Instructor: *Field/Mitselmakher*

PHYSICS DEPARTMENT

PHY 2054 Exam 1 February 9, 2016

Name (PRINT, last, first): ______________________ Signature: ______________________

On my honor, I have neither given nor received unauthorized aid on this examination.

YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.

DIRECTIONS

(1) **Code your test number on your answer sheet (use 76–80 for the 5-digit number)**. Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY**. Code your student number on your answer sheet.
(2) Print your name on this sheet and sign it also.
(3) Do all scratch work anywhere on this exam that you like. At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout with scratch work most questions demand.
(4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink**. Do not make any stray marks or the answer sheet may not read properly.
(5) The answers are rounded off. Choose the closest to exact. There is no penalty for guessing.

>>>>>>>>>**WHEN YOU FINISH** <<<<<<<<<
Hand in the answer sheet separately.

Constants			
$\epsilon_0 = 8.85 \times 10^{-12}$ F/m	$m_e = 9.11 \times 10^{-31}$ kg	$m_p = m_n = 1.67 \times 10^{-27}$ kg	$e = 1.6 \times 10^{-19}$ C
$k = 8.99 \times 10^9$ N m^2/C^2	$\mu_0 = 12.56 \times 10^{-7}$ H/m	$N_A = 6.02 \times 10^{23}$ atoms/mole	$c = 3 \times 10^8$ m/s
milli $= 10^{-3}$	micro $= 10^{-6}$	nano $= 10^{-9}$	pico $= 10^{-12}$

PHY2054 Spring 2016

PHY2054 Exam 1 Formula Sheet

Vectors & Quadratic Formula

$\vec{a} = a_x\hat{x} + a_y\hat{y} + a_z\hat{z}$ $\vec{b} = b_x\hat{x} + b_y\hat{y} + b_z\hat{z}$ **Magnitudes:** $|\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$ $|\vec{b}| = \sqrt{b_x^2 + b_y^2 + b_z^2}$

Scalar Product: $\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z = |\vec{a}||\vec{b}|\cos\theta$ (θ = angle between $\vec{a}$ and $\vec{b}$)

Quadratic Formula: if $ax^2 + bx + c = 0$ then $x = \left(-b \pm \sqrt{b^2 - 4ac}\right)/(2a)$

Electrostatic Force and Electric Field

Electrostatic Force (vector): $\vec{F} = k\frac{q_1 q_2}{r^2}\hat{r}$ (r = distance between charge q_1 and charge q_2, units = N)

$k = 1/(4\pi\varepsilon_0) = 8.99\text{x}10^9\ \text{N}\cdot\text{m}^2/\text{C}^2$ $\varepsilon_0 = 8.85\text{x}10^{-12}\ \text{C}^2/(\text{N}\cdot\text{m}^2)$

Electric Field (at q_2 due to q_1): $\vec{E} = \vec{F}/q_2 = k\frac{q_1}{r^2}\hat{r}$ (units = N/C = V/m)

Electric Flux (through the infinitesimal surface area dA)**:** $d\Phi_E = \vec{E} \cdot d\vec{A}$ (units = Nm^2/C)

Vector Area (directed area): $\vec{A} = A\hat{n}$ (where $\hat{n}$ = normal to the surface)

Gauss' Law: $\Phi_E = \oint_S \vec{E} \cdot d\vec{A} = \sum_S \vec{E} \cdot \Delta\vec{A} = \frac{Q_{enclosed}}{\varepsilon_0}$ ($Q_{enclosed}$ = charge enclosed)

Gauss' Law: Net flux through closed surface **S** = the charge enclosed by surface S divided by ε_0

Electric Potential and Potential Energy

Electric Potential Energy: work done against a constant field E in moving charge q a distance d along straight line path from A to B, $\Delta U = U_B - U_A = -q\vec{E} \cdot \vec{d}$ (units = J)

Electric Potential: Work done per unit charge against a constant field E in moving charge q a distance d along straight line path from A to B, $\Delta V = \Delta U / q = -\vec{E} \cdot \vec{d}$ (units = J/C = V)

Electric Potential (distance r from a point charge q)**:** $V(r) = k\frac{q}{r}$ N point charges: $V(r) = \sum_{i=1}^{N} k\frac{q_i}{r_i}$

Electric Potential Energy (N point charges): $U = \frac{1}{2}\sum_{i=1}^{N} q_i V_i$, where V_i is the electric potential at q_i due to the other charges

Stored Electric Potential Energy (N conductors with charge Q_i and electric potential V_i)**:** $U = \frac{1}{2}\sum_{i=1}^{N} Q_i V_i$

Capacitance (definition)**: C = Q/V** or **C = Q/ΔV** (units = C/V = F)

Parallel Plate Capacitor with Dielectric κ: $C = \kappa\varepsilon_0 A/d$

Energy Density of the Electric Field: $u = \frac{1}{2}\varepsilon_0 E^2$ (units = J/m^3)

Electric Current and Circuits

Current (through directed area A)**:** $I = \frac{dQ}{dt} = nq\vec{v}_{drift} \cdot \vec{A}$ (units = C/s = A, n is the number of charged particles q per unit volume, v_{drift} is the average velocity of the charged particles).

