Physics 202 TR 2:20 pm Spring 2014 **Exam 1** Lab Section __________

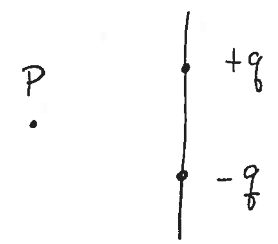
PRINT Last Name ______________________ PRINT First Name__________________________

Sign signature as on ID ____

Multiple choice questions. **Circle the correct answer.** No work needs to be shown and no partial credit will be given.

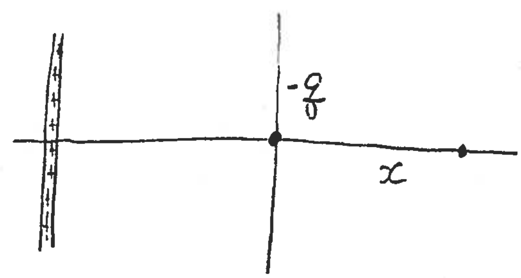
1. Point P is equal distance from two fixed point charges +q and –q as shown. If a negative point charge is placed on P, the net electrical force due to the fixed charges on it will be [5 pts]

(a) directed upward
(b) directed downward
(c) zero
(d) directed to the left
(e) directed to the right



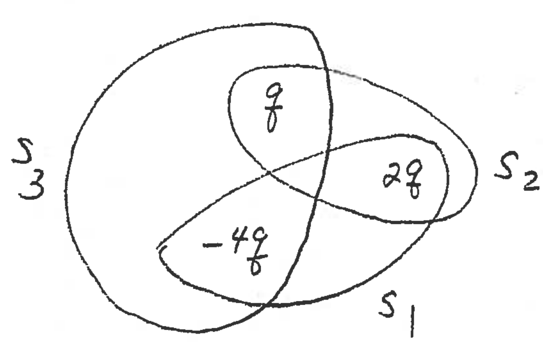
2. A negative point charge –q is at the coordinate origin, at some distance from a positively and uniformly charge plate producing a constant electric field of magnitude E. At a distance x from the point charge as shown, the electric field is [5 pts]

(a) $E+kq/x^2$
(b) $E-kq/x^2$
(c) $-E+kq/x^2$
(d) $-E-kq/x^2$
(e) 0



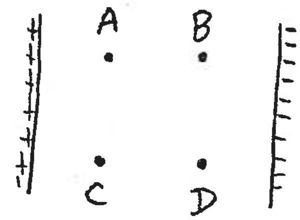
3. Three Gaussian surfaces S_1, S_2, S_3 are enclosing charges as shown. The flux enclosed by each corresponding surface can be ordered from the most positive to the most negative as: [5 pts]

(a) $\Phi_1 > \Phi_2 > \Phi_3$
(b) $\Phi_1 > \Phi_3 > \Phi_2$
(c) $\Phi_2 > \Phi_3 > \Phi_1$
(d) $\Phi_2 > \Phi_1 > \Phi_3$
(e) $\Phi_3 > \Phi_1 > \Phi_2$



4. Two equal but opposite charged plate with uniformly distributed charges are as shown. Which of the following statement is ***incorrect*** ? [6 pts]

(a) Position A is at a higher potential than position B
(b) Position A is at a higher potential than position D
(c) Position C is at a higher potential than position A
(d) Position C is at a higher potential than position B
(e) Position C is at a higher potential than position D



5. Two thin concentric spherical shells have radii R_1 and R_2 with $R_1 < R_2$. A total charge of Q is uniformly spread in the inner shell and a total charge of $-2Q$ is spread on the outer shell. The electric field in the region between the two shells, at $R_1 < r < R_2$, is [5 pts]

(a) pointing outward with magnitude kQ/r^2
(b) pointing inward with magnitude kQ/r^2
(c) pointing outward with magnitude $k2Q/r^2$
(d) pointing inward with magnitude $k2Q/r^2$
(e) zero

6. A small particle with charge $q = 4.0\ \mu C$ is released from rest at point a. When the particle reaches point b, its kinetic energy is $80.0\ \mu J$. The only force acting of the particle is the electric force. If the electric potential V_a at point a is 50.0 V, what is the electric potential V_b at point b? [5 pts]

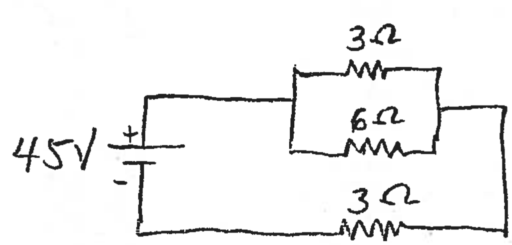
(a) 10 V
(b) 30 V
(c) 50 V
(d) 70 V
(e) 90 V

7. If the electric field inside of a parallel-plate capacitor is doubled, then the energy stored in the capacitor will be [5 pts]

(a) twice as much as before
(b) half as much as before
(c) four times as much as before
(d) quarter as much as before
(e) triple as much as before

8. In the following circuit, the current flowing out of the battery is

(a) 3.0 A
(b) 6.0 A
(c) 9.0 A
(d) 12.0 A
(e) 15.0 A



On the following problems show all your work. Partial credit will be given, if earned. Write your answers in the blanks provided. All answers must include the correct plus or minus sign and the correct units.

9. Positive point charge $Q_1 = 2 \times 10^{-6}$ C is at the origin and negative point charge $Q_2 = -4 \times 10^{-6}$ C is on the negative x-axis at $x = -0.20$ m. Point A is on the $+x$-axis at $x = 0.15$ m. [20 pts]

(a) What is the electric field produced by Q_1 at A?

