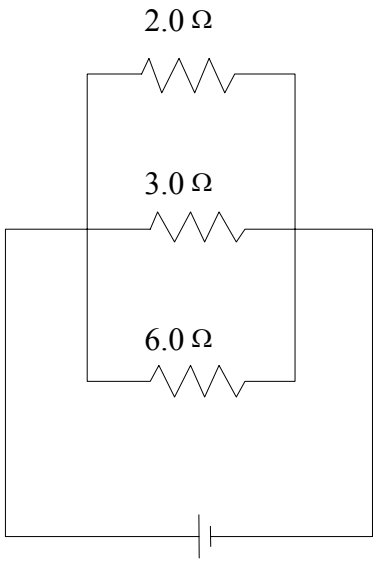
Physical Science 430-2008
Pretest 3.3

1. The heating element of an electric stove has a resistance of 50 Ω. It is connected to a power source of 220 V and turned on for 2.0 minutes.

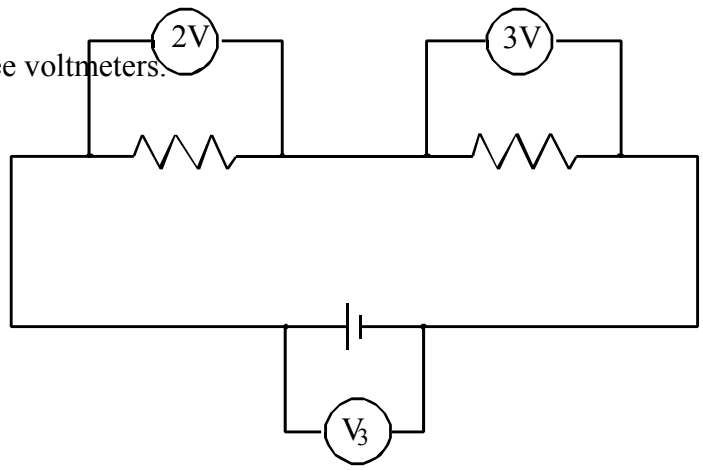
   What is the current which flows through this heating element?

2. Three known resistances are connected in parallel to the terminals of a power source. The current passing through the 3.0 Ω resistance is 1.0 A.

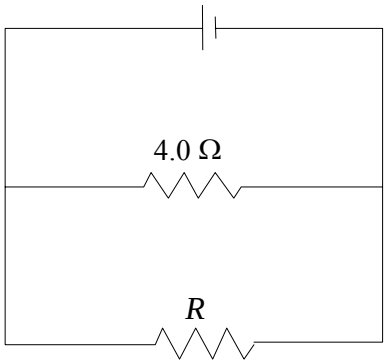


   What is the intensity of the current coming from the power source?

3. Given the following electric circuit with three voltmeters.
   What is the reading on voltmeter V_3?

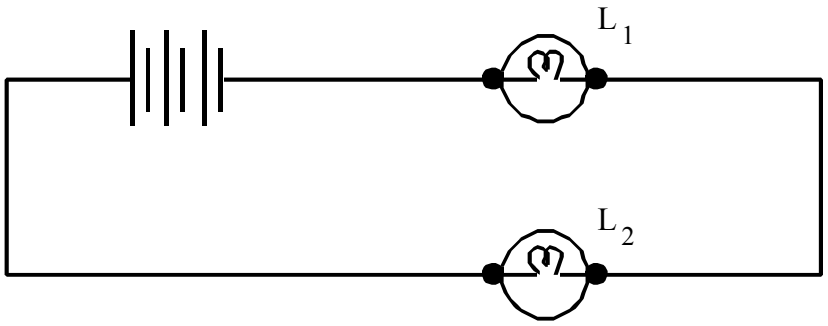


4. In the following electric circuit, one of the two resistances is 4.0 Ω. The other resistance, "*R*", is unknown. The voltage of the power source is 12 V and the electric current from the source is 4.5 A.



What is the value of resistance "*R*"?

5. The diagram below represents an electric circuit consisting of batteries and two identical light bulbs.



The potential difference across light bulb L_2 is _____.

