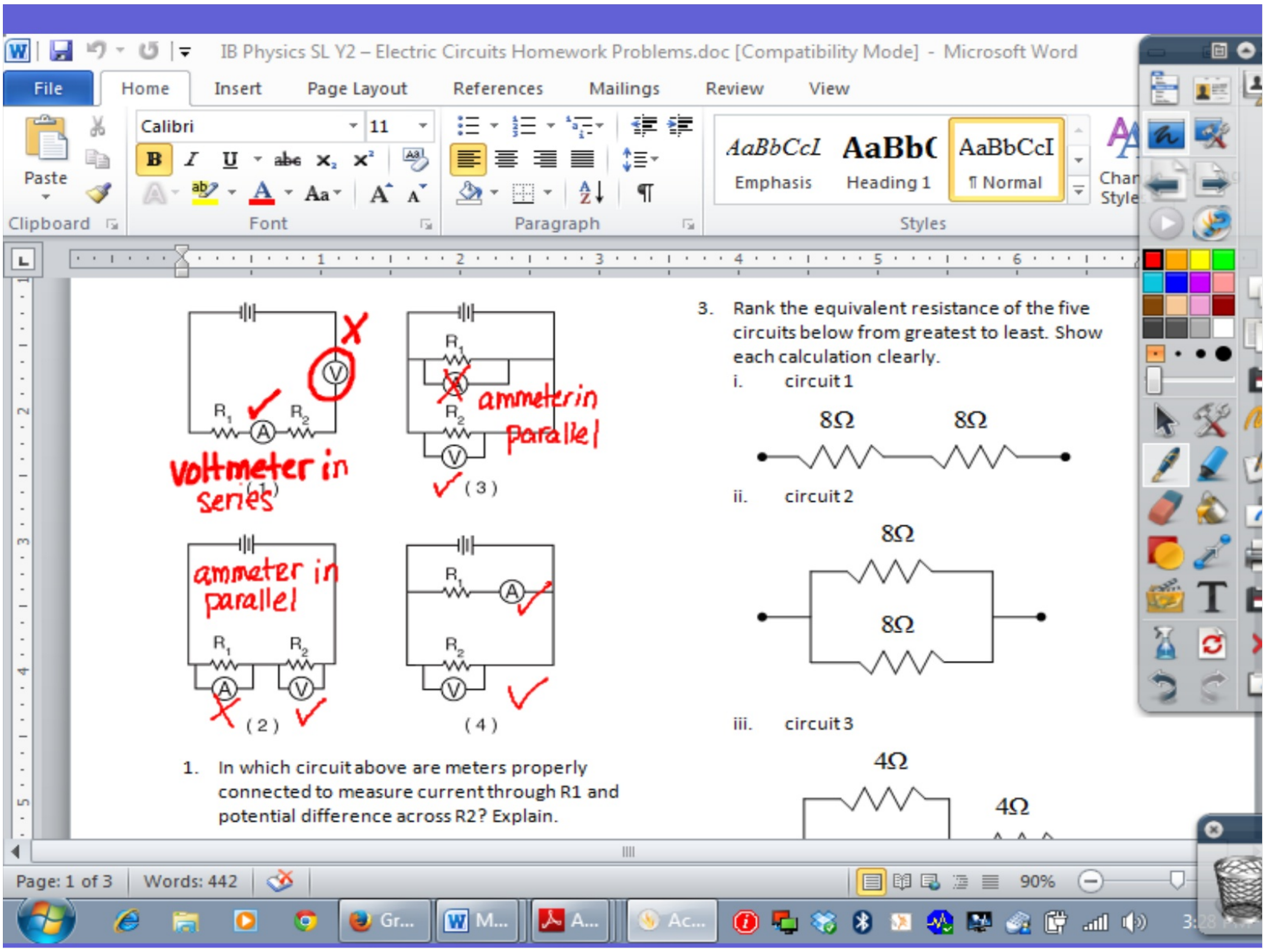

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(1) voltmeter in series ✗
(2) ammeter in parallel ✗
(3) ammeter in parallel ✗ ✓
(4) ✓

1. In which circuit above are meters properly connected to measure current through R1 and potential difference across R2? Explain.