Ohm's Law: $|\Delta V| = IR$, $R = \rho L / A$ (Resistance R units = V/A = Ω)

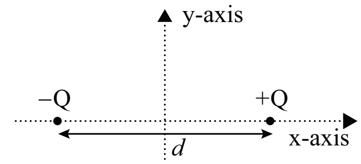
Power (supplied by EMF ε)**:** P = εI **Power** (dissipated in resistor R)**:** $P = I^2R$ (units = J/s = W)

RC Circuits (charging capacitor C through resistor R with EMF ε)**:** $Q(t) = \varepsilon C(1 - e^{-t/\tau})$

RC Circuits (discharging capacitor C with initial charge Q_0 through resistor R)**:** $Q(t) = Q_0 e^{-t/\tau}$

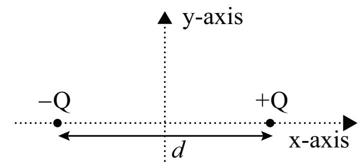
RC Circuits (time constant)**:** τ = RC (units = Ω·F = s)

1. Two point particles with equal and opposite charge lie on the x-axis with charge $+Q$ at $x = d/2$ and charge $-Q$ at $x = -d/2$ as shown in the figure. At what point on the x-axis must a third point particle with positive charge $+8Q$ be placed so that the net electric field from the three charges is zero at the origin ($i.e.$, $x = y = 0$)?



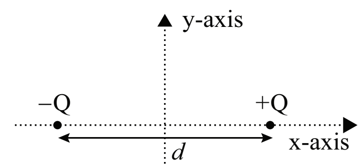
(1) $x = -d$ (2) $x = -2d$ (3) $x = -3d$ (4) $x = +d$ (5) $x = +2d$

2. Two point particles with equal and opposite charge lie on the x-axis with charge $+Q$ at $x = d/2$ and charge $-Q$ at $x = -d/2$ as shown in the figure. At what point on the x-axis must a third point particle with positive charge $+32Q$ be placed so that the net electric field from the three charges is zero at the origin ($i.e.$, $x = y = 0$)?



(1) $x = -2d$ (2) $x = -d$ (3) $x = -3d$ (4) $x = +d$ (5) $x = +2d$

3. Two point particles with equal and opposite charge lie on the x-axis with charge $+Q$ at $x = d/2$ and charge $-Q$ at $x = -d/2$ as shown in the figure. At what point on the x-axis must a third point particle with positive charge $+72Q$ be placed so that the net electric field from the three charges is zero at the origin ($i.e.$, $x = y = 0$)?



(1) $x = -3d$ (2) $x = -d$ (3) $x = -2d$ (4) $x = +d$ (5) $x = +3d$

4. A positively charged point particle with mass M and charge Q starts from rest at $t = 0$ in a uniform electric field which points in the positive x direction and travels 20 meters in 4 seconds. If at $t = 4$ s the electric field is reversed so that it points in the negative x direction and doubled in field strength, at what time t (in s) does the particle come to rest?

(1) 6 (2) 12 (3) 24 (4) 8 (5) 16

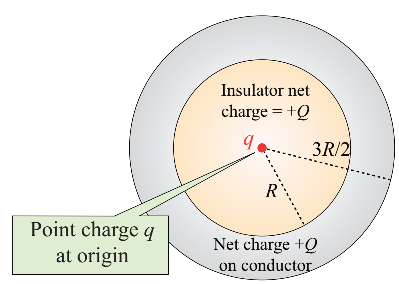
5. A positively charged point particle with mass M and charge Q starts from rest at $t = 0$ in a uniform electric field which points in the positive x direction and travels 20 meters in 8 seconds. If at $t = 8$ s the electric field is reversed so that it points in the negative x direction and doubled in field strength, at what time t (in s) does the particle come to rest?

(1) 12 (2) 6 (3) 24 (4) 8 (5) 16

6. A positively charged point particle with mass M and charge Q starts from rest at $t = 0$ in a uniform electric field which points in the positive x direction and travels 20 meters in 16 seconds. If at $t = 16$ s the electric field is reversed so that it points in the negative x direction and doubled in field strength, at what time t (in s) does the particle come to rest?