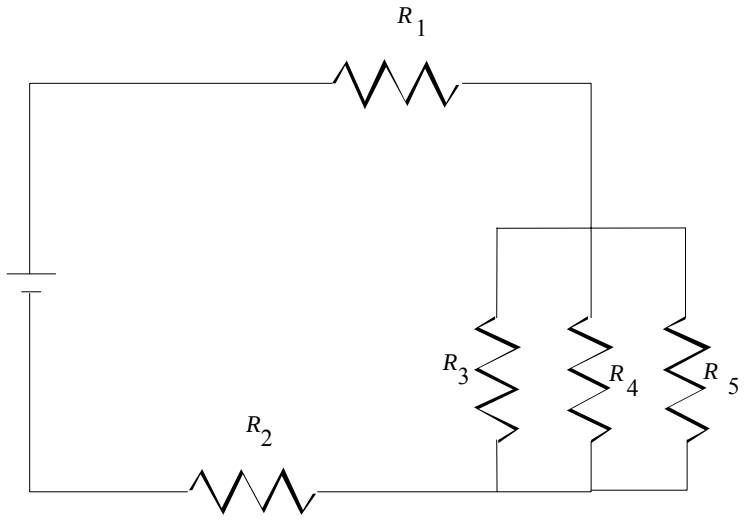
A) the same as that across the terminals of the batteries.

B) twice that across light bulb L_1.

C) half that across light bulb L_1.

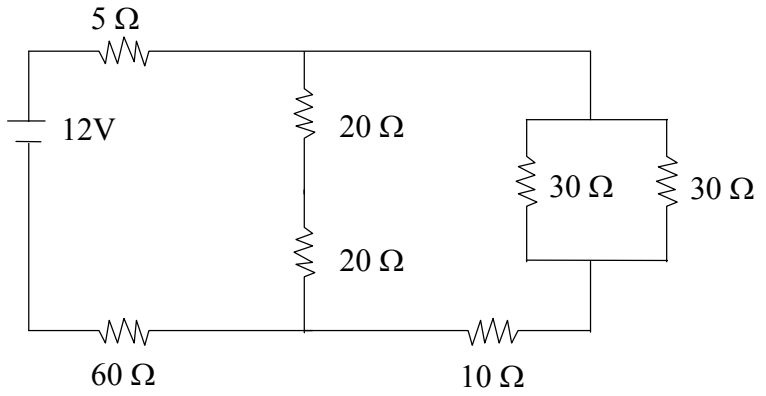
D) the same as that across light bulb L_1.

6 You must build a circuit equivalent to the one below but with only one resistor. What would be the value of its resistance?

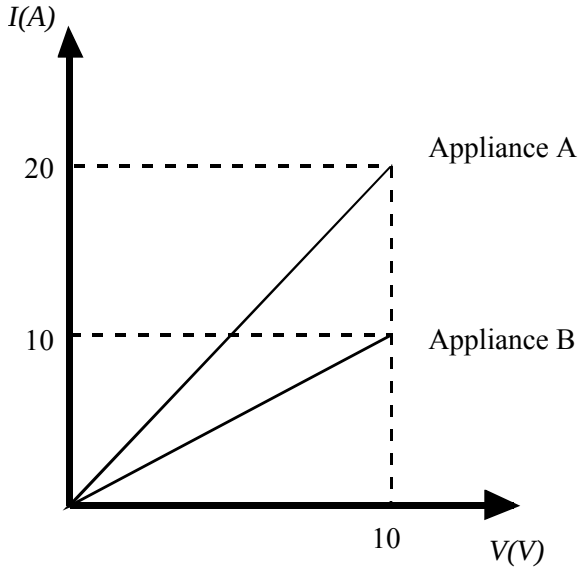


$R_1 = 25\ \Omega$ $R_2 = 15\ \Omega$ $R_3 = 20\ \Omega$
$R_4 = 30\ \Omega$ $R_5 = 60\ \Omega$

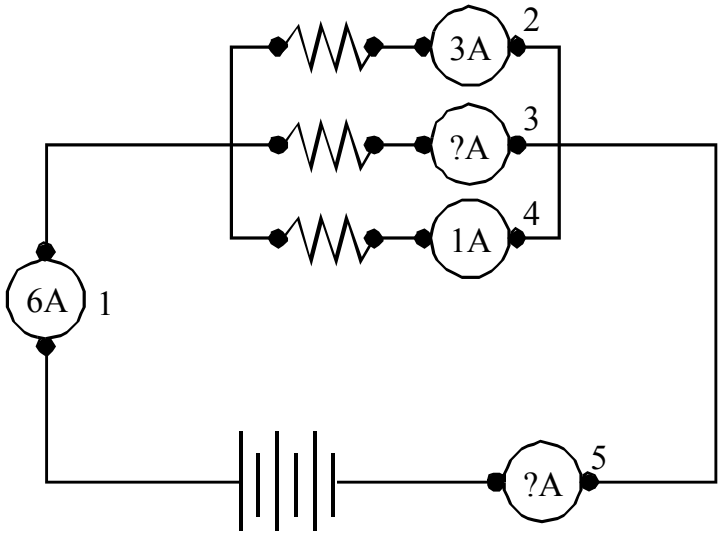
7 What is the voltage across each of the 20 Ω resistors? The total voltage of the circuit is 12 V.



