# Electrostatics Homework Problems:
# p. 389: #7, 8a, 10, 12, 17

Problems taken from the school's old textbook:
Giancoli, D. (1980). *Physics*, 2nd Ed. Englewood Cliffs, NJ: Prentice Hall.

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Helpful constants:

- rest mass of an electron = $9.11 \times 10^{-31}$ kg
- charge of an electron: $-1.6 \times 10^{-19}$ C
- charge of a proton: $1.6 \times 10^{-19}$ C

7. An electron acquires $6.4 \times 10^{-16}$ J of kinetic energy when it is accelerated by an electric field from Plate A to Plate B. What is the potential difference between the plates, and which plate is at the higher potential?

8a. A lightning flash transfers 30 C of charge to earth through a potential difference of $3.5 \times 10^{7}$ V. How much energy is dissipated?

10. As you know, charges are usually small quantities. As a result, when we talk about the energy associated with the movement of one charge, it will generally be a really small number. To avoid a bunch of negative exponents, physicists have come up with a new unit of energy – the electron volt (eV).

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}.$$

One eV represents the energy required to move an electron across a potential difference of 1 V. While this unit does make referencing small quantities of energy cleaner, the downside is that you still must be consistent with units. When energy or work is used in an equation, it must be expressed in joules, not eV. What is the speed of a 350 eV electron?

12. In an old-style television picture tube, electrons are accelerated by thousands of volts through a vacuum from the back of the television to the screen. If a television set were laid on its back so that the screen is facing upwards, would electrons be able to move upward against the force of gravity? What potential difference, acting over a distance of 20 cm, would be needed to balance the downward force of gravity so that an electron would remain stationary? Assume that the electric field within the television picture tube is uniform.

17. A +20 $\mu$C charge is placed 60 cm from an identical +20 $\mu$C charge. How much work would be required to move a +0.20 $\mu$C test charge from a point midway between the two larger charges to a point 10 cm closer to either of the larger charges?

## **ANSWERS**:

7. 4000 V; positive charges move from places of high electric potential (high voltage) to places of low electric potential. Since this electron (like all electrons) is negative, it would only move (on its own) from a place of low potential to high potential. Therefore, Plate B is at a higher potential, in this case 4000 V higher in potential, than Plate A.

8a. $1.05 \times 10^{9}$ J

10. $1.11 \times 10^{7}$ m/s

12. $1.12 \times 10^{-11}$ V

17. 0.03 J; the positive answer implies that we would need to force this positive charge from its original position directly between the two larger positive charges to a position closer to one of the two charges. We would have to do this amount of work on this charge to make this happen.