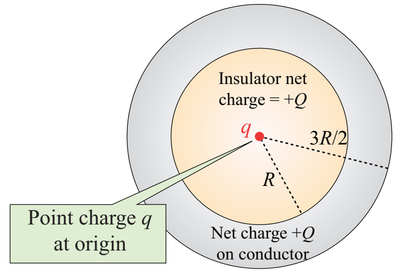
(1) 24 (2) 6 (3) 12 (4) 8 (5) 16

7. A solid insulating ball with radius R has a uniform charge density ρ and total charge $+Q$. There is a point charge $q = +2Q$ embedded at the center of the insulator (not part of the insulator). The insulating ball is surrounded by a spherical conducting shell with inner radius R and outer radius $3R/2$ as shown in the figure. The net charge on the conductor is $+Q$. How much charge is located on the outer surface ($r = 3R/2$) of the conductor?



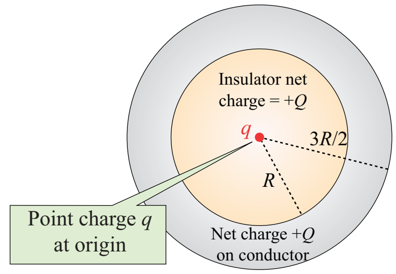
(1) $+4Q$ (2) $+5Q$ (3) $+6Q$ (4) zero (5) $-2Q$

8. A solid insulating ball with radius R has a uniform charge density ρ and total charge $+Q$. There is a point charge $q = +3Q$ embedded at the center of the insulator (not part of the insulator). The insulating ball is surrounded by a spherical conducting shell with inner radius R and outer radius $3R/2$ as shown in the figure. The net charge on the conductor is $+Q$. How much charge is located on the outer surface ($r = 3R/2$) of the conductor?



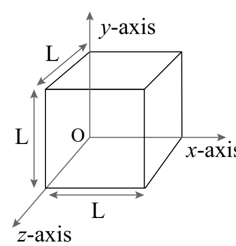
(1) $+5Q$ (2) $+4Q$ (3) $+6Q$ (4) zero (5) $-2Q$

9. A solid insulating ball with radius R has a uniform charge density ρ and total charge $+Q$. There is a point charge $q = +4Q$ embedded at the center of the insulator (not part of the insulator). The insulating ball is surrounded by a spherical conducting shell with inner radius R and outer radius $3R/2$ as shown in the figure. The net charge on the conductor is $+Q$. How much charge is located on the outer surface ($r = 3R/2$) of the conductor?



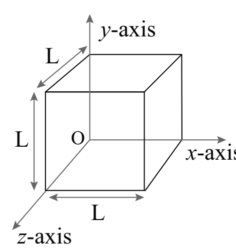
(1) $+6Q$ (2) $+4Q$ (3) $+5Q$ (4) zero (5) $-2Q$

10. Consider a cube of sides $L = 2$ m as shown in the figure and suppose that a non-uniform electric field is present and is given by $\vec{E}(x) = (a + bx^2)\,\hat{x}$, where $a = 200$ V/m and $b = 25$ V/m^3 are constants. The electric field points in the x-direction and has magnitude $E(x) = a + bx^2$. What is the net electric charge (in nanoC) contained within the cube?



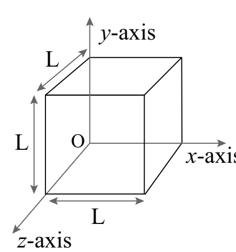
(1) 3.54 (2) 17.92 (3) 56.65 (4) -3.54 (5) -17.92

11. Consider a cube of sides $L = 3$ m as shown in the figure and suppose that a non-uniform electric field is present and is given by $\vec{E}(x) = (a + bx^2)\,\hat{x}$, where $a = 200$ V/m and $b = 25$ V/m^3 are constants. The electric field points in the x-direction and has magnitude $E(x) = a + bx^2$. What is the net electric charge (in nanoC) contained within the cube?



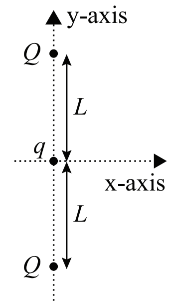
(1) 17.92 (2) 3.54 (3) 56.65 (4) -3.54 (5) -17.92

12. Consider a cube of sides $L = 4$ m as shown in the figure and suppose that a non-uniform electric field is present and is given by $\vec{E}(x) = (a + bx^2)\,\hat{x}$, where $a = 200$ V/m and $b = 25$ V/m^3 are constants. The electric field points in the x-direction and has magnitude $E(x) = a + bx^2$. What is the net electric charge (in nanoC) contained within the cube?



