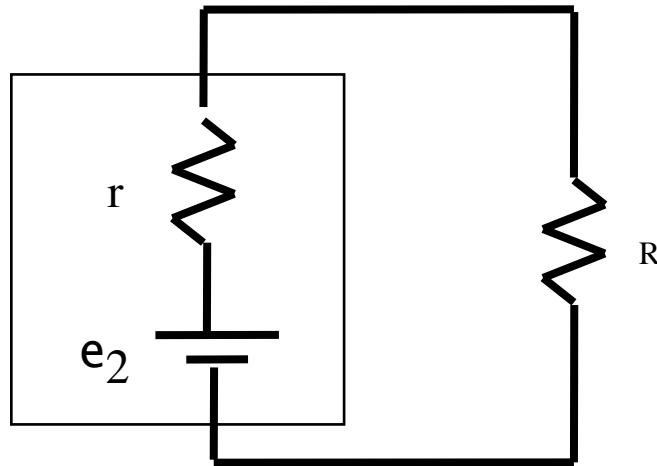


**Exam 3**  
**Physics 132**

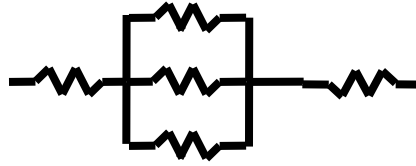
**Short Answer Section. Please answer all of the questions.**

1. What is the current in the circuit shown below? Take  $r=10$  Ohms,  $R=1000$  Ohms, and the emf to be 12 V. What is the power in  $r$ ? If  $r=0$ , what current would flow through  $R$ ?



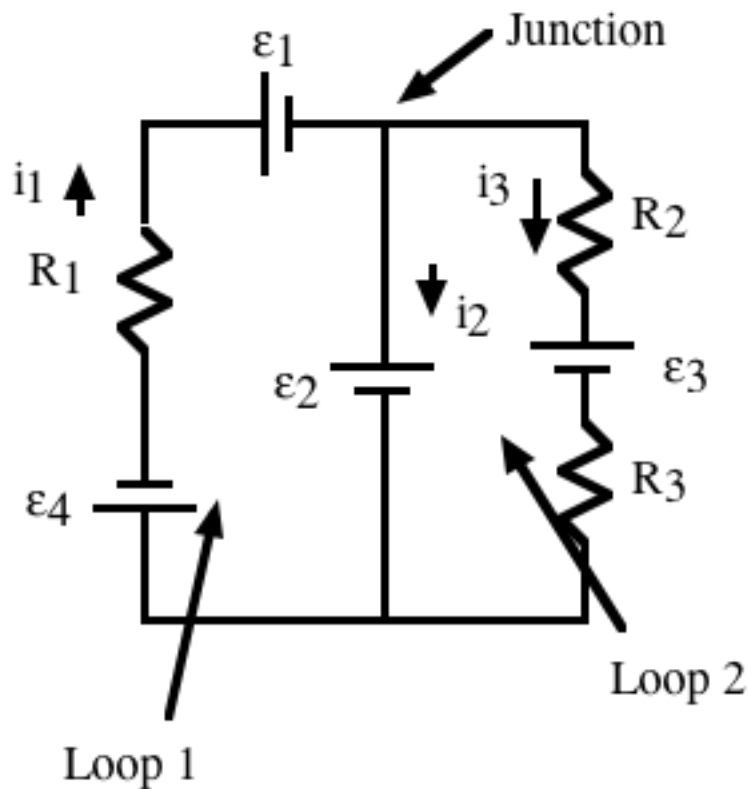
2. How is a real battery different from an ideal battery
3. State Kirchoff's two laws clearly.
4. State the voltage convention that is used with Kirchoff's voltage law.
5. An oxygen nucleus enters a region of uniform magnetic field. If the radius of curvature of the oxygen nucleus is 1 m and the field strength was 2T perpendicular to the velocity, what velocity did the nucleus have. Draw a picture of this event, and be sure to include the direction of the velocity (to the right) when it enters the field region, the force it experiences, and the field direction. Take the charge of the nucleus to be  $q = +8e$ ,  $m = 16 \cdot 1.66 \times 10^{-27} \text{ kg}$
6. A straight wire of length 6 m carries a 2 A current of in  $-\hat{i}$  direction. This wire is in a magnetic field given by  $\vec{B} = 3\hat{j} + 4\hat{k}$ . What force vector does the wire experience?
7. A square loop of wire is composed of 10 turns and it has side length 0.2 m. It is placed in a magnetic field of strength 0.5 T at an angle of 30 degrees and it experiences a torque of 2 Nm. What current must be present in the wire?
8. An RC circuit has a time constant  $\tau = 2s$ . If the resistance in the circuit is 2000 Ohms, what is the capacitance? If the capacitor is fully charged at  $t=0$  and it begins discharging, what charge will be left on the capacitor in 4s?

9. Resistors are arranged as show below. Each resistor is 6 Ohms. What is the equivalent resistance?



**Problems. Please work 2 of three problems**

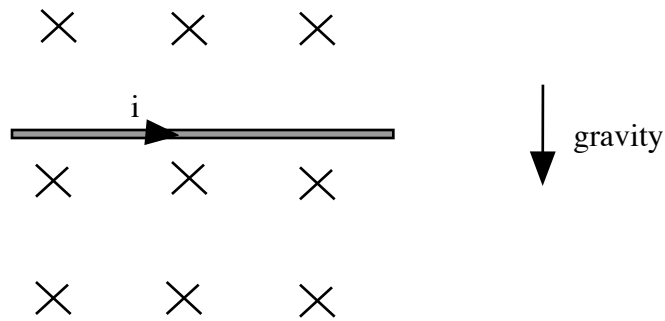
1. Consider the circuit below



$R_1 = 200$  Ohms,  $R_2 = 300$  Ohms,  $R_3 = 400$  Ohms,  $e_1 = 40$  V,  $e_2 = 20$  V,  $e_3 = 10$  V,  $e_4 = 30$  V.

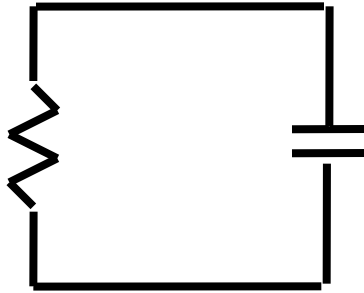
- Using the loops indicated, write Kirchoff's voltage loop rule for each loop.
- Apply Kirchoff's junction law to the junction indicated.
- Solve for the currents.

2. A magnetic levitation train uses the force on a current conducting wire to allow a train to float just above a track, as shown below. The rod below has a mass 2 kg and a length of 2m.  $B=2T$



- a) What current is necessary to get the rod to just float?
- b) Taking the resistance of the rod to have a resistance of just 0.1 Ohms, what battery voltage would be necessary to drive this current in simple loop circuit.
- c) Draw the simple loop circuit and compute the power in the rod as resistor.
- d) You would need to be able to support the battery as well as the rod in a real train. If the mass of the battery, wires, and all the other stuff needed to build this device had a mass of 4 kg, how much more current would you need to support it. What voltage battery would you now need?

3. A simple RC circuit is shown below. The resistance is known to be 20,000 Ohms, but the capacitance is unknown.



The capacitor is initially charged to a voltage of 12 Volts. It discharges through the resistor and reaches a voltage of 8 volts in 5s.

- a) Sketch the discharge and write the equation that describes the discharge.
- b) Given the information that you have, find the time constant for the decay.
- c) What is the capacitance?
- d) Now that you have the time capacitance, what was the original charge on the capacitor?