

8.53) A hydrogen-like  $Mg^{11+}$  drops from  $n=2$  to  $n=1$ .  
 What is the wavelength of the photon? What band?

$Mg$  has 12 protons  $\Rightarrow Z=12$

The energy of a given level is

$$E = -Z^2 \frac{E_R}{n^2} \quad (8.100)$$

Thus, the energy difference between  $n=2$  and  $n=1$  is

$$\Delta E = -Z^2 E_R \left( \frac{1}{(2)^2} - \frac{1}{(1)^2} \right) = + \frac{3Z^2 E_R}{4}$$

The wavelength of the emitted light will be

$$\lambda = \frac{hc}{\Delta E} = \frac{4(1240 \text{ eV}\cdot\text{nm})}{3(144)(13.6 \text{ eV})} \quad (4.7)$$

$$\lambda = 0.844 \text{ nm}$$

This is in the X-ray band (0.1 - 10 nm)  
 according to Wikipedia.