(1) 56.65 (2) 3.54 (3) 17.92 (4) -3.54 (5) -56.65

13. Two identical point charges Q are on the y-axis at $y = L$ and $y = -L$. A third point charge q is located at the origin ($x = y = 0$) as shown in the figure. If $q = -Q$, what is the magnitude of the electric field on the x-axis a distance $x = L$ from the origin? Note: $k = 1/(4\pi\epsilon_0)$.

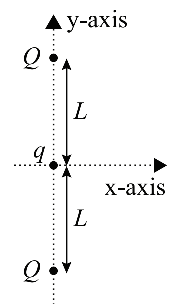


(1) $0.293\, kQ/L^2$
(2) $0.207\, kQ/L^2$
(3) $0.457\, kQ/L^2$
(4) $1.707\, kQ/L^2$
(5) kQ/L^2

14. In the previous problem, what is the electric potential on the x-axis a distance $x = L$ from the origin? Take $V = 0$ at infinity as the reference point. Note: $k = 1/(4\pi\epsilon_0)$.

(1) $0.414\, kQ/L$ (2) $0.914\, kQ/L$ (3) $1.164\, kQ/L$ (4) $2.414\, kQ/L$ (5) kQ/L

15. Two identical point charges Q are on the y-axis at $y = L$ and $y = -L$. A third point charge q is located at the origin ($x = y = 0$) as shown in the figure. If $q = -Q/2$, what is the magnitude of the electric field on the x-axis a distance $x = L$ from the origin? Note: $k = 1/(4\pi\epsilon_0)$.

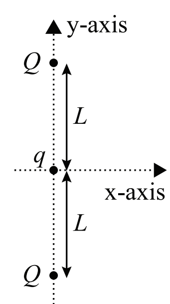


(1) $0.207\, kQ/L^2$
(2) $0.293\, kQ/L^2$
(3) $0.457\, kQ/L^2$
(4) $1.707\, kQ/L^2$
(5) kQ/L^2

16. In the previous problem, what is the electric potential on the x-axis a distance $x = L$ from the origin? Take $V = 0$ at infinity as the reference point. Note: $k = 1/(4\pi\epsilon_0)$.

(1) $0.914\, kQ/L$ (2) $0.414\, kQ/L$ (3) $1.164\, kQ/L$ (4) $2.414\, kQ/L$ (5) kQ/L

17. Two identical point charges Q are on the y-axis at $y = L$ and $y = -L$. A third point charge q is located at the origin ($x = y = 0$) as shown in the figure. If $q = -Q/4$, what is the magnitude of the electric field on the x-axis a distance $x = L$ from the origin? Note: $k = 1/(4\pi\epsilon_0)$.



(1) $0.457\, kQ/L^2$
(2) $0.293\, kQ/L^2$
(3) $0.207\, kQ/L^2$
(4) $1.707\, kQ/L^2$
(5) kQ/L^2

18. In the previous problem, what is the electric potential on the x-axis a distance $x = L$ from the origin? Take $V = 0$ at infinity as the reference point. Note: $k = 1/(4\pi\epsilon_0)$.

(1) $1.164\, kQ/L$ (2) $0.414\, kQ/L$ (3) $0.914\, kQ/L$ (4) $2.414\, kQ/L$ (5) kQ/L

19. If at a distance of 2 m from an isolated point charge the electric field points radially away from the charge and has a magnitude of 100 N/C, at what distance (in m) from the charge is the electric potential equal to 50 Volts. Take $V = 0$ at infinity as the reference point.

(1) 8 (2) 18 (3) 32 (4) 4 (5) 9

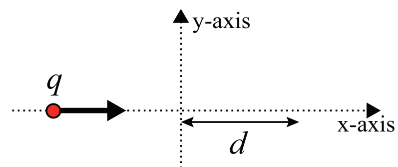
20. If at a distance of 3 m from an isolated point charge the electric field points radially away from the charge and has a magnitude of 100 N/C, at what distance (in m) from the charge is the electric potential equal to 50 Volts. Take $V = 0$ at infinity as the reference point.

(1) 18 (2) 8 (3) 32 (4) 4 (5) 9

21. If at a distance of 4 m from an isolated point charge the electric field points radially away from the charge and has a magnitude of 100 N/C, at what distance (in m) from the charge is the electric potential equal to 50 Volts. Take $V = 0$ at infinity as the reference point.

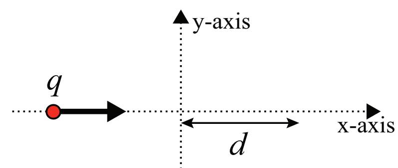
(1) 32 (2) 8 (3) 18 (4) 4 (5) 9

22. A charged particle q traveling to the right along the negative x-axis as shown in the figure has an initial kinetic energy of $80\,\mu$J. At $x = 0$ it experiences a non-uniform electric potential given by $V(x) = bx^3$, where $b = 5$ V/m^3 is a constant and x is measured in meters. If $q = 2\,\mu$C, what is the largest positive x-value (in meters) reached by the particle before it comes to rest?



