

HW 2

Levon Dovlatyan, SI: 24451582
E45

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Problem 2.9. A copper penny has a mass of 2.60 g. Assuming pure copper, how much of this mass is contributed by **(a)** the neutrons in the copper nuclei and **(b)** electrons?

(a) Cu-63 has 29 protons and 34 neutrons. The mass of a copper atom is,

$$\frac{63.546 \text{ g}}{1 \text{ mole}} = \frac{63.546 \text{ g}}{6.022 \times 10^{23} \text{ atoms}} = \frac{1.055 \times 10^{-22} \text{ g}}{\text{Cu atom}}$$

Now find the mass percent of neutrons in a copper atom

$$\frac{34 \text{ neutrons} \times 1.6749 \times 10^{-24} \text{ g}}{1 \text{ neutron}} = 5.695 \times 10^{-23} \text{ g} \Rightarrow \frac{5.695 \times 10^{-23} \text{ g/Cu}}{1.055 \times 10^{-22} \text{ g/Cu}} = 53.98\% \text{ neutron mass in Cu}$$

Finally, $2.60 \text{ g} \times 0.5398 = 1.40 \text{ g}$ of neutrons.

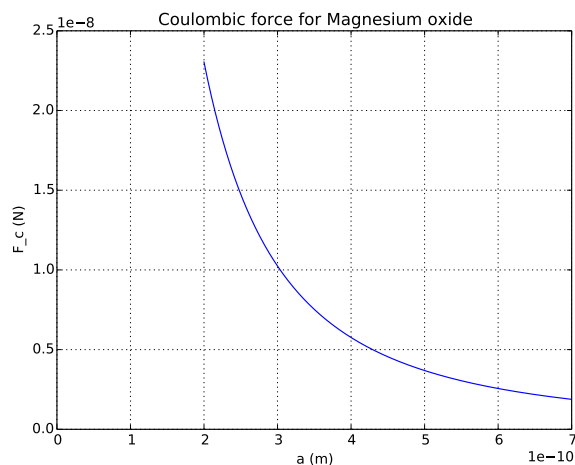
(b) Same idea for electrons. Find the mass of 29 electrons and compare to Cu atom mass.

$$29 \text{ electrons} \times \frac{9.11 \times 10^{-28} \text{ g}}{1 \text{ electron}} = 2.64 \times 10^{-26} \text{ g}$$
$$\frac{2.64 \times 10^{-26} \text{ g/Cu}}{1.055 \times 10^{-22} \text{ g/Cu}} = 2.50 \times 10^{-4} \% \text{ electron mass in Cu}$$

Finally, $2.60 \text{ g} \times 2.50 \times 10^{-4} = 6.51 \times 10^{-4} \text{ g}$ of electrons.

Problem 2.13. Make an accurate plot of F_c versus a (comparable to that shown in Figure 2.6) for an $Mg^{2+} - O^{2-}$ pair. Consider the range of a from 0.2 to 0.7 nm.

Using the equation $F_c = \frac{-K}{a^2}$ where $K = k_0 Z_1 Z_2 q^2$ and $Z_1 = +2, Z_2 = -2$.

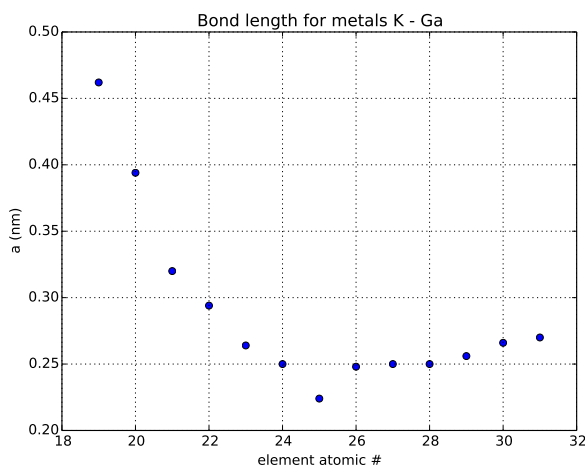


Problem 2.33. The first step in the formation of phenolformaldehyde, a common phenolic polymer, is shown in Figure 12.6. Calculate the net reaction energy (per mole) for this step in the overall polymerization reaction.

initially the $C = O$ bond is broken and two $C - H$ bonds are formed.

$$\begin{aligned}
 C = C &\rightarrow 2 C - H \\
 535\text{kJ/mole} &\rightarrow 2(435\text{kJ/mole}) \\
 (870 - 535)\text{kJ/mole} &= 335\text{kJ/mole}
 \end{aligned}$$

Problem 2.46. Plot the bond length of the metals in the long row of metallic elements (K to Ga).



Problem 2.52. Due to its large atomic diameter, neon has a higher heat of solution in vitreous silica than helium. If the heat of solution of neon in vitreous silica is -6.70 kJ/mol and the solubility at 25°C is $9.07 \times 10^{23} \text{ atoms}/(\text{m}^3 \cdot \text{atm})$, calculate the solubility at 200°C . (See problem 2.51.)