1. (5 points) Two point particles, one with charge 8×10^{-9} C and the other with charge -2×10^{-9} C, are separated by 4 m. The magnitude of the electric field (in N/C) midway between them is:

A. 9×10^{9}
B. 13,500
C. 135,000
D. 36×10^{-9}
E. 22.5

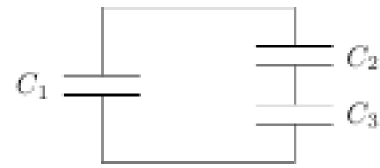
2. (5 points) A 3.5 cm radius hemisphere contains a total charge of 6.6×10^{-7} C. The flux through the spherical portion of the surface is 9.8×10^{4} N · m^2 /C. The flux through the flat base is:

A. 0
B. +2.3 × 10 4 N · m^2 /C
C. −2.3 × 10 4 N · m^2 /C
D. −9.8 × 10 4 N · m^2 /C
E. +9.8 × 10 4 N · m^2 /C

3. (5 points) A parallel-plate capacitor in a vacuum has a plate area of 0.2 m^2 and a plate separation of 0.1 mm. If the charge on each plate has a magnitude of 4×10^{-6} C the potential difference across the plates is approximately:

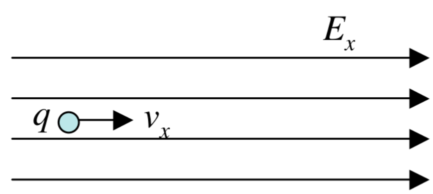
A. 0
B. 4×10^{-2} V
C. 1×10^{2} V
D. 2×10^{2} V
E. 4×10^{8} V

4. (5 points) Capacitor C_1 is connected alone to a battery and charged until the magnitude of the charge on each plate is 4.0×10^{-8} C. Then it is removed from the battery and connected to two other capacitors C_2 and C_3, as shown. The charge on the positive plate of C_1 after it is attached is reduced to 1.0×10^{-8} C. The charges on each plate of C_2 and C_3 are:



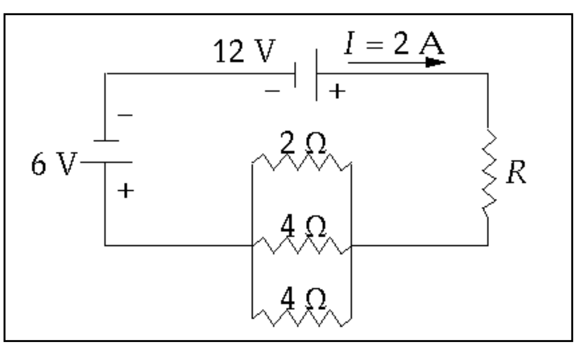
A. $q_2 = 3.0 \times 10^{-8}$ C and $q_3 = 3.0 \times 10^{-8}$ C
B. $q_2 = 2.0 \times 10^{-8}$ C and $q_3 = 2.0 \times 10^{-8}$ C
C. $q_2 = 5.0 \times 10^{-8}$ C and $q_3 = 1.0 \times 10^{-8}$ C
D. $q_2 = 3.0 \times 10^{-8}$ C and $q_3 = 1.0 \times 10^{-8}$ C
E. $q_2 = 1.0 \times 10^{-8}$ C and $q_3 = 3.0 \times 10^{-8}$ C

5. (5 points) A particle with charge $q = -1.6 \times 10^{-19}$ C and a mass $m = 10^{-27}$ kg, with an initial velocity $v_x = 10^7$ m/s, travels in a uniform electric field $E_x = 500$ V/m. Determine the time (in seconds) it takes for the particle comes to rest.

