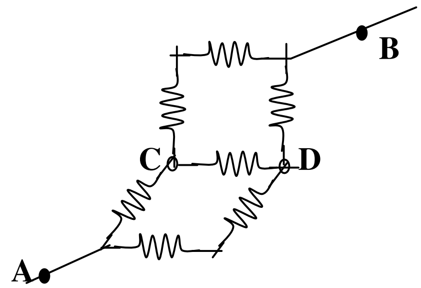
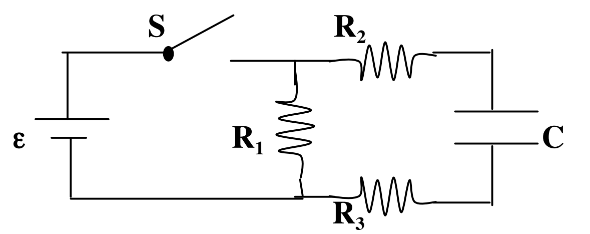
PHYSICS 4C QUIZ 3 (open book) Fall QUARTER 2011
PROF. HIRSCH NOVEMBER 4

Problem 1 (10 pts)



The figure shows the bottom and back faces of a resistor "cube", the others are missing. All the resistors in the figure have the same value R.
(a) Find the equivalent resistance between points A and B, in terms of R.
(b) If the electric potential at point A is V_A= 14V and the electric potential at point B is V_B= 0V, find the values of the electric potential at points C and D (in V), V_C and V_D.

Problem 2 (10 pts)



In the circuit in the figure, all resistors have the same value, $R=R_1=R_2=R_3$. The switch S is initially open and the capacitor is uncharged. At time t=0 the switch is closed.
At time t_0= 1 minute after the switch is closed the charge in the capacitor is 50C. 1 hour after the switch is closed the charge in the capacitor is 100C.
(a) Make qualitative plots of i_1 versus t, i_2 versus t and q versus t, where i_1 is the current through resistor R_1, i_2 is the current through R_2, and q is the charge in the capacitor. (charge in the capacitor means charge in one of the plates of the capacitor, of course).
(b) Give the values of i_1 and i_2 right after the switch S is closed, in terms of ε and R.
(c) Give the values of i_1 and i_2 1 minute after the switch S is closed, in terms of ε and R.
(d) 1 hour after the switch S is closed, it is opened again. How long after S is opened again will the charge in the capacitor be 50C? Give your answer in seconds.

<u>Hint:</u> formulas for RC circuits given in class that should be on your formula sheet:
$q(t) = C\varepsilon(1-e^{-t/RC})$, $q(t) = q_0 e^{-t/RC}$

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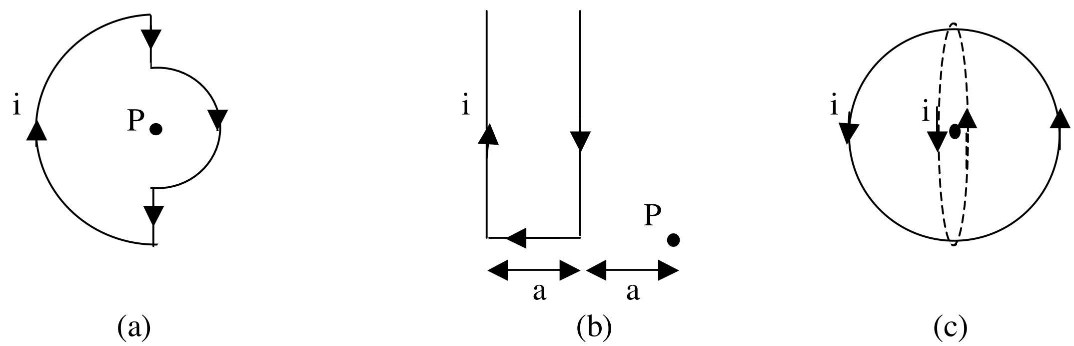
Problem 3 (10 pts)



Find the magnetic field at the point P (black dot) for the 3 cases (a), (b), (c) shown above, in terms of the current i, μ_o and the lengths in the problem:

(a) The point P is at the center of both half-circles, that have radii b and 2b respectively. The straight wires on top and bottom have length b each. Find the magnitude of the magnetic field B at point P and state its direction.

(b) The two parallel wires extend to infinity in the upward direction and are at distance a from each other. The point P is at distance a from the closer wire. All wires carry the current i in the direction shown. Find the magnitude of the magnetic field B at point P and state its direction.

(c) The two circular loops carry current i each, they are not connected. Both have radius R. One loop is on the plane of the paper, carrying current counterclockwise. The other loop is perpendicular to the paper, its normal is on the paper, the part behind the paper carries the current in the upward direction. The center of both loops is at the black dot. Give the magnitude of the magnetic field at that point and state its direction.

Just in case you forgot to write this formula on your card:

$$d\vec{B} = \frac{\mu_0}{4\pi}\frac{i d\vec{\ell} \times \hat{r}}{r^2}$$

If you forgot to write other formulas you may need ask Grigor (nicely).

Justify all your answers to all problems