Physics 2145　　Spring 2019　　Test 2 (4 pages)

Name:_____　　March 22, 2019　　Total Score:_____/120_

$e = 1.602 \times 10^{-19}$ C　　$I = \frac{\Delta q}{\Delta t}$　　$I = \frac{V}{R}$　　$R = \rho \frac{L}{A}$　　$P = IV = \frac{V^2}{R} = I^2 R$

series: $R_{eq} = \Sigma_i R_i$　　parallel: $\frac{1}{R_{eq}} = \Sigma_i \frac{1}{R_i}$　　$C = \frac{Q}{V}$

Discharging　$Q = Q_0 e^{-\frac{t}{RC}}$　　　　$I = I_0 e^{-\frac{t}{RC}}$　　　　$V_C = V_{C0} e^{-\frac{t}{RC}}$

Charging　　$Q = Q_f \left(1 - e^{-\frac{t}{RC}}\right)$　　$I = I_0 e^{-\frac{t}{RC}}$　　$V_C = V_{Cf} \left(1 - e^{-\frac{t}{RC}}\right)$
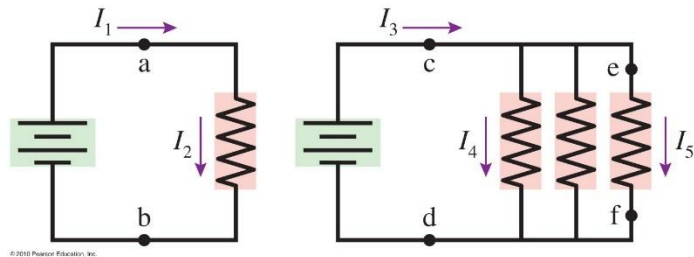
___1.(5) A wire has resistance R. What will be its resistance if it is stretched to twice its original length without changing the volume of the wire?

A) ½ R　　　　B) R　　　　C) 2R　　　　D) 4R

___2. (5) In the two circuits on the right, the batteries are identical and all resistors are identical. Which of the statements is **FALSE**?
A) $I_1 = I_2$　　　B) $I_1 = I_3$
C) $I_1 = I_4$　　　D) $I_1 = \frac{1}{3} I_3$

___3. (5) If the voltage across a resistor is doubled, which of the following is true? The power dissipated by the resistor_____, and the resistance_____.
A) doubles, doubles.
B) quadruples, doubles.
C) doubles, remains unchanged.
D) quadruples, remains unchanged

___4. (5) A capacitor is charged through a resistor. Which of the graphs at the right represent best the capacitor voltage and the current?
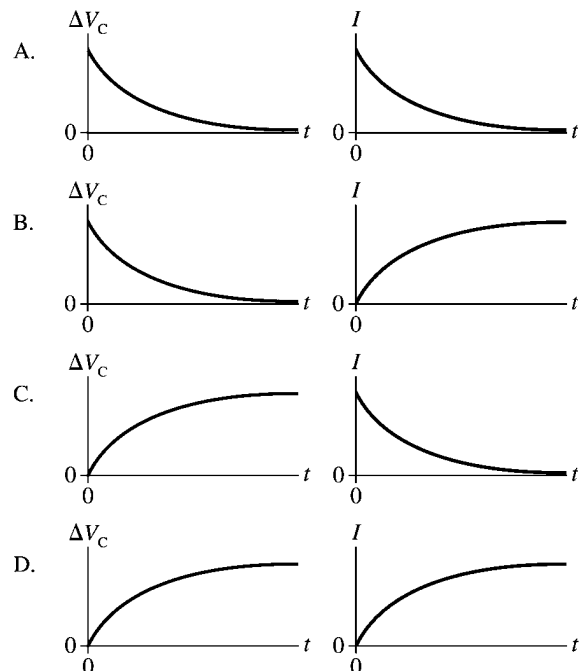
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5) (20) A potassium ion channel in a cell membrane is filled with intracellular fluid. The potassium ions have charge e. If the channel is open for 2ms, 1.5×10^4 ions flow through the channel. The potential difference across the channel is 70mV.

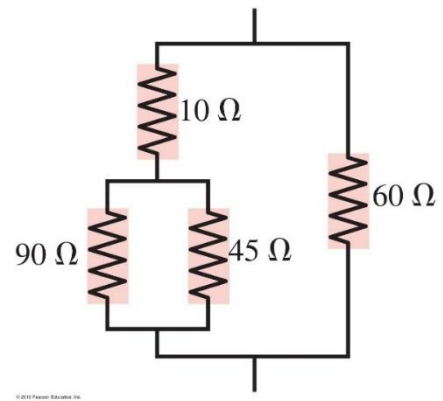a)(5) Calculate the current through the channel.

b)(5) Calculate the resistance of the ion channel.

c) (5) The channel has the shape of a cylinder with a diameter of 0.30nm and a length of 5.0nm. Calculate the resistivity of the intracellular fluid.

c)(5) Calculate the power dissipated in the channel.

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6. a) (20 points) Find the equivalent resistance of the resistor circuit shown in the figure.

10 Ω

60 Ω

90 Ω   45 Ω

b) (20) A battery provides a potential difference of 48V between points A and B. Calculate the total current through the network, the potential drop across each of the resistors, and the current through each resistor. Put the answers in the table below.
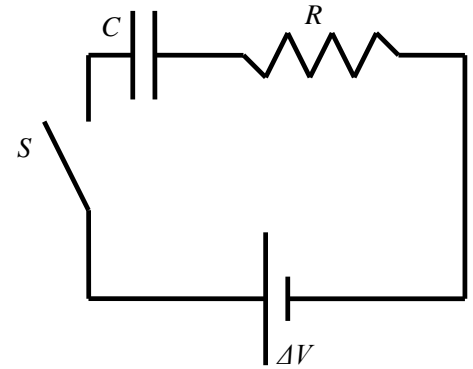
Total current:

10Ω	V=	I=
45 Ω	V=	I=
90 Ω	V=	I=
60 Ω	V=	I=

_____/40 points for this page

7) (40) A 4.0 µF capacitor is initially uncharged. It is connected in series with a switch, a 20 kΩ resistor, and an emf of 20 volts.

a)(5) Calculate the time constant of the circuit.

b)(5) Calculate the current through the resistor immediately after the switch is closed.

c)(5) Determine the charge on the capacitor a very long time ($t \rightarrow \infty$) after the switch is closed.

d) (10) Calculate the charge on the capacitor 20 ms after the switch is closed.

e) (15) Calculate the time after which the current has decreased to one fourth its maximum value.

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