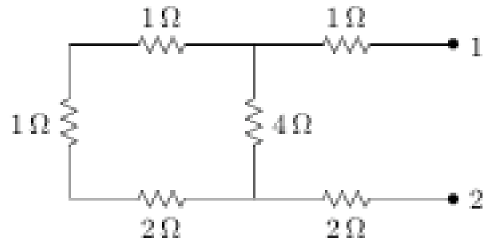


A. never comes to rest
B. 7.60×10^{-3} s
C. 2.50×10^{-4} s
D. 1.25×10^{-4} s
E. 1.25×10^{-3} s

6. (5 points) The power dissipated in the unknown resistor (R) is
A) 4 W
B) 6 W
C) 8 W
D) 2 W
E) 10 W



7. (5 points) The equivalent resistance between points 1 and 2 of the circuit shown is:



A. 3 Ω
B. 4 Ω
C. 5 Ω
D. 6 Ω
E. 7 Ω

8. (5 points) A certain capacitor, in series with a 720-Ω resistor, is being charged. At the end of 10 ms its charge is half the final value. The capacitance is about:

A. 9.6 μF
B. 14 μF
C. 20 μF
D. 7.2 F
E. 10 F

.

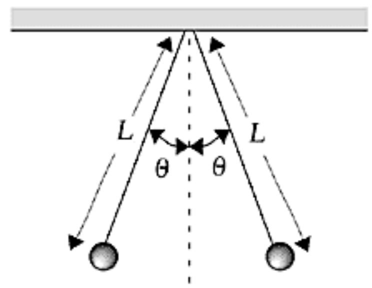
9. (5 points) V(x,y,z) are equipotential surfaces expressed in x, y, and z.

$$V(x,y,z) = x^2y+y^2x + zxy$$

Find the x component of $\vec{E}(x,y,z)$ at the point P(2, -4, 6).

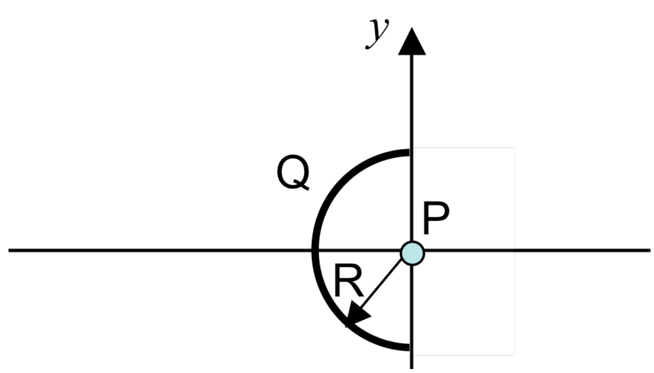
A) -24 V/m
B) 10 V/m
C) -56 V/m
D) -8 V/m
E) 24 V/m

10. (5 points) Two small spheres, each with mass m = 5.0 g and charge q, are suspended from a point by threads of length L = 0.30 m. What is the charge on each sphere if the threads make an angle $\theta = 20°$ with the vertical?



(A) 7.9×10^{-7} C
(B) 2.9×10^{-7} C
(C) 7.5×10^{-2} C
(D) 6.3×10^{-13} C
(E) 1.8×10^{-7} C

11. Consider the uniformly charged semicircle of radius R and total charge Q. The arc produces a field of magnitude E_x at the center of the curvature with radius R. What is the electric field at P in the terms of k, R, and Q?

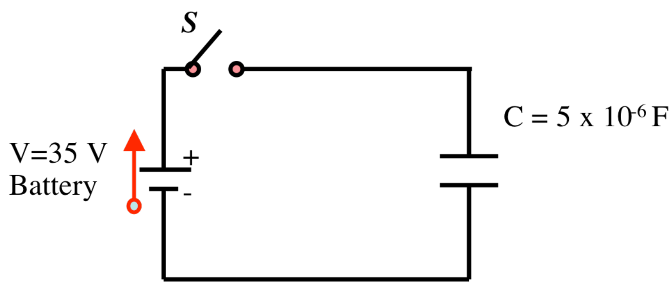


A) $(A)\dfrac{kQ}{2R^2}$ $(B)\dfrac{kQ}{\pi R^2}$ $(C)\dfrac{\pi kQ}{2R^2}$ $(D)\dfrac{2kQ}{\pi R^2}$ E) none of the above

12. Two long, charged, thin-walled, concentric cylindrical shells have radii of 3.0 cm and 6.0 cm. The charge per unit length is 5.0×10^{-6} C/m on the inner shell and -7.0×10^{-6} C/m on the outer shell. Find the magnitude of the electric field at r = 8.0 cm, where r is the radial distance from the common axis.