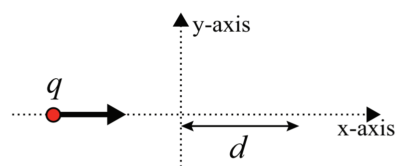
(1) 2 (2) 3 (3) 4 (4) 1 (5) 5

23. A charged particle q traveling to the right along the negative x-axis as shown in the figure has an initial kinetic energy of $270\,\mu$J. At $x = 0$ it experiences a non-uniform electric potential given by $V(x) = bx^3$, where $b = 5$ V/m^3 is a constant and x is measured in meters. If $q = 2\,\mu$C, what is the largest positive x-value (in meters) reached by the particle before it comes to rest?



(1) 3 (2) 2 (3) 4 (4) 1 (5) 5

24. A charged particle q traveling to the right along the negative x-axis as shown in the figure has an initial kinetic energy of $640\,\mu$J. At $x = 0$ it experiences a non-uniform electric potential given by $V(x) = bx^3$, where $b = 5$ V/m^3 is a constant and x is measured in meters. If $q = 2\,\mu$C, what is the largest positive x-value (in meters) reached by the particle before it comes to rest?



(1) 4 (2) 2 (3) 3 (4) 1 (5) 5

25. Four identical point charges $Q = 2\mu$C are placed on the corners of a square with sides of length L. The four charges are released simultaneously with zero initial velocities. If the kinetic energy of each of the four charges is 0.1 J when they are very far apart, what is L (in cm)?

(1) 48.7 (2) 24.3 (3) 16.2 (4) 10.4 (5) 92.9

26. Four identical point charges $Q = 2\mu$C are placed on the corners of a square with sides of length L. The four charges are released simultaneously with zero initial velocities. If the kinetic energy of each of the four charges is 0.2 J when they are very far apart, what is L (in cm)?

(1) 24.3 (2) 48.7 (3) 16.2 (4) 10.4 (5) 92.9

27. Four identical point charges $Q = 2\mu$C are placed on the corners of a square with sides of length L. The four charges are released simultaneously with zero initial velocities. If the kinetic energy of each of the four charges is 0.3 J when they are very far apart, what is L (in cm)?

(1) 16.2 (2) 48.7 (3) 24.3 (4) 10.4 (5) 92.9

28. The electric field at the surface of an isolated solid spherical conductor with capacitance $C = 1.112$ pF points radially away from the conductor and has an energy density $u = 0.2$ J/m^3. How much electric energy (in microJ) is stored by this solid spherical conductor?

(1) 2.51 (2) 20.11 (3) 67.86 (4) 1.65 (5) 12.23

29. What is the radius (in cm) of the solid spherical conductor in the previous problem?

(1) 1.0 (2) 2.0 (3) 3.0 (4) 4.0 (5) 0.5

30. The electric field at the surface of an isolated solid spherical conductor with capacitance $C = 2.225$ pF points radially away from the conductor and has an energy density $u = 0.2$ J/m^3. How much electric energy (in microJ) is stored by this solid spherical conductor?

(1) 20.11 (2) 2.51 (3) 67.86 (4) 1.65 (5) 12.23

31. What is the radius (in cm) of the solid spherical conductor in the previous problem?

(1) 2.0 (2) 1.0 (3) 3.0 (4) 4.0 (5) 0.5

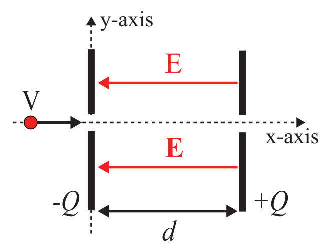
32. The electric field at the surface of an isolated solid spherical conductor with capacitance $C = 3.337$ pF points radially away from the conductor and has an energy density $u = 0.2$ J/m^3. How much electric energy (in microJ) is stored by this solid spherical conductor?

(1) 67.86 (2) 2.51 (3) 20.11 (4) 1.65 (5) 12.23

33. What is the radius (in cm) of the solid spherical conductor in the previous problem?

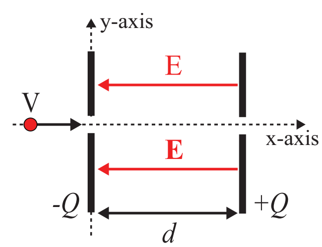
(1) 3.0 (2) 1.0 (3) 2.0 (4) 4.0 (5) 0.5

34. A positively charged particle with a charge to mass ratio $q/m = 0.01$ C/kg is traveling to the right along the x-axis. At $x = 0$ it enters an ideal parallel plate capacitor through a small hole with speed V as shown in the figure. The plates of the capacitor have area $A = 10$ m^2 and lie in the y-z plane. The plate at $x = 0$ carries charge $-Q$ and the plate at $x = d$ carries charge $+Q$. If $Q = 8.85\,\mu$C and $d = 5$ cm, what is the minimum speed (in m/s) that the particle must have at $x = 0$ in order to make it through the small hole at $x = d$?



