Physics 208, Spring 2015 - Mid-Term #2 A

Name (Last, First): ______________________________

ID#: ______________________________

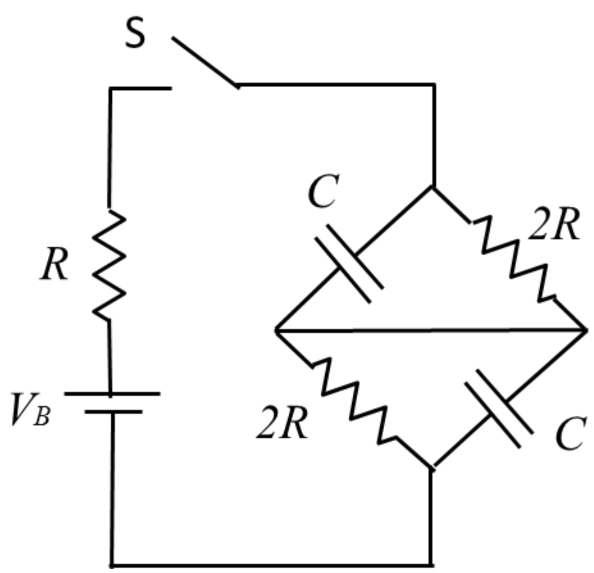
Section #: ______________________________

- You have 75 minutes to complete the exam
- Formulae are provided on a separate colored sheet. **You may not use any other formula sheet.**
- You may use only a simple calculator: one without memory, or with a memory demonstrated to be cleared. **You MUST show your work for system of equations, solutions to quadratic equations, etc**
- When calculating numerical values, be sure to keep track of units. Results must include proper units.
- Be alert to the number of significant figures in the information given. Results must have the correct number of significant figures.
- If you are unable to solve part of a problem whose solution is needed in another part of the problem, then assign a symbol for the solution of the first part and use that symbol in solving the second/later part of the problem.
- If you need additional space to answer a problem, use the back of the sheet it is written on **AND ensure to note on the main page of the problem** that you have continued your work overleaf.
- **Show your work**. Without supporting work, the answer alone is worth nothing.
- Mark your answers clearly by drawing boxes around them.
- This booklet has 8 pages. **DO NOT remove any sheets.**
- Please write clearly. You may gain marks for a partially correct calculations if your work can be deciphered.

Multiple Choice (20 points)	Problem 2 (20 points)	Problem 3 (20 points)	Problem 4 (20 points)	Problem 5 (20 points)	TOTAL (100 points)

MULTIPLE CHOICE: *Clearly* ***CIRCLE*** *the correct option* [Each MC: 5 points. Total: 20 points]

1. In the circuit below, the capacitors are *identical* and initially *uncharged* with the switch in the open (OFF) position. What will be current through the resistor with resistance R (*next to the battery*) in the two cases: a) Just after the switch is closed (I_a) and b) Long after the switch remains closed (I_b)



