Two charged plates are 2 mm apart. An electron escapes from the negatively charged plate to the positively charged plate in $1.2\cdot10^{-8}$ seconds. Find the electric field between the plates.

Solution.

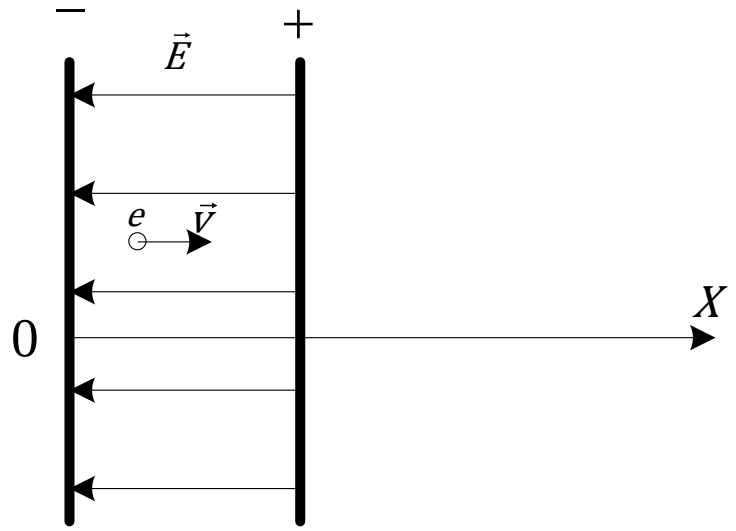

Figure 1.

Write Newton's Second Law in projections on the X-axis (see Figure 1):

$$m_e a = Ee,$$

where $m_e = 9.1\cdot10^{-31}$ kg is the mass of the electron, E is the module of the electric field between the plates, a is the module of the acceleration of the electron, $e = 1.6\cdot10^{-19}$ C is the elementary charge.

Find a:

$$a = \frac{Ee}{m_e}.$$

The initial velocity of the electron equals zero. So using the formula for distance for uniformly accelerated motion we have:

$$d = \frac{at^2}{2} = \frac{Eet^2}{2m_e},$$

where d is the distance between the plates, t is the time that the electron spend to go from the negative charged plate to the positive charged plate. From the formula above we find E:

$$E = \frac{2m_e d}{et^2} = \frac{2\cdot9.1\cdot10^{-31}\cdot2\cdot10^{-3}}{1.6\cdot10^{-19}\cdot1.2^2\cdot10^{-16}} = 158 \text{ V/m}.$$

Answer: 158 V/m.