

287.

Problem 22.33P (HRW)

A 100 W lamp operated on a 120 V circuit has a current (assumed steady) of 0.83 A in its filament. We have to find the time in which 1 mol of electrons will pass through the lamp.

Solution:

The current flowing through the filament of the lamp is 0.83 A. Therefore, 0.83 C of charge carried by electrons passes through the filament per second. As the charge of an electron is 1.6×10^{-19} C, the number of electrons that flow out through the filament per second will be

$$N = \frac{0.83}{1.6 \times 10^{-19}} = 5.1875 \times 10^{18}.$$

The time required for one mol of electrons, that is 6.02×10^{23} electrons to pass through the filament will be

$$t = \frac{6.02 \times 10^{23}}{5.1875 \times 10^{18}} \text{ s} = 1.16 \times 10^5 \text{ s}.$$

As

$$1 \text{ day} = 8.640 \times 10^4 \text{ s},$$

we have

$$t = \frac{1.16 \times 10^5}{8.64 \times 10^4} \text{ days} = 1.3 \text{ days.}$$

