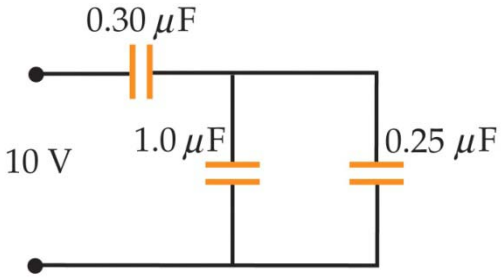
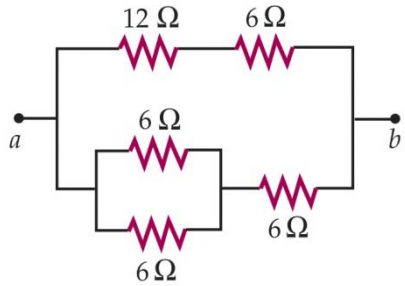
Physics 240 Review Problems, Test 3
Note: numbering starts at #2; scanned answers will be posted in Wiley Plus

2) For the circuit shown below, find (a) the total equivalent capacitance between the terminals, (b) the charge stored on each capacitor, (c) the total stored energy, and (d) the voltage across each capacitor.

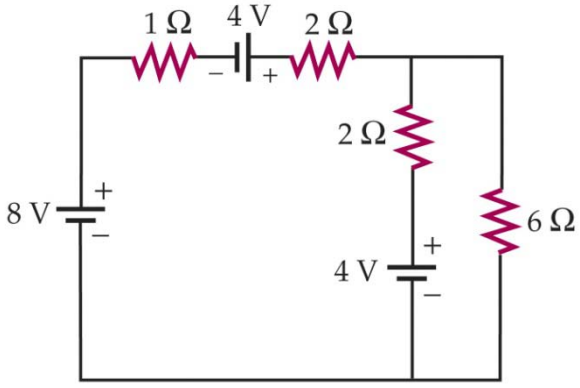


3) The third (current-carrying) rail of a subway track is made of steel and has a cross-sectional area of about 55 cm^2. The resistivity of steel is $10^{-7}\Omega\cdot m$. What is the resistance of 10 km of this track?

4) (a) Find the equivalent resistance between point *a* and point *b* in the circuit shown below. If the potential drop between point *a* and point *b* is 12 V, find the current in each resistor and the power dissipated in the circuit.



5) For the circuit shown below, find (a) the current in each resistor, (b) the power supplied by each source of *emf*, and (c) the power dissipated in each resistor. Use Kirchoff's loop and node rules!

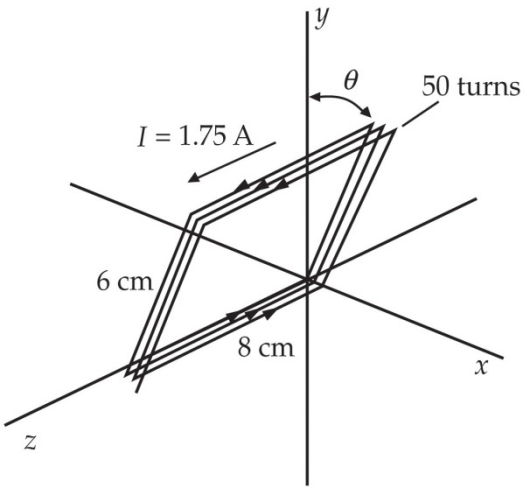


6) A 0.12-μF capacitor is given a charge Q_0. After 4 s, the capacitor's charge is ½ Q_0. What is the effective resistance across this capacitor?

7) A uniform magnetic field of magnitude 1.48 T is in the positive *z* direction. Find the force exerted by the field on a proton if the proton's velocity is (a) $\vec{v}$ = 2.7 Mm/s $\hat{i}$, (b) $\vec{v}$ = 3.7 Mm/s $\hat{j}$, (c) $\vec{v}$ = 6.8 Mm/s $\hat{k}$, and (d) $\vec{v}$ = 4.0 Mm/s $\hat{i}$ + 3.0 Mm/s $\hat{j}$.

8) A straight wire segment $I\vec{L} = (2.7\text{A})(3\text{cm}\ \hat{i} + 4\ \text{cm}\ \hat{j})$ is in a uniform magnetic field $\vec{B} = 1.3\ \text{T}\ \hat{i}$. Find the force on the wire.

9) A rectangular, 50-turn coil has sides 6-cm long and 8-cm long and carries a current I of 1.75A. It is oriented and pivoted about the *z* axis, as shown below. (a) If the wire in the *xy* plane makes and angle of $\theta = 37°$ with the *y* axis as shown, what angle does the unit normal $\hat{n}$ make with the *x* axis? (b) Write an expression for $\hat{n}$ in terms of the unit vectors $\hat{i}$ and $\hat{j}$. (c) What is the magnetic moment of the coil? (d) Find the torque on the coil when there is a uniform magnetic field $\vec{B} = 1.5\ \text{T}\ \hat{j}$.



10) The coil in the problem above is pivoted about the z axis and held at various positions in a uniform magnetic field $\vec{B} = 2.0\ \text{T}\ \hat{j}$ .Sketch the position of the coil and find the torque exerted when the unit normal is (a) $\hat{n} = \hat{i}$, (b) $\hat{n} = \hat{j}$, (c) $\hat{n} = -\hat{j}$, and (d) $\hat{n} = (\hat{i} + \hat{j})/\sqrt{2}$

11) A particle of mass m and charge q enters a region where there is a uniform magnetic field $\vec{B}$ along the x axis. The initial velocity of the particle is $\vec{v} = v_{0x}\hat{i} + v_{0y}\hat{j}$, so the particle moves in a helix. (a) Show that the radius of the helix is $r = mv_{0y}/qB$. (b) Show that the particle takes a time $t = 2\pi m/qB$ to make one orbit around the helix. (c) What is the spacing between each loop of the helix?