Solutions

Each answer shows the steps, then the **result**.

2.1

$$C = \frac{Q}{V} = \frac{6.0 \times 10^{-4}\ \text{C}}{12\ \text{V}}$$

- $C = \mathbf{5.0 \times 10^{-5}}\ \text{F}\ (= 50\ \mu\text{F})$

2.2

- it increases (smaller separation gives larger capacitance)

2.3

$$U = \tfrac{1}{2}CV^2 = \tfrac{1}{2}(5.0 \times 10^{-6}\ \text{F})(20\ \text{V})^2$$

- $U = \mathbf{1.0 \times 10^{-3}}\ \text{J}$

2.4

- the capacitance increases
- the field induced in the dielectric opposes the plates' field, so the potential difference for the same charge falls and $C = Q/\Delta V$ rises

3.1 B

- Q/V.

3.2 B

- $\tfrac{1}{2}CV^2$.

3.3

(a)

$$Q = CV = (100 \times 10^{-6}\ \text{F})(50\ \text{V})$$

- $Q = \mathbf{5.0 \times 10^{-3}}\ \text{C}$

(b)

$$U = \tfrac{1}{2}CV^2 = \tfrac{1}{2}(100 \times 10^{-6}\ \text{F})(50\ \text{V})^2$$

- $U = \mathbf{0.125}\ \text{J}$

3.4

(a)

- $E = \dfrac{\Delta V}{d} = \dfrac{400}{0.020} = \mathbf{2.0 \times 10^{4}}\ \text{V m}^{-1}$

(b)

- $a = \dfrac{eE}{m_e} = \dfrac{(1.6 \times 10^{-19})(2.0 \times 10^{4})}{9.11 \times 10^{-31}} = \mathbf{3.5 \times 10^{15}}\ \text{m s}^{-2}$
- toward the **positive** (upper) plate, opposite to the field

(c)

- time between the plates $t = \dfrac{0.040}{2.0 \times 10^{7}} = 2.0 \times 10^{-9}\ \text{s}$
- $y = \tfrac{1}{2}at^2 = \tfrac{1}{2}(3.5 \times 10^{15})(2.0 \times 10^{-9})^2 = \mathbf{7.0 \times 10^{-3}}\ \text{m}$ (0.70 cm, so it misses the plate)

(d)

- a parabola: constant horizontal velocity and constant acceleration toward one plate, like a projectile in a uniform gravitational field

3.5 A

- an external force must do work to move charge from one plate to the other; that work is stored as electric potential energy