8. Which appliance has greater conductance? (see graph) Explain.



9. The electric circuit in the diagram below consists of 3 resistors and 5 ammeters numbered 1 to 5.



What are the readings of ammeter 3 and ammeter 5?

10. Pauline is repairing her radio. She needs to replace a 250 Ω resistor that has burnt out.
There are only 100 Ω resistors available.
Draw a circuit diagram to suggest a way that they can be used to replace the burnt resistor.[1]

[1] Flashback topics: naming simple ionic and covalent compounds(no polyatomics; no transition metals). Calculating g/L.

ANSWERS

1. $V = IR$
$220 = I(50)$
$I = 220/50 = 4.4A$

2. Since V is constant, $V = I_2R_2$
$V = 1A(3\Omega) = 3V$
$I_1 = V/R_1 = 3/2 = 1.5A$
$I_3 = V/R_3 = 3/6 = 0.5A$

$I_T = I_1 + I_2 + I_3$
$= 1 + 1.5 + 0.5 = 3A.$

Another way: Since V is constant, $V = I_2R_2$
$V = 1A(3\Omega) = 3V$

Get total resistance: $1/R_T = 1/R_1+1/R_2+1/R_3$
$1/R_T = 1/2+1/3+1/6$
$1/R_T = 3/6+2/6+1/6$
$1/R_T = 6/6 = 1\ \Omega.$
$R_T = 1\ \Omega$
$V = I_T R_T$
$3 = I_T (1)$
$I_T = 3A$

3. $V_T = V_3 = V_1+V_2$
$= 2V + 3V = 5V$

4. $V = I_1R_1$
$12 = I_1(4)$
$I_1 = 12/4 = 3A$
But total current is 4.5A, so $I_2 = 4.5A - 3A = 1.5A$

Since voltage is current in parallel,

$R_2 = V/I_2 = 12/1.5 = 8\ \Omega.$

5. (D)same as L_1, because they are identical lightbulbs. Note that it's a series circuit, so $V_1+V_2 = V_T$

6. $1/R_p = 1/R_3 + 1/R_4 + 1/R_5$
$1/R_p = 1/20 + 1/30 + 1/60$
$1/R_p = 3/60 + 2/60 + 1/60$
$1/R_p = 6/60$
$R_P = 60/6 = 10\ \Omega.$
$R_T = R_1 + R_P + R_2$
$= 25 + 10 + 15 = 50\ \Omega.$

7. The two parallel 30 Ω. resistors have an equivalent resistance of 15 Ω. They are in series with 10 Ω, giving them an equivalent of 25 Ω. But this equivalent of 25 Ω is parallel to the two 20 Ω guys (40 Ω in all), to produce a parallel resistance of:

$1/R_p = 1/40 + 1/25$
$1/R_p = 5/200 + 8/200$
$1/R_p = 13/200$
$R_p = 200/13 = 15.38\ \Omega.$

$R_T = 15.38 + 5 + 60 = 80.38\ \Omega.$

$V_T = I_T R_T$
$12 = I_T (80.38\ \Omega.)$
$I_T = 12/80.38 = 0.149A$

This is the current arriving at the parallel branch before it splits up, where $R_P = 15.38\ \Omega.$
So the voltage for the parallel branch is $V_P = IR_P = 0.149A(15.38\ \Omega.) = 2.30$ V

So each 20 Ω resistor will experience 2.30V/2 = 1.15 V.

Are you still there?

8. The conductance of appliance A is greater than that of appliance B because:

- at the same point on the graph, the current intensity is greater for appliance A;
- the slope of the line is greater for appliance A;
- for the same voltage, the *I/U* ratio is greater for appliance A.

9. The readings of ammeter 3 and ammeter 5 are 2 A and 6 A, respectively.

10.