c.) (15 pts.) An electron with initial energy 50 eV is scattered from the atom when it is in its ground state. Later, when the scattered electron is far away, the atom emits a photon of wave length 689 nm. What is the energy of the scattered electron?

$E_e + E_i(\text{atom}) = E_e' + E_f'(\text{atom})$ — for scattering of electron from energy E_e to final energy E_e'.

↑ ground state

$E'(\text{atom}) = E_f(\text{atom}) + E_{ph}$ & $E_{ph} = \frac{hc}{\lambda} = \frac{1240 \text{ eV nm}}{689 \text{ nm}} = 1.8 \text{ eV}$

so $E'(\text{atom}) = -2.5 \text{ eV}$, $E_f(\text{atom}) = -4.3 \text{ eV}$, and $E_e' = 50 \text{ eV} - 4.8 \text{ eV} + 2.5 \text{ eV} = 45.7 \text{ eV}$

5.) Laser light passes through two narrow slits that are 0.1 mm apart. On a screen that is 4m behind the slits, the light is observed to make a series of bright and dark spots.

a.) (15 pts.) Measurements show that the bright spots on the screen are 2.5 cm apart from one another. Determine the wave length of the laser.

$\Delta y = .025 \text{ m}$, $\Delta y = L\Delta\theta$, $d \sin\theta = d\theta = m\lambda$

$\lambda = d\Delta\theta = d\frac{\Delta y}{L} = \frac{(1\times10^{-4}\text{m})(2.5\times10^{-2}\text{m})}{4\text{m}} = 625 \text{ nm}$

b.) (15 pts.) If the same laser light passes through a diffraction grating that has 1000 lines per cm and the light is observed on the same screen that is 4m away, determine the separation between bright spots on the screen.

$d = \frac{1 \text{ cm}}{1000} = 1\times10^{-5} \text{ m}$ $\quad \Delta y = \frac{L\lambda}{d} = \frac{(4\text{m})(625\times10^{-9}\text{m})}{1\times10^{-5}} = 0.25 \text{ m} = 25 \text{ cm}$

c.) (10 pts.) If you were trying to determine the wave length of the laser precisely, which would give a more precise value, the two slits or the diffraction grating? Explain why your answer is correct.

diffraction grating gives much sharper peaks (they are narrow in the y direction). The distance between peaks can be measured much more precisely.