General Chemistry I
Tutorial 11

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Outline

Quiz 13.1

Suppose 50% of an infrared light can pass through 1 cm thickness of CO gas.

a. What percentage of the infrared light can pass through 2 cm of CO gas?
b. What percentage of the infrared light can pass through 3 cm of CO gas?
c. Can you give a general formula for this trend?
d. What is the thickness that will transmit only 10% of the light?

Remark 1.1

Beer–Lambert law *is givern by:*

$$A = \varepsilon l c = -\log \frac{\mathrm{I}}{\mathrm{I}_0}$$

PS 7.1

Of the ten fourth-period transition metal elements in Table 8.1, which **two** have relatively low melting and boiling points? How can you explain this in terms of the electronic configuration of these two elements?

TABLE 8.1

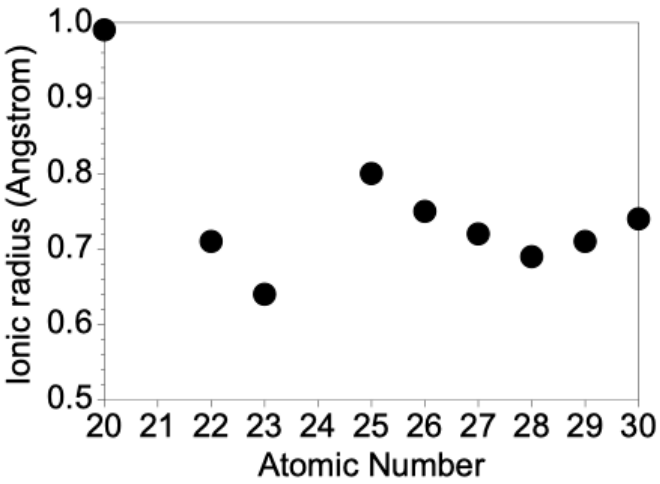
Properties of the Fourth-Period Transition Elements

Element	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
IE_1 (kJ mol^{-1})	631	658	650	653	717	759	758	737	745	906
IE_2 (kJ mol^{-1})	1235	1310	1414	1592	1509	1562	1648	1753	1958	1733
Boiling point (°C)	2831	3287	3380	2672	1962	2750	2870	2732	2567	907
Melting point (°C)	1541	1660	1890	1857	1244	1535	1495	1453	1083	420
Atomic radius (Å)	1.61	1.45	1.31	1.25	1.37	1.24	1.25	1.25	1.28	1.34
M^{2+} Ionic radius (Å)	0.81	0.68	0.88	0.89	0.80	0.72	0.72	0.69	0.72	0.74
M^{2+} configuration	d^1	d^2	d^3	d^4	d^5	d^6	d^7	d^8	d^9	d^{10}
$\Delta H_{hyd}(M^{2+})^{\dagger}$ (kJ mol^{-1})				−2799	−2740	−2839	−2902	−2985	−2989	−2937

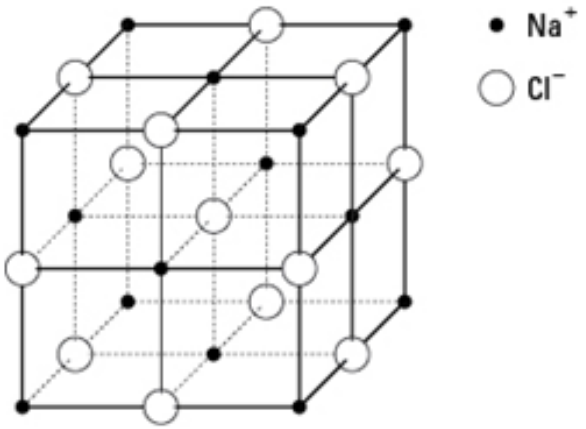
†Defined as $\Delta H_f^\circ(M^{2+}(aq)) - \Delta H_f^\circ(M^{2+}(g))$.

PS 7.2

The following ionic radii (in angstroms) are estimated for the 12 ions of selected elements of the first transition-metal series, based on the structures of their oxides: Ca^{2+} (0.99), Ti^{2+} (0.71), V^{2+} (0.64), Mn^{2+} (0.80), Fe^{2+} (0.75), Co^{2+} (0.72), Ni^{2+} (0.69),Cu^{2+} (0.71), Zn^{2+} (0.74). Draw a graph of ionic radius versus atomic number in this series, identify the local minima and maxima, and account for its shape. The oxides take the rock salt (NaCl) structure.



The crystal structure of NaCl is as follows:

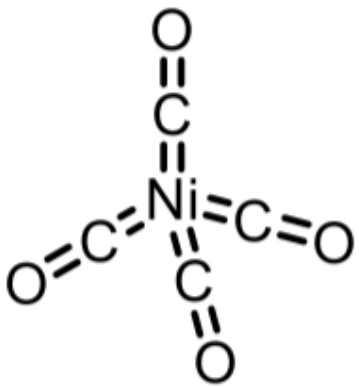


PS 7.3

In the coordination compound $(NH_4)_2[Fe(OH_2)F_5]$, the Fe is octahedrally coordinated.
(a) Based on the fact that F is a weak-field ligand, predict whether this compound is diamagnetic or paramagnetic. If it is paramagnetic, tell how many unpaired electrons it has.
(b) By comparison with other complexes reviewed in this chapter, discuss the likely color of this compound.

PS 7.4

In what directions do you expect the bond length and strength of a free CO molecule to change when it becomes a CO ligand in a$Ni(CO)_4$ molecule? Explain your reasoning.



PS 7.5

The compound $WH_2(C_5H_5)_2$ acts as a base, but $TaH_3(C_5H_5)_2$ does not. Explain.

PS 7.6

Mendeleev's early periodic table placed manganese and chlorine in the same group. Discuss the chemical evidence for these placements, focusing on the oxides of the two elements and their acid–base and redox properties. Is there a connection between the electronic structures of their atoms? In what ways are the elements different?