	–348.7 kJ/mole
$Na(g) + Cl(g) \longrightarrow Na^+(g) + Cl^-(g)$	ΔH	**+146 kJ/mole**

b.

$Mg(g) \longrightarrow Mg^+(g) + e^-$	IE_1	+735 kJ/mole
$F(g) + e^- \longrightarrow F^-(g)$	EA_1	–327.8 kJ/mole
$Mg(g) + F(g) \longrightarrow Mg^+(g) + F^-(g)$	ΔH	**+407 kJ/mole**

c.

$Mg^+(g) \longrightarrow Mg^{2+}(g) + e^-$	IE_2	+1445 kJ/mole
$F(g) + e^- \longrightarrow F^-(g)$	EA_1	–327.8 kJ/mole
$Mg^+(g) + F(g) \longrightarrow Mg^{2+}(g) + F^-(g)$	ΔH	**+1117 kJ/mole**

d.

$Mg(g) \longrightarrow Mg^{2+}(g) + 2e^-$	$IE_1 + IE_2$	+2180 kJ/mole
$2F(g) + 2e^- \longrightarrow 2F^-(g)$	$2 \times EA_1$	–655.6 kJ/mole
$Mg(g) + 2F(g) \longrightarrow Mg^{2+}(g) + 2F^-(g)$	ΔH	**+1524 kJ/mole**

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

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

$$E = h\nu = \frac{hc}{\lambda} = \frac{\left(6.626 \text{ x } 10^{-34} \text{ J-}\cancel{s}\right)\left(2.9979 \text{ x } 10^{8} \ \cancel{m}/\cancel{s}\right)}{253.4 \text{ n}\cancel{m} \text{ x } \frac{1 \ \cancel{m}}{10^9 \text{ n}\cancel{m}}} = 7.839 \text{ x } 10^{-19} \text{ J emitted}$$

$$\Delta E = E_n - E_5 = -7.839 \text{ x } 10^{-19} \text{ J}$$
$$E_n = \Delta E + E_5 = \left(\left(-7.839 \text{ x } 10^{-19} \text{ J}\right) + \left(-1.394 \text{ x } 10^{-18} \text{ J}\right)\right)$$
$$E_n = -2.178 \text{ x } 10^{-18} \text{ J}$$

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