3-8. On drop #16, Millikan measured the following total charges, among others, at different times:

$25.41 \times 10^{-19}\,\text{C}$ $\quad 17.47 \times 10^{-19}\,\text{C}$ $\quad 12.70 \times 10^{-19}\,\text{C}$

$20.64 \times 10^{-19}\,\text{C}$ $\quad 19.06 \times 10^{-19}\,\text{C}$ $\quad 14.29 \times 10^{-19}\,\text{C}$

What value of the fundamental quantized charge e do these numbers imply?

3-14. Show that Planck's law, Equation 3-18, expressed in terms of the frequency f, is

$$u(f) = \frac{8\pi f^2}{c^3} \frac{hf}{e^{hf/kT} - 1}$$

3-30. Using apparatus similar to that in Figure 3-8, the photoelectric effect data below were measured.

λ nm	544	594	604	612	633
$E_{k,\max}$ eV	0.360	0.199	0.156	0.117	0.062

(*a*) From a graph of $E_{k,\max}$ versus f, find a value for Planck's constant. (*b*) By what percentage (+ or −) does the value found in (*a*) differ from the accepted value? (*c*) Based on the graph plotted in (*a*), what is the approximate value of the work function of the metal used in the cathode of the apparatus? (*d*) What metal was most likely used for the cathode?

3-54. Millikan's data for the photoelectric effect in lithium are shown in the table.

Incident λ (nm)	253.5	312.5	365.0	404.7	433.9
Stopping Voltage V_0 (V)	2.57	1.67	1.09	0.73	0.55

(*a*) Graph the data and determine the work function for lithium. (*b*) find the value of Planck's constant directly from the graph in (*a*). (*c*) The work function for lead is 4.14 eV. Which, if any, of the wavelengths in the table would not cause emission of photoelectrons from lead?

3-59. An electron accelerated to 50 keV in an x-ray tube has two successive collisions in being brought to rest in the target, emitting two bremsstrahlung photons in the process. The second photon emitted has a wavelength 0.095 nm longer than the first. (*a*) What are the wavelengths of the two photons? (*b*) What was the energy of the electron after emission of the first photon?