Exam Total
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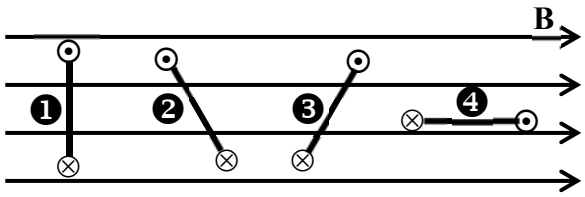
PHYS 2135 Exam II
October 16, 2018

Name: _____ Section: _____

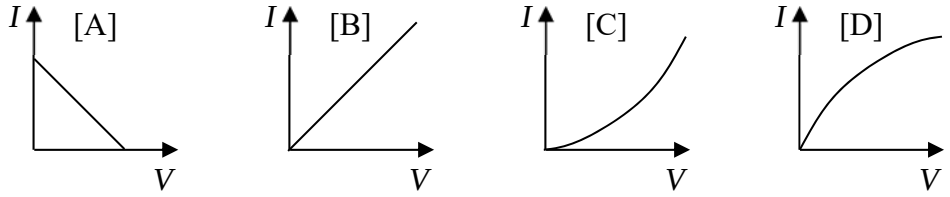
For questions 1-5, select the best answer. For problems 6-9, solutions must begin with an Official Starting Equation, when appropriate. Work must be shown to receive credit. Calculators are not allowed.

(8) _____ 1. Two light bulbs are both rated for 110V operation. One bulb is 100W and the other is 40W. They are wired in parallel with a 110V source. The 100W bulb burns out. What happens next?
[A] The current flowing through the 40W bulb goes to zero.
[B] The voltage across the 40W bulb decreases but does not decrease to zero.
[C] The current flowing through the 40W bulb increases to 10/4 of its initial value.
[D] None of the above.

(8) _____ 2. The diagram shows a side view of four loops in a uniform magnetic field. All four loops are identical. For which loop is the potential energy of the magnetic dipole equal to zero.?
[A] ❶ [B] ❷
[C] ❸ [D] ❹



(8) _____ 3. A resistor with resistance *R* obeys Ohm's law. It is connected to a variable voltage source and the current through the resistor as a function of applied voltage is measured. Which plot (A, B, C, or D) best describes the results of the measurements?



(8) _____ 4. A vertical straight wire of length *L*, carries a current *I* upward from the ground. The earth's magnetic field, which is directed towards the north, exerts a force on the wire. The direction of the force on the wire is towards the
[A] north [B] south [C] east [D] west.

(8) _____ 5. Free point problems often involve animals because
[A] they are found in fields.
[B] we lack resistance against them.
[C] they have the capacity to charge.
[D] of unknown reasons, the subject of current research.

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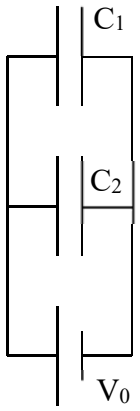
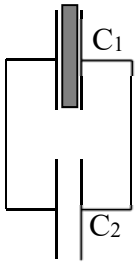
6. Two capacitors with capacitance $C_1 = C$ and $C_2 = 2C$ are connected across a potential difference V_0 as shown. **Express answers in terms of given quantities. Simplify when possible.**



(10) (a) Calculate the charge on each capacitor.

(10) (b) After the *battery is disconnected*, a dielectric with dielectric constant $K = 4$ is inserted into capacitor C_1 completely filling the space between the capacitor plates. Calculate the charge on each capacitor now.



7. A light bulb has a resistance of 20 Ω when off (20 °C) and a resistance of 120 Ω when on (hot).

(20) If the temperature coefficient for the light bulb filament is 1/60 $(°C)^{-1}$ what is the operating temperature of the bulb? You may neglect thermal expansion of the filament. **A numerical answer is required.**