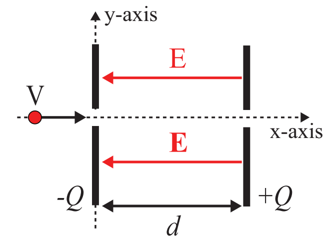
(1) 10 (2) 30 (3) 40 (4) 5 (5) 50

35. A positively charged particle with a charge to mass ratio $q/m = 0.09$ C/kg is traveling to the right along the x-axis. At $x = 0$ it enters an ideal parallel plate capacitor through a small hole with speed V as shown in the figure. The plates of the capacitor have area $A = 10$ m^2 and lie in the y-z plane. The plate at $x = 0$ carries charge $-Q$ and the plate at $x = d$ carries charge $+Q$. If $Q = 8.85\,\mu$C and $d = 5$ cm, what is the minimum speed (in m/s) that the particle must have at $x = 0$ in order to make it through the small hole at $x = d$?



(1) 30 (2) 10 (3) 40 (4) 5 (5) 50

36. A positively charged particle with a charge to mass ratio $q/m = 0.16$ C/kg is traveling to the right along the x-axis. At $x = 0$ it enters an ideal parallel plate capacitor through a small hole with speed V as shown in the figure. The plates of the capacitor have area $A = 10\ \mathrm{m}^2$ and lie in the y-z plane. The plate at $x = 0$ carries charge $-Q$ and the plate at $x = d$ carries charge $+Q$. If $Q = 8.85\,\mu$C and $d = 5$ cm, what is the minimum speed (in m/s) that the particle must have at $x = 0$ in order to make it through the small hole at $x = d$?



(1) 40 (2) 10 (3) 30 (4) 5 (5) 50

37. When a parallel-plate capacitor (initially filled with air) is connected across a battery, it acquires a charge of $100\,\mu$C on each plate. While the battery is still connected, a dielectric filling is inserted into the capacitor in the region between the plates. It results in accumulation of an additional charge of $120\,\mu$C on each plate. What is the dielectric constant of this filling?

(1) 2.2 (2) 2.5 (3) 2.8 (4) 1.2 (5) 1.5

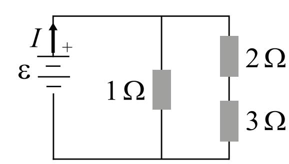
38. When a parallel-plate capacitor (initially filled with air) is connected across a battery, it acquires a charge of $100\,\mu$C on each plate. While the battery is still connected, a dielectric filling is inserted into the capacitor in the region between the plates. It results in accumulation of an additional charge of $150\,\mu$C on each plate. What is the dielectric constant of this filling?

(1) 2.5 (2) 2.2 (3) 2.8 (4) 1.2 (5) 1.5

39. When a parallel-plate capacitor (initially filled with air) is connected across a battery, it acquires a charge of $100\,\mu$C on each plate. While the battery is still connected, a dielectric filling is inserted into the capacitor in the region between the plates. It results in accumulation of an additional charge of $180\,\mu$C on each plate. What is the dielectric constant of this filling?

(1) 2.8 (2) 2.2 (3) 2.5 (4) 1.2 (5) 1.8

40. Consider the circuit consisting of an EMF and three resistors shown in the figure. If the EMF $\epsilon = 5$ V, how much current I flows through the EMF (in Amps)?

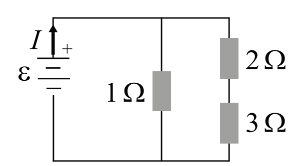


(1) 6 (2) 12 (3) 18 (4) 4 (5) 20

41. In the previous problem, what is the magnitude of the potential difference across the 2Ω resistor (in Volts)?

(1) 2 (2) 4 (3) 6 (4) 5 (5) 10

42. Consider the circuit consisting of an EMF and three resistors shown in the figure. If the EMF $\epsilon = 10$ V, how much current I flows through the EMF (in Amps)?

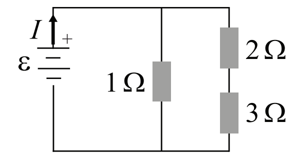


(1) 12 (2) 6 (3) 18 (4) 4 (5) 20

43. In the previous problem, what is the magnitude of the potential difference across the 2Ω resistor (in Volts)?

(1) 4 (2) 2 (3) 6 (4) 5 (5) 10

44. Consider the circuit consisting of an EMF and three resistors shown in the figure. If the EMF $\epsilon = 15$ V, how much current I flows through the EMF (in Amps)?

