

53. The angular momentum in the hydrogen atom is given both by the Bohr model and by quantum mechanics. Compare the results for $n = 2$.
54. An 1100-kg car is traveling with a speed of (22 ± 0.22) m/s. With what maximum accuracy can its position be determined?
55. An atomic spectrum contains a line with a wavelength centered at 488 nm. Careful measurements show the line is really spread out between 487 and 489 nm. Estimate the lifetime of the excited state that produced this line.
56. Protons are accelerated from rest across 550 V. They are then directed at two slits 0.70 mm apart. How far apart will the interference peaks be on a screen 28 m away?
57. An electron and a proton, each initially at rest, are accelerated across the same voltage. Assuming that the uncertainty in their position is given by their de Broglie wavelength, find the ratio of the uncertainty in their momentum.
58. If the principal quantum number n were limited to the range from 1 to 6, how many elements would we find in nature?
59. If your de Broglie wavelength were 0.50 m, how fast would you be moving if your mass is 75.0 kg? Would you notice diffraction effects as you walk through a doorway? Approximately how long would it take you to walk through the doorway?
60. Suppose that the spectrum of an unknown element shows a series of lines with one out of every four matching a line from the Lyman series of hydrogen. Assuming that the unknown element is an ion with Z protons and one electron, determine Z and the element in question.
- * 61. Photons of wavelength 0.154 nm are emitted from the surface of a certain metal when it is bombarded with high energy radiation. If this photon wavelength corresponds to the K_α line, what is the element?
- * 62. Show that the diffractive spread of a laser beam, $\approx \lambda/D$ as described in Section 28-11, is precisely what you might expect from the uncertainty principle. [*Hint*: since the beam's width is constrained by the dimension of the aperture D , the component of the light's momentum perpendicular to the laser axis is uncertain.]

Answers to Exercises

A: 2.1×10^{-24} kg·m/s, 2.3×10^6 m/s.
B: 2, 1, 0, -1, -2.

C: -0.38 eV, $\sqrt{20} \hbar$.
D: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^1$.
