

**Physics 133 Homework 4**  
**Circuits**  
**Due Monday October 29**

**Problem 1.**

A typical AA battery has a voltage of 1.5 volts, and an internal resistance of  $0.4 \Omega$ . It has a capacity of 1.4 Amp-hr. If a  $2.6 \Omega$  light bulb is placed across the battery,

- a) How much current flows out of the battery?
- b) What is the terminal voltage of the battery?
- c) How long can the battery keep the light bulb lit?

**Problem 2.**

A  $1 \Omega$ ,  $3 \Omega$ , and two  $6 \Omega$  resistors are connected as shown on the figures page. Find the equivalent resistance of the combination.

**Problem 3.**

Three  $100 \Omega$  resistors are connected as shown on the figures page. The maximum power that can be dissipated in any one of the resistors is 25 Watts.

- a) What is the maximum voltage that can be connected across the terminals  $a$  and  $b$ ?
- b) What is the total power dissipated by the resistors in the circuit when connected to the maximum voltage allowed?

**Problem 4.**

Three resistors of resistance  $3 \Omega$ ,  $6 \Omega$  and  $4 \Omega$  are connected across a 24 volt battery as shown in the figures page. Find the current through and the voltage drop across each resistor in the circuit.

**Problem 5.**

Three resistors of resistance  $4 \Omega$ ,  $3 \Omega$  and  $2 \Omega$  are connected in a circuit with two batteries as shown in the figures page. Find the current through and the voltage drop

across each resistor in the circuit.

**Problem 6.**

Five resistors are connected in a Wheatstone Bridge as shown in the figures page. If a 8 volt battery is connected across the Wheatstone Bridge,

- a) How much current flows from the battery?
- b) What is the effective resistance of the Wheatstone Bridge?

**Problem 7.**

a) A parallel plate capacitor of Capacitance  $C$  is connected to a battery of voltage  $V$ . If the separation of the plates  $d$  is doubled while connected to the battery, what is the fractional change in the electrical energy of the capacitor?

b) A parallel plate capacitor of Capacitance  $C$  has a charge of  $\pm Q$  on its plates. If the separation  $d$  is doubled keeping the charge the same, what is the fractional change in the electrical energy of the capacitor?

**Problem 8.**

An infinite number of resistors are connected in a "ladder" network as shown in the figures page. Each resistor has a resistance  $r$ . Find the equivalent resistance  $R$  of the infinite string of resistors. Express your answer in terms of  $r$ .

**Problem 9.**

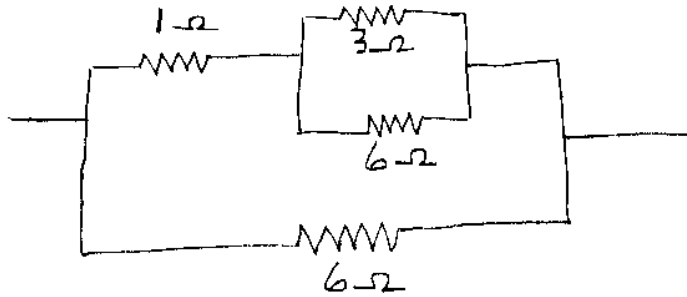
If one Kw-hr costs 15 cents, how much does it cost to operate the following appliances for the time stated?

- a) a 60 Watt light bulb for 12 hours.
- b) a 1500 Watt heater for 1/2 hour.
- c) a 2000 Watt air conditioner for 8 hours.
- d) a 100 Watt evaporative cooler (swamp cooler) for 8 hours.

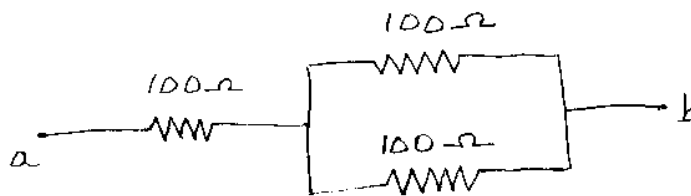
*See the next two pages for the figures*

FIGURES FOR HWK 4

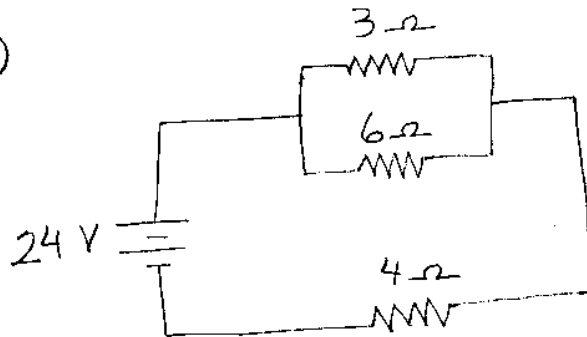
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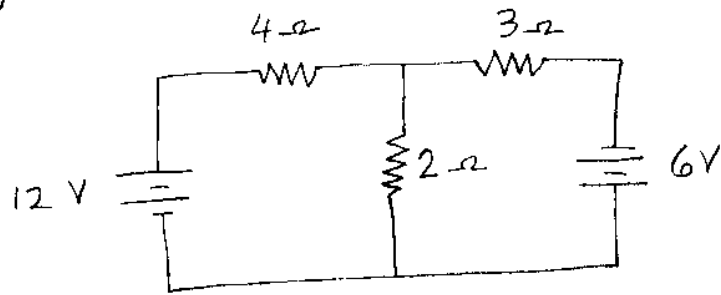
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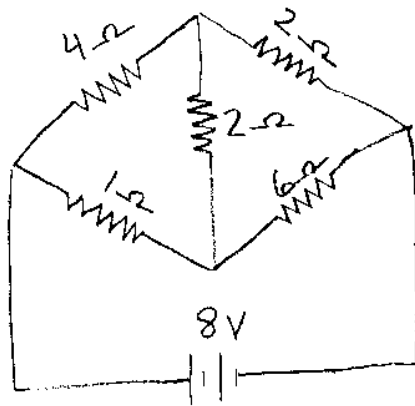
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