i) $I_a = \frac{V_B}{R}$; $I_b = \frac{V_B}{2R}$

ii) $I_a = \frac{V_B}{R}$; $I_b = \frac{V_B}{R}$

iii) $I_a = \frac{V_B}{3R}$; $I_b = \frac{V_B}{3R}$

iv) $I_a = \frac{V_B}{3R}$; $I_b = 0$

v) $I_a = \frac{V_B}{R}$; $I_b = 0$

vi) $I_a = \frac{V_B}{2R}$; $I_b = 0$

vii) $I_a = \frac{V_B}{4R}$; $I_b = 0$

viii) $I_a = \frac{V_B}{5R}$; $I_b = 0$

ix) $I_a = 0$; $I_b = 0$

x) $I_a = \frac{V_B}{R}$; $I_b = \frac{V_B}{4R}$

xi) $I_a = \frac{V_B}{R}$; $I_b = \frac{V_B}{R}$

xii) $I_a = \frac{V_B}{R}$; $I_b = \frac{V_B}{5R}$

xiii) $I_a = 0$; $I_b = \frac{V_B}{R}$

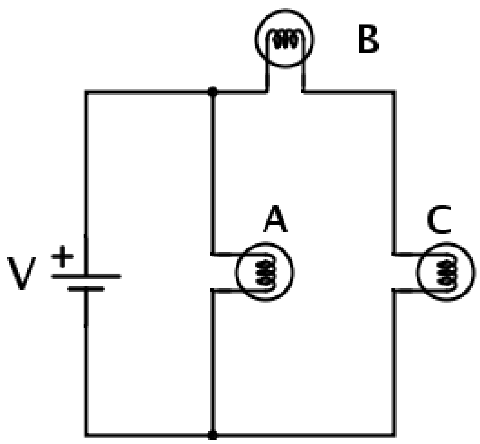
xiv) $I_a = 0$; $I_b = \frac{V_B}{2R}$

xv) $I_a = 0$; $I_b = \frac{V_B}{3R}$

xvi) $I_a = 0$; $I_b = \frac{V_B}{4R}$

xvii) $I_a = 0$; $I_b = \frac{V_B}{5R}$

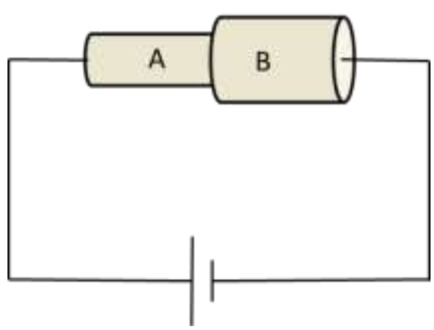
2. In the circuit below, three light bulbs are connected to a battery. The resistances of the <u>three</u> bulbs are *given by* $\boldsymbol{R_A = 3R}$; $\boldsymbol{R_B = R}$; $\boldsymbol{and\ R_C = 2R}$ where $\boldsymbol{R}$ has the same numerical value for *all* the bulbs. Which of the following correctly indicate the relative brightnesses of the bulbs ?



Note: A > B implies that bulb A is brighter than bulb B.

i. A>B>C
ii. A>C>B
iii. A>(B=C)
iv. (B=C)>A
v. A=B=C
vi. B>(A=C)
vii. (A=C)>B
viii. B>A>C
ix. C>A>B
x. C>B>A

3. Two solid-cylindrical conductors, both made of the *exact same* material (Copper), are connected end-to-end and on to a battery as shown in the figure. They both have the <u>same physical length</u> but *B* has <u>twice the diameter</u> of *A*. Which conductor has the largest current *I* ***and*** which conductor has the largest magnitude of drift velocity v_d of electrons?



i) A has the largest I and largest v_d

ii) B has the largest I and largest v_d

iii) A has the largest I, $but\ B\ has\ the$ largest v_d

iv) B has the largest I, $but\ A\ has\ the$ largest v_d

v) They both have the same I, $but\ A\ has\ the$ largest v_d

vi) They both have the same I, $but\ B\ has\ the$ largest v_d

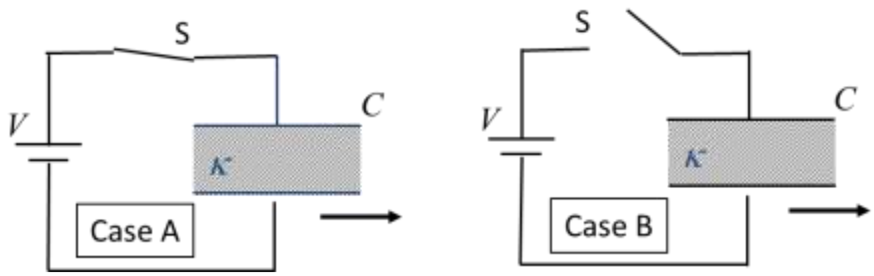
vii) $They\ both\ have\ the\ same\ I\ and\ the\ same\ v_d$

viii) They both have the same $v_{d,}$ $but\ A\ has\ the\ largest\ I$

ix) They both have the same $v_{d,}$ $but\ B\ has\ the\ largest\ I$

4. A *single* capacitor is connected in series with a battery and a switch. The capacitor *is first allowed to attain maximum possible charge with the switch* ***initially*** *in the closed position*.

Now consider *the two cases* for the same capacitor-battery pair as shown below. In Case A, the dielectric is removed (assume instantaneously) with the switch still in the closed position. In Case B, the switch is first OPENED (OFF) and the dielectric is then removed (instantaneously) from the capacitor.



Select the correct relationship for the energy stored in the capacitor for the two cases after the dielectric is removed with respect to the energy in the capacitor before the dielectric is removed.

i) U_A *decreases*, U_B *increases*

ii) U_B *decreases*, U_A *increases*

iii) U_A *and* U_B *both decrease*

iv) U_A *and* U_B *both increase*

v) U_A *decreases*, U_B *remains unchanged.*

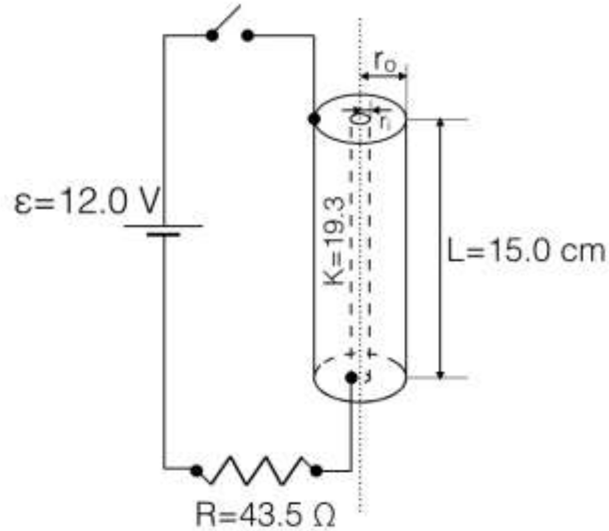
vi) U_A *increases*, U_B *remains unchanged.*