3. Rank the equivalent resistance of the five circuits below from greatest to least. Show each calculation clearly.

i. circuit 1

8Ω 8Ω

ii. circuit 2

8Ω
8Ω

iii. circuit 3

4Ω
4Ω

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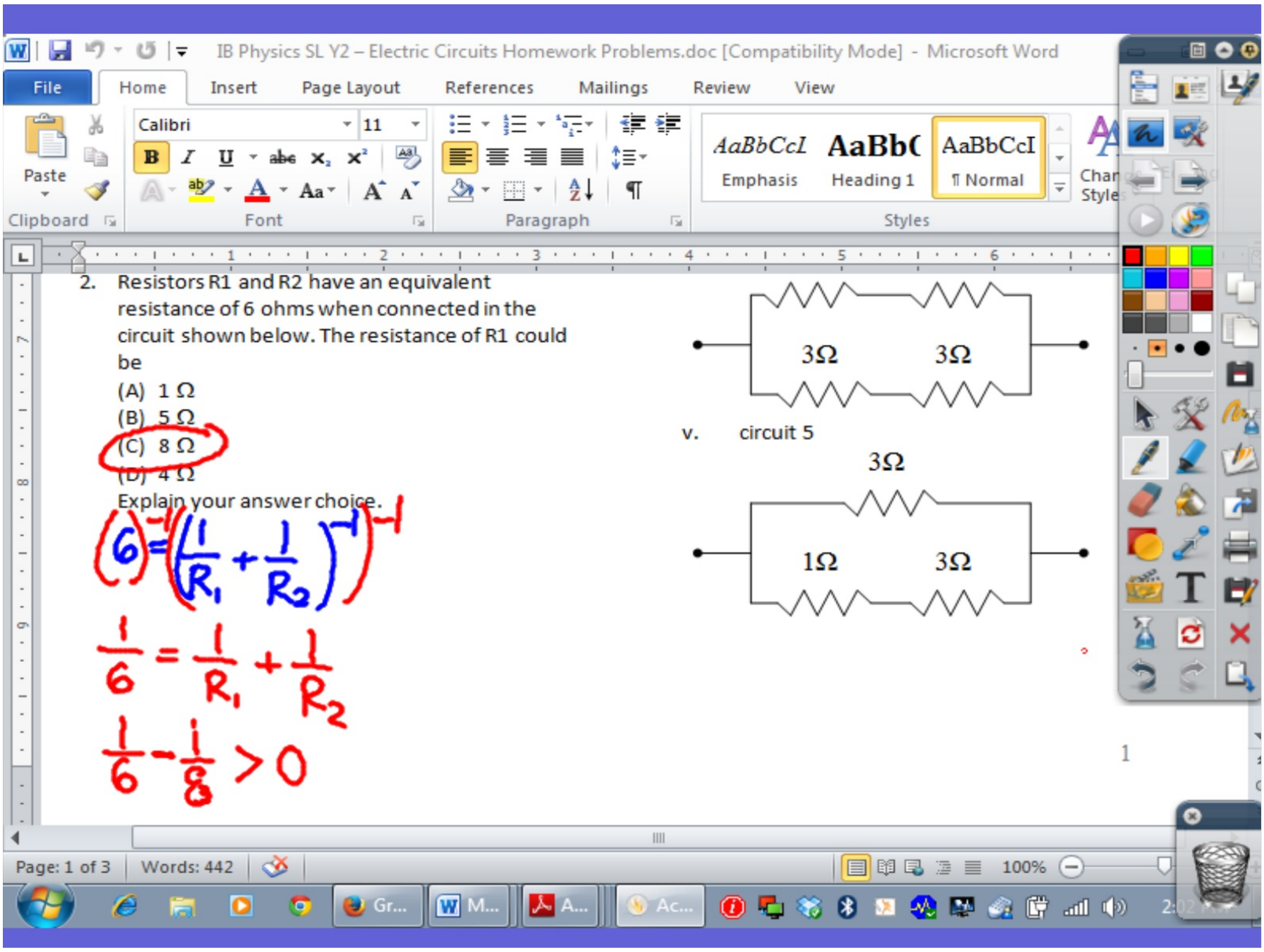

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2. Resistors R1 and R2 have an equivalent resistance of 6 ohms when connected in the circuit shown below. The resistance of R1 could be

(A) 1 Ω
(B) 5 Ω
(C) 8 Ω
(D) 4 Ω

Explain your answer choice.

$$6^{-1} = \left(\left(\frac{1}{R_1} + \frac{1}{R_2}\right)^{-1}\right)^{-1}$$

$$\frac{1}{6} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{6} - \frac{1}{8} > 0$$