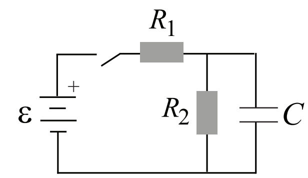


(1) 18 (2) 6 (3) 12 (4) 4 (5) 20

45. In the previous problem, what is the magnitude of the potential difference across the 2Ω resistor (in Volts)?

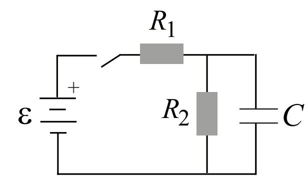
(1) 6 (2) 2 (3) 4 (4) 5 (5) 10

46. Consider the charging of a capacitor with a 12 V EMF as shown in the figure. The capacitor has capacitance $C = 3\,\mu$F and no initial charge. The resistors have resistance $R_1 = 2\Omega$ and $R_2 = 1\Omega$, and the switch is closed at $t = 0$. What is the maximum energy stored in the capacitor (in μJ)?



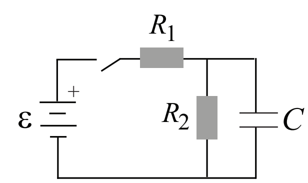
(1) 24 (2) 96 (3) 150 (4) 216 (5) 12

47. Consider the charging of a capacitor with a 12 V EMF as shown in the figure. The capacitor has capacitance $C = 3\,\mu$F and no initial charge. The resistors have resistance $R_1 = 1\Omega$ and $R_2 = 2\Omega$, and the switch is closed at $t = 0$. What is the maximum energy stored in the capacitor (in μJ)?



(1) 96 (2) 24 (3) 150 (4) 216 (5) 12

48. Consider the charging of a capacitor with a 12 V EMF as shown in the figure. The capacitor has capacitance $C = 3\,\mu$F and no initial charge. The resistors have resistance $R_1 = 1\Omega$ and $R_2 = 5\Omega$, and the switch is closed at $t = 0$. What is the maximum energy stored in the capacitor (in μJ)?



(1) 150 (2) 24 (3) 96 (4) 216 (5) 12

49. Initially two isolated capacitors with capacitance C_1 and C_2 both carry charge Q. The two capacitors are then connected together in parallel (*i.e.,* the positive plate of C_1 connected to the positive plate of C_2 and the negative plate of C_1 connected to the negative plate of C_2). If $C_2 = 2C_1$, what is the charge on capacitor C_2 after they come to equilibrium?

(1) $4Q/3$ (2) $3Q/2$ (3) $2Q/3$ (4) Q (5) $2Q$

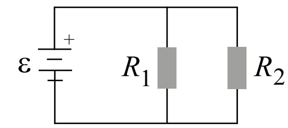
50. Initially two isolated capacitors with capacitance C_1 and C_2 both carry charge Q. The two capacitors are then connected together in parallel (*i.e.,* the positive plate of C_1 connected to the positive plate of C_2 and the negative plate of C_1 connected to the negative plate of C_2). If $C_2 = 3C_1$, what is the charge on capacitor C_2 after they come to equilibrium?

(1) $3Q/2$ (2) $4Q/3$ (3) $2Q/3$ (4) Q (5) $2Q$

51. Initially two isolated capacitors with capacitance C_1 and C_2 both carry charge Q. The two capacitors are then connected together in parallel (*i.e.,* the positive plate of C_1 connected to the positive plate of C_2 and the negative plate of C_1 connected to the negative plate of C_2). If $C_2 = C_1/2$, what is the charge on capacitor C_2 after they come to equilibrium?

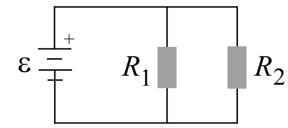
(1) $2Q/3$ (2) $4Q/3$ (3) $3Q/2$ (4) Q (5) $2Q$

52. Consider the circuit consisting of an EMF and two resistors shown in the figure. If the EMF delivers 120 W of power and resistor R_1 dissipates 90 W, what is the resistance of resistor R_2?



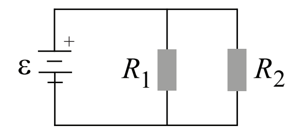
(1) $3R_1$ (2) $2R_1$ (3) $R_1/2$ (4) $4R_1$ (5) $R_1/3$

53. Consider the circuit consisting of an EMF and two resistors shown in the figure. If the EMF delivers 120 W of power and resistor R_1 dissipates 80 W, what is the resistance of resistor R_2?



