Exam 1 Chapters 17-19 in Young 9e

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

(6 pts) 1. A negative charge \( q \) is at the origin. Point \( P \) is on the \(-x\)-axis at \( x = -2.0 \) m. What is the direction of the electric field at point \( P \) due to charge \( q \)?

(a) \(-x\)
(b) \(+x\)

(6 pts) 2. An air-filled capacitor is connected to a battery and 12.0 J of energy is stored in the capacitor. The capacitor is then removed from the battery without being allowed to discharge. After the battery is disconnected a dielectric with dielectric constant \( K = 2 \) is inserted between the plates of the capacitor. After the dielectric has been inserted the energy stored in the capacitor is

(a) 12.0 J
(b) greater than 12.0 J
(c) less than 12.0 J

(6 pts) 3. A small particle with charge \( q = -6.0 \times 10^{-6} \) C is released from rest at point \( a \). When the particle reaches point \( b \) its kinetic energy is \( 48.0 \times 10^{-6} \) J. The only force acting on the particle is the electric force. If the electric potential at point \( b \) is 12.0 V, what is the electric potential at point \( a \)?

(a) -8.0 V
(b) zero
(c) +4.0 V
(d) +8.0 V
(e) +20.0 V
(f) none of the above answers

(6 pts) 4. In the circuit show in the sketch the battery emf is \( \mathcal{E} = 48.0 \) V, \( R = 8.0 \) \( \Omega \), and \( C = 4.0 \times 10^{-6} \) F. Initially the switch is open and the charge on the capacitor is zero. At time \( t \) after the switch is closed, the current in the resistor is 2.00 A. When the current has this value, what is the charge \( q \) on the capacitor?

(a) zero
(b) \( 64.0 \times 10^{-6} \) C
(c) \( 128 \times 10^{-6} \) C
(d) \( 192 \times 10^{-6} \) C
(e) none of the above answers
(6 pts) 5. Three resistors are connected to a battery as shown in the sketch. When the switch $S$ is closed, the voltage across $R_1$

(a) increases
(b) decreases
(c) stays the same

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.

(18 pts) 6. Positive point charge $q_1 = +5.00 \times 10^{-6}$ C is at the origin. Negative point charge $q_2 = -8.00 \times 10^{-6}$ C is on the +x-axis at $x = 0.300$ m. Point $P$ is on the $-y$-axis at $y = -0.400$ m. What are the $x$ and $y$ components of the net electric field at point $P$ due to $q_1$ and $q_2$? Be sure to indicate whether each component is positive or negative.

Ans. $E_x = +1.73 \times 10^5 \text{ N/C}$

$E_y = -5.1 \times 10^4 \text{ N/C}$
(16 pts) 7.
a) The circuit shown in the sketch consists of two resistors and a battery with emf $\mathcal{E} = 24.0 \, \text{V}$ and negligible internal resistance. $R_1 = 2.00 \, \Omega$ and $R_2 = 4.00 \, \Omega$. What is the current through each resistor and what current $I$ flows through the battery?

Ans. $I_1 = 12 \, \text{A}$

$I_2 = 6 \, \text{A}$

$I = 18 \, \text{A}$

b) The circuit shown in the sketch consists of two resistors and a battery with emf $\mathcal{E} = 24.0 \, \text{V}$ and negligible internal resistance. $R_1 = 2.00 \, \Omega$ and $R_2 = 4.00 \, \Omega$. What is the voltage across each resistor?

Ans. $V_1 = 8 \, \text{V}$

$V_2 = 16 \, \text{V}$
8. Four capacitors are connected to a battery as shown in the sketch. $V_s = 36.0 \text{ V}$, $C_1 = 2.00 \times 10^{-6} \text{ F}$, $C_2 = 4.00 \times 10^{-6} \text{ F}$, $C_3 = 1.00 \times 10^{-6} \text{ F}$ and $C_4 = 5.00 \times 10^{-6} \text{ F}$.

a) Calculate the equivalent capacitance for the network.

Ans. $3.0 \times 10^{-6} \text{ F}$

b) Calculate the voltage across each capacitor.

Ans. $V_1 = 18 \text{ V}$

$V_2 = 18 \text{ V}$

$V_3 = 18 \text{ V}$

$V_4 = 18 \text{ V}$
9. Consider the circuit shown in the sketch. Note that two currents are given.

![Circuit Diagram]

a) Solve for the two emf values $\varepsilon_1$ and $\varepsilon_2$.

$\varepsilon_1 = 5.5 \text{ V}$

$\varepsilon_2 = 9 \text{ V}$

b) What is the potential difference $V_{ab}$ between points $a$ and $b$? Which point is at higher potential, point $a$ or point $b$?

$V_{ab} = 15 \text{ V}$

Point that is at higher potential $a$