3Ω 3Ω
3Ω 3Ω

v. circuit 5

3Ω
1Ω 3Ω
3Ω

1

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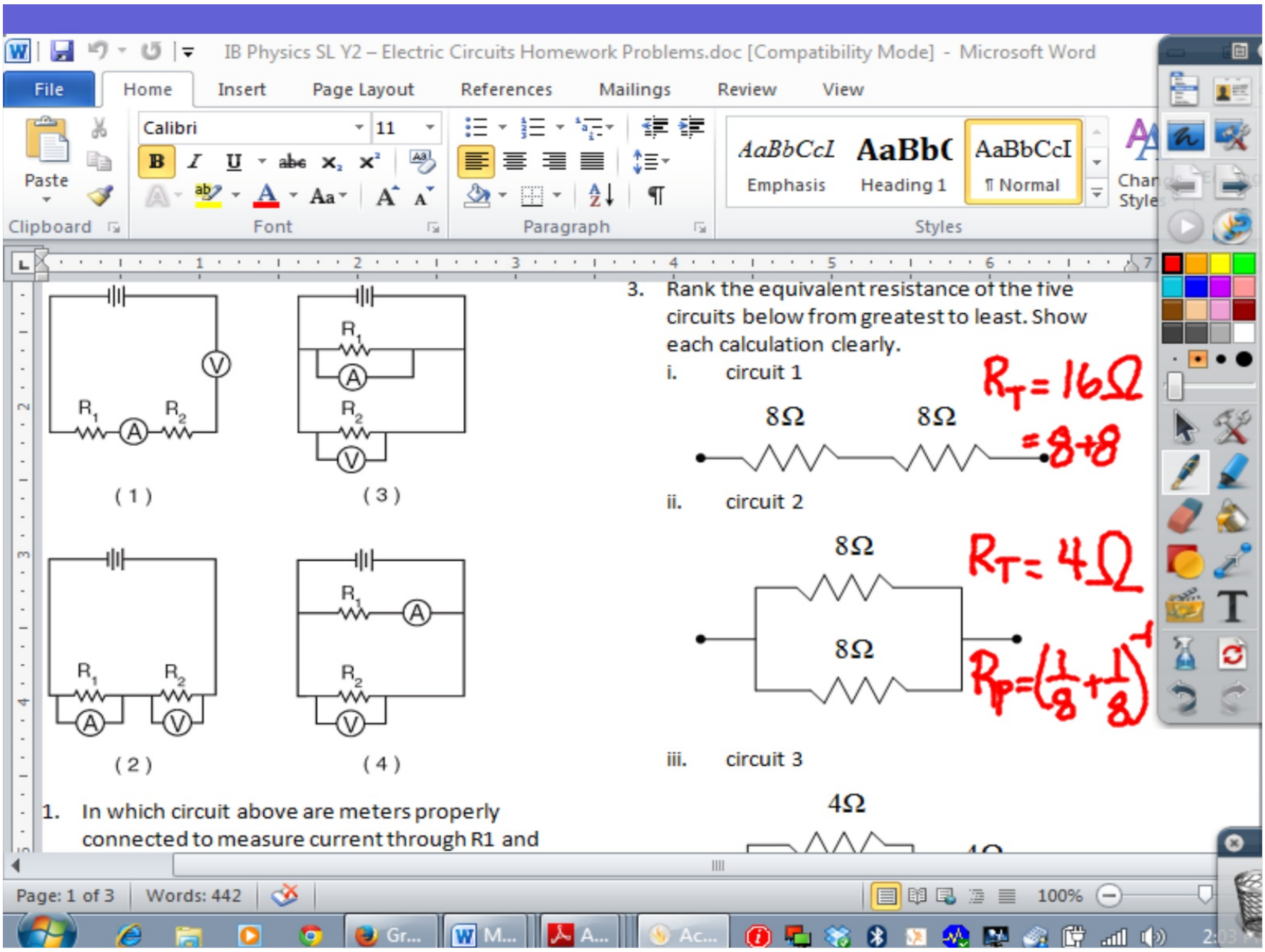