A) 2.3×10^6 N/C
B) 0.8×10^6 N/C
C) 4.5×10^5 N/C
D) 2.7×10^5 N/C
E) 73×10^4 N/C

13. With the switch open, the capacitor is uncharged. What is the charge Q on the capacitor a longtime after the switch is closed and how much electrostatic energy is stored in C?



	Q	U
A)	3.6×10^{-4} C	3×10^{-3} J
B)	1.4×10^{-3} C	6×10^{-3} J
C)	1.8×10^{-4} C	3×10^{-3} J
D)	1.8×10^{-4} C	6×10^{-3} J

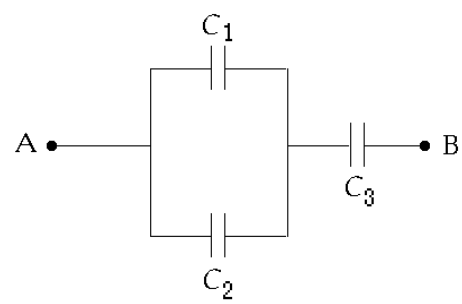
14. Two parallel horizontal plates are spaced 0.40 cm apart in air. You introduce an oil droplet of mass 4.9×10^{-17} kg between the plates. If the droplet carries two electric charges and if there were no air buoyancy, you could hold the droplet motionless between the plates if you kept the potential difference between them at

A) 60 V B) 12 V C) 3.0 V D) 0.12 kV E) 6.0 V

15. Two charges Q_1 and Q_2 are at rest a distance of 66 cm apart. How much work must be done to slowly move the charges to a separation of 33 cm?
($Q_1 = +6.6 \times 10^{-9}$ C and $Q_2 = -3.3 \times 10^{-9}$ C)

A) -3.0×10^{-7} J
B) 8.9×10^{-7} J
C) -2.0×10^{-6} J
D) -8.9×10^{-7} J
E) 3.0×10^{-7} J

16. You connect three capacitors as shown in the diagram. $C_1 = C_3 = 2.5$ μF, and $C_2 = 5.0$ μF. A potential difference of 9.0 V is maintained between the terminals A and B. The magnitude of the charge on capacitor C_3 is approximately



A) 4.2 μC
B) 4.8 μC
C) 17 μC
D) 37 μC
E) 90 μC

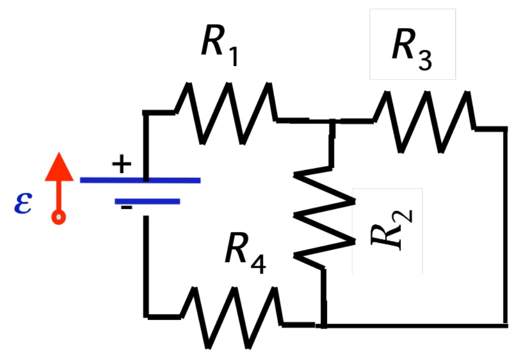
17. A parallel-plate capacitor has square plates of side 12 cm and a separation of 6.0 mm. A dielectric slab of constant $\kappa = 2.0$ has the same area as the plates but has a thickness of 3.0 mm. What is the capacitance of this capacitor with the dielectric slab between its plates?

A) 28 pF B) 21 pF C) 16 pF D) 37 pF E) 53 pF

18. A motor running from a 220-V line is lifting a mass of 35 kg against the earth's gravity at a constant speed of 6.0 m/s. If we assume 100% efficiency, the current required is

A) 0.27 A B) 9.4 A C) 7.7 A D) 3.3 A E) 4.7 A

19. The multi-loop circuit contains one ideal battery and four resistors with the following values: $R_1 = 20\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 30\ \Omega$, $R_4 = 8.0\ \Omega$. What is the current (in Amperes) through the battery?



A) 1
B) 0.5
C) 0.3
D) 12
E) 0.2

20. A 15.0 kW resistor and a discharged capacitor are connected in series with no applied voltage. A 12.0 V potential difference is suddenly applied across them. The potential difference across the capacitor rises to 5.00 V in 1.30 μs. What is the time constant of the circuit?

A) 1.61 ps B) 2.41 μs C) 1.30 μs D) 0.22 ms E) 1.0 ns