Exam 2

P202 Spring 2009,
Instructor: Prof. Abanov

03/04/09

Name_____________ Section____________
(print)

517 Labs at 12:40-03:30 pm, TA: Wenlong Yang
518 Labs at 01:50-04:40 pm, TA: Jianping Xiao
519 Labs at 03:00-05:50 pm, TA: Kyle Damborsky
Problem 1.
A 2.5-A current is maintained in a simple circuit with a total resistance of 400 Ω.

What is the potential difference across the resistance?____

What net charge passes through any point in the circuit during a one minute interval?____

How much energy dissipated in the resistor during this time interval?____

What net charge would pass through any point in the circuit during a one minute interval if we doubled the resistance but kept the current constant?____

What net charge would pass through any point in the circuit during a one minute interval if we doubled the resistance but kept the voltage constant instead?____
Problem 2.

A battery with $E = 20\text{V}$ and internal resistance $r = 1\text{k}\Omega$ is connected to a simple circuit shown in the schematics with $R = 18\text{k}\Omega$.

What is the current through the battery?_____

What is the potential difference between the battery's terminals?_____

How much power does the battery supply to the simple circuit?_____ 

How much power dissipates inside the battery?______
Problem 3.

In the circuit shown in the picture

\[ E = 10\, \text{V}, \quad r = 1\, \text{k}\Omega, \quad R_1 = 1\, \text{k}\Omega, \]
\[ R_2 = 3\, \text{k}\Omega, \quad R_3 = 7\, \text{k}\Omega, \quad R_4 = 5\, \text{k}\Omega \]

What is the current at point “a” of the circuit?_______

What is the current at point “c” of the circuit?_______

What is the current at point “d” of the circuit?_______

What is the potential difference between points “a” and “b”?_______

What is the potential difference between points “a” and “c”?_______

What is the potential difference between points “a” and “d”?_______

What is the potential difference between points “c” and “d”?_______
Problem 4.

In the circuit shown in the figure \( E_1 = 28\, \text{V} \), \( R_2 = 6\, \text{k}\, \Omega \), \( R_3 = 3\, \text{k}\, \Omega \), \( I_2 = 4\, \text{mA} \), and \( I_3 = 8\, \text{mA} \) (directions of \( I_2 \) and \( I_3 \) are shown).

What is the magnitude and direction (show in the figure) of the current \( I_1 \) ?

What is the value of the resistor \( R_1 \) ?

What is \( E_2 \) ?

What total power is being dissipated by all the resistors together?
Problem 5.
A wire with a current $I=2\text{mA}$ has the form shown in the figure with dimensions $L=10\text{cm}$ and $h$ unknown. It was placed in the magnetic field $B=0.5\text{T}$ pointing out of the paper.

What is $x$ component of the force acting on the wire?___

What is $y$ component of the force acting on the wire?____
Problem 6.

In the circuit shown in the figure \( E=10\text{V} \), \( r=6\text{k}\Omega \), \( R=4\text{k}\Omega \), and \( C=4\mu\text{F} \). Initially the capacitor is uncharged. At the moment \( t_0 \) the switch is closed.

What is the current in point “a” immediately after \( t_0 \)?

What is the current in point “a” after a very long time?

What is the charge on the capacitor \( C \) long time after \( t_0 \)?
Problem 7.

A planar loop of area $A = 0.02 \text{m}^2$ carries a current $I = 1 \text{A}$. The magnetic field $B = 0.5 \text{T}$ is at angle 30° with the norm to the loop.

What is magnetic moment of the loop?_____

What torque should be applied to the loop in order to keep it at rest?_____

What torque would be needed if the loop had 100 turns?
Problem 8.
Two high current transmission lines carry currents of 50A and 75A in the opposite directions. And are suspended parallel to each other 35cm apart. The vertical posts supporting these wires divide the lines into straight 15m segments.

What magnetic force does each segment exert on the other?_______

Is this force attractive or repulsive?___________

What would happen to the force if we double each current?___________
Problem 9.

A metal bar of mass $m = 10\text{kg}$ can move frictionlessly along two vertical straight rails which are $L = 1\text{m}$ apart from one another. The resistor $R = 2\Omega$ and battery $E = 2\text{V}$ are connected to the rails. Magnetic field is $B = 0.5\text{T}$. At the first moment the bar is released at zero velocity.

What is the direction of the electric current in the bar at the first moment? (to the left, or to the right)

What is the magnitude of the electric current in the bar at the first moment?____

What is the direction of electric current after a long period of time? (show on the figure)

What is the direction of the magnetic force on the bar after a long period of time? (show on the figure)

What is the velocity of the bar after a long period of time?_____
Problem 10.
A circuit shown on the figure has $E = 15\text{V}$, $R = 5\text{k}\Omega$, $L = 5\text{mH}$.

What is the current right after the switch is closed?_____

How fast the current is changing right after the switch is closed?_____

What is the current long time after the switch is closed?_____

What is the time constant of this circuit?_____