1. In which circuit above are meters properly connected to measure current through R1 and

3. Rank the equivalent resistance of the five circuits below from greatest to least. Show each calculation clearly.

i. circuit 1

8Ω 8Ω

$R_T = 16\Omega = 8+8$

ii. circuit 2

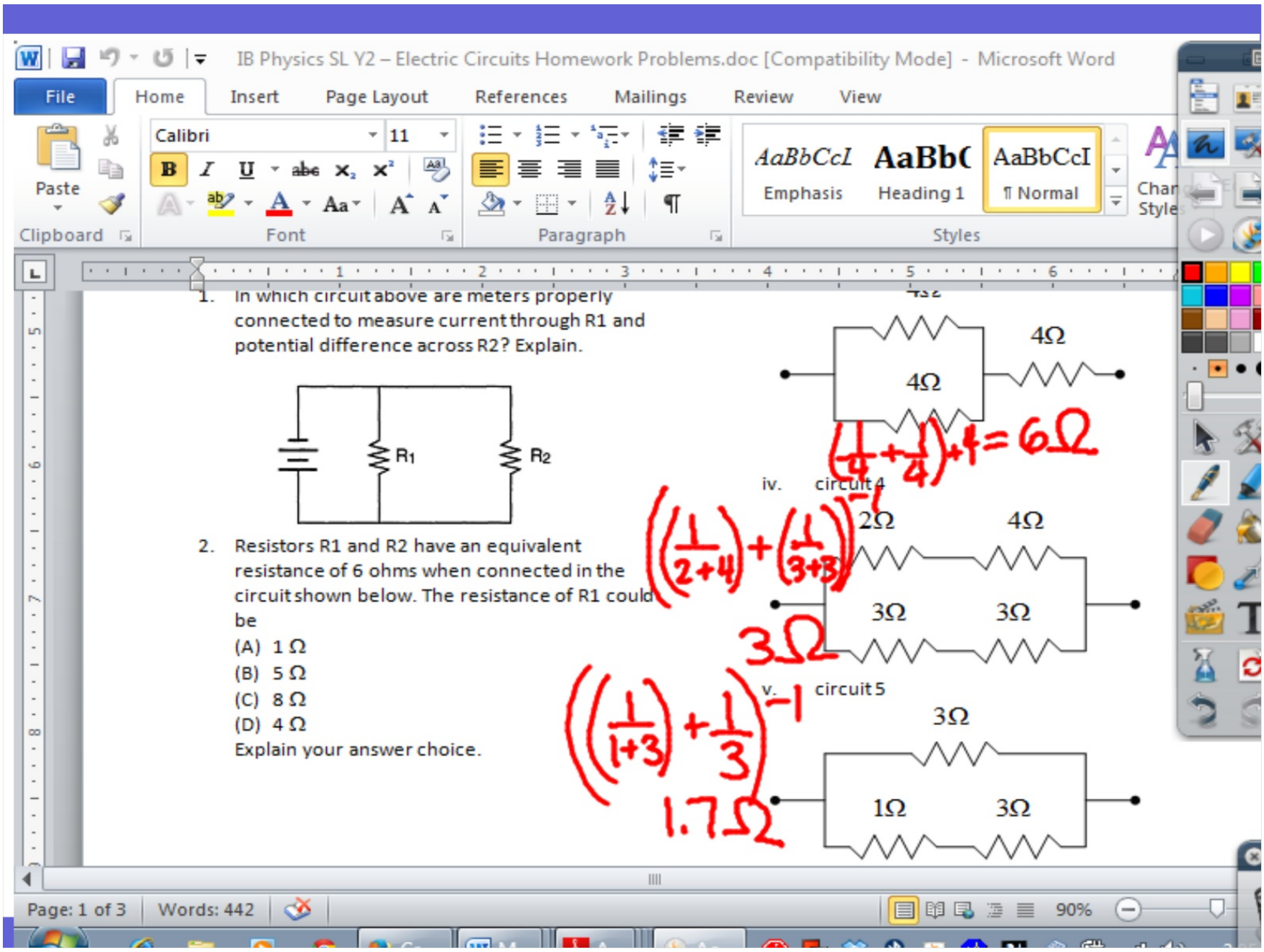
8Ω 8Ω

$R_T = 4\Omega$

$R_p = \left(\frac{1}{8}+\frac{1}{8}\right)^{-1}$

iii. circuit 3

4Ω



1. In which circuit above are meters properly connected to measure current through R1 and potential difference across R2? Explain.

2. Resistors R1 and R2 have an equivalent resistance of 6 ohms when connected in the circuit shown below. The resistance of R1 could be
(A) 1 Ω
(B) 5 Ω
(C) 8 Ω
(D) 4 Ω
Explain your answer choice.

4Ω 4Ω 4Ω

$\left(\frac{1}{4}+\frac{1}{4}\right)^{-1}+4 = 6\Omega$

iv. circuit 4

2Ω 4Ω 3Ω 3Ω

$\left(\left(\frac{1}{2+4}\right)+\left(\frac{1}{3+3}\right)\right)^{-1}$

3Ω

v. circuit 5

3Ω 1Ω 3Ω

$\left(\left(\frac{1}{1+3}\right)+\frac{1}{3}\right)^{-1}$

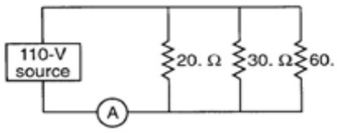
1.7Ω

4. Three identical resistors have an equivalent resistance of 12 ohms when connected in series. What is the equivalent resistance if they are connected in parallel?