vii) *The energy stored remains the same in both cases, because the capacitor is initially fully charged*

viii) U_A *increases while* U_B *goes to zero since the battery is disconnected.*

ix) U_A *decreases while* U_B *goes to zero since the battery is disconnected.*

x) *Both* U_A *and* U_B *go to zero since once the dielectric is removed, there is just vacuum between the plates and hence no energy is stored.*

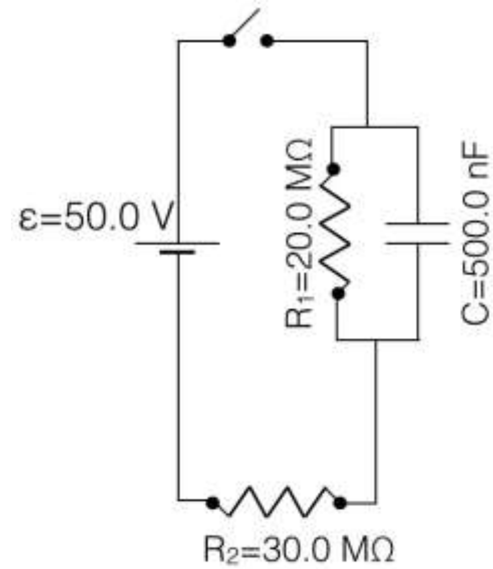
Problem II. (20 points) A cylindrical capacitor of length **L = 15.0** cm with inner radius of $r_i = 0.20\ cm$ and outer radius of $r_0 = 1.0\ cm$ has an insulating material between the plates with a dielectric constant of **K=19.3**. It is connected to an emf **ε=12.0**V that has negligible internal resistance through a resistor **R=43.5** Ω and a switch (as shown in the figure). The capacitor is initially uncharged and the switch is open (OFF position). a) Find the capacitance of the capacitor. b) How much time does it take to charge this capacitor to 90% of its final charge after the switch is closed (ON position).	

Problem III. (20 points)

A circuit that consists of a switch, a source of emf **ε=50.0** V with negligible internal resistance, resistors **R_1=20.0** MΩ and **R_2=30.0** MΩ, and a capacitor **C=500.0** nF is shown in the figure.

a) Find power dissipating in the resistor R_1 after the switch has been closed for **a very long time** (consider infinite time).

b) After the switch has been closed for **a very long time** it is opened. Find charge on the capacitor plates **5.00** seconds after the switch was opened (OFF position).

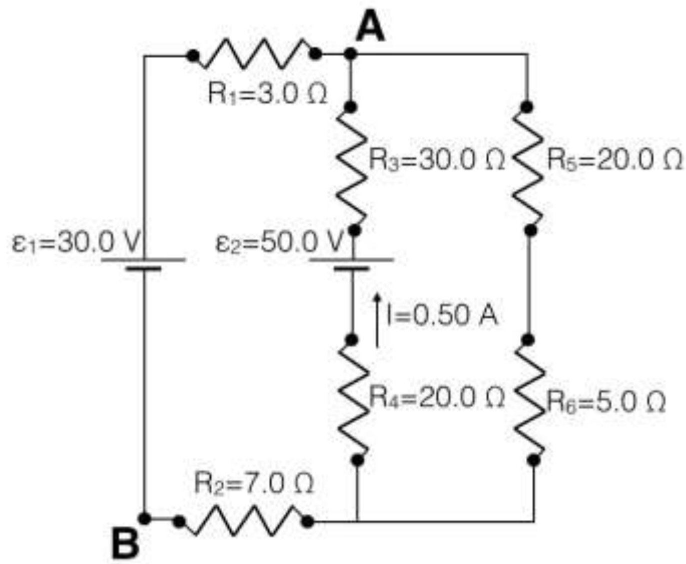


Problem IV. (20 points)

In the circuit is shown in the figure, all emfs have negligible internal resistances.

Current through the second emf $\boldsymbol{\varepsilon_2}$ is 0.50 A.

Find potential difference between points **A** and **B** (V_A - V_B).



Problem V. (20 points)

A switch, two capacitors (capacitances C_1 and C_2 are known) and a resistor **R** are connected as shown in the figure. The capacitors are charged and it is known that the C_1 has charge Q_1 on the plates when the switch is open. Find **total** energy dissipated in the resistor **R** after the switch is closed (assume that the switch remains closed for a very long time, sufficient for complete discharge of the capacitors).