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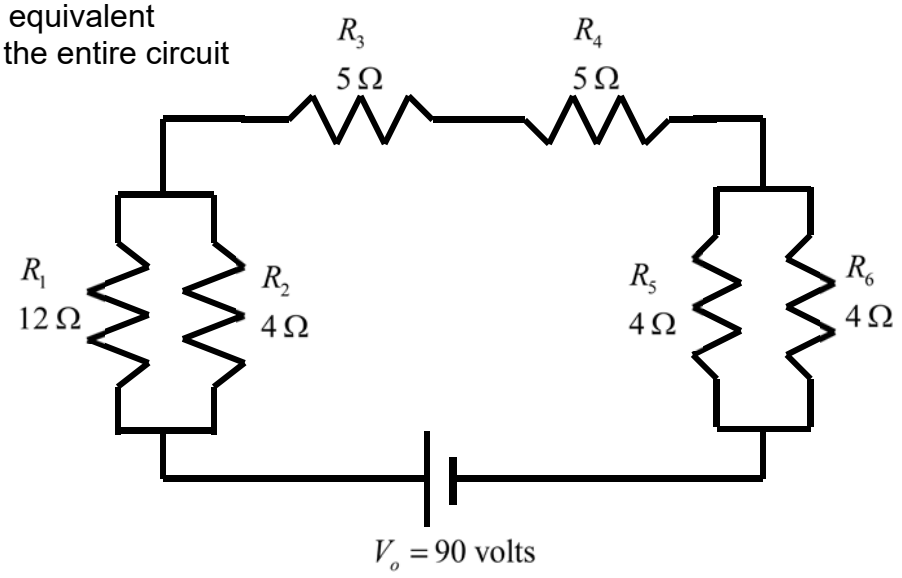
8. Numerical answers are required for all parts of problem 8.

(10) (a) Calculate the equivalent resistance of the entire circuit shown.



(10) (b) Find the current I_3 in resistor R_3.

(10) (c) Find the voltage V_1 across resistor R_1.

(10) (d) Assume resistor R_5 has a cylindrical shape with a diameter of 6 mm, a length ℓ and is made out of Carbon. Estimate the length ℓ of the Carbon rod so that it has a resistance of $4\,\Omega$. The resistivity of Carbon $\rho = 3.6\times10^{-5}\,\Omega\cdot m$ and assume $\pi \approx 3$ for estimation purposes. **A numerical answer of one significant figure is required.**

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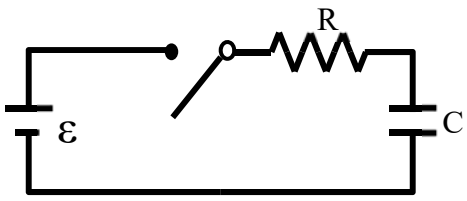
9. In the circuit shown, an uncharged capacitor with capacitance C and a resistor with resistance R are in series with a battery of emf Ɛ.



(10) (a) After the switch has been closed for a very long time what is the final charge on the capacitor and what is the total energy stored in it? **Express your answers in terms of Ɛ and C.**

(15) (b) When the power dissipated by the resistor is equal to $Ɛ^2/(9R)$, what is the energy stored in the capacitor? **Express your answer in terms of Ɛ and C.**

(15) (c) Determine the time after the switch is closed when the charge on the capacitor is $\frac{2}{3}$ of its final charge. **Express your answers using Ɛ, C, and R, as appropriate.**

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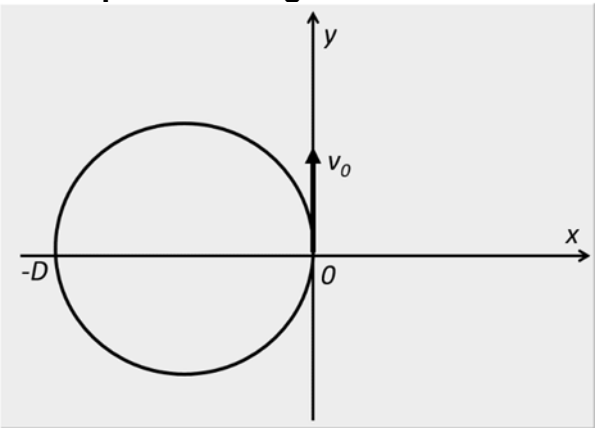
10. An electron of mass m_e and charge *-e* enters a region (indicated by the shaded area) of uniform magnetic field, moving initially with a velocity $v = v_0$ along positive *y*-axis. The electron moves in a circular path in the *xy*-plane and crosses the *x*-axis at *x* = *-D*. **Express all answers for problem 10 in terms of parameters given in the statement of the problem.**



(15) (a) Begin with starting equations and calculate the magnitude of the magnetic field.

(5) (b) Which of the following is the direction of the magnetic field? [Circle the correct answer.]

[A]	$\hat{\imath}$	[B]	$\hat{\jmath}$	[C]	$\hat{k}$	[D]	Clockwise
[E]	$-\hat{\imath}$	[F]	$-\hat{\jmath}$	[G]	$-\hat{k}$	[H]	Counterclockwise

(10) (c) Calculate the magnitude of the magnetic flux through the area defined by the circular path.

(10) (d) A positron (particle of mass m_e and charge *+e*) enters the same region with the same initial velocity $v = v_0$ along the positive *y*-axis. Find the position where the positron crosses the x-axis in its circular path.

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