

## HW 9 Solutions

ch 9 #5 a)  $U = \frac{k_e q_1 q_2}{\text{constant } r} = \frac{k_e (+e) \cdot (-e)}{0.267 \text{ nm}} = - \frac{1.44 \text{ eV} \cdot \text{nm}}{0.267 \text{ nm}} = -5.39 \text{ eV}$

b)  $U_{\text{ion}} = (4.18 - 3.62) \text{ eV} = 0.56 \text{ eV}$

$E'_d = (-5.39 + 0.56) \text{ eV} = -4.83 \text{ eV}$

c)  $E_{\text{ex}} = E_d - E'_d = -4.37 \text{ eV} - (-4.83) \text{ eV} = 0.46 \text{ eV}$

#6.  $E_{\text{ex}} = E_d - E_{\text{eal.}} - E_{\text{ion}} = 3.94 \text{ eV} - \frac{ke^2}{0.282 \text{ nm}} - (4.34 - 3.36) \text{ eV}$   
 $= 0.186 \text{ eV} @ 0.282 \text{ nm}$

#7  $E_d = E_{\text{ex}} + E_{\text{coulomb}} + E_{\text{ion}} = \frac{A}{r^n} + \frac{-ke^2}{r} + E_{\text{ion}}$   
 $F=0: \frac{d}{dr} \left( \frac{A}{r^n} + \frac{-ke^2}{r} \right) = -nAr^{n-1} + \frac{ke^2}{r^2} = 0$

also  $Ar^{-n} = E_{\text{ex}}$   $Ar^{1-n} = \frac{ke^2}{n}$

taking the ratio,  $\frac{r^{1-n}}{r^{-n}} = \frac{ke^2/n}{E_{\text{ex}}}$  ~~or~~

$n = \frac{ke^2}{r \cdot E_{\text{ex}}} = \frac{1.44 \text{ eV} \cdot \text{nm}}{0.282 \text{ nm} \cdot 0.186 \text{ eV}} = 27.4$

$A = E_{\text{ex}} \cdot r^n = 0.186 \text{ eV} \cdot (0.282 \text{ nm})^{27} = 2.668 \times 10^{-16} \text{ eV} \cdot \text{nm}^{27}$

#11 a) ionic b) covalent c) covalent.

#37  $\mathcal{P} = \frac{E}{t} = \frac{nhf}{t} = \frac{nhc}{t\lambda}$   $\frac{n}{t} = \frac{\mathcal{P} \cdot \lambda}{hc} = \frac{4 \text{ mW} \cdot 632.8 \text{ nm}}{1240 \text{ eV} \cdot \text{nm}} = 1.27 \times 10^{16} / \text{s}$

ch 10 #10.  $\rho = \frac{m_e \langle v \rangle}{n e^2 \lambda} = \frac{9.11 \times 10^{-31} \text{ kg} \cdot 1.17 \times 10^5 \text{ m/s}}{8.47 \times 10^{28} \text{ m}^{-3} (1.6 \times 10^{-19} \text{ C})^2 (0.4 \text{ nm})} = 12.25 \mu\text{b/cm}$

$\rho[100\text{K}] = \rho[300\text{K}] \times \sqrt{\frac{100}{300}} = 7.07 \mu\text{b/cm}$

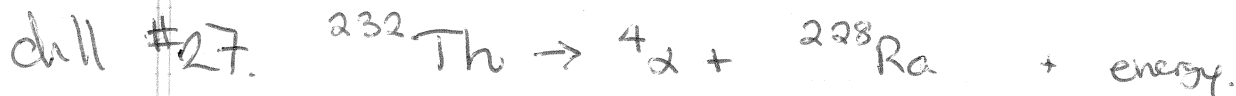
#16. a)  $\langle E \rangle = \frac{3}{5} E_F = \frac{3}{5} (7.06) = 4.24 \text{ eV}$

b)  $\langle E \rangle = \frac{3}{5} \cdot 4.77 \text{ eV} = 2.86 \text{ eV}$

#27. a)  $\lambda = \frac{hc}{\Delta E} = \frac{1240 \text{ eV nm}}{1.14 \text{ eV}} = 1087.6 \text{ nm}$

b)  $\lambda = \frac{1240 \text{ eV nm}}{0.72 \text{ eV}} = 1722 \text{ nm}$

c)  $\lambda = \frac{1240 \text{ eV nm}}{7.0 \text{ eV}} = 177 \text{ nm}$



$232.038051 = 4.0026 + 228.031064 + E$

$E = 0.004387 \text{ u} = 4.086 \text{ MeV}/c^2$

$P_\alpha = P_{\text{Ra}} \equiv P \quad E_\alpha = \frac{p^2}{2m_\alpha} \quad E_{\text{Ra}} = \frac{p^2}{2m_{\text{Ra}}}$

$E = \frac{p^2}{2m_\alpha} + \frac{p^2}{2m_{\text{Ra}}} = 4.086 \text{ MeV}$

$\frac{E_{\text{Ra}}}{E_\alpha} = \frac{1/m_{\text{Ra}}}{1/m_\alpha} = \frac{m_\alpha}{m_{\text{Ra}}} = \frac{4}{232} = 0.01724$

thus  $E_{\text{Ra}} = \frac{0.01724}{1+0.01724} E = 0.06926 \text{ MeV}$

$E_\alpha = \frac{1}{1+0.017} E = 4.0172 \text{ MeV}$