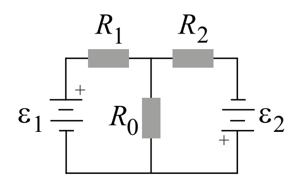
(1) $2R_1$ (2) $3R_1$ (3) $R_1/2$ (4) $4R_1$ (5) $R_1/3$

54. Consider the circuit consisting of an EMF and two resistors shown in the figure. If the EMF delivers 120 W of power and resistor R_1 dissipates 40 W, what is the resistance of resistor R_2?



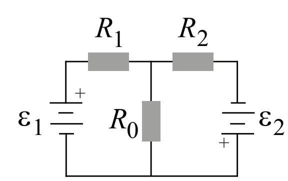
(1) $R_1/2$ (2) $3R_1$ (3) $2R_1$ (4) $4R_1$ (5) $R_1/3$

55. Consider the circuit consisting of 2 EMF's and three resistors shown in the figure. If the current through resistor R_0 is zero when $R_1 = R_0$ and $R_2 = 3R_0$, what is ϵ_2?



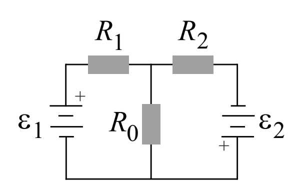
(1) $3\epsilon_1$ (2) $5\epsilon_1$ (3) $7\epsilon_1$ (4) $\epsilon_1/3$ (5) $\epsilon_1/5$

56. Consider the circuit consisting of 2 EMF's and three resistors shown in the figure. If the current through resistor R_0 is zero when $R_1 = R_0$ and $R_2 = 5R_0$, what is ϵ_2?



(1) $5\epsilon_1$ (2) $3\epsilon_1$ (3) $7\epsilon_1$ (4) $\epsilon_1/3$ (5) $\epsilon_1/5$

57. Consider the circuit consisting of 2 EMF's and three resistors shown in the figure. If the current through resistor R_0 is zero when $R_1 = R_0$ and $R_2 = 7R_0$, what is ϵ_2?



(1) $7\epsilon_1$ (2) $3\epsilon_1$ (3) $5\epsilon_1$ (4) $\epsilon_1/3$ (5) $\epsilon_1/7$

58. Two capacitors have an equivalent capacitance of 9 pF if connected in parallel, and an equivalent capacitance of 2 pF if connected in series. What is the capacitances (in pF) of each of the capacitors?

(1) 6 and 3 (2) 12 and 6 (3) 18 and 9 (4) 5 and 4 (5) 7 and 2

59. Two capacitors have an equivalent capacitance of 18 pF if connected in parallel, and an equivalent capacitance of 4 pF if connected in series. What is the capacitances (in pF) of each of the capacitors?

(1) 12 and 6 (2) 6 and 3 (3) 18 and 9 (4) 10 and 8 (5) 9 and 9

60. Two capacitors have an equivalent capacitance of 27 pF if connected in parallel, and an equivalent capacitance of 6 pF if connected in series. What is the capacitances (in pF) of each of the capacitors?

(1) 18 and 9 (2) 6 and 3 (3) 12 and 6 (4) 20 and 7 (5) 16 and 11

THE FOLLOWING QUESTIONS, NUMBERED IN THE ORDER OF THEIR APPEARANCE ON THE ABOVE LIST, HAVE BEEN FLAGGED AS CONTINUATION QUESTIONS: 14 16 18 29 31 33 41 43 45 FOLLOWING GROUPS OF QUESTIONS WILL BE SELECTED AS ONE GROUP FROM EACH TYPE

TYPE 1
Q# S 1
Q# S 2
Q# S 3
TYPE 2
Q# S 4
Q# S 5
Q# S 6
TYPE 3
Q# S 7
Q# S 8
Q# S 9
TYPE 4
Q# S 10
Q# S 11
Q# S 12
TYPE 5
Q# S 13 14
Q# S 15 16
Q# S 17 18
TYPE 6
Q# S 19
Q# S 20
Q# S 21
TYPE 7
Q# S 22
Q# S 23
Q# S 24
TYPE 8
Q# S 25
Q# S 26
Q# S 27
TYPE 9
Q# S 28 29
Q# S 30 31
Q# S 32 33
TYPE 10
Q# S 34
Q# S 35
Q# S 36
TYPE 11
Q# S 37
Q# S 38
Q# S 39
TYPE 12
Q# S 40 41
Q# S 42 43
Q# S 44 45
TYPE 13
Q# S 46
Q# S 47
Q# S 48
TYPE 14
Q# S 49
Q# S 50
Q# S 51
TYPE 15
Q# S 52
Q# S 53
Q# S 54

TYPE 16
Q# S 55
Q# S 56
Q# S 57
TYPE 17
Q# S 58
Q# S 59
Q# S 60