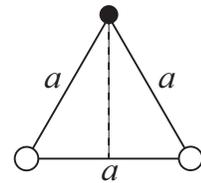


5. A special room is set up with a downward pointing electric field of magnitude $E = 23,000 \text{ V/m}$. A charged ball of mass 2.1 kg and charge $-150 \mu\text{C}$ is shot vertically from the floor at 15 m/s . How high does the ball reach? $g = 9.8 \text{ m/s}^2$
- (1) 13.8 m (2) 8.5 m (3) 11.5 m (4) 9.8 m (5) 17.7 m
6. Two charged point particles are located at two vertices of an equilateral triangle and the electric field is zero at the third vertex. We conclude
- (1) at least one other charge is present
 (2) the two particles have charges with opposite signs and the same magnitude
 (3) the two particles have charges with opposite signs and different magnitudes
 (4) the two particles have identical charges
 (5) the two particles have charges with the same sign and different magnitudes
7. An electron traveling with velocity 4000 m/s along the $+x$ direction, enters a region of uniform electric field $1 \times 10^{-8} \text{ V/m}$ pointing in the $+y$ direction. After 3 sec, what is the speed of the electron in m/s ?
- (1) 6620 (2) 5270 (3) 4370 (4) 1760 (5) 2600
8. A 2.5-mC charge is on the y -axis at $y = 3.0 \text{ m}$ and a 6.3-mC charge is on the x -axis at $x = 3.0 \text{ m}$. What is the direction of the potential at the origin?
- (1) potential has no direction (2) 168° (3) 292° (4) 332° (5) 22°

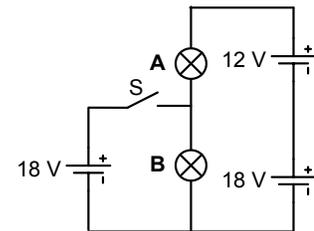
9. Two particles with charges Q and Q are fixed at the vertices of an equilateral triangle with sides of length a . If $k = 1/4\pi\epsilon_0$, the work required to move a particle with a charge q from the other vertex to the center of the line joining the fixed charges is:



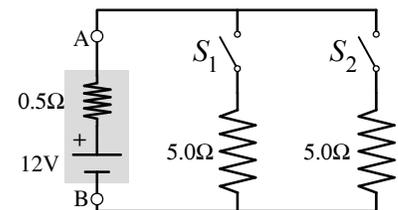
- (1) $2kQq/a$ (2) kQq/a (3) kQq/a^2 (4) 0 (5) $\sqrt{2}kQq/a$
10. The plate areas and plate separations of five parallel plate capacitors are
- (1) capacitor 1: area A_0 , separation d_0
 (2) capacitor 2: area $2A_0$, separation $2d_0$
 (3) capacitor 3: area $2A_0$, separation $d_0/2$
 (4) capacitor 4: area $A_0/2$, separation $2d_0$
 (5) capacitor 5: area A_0 , separation $d_0/2$
- Rank these according to their capacitances, least to greatest.
- (1) 4, 1 and 2 tie, then 5, 3 (2) 5, 4, 3, 2, 1 (3) 5, 3 and 4 tie, then 1, 2 (4) 1, 2, 3, 4, 5 (5) 3, 5, 1 and 2 tie, 4
11. A uniform electric field, with a magnitude of 600 V/m , is directed parallel to the positive x -axis. If the potential at $x = 3.0 \text{ m}$ is 1000 V , what is the change in potential energy of a proton as it moves from $x = 3.0 \text{ m}$ to $x = 1.0 \text{ m}$?
- (1) $1.9 \times 10^{-16} \text{ J}$ (2) $8.0 \times 10^{-17} \text{ J}$ (3) $0.80 \times 10^{-21} \text{ J}$ (4) 500 J (5) $5.7 \times 10^{-16} \text{ J}$

12. A pair of parallel plates, forming a capacitor, are connected to a battery. While the capacitor is still connected to the battery maintaining a constant voltage, the plates are pulled apart to double their original distance. What is the ratio of the final energy stored to the original energy stored?
- (1) $1/2$ (2) 1 (3) 2 (4) $1/4$ (5) 4
13. An air-filled 3.0 nF capacitor is charged to 8.0 V . If the plate separation is $100 \mu\text{m}$, what is the energy density in the electric field?
- (1) 28 mJ/m^3 (2) 280 J/m^3 (3) 57 mJ/m^3 (4) 57 J/m^3 (5) more than 50 J/m^3
14. An air-filled parallel-plate capacitor has a capacitance of 2 pF . The plate separation is then tripled and a wax dielectric is inserted, completely filling the space between the plates. As a result, the capacitance becomes 4 pF . The dielectric constant of the wax is:
- (1) 6.0 (2) 4.0 (3) 2.0 (4) 3.0 (5) 8.0
15. A resistor in the form of a solid cylinder of material is connected across the terminals of an ideal battery and the current is measured to be 6.0 A . A second resistor made of the same material and having the same volume but three times the length is put in series with the first resistor. What is the current in the new circuit?
- (1) 0.60 A (2) 1.5 A (3) 2.0 A (4) 24.0 A (5) 18.0 A

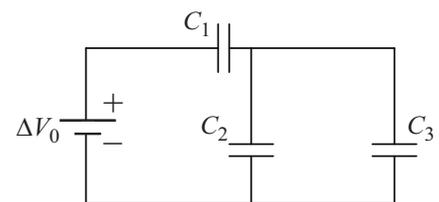
16. A light bulb is basically a wire with resistance that emits light when current goes through it (more current increases brightness). The light bulbs A and B in the circuit shown are identical. When the switch S is closed, what happens to the brightness of the two bulbs?



- (1) B gets brighter, A dimmer
 (2) A gets brighter, B dimmer
 (3) A gets dimmer, B dimmer
 (4) A gets brighter, B brighter
 (5) Nothing changes
17. As shown in the figure, a 12-V battery with a 0.5Ω internal resistance has initially no load connected across its terminals. Then the switches S_1 and S_2 are closed successively. The voltages across A and B (the terminals of the real battery) has which set of successive values (in volts)?



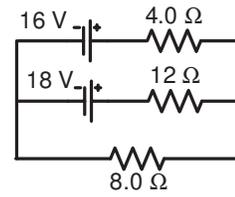
- (1) 12.0, 10.9, 10.0 (2) 12.0, 1.1, 2.0 (3) 8.0, 10.9, 12.0 (4) 12.0, 12.0, 12.0 (5) 12.0, 9.8, 8.0
18. If $C_1 = 25 \mu\text{F}$, $C_2 = 20 \mu\text{F}$, $C_3 = 10 \mu\text{F}$, and $\Delta V_0 = 22 \text{ V}$, determine the charge stored by C_2 (in μC).



- (1) 200
 (2) 300
 (3) 100
 (4) 150
 (5) 400

19. What is the current through the $8\ \Omega$ resistor?

- (1) 1.5 A
- (2) 0.50 A
- (3) 1.0 A
- (4) 2.0 A
- (5) none of these



20. What is the equivalent capacitance of the combination shown (in μF)?

- (1) 10
- (2) 29
- (3) 40
- (4) 12
- (5) 25