Ans. $E =$ ______________

direction ______________

(b) What is the electric field produced by Q_2 at A?

Ans. $E =$ ______________

direction ______________

(c) What is the total electric field produced by both charges at A? (give magnitude and direction)

Ans. $E =$ ______________

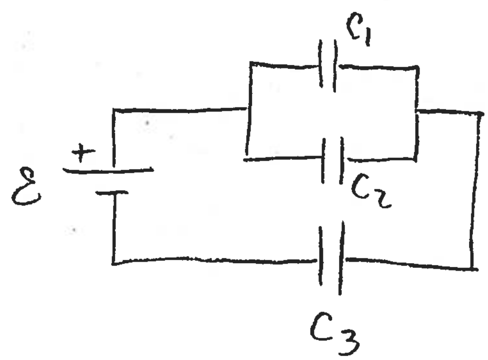
direction ______________

(d) What is the total force on $Q_3 = -7 \times 10^{-6}$ if placed at A? (give magnitude and direction)

Ans. $E =$ ______________

direction ______________

10. Three capacitors are connected to a battery as shown in the sketch. C_1=3.0 μF, C_2=3.0 μF and C_3=12.0 μF. Capacitor C_1 has charge Q_1=12.0 μC. [20 pts]



a) What is the charge Q_2 on capacitor C_2?

Ans. ________________

b) What is the charge Q_3 on capacitor C_3?

Ans. ________________

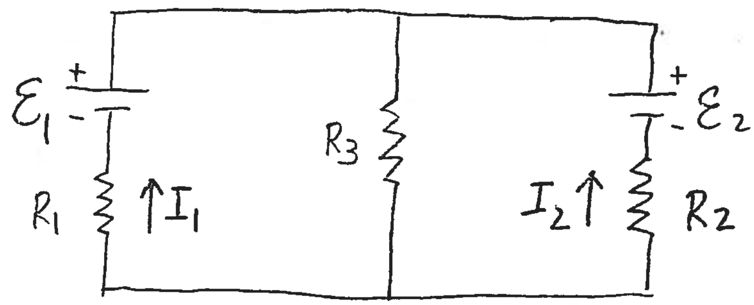
c) What is the emf of the battery?

Ans. ________________

d) What is C_{eq} of the three-capacitors ?

Ans. ________________

11. Consider the circuit shown in the sketch. There are two emfs and three resistors. $R_1 = 4.0\ \Omega$, $R_2 = 8.0\ \Omega$ and $R_3 = 6.0\ \Omega$. The current I_1 through R_1 is 3.0 A, in the direction shown. The current I_2 through R_2 is 2.0 A, in the direction shown. Calculate



a) the voltage across resistor R_3

Ans. ____________________

b) the emf $\mathcal{E}_1$

Ans. ____________________

c) the emf $\mathcal{E}_2$

Ans. ____________________

PHYS 202 Formula Sheet Chapters 17—19 (Exam 1)

electron: $m_e = 9.11 \times 10^{-31}$ kg, $q_e = -e$ proton: $m_p = 1.67 \times 10^{-27}$ kg, $q_p = +e$

neutron: $m_n = 1.67 \times 10^{-27}$ kg, $q_n = 0$, $e = 1.60 \times 10^{-19}$ C

$F = k\frac{|q_1 q_2|}{r^2}$ $k = \frac{1}{4\pi\varepsilon_0}$ $k = 8.99 \times 10^9\ \text{N}\cdot\text{m}^2/\text{C}^2$ $\varepsilon_0 = 8.854 \times 10^{-12}\ \text{C}^2/(\text{N}\cdot\text{m}^2)$

$\vec{E} = \frac{\vec{F}}{q}$ point charge: $E = k\frac{|q|}{r^2}$ $\sum E_{\perp}\Delta A = 4\pi k Q_{\text{encl}}$

circumference of a circle $= 2\pi r$ area of a circle $= \pi r^2$

surface area of a cylinder $= 2\pi r l + 2\pi r^2$ volume of a cylinder $= \pi r^2 l$

surface area of a sphere $= 4\pi r^2$ volume of a sphere $= \frac{4}{3}\pi r^3$

$W_{a\to b} = U_a - U_b$ $K_a + U_a = K_b + U_b$ point charges: $U = k\frac{qq'}{r}$

$V = \frac{U}{q'}$ point charge: $V = k\frac{q}{r}$ $E = -\frac{\Delta V}{\Delta s}$

$C = \frac{Q}{V_{ab}}$ $E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A}$ parallel-plate capacitor: $C_0 = \varepsilon_0 \frac{A}{d}$

series: $\frac{1}{C_{\text{eq}}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \ldots$ parallel: $C_{\text{eq}} = C_1 + C_2 + C_3 + \ldots$

$U = \frac{1}{2}QV = \frac{Q^2}{2C} = \frac{1}{2}CV^2$ energy density $u = \frac{1}{2}\varepsilon_0 E^2$ $K = \frac{C}{C_0}$

$I = \frac{\Delta Q}{\Delta t}$ $V = IR$ $R = \frac{\rho L}{A}$ $R = R_0[1 + \alpha(T - T_0)]$

$P = V_{ab}I$ $P = V_{ab}I = I^2 R = \frac{V^2}{R}$

series: $R_{\text{eq}} = R_1 + R_2 + R_3 + \ldots$ parallel: $\frac{1}{R_{\text{eq}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots.$

junction rule: $\sum I = 0$ loop rule: $\sum_{\text{around loop}} V = 0$

$i = I_0 e^{-t/RC}$ $q = Q_{\text{final}}(1 - e^{-t/RC})$ $\tau = RC$ $i = I_0 e^{-t/RC}$ $q = Q_0 e^{-t/RC}$