16.2 Five *d*-block elements can be found in Appendix 2B with positive standard potentials. They are

Ag, $E° = +0.80$ V

Cu, $E° = +0.34$ V

Au, $E° = +1.40$ V

Pt, $E° = +1.20$ V

Hg, $E° = +0.79$ V

16.6 (a) Co is very slightly higher.

(b) Fe

(c) Cr is slightly higher.

(d) Because silver is larger, one expects it to have a lower first ionization potential, which is the case (731 $kJ\cdot mol^{-1}$).

(e) One might expect the third row transition metal to have a lower first ionization energy; however, due to the lanthanide contraction, the ionization potential for silver is less than for gold (731 $kJ\cdot mol^{-1}$ vs. 890 $kJ\cdot mol^{-1}$).

16.44 (a) 3; (b) 6; (c) 6; (d) 9; (e) 4; (f) 6

16.58 Cu(II) compounds contain one unpaired electron ($3d^9$ configuration); Cu(I) compounds have no unpaired electrons ($3d^{10}$). Therefore, Cu(II) compounds may be colored and paramagnetic, but Cu(I) compounds are not.

16.60 (a) $\Delta_0 = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}\ \text{J}\cdot\text{s}^{-1})(3.00 \times 10^{8}\ \text{m}\cdot\text{s}^{-1})}{295 \times 10^{-3}\ \text{m}} = 6.75 \times 10^{-19}\text{J}$

(b) $\Delta_0 = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}\ \text{J}\cdot\text{s}^{-1})(3.00 \times 10^{8}\ \text{m}\cdot\text{s}^{-1})}{435 \times 10^{-9}\ \text{m}} = 4.75 \times 10^{-19}\text{J}$

(c) $\Delta_0 = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}\ \text{J}\cdot\text{s}^{-1})(3.00 \times 10^{8}\ \text{m}\cdot\text{s}^{-1})}{540 \times 10^{-9}\ \text{m}} = 3.68 \times 10^{-19}\text{J}$

The above numbers can be multiplied by 6.022×10^{23} to obtain the energies in $\text{kJ}\cdot\text{mol}^{-1}$.

(a) $6.74 \times 10^{-19}\ \text{J} \times 6.022 \times 10^{23}\ \text{mol}^{-1} = 4.06 \times 10^{5}\ \text{J}\cdot\text{mol}^{-1}$

$= 406\ \text{kJ}\cdot\text{mol}^{-1}$

16.80 A diamagnetic substance has no unpaired electrons and is weakly pushed out of a magnetic field. Paramagnetism refers to the presence of unpaired electrons in a substance. A paramagnetic compound is pulled toward a magnetic field. Ferromagnetism is an extensive property that occurs when the unpaired electrons on a number of metal ions within a sample align with each other. Paramagnetism is a property of any substance with unpaired electrons, whereas ferromagnetism is a property of certain substances that can become permanently magnetized. Their spins become aligned, and this alignment can be retained even in the absence of a magnetic field. In a paramagnetic substance, the alignment is lost when the magnetic field is removed. Antiferromagnetism is the opposite of ferromagnetism—it occurs when the unpaired electrons on a number of metal ions within a sample pair between the metal ions, so that the overall magnetism cancels.

16.82 $n\,(H_2O) = 2.387\ \text{g}\ H_2O \times \frac{1\ \text{mol}\ H_2O}{18.016\ \text{g}\ H_2O} = 0.1324\ \text{mol}$

$n\,(Cl_2) = 1.57\ \text{g}\ Cl_2 \times \frac{1\ \text{mol}\ Cl_2}{70.90\ \text{g}\ Cl_2} = 0.0221\ \text{mol}\ Cl_2$

16.98 If the sample were 100% pure, its optical rotation would be 48.0 degrees$(\text{mol}\cdot\text{L}^{-1})^{-1}\cdot\text{cm}^{-1}$. Because the rotation is only 46.5 degrees $(\text{mol}\cdot\text{L}^{-1})^{-1}\cdot\text{cm}^{-1}$, we know that the percentage of the sample of A that is giving rise to the rotation is $(46.5 \div 48.0) \times 100 = 96.9\%$. But because the impurity is A^*, this is not all of the A in the sample.

Consider the case where [A] = [A*], which gives rise to no rotation of light because the degree of rotation of A^* will exactly cancel the rotation of A. If we have a mixture of 10% A^* and 90% A, then the rotation os 10% of A^* will cancel an equal amount of rotation by A. Thus, the observed rotation will be 80% of the value of pure A or 0.80×48.0 degrees$\cdot(\text{mol}\cdot\text{L}^{-1})^{-1}\cdot\text{cm}^{-1} = 38$ degrees$\cdot(\text{mol}\cdot\text{L}^{-1})^{-1}\cdot\text{cm}^{-1}$. For the specific case in hand, the 3.1% rotation that is lost must be due to a 1:1 mixture of A and A^*. So the total amount of A in the sample will be $96.9\% + 1/2(3.1\%) = 98.5\%$.