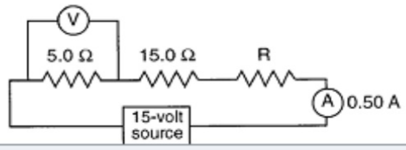
$12\Omega = R_T = R_1 + R_2 + R_3 = 3R$

$R = 4\Omega$

$R_p = \left(\frac{1}{4} + \frac{1}{4} + \frac{1}{4}\right)^{-1} = \boxed{1.3\Omega}$



5. The diagram above shows a parallel circuit.
- What is the equivalent resistance?
- What is the current measured by the ammeter?
- What is the voltage drop across each resistor?
- What is the current through each resistor?



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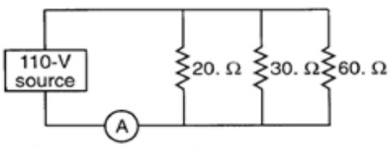


5. The diagram above shows a parallel circuit.
- What is the equivalent resistance? ✓
- What is the current measured by the ammeter? ✓
- What is the voltage drop across each resistor? ✓
- What is the current through each resistor?

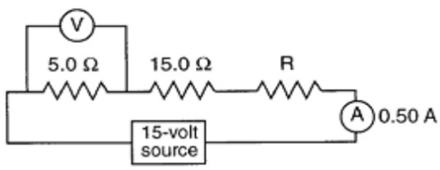
(a) $R_T = \left(\frac{1}{20} + \frac{1}{30} + \frac{1}{60}\right)^{-1} = \boxed{10\Omega}$

(b) $I_T = \frac{V_T}{R_T} = \frac{110V}{10\Omega} = \boxed{11A}$

(c) B/c the 20Ω, 30Ω, and 60Ω resistor are in parallel they all have the same potential difference ⇒ $\boxed{110V}$

(d) $I_{20\Omega} = \frac{110V}{20\Omega} = \boxed{5.5A}$ $I_{30\Omega} = \frac{110V}{30\Omega} = \boxed{3.7A}$

$I_{60\Omega} = \frac{110V}{60\Omega} = \boxed{1.8A}$



6. Consider the series circuit shown above. A voltmeter and ammeter are connected as shown.

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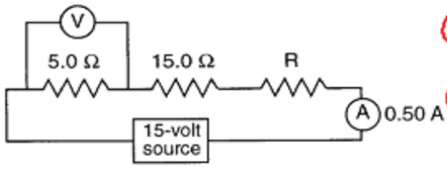
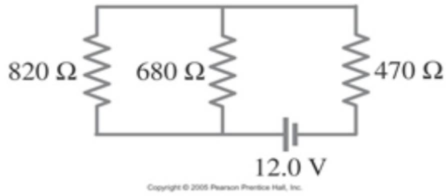


(a) $V = IR = (0.50A)(5.0\Omega) = \boxed{2.5V}$

(b) $V_T = I_T R_T$ $\quad R = R_T - 5 - 15 \Rightarrow \boxed{R = 10\Omega}$

$15V = (0.50A)R_T \Rightarrow R_T = 30\Omega$

6. Consider the series circuit shown above. A voltmeter and ammeter are connected as shown.
   - What reading would the voltmeter show? ✓
   - What is the value of the resistor R? ✓



7. Determine (a) the equivalent resistance of the circuit shown above, (b) the voltage across each resistor,

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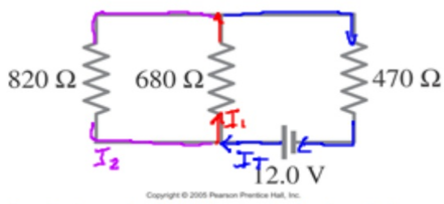

(a) $R_T = 470\Omega + \left(\frac{1}{680} + \frac{1}{820}\right)^{-1} = 841.7\Omega = \boxed{840\Omega}$ 2 SF!

(b) $I_T = \frac{12.0V}{840\Omega} = \boxed{.014A}$

$V_{470\Omega} = (.014A)(470\Omega) = 6.58 = \boxed{6.6V}$

7. Determine (*a*) the equivalent resistance of the circuit shown above, (*b*) the voltage across each resistor, and (*c*) the current through each resistor.

$V_{680\Omega} = V_{820\Omega} = V_T - V_{470\Omega} = 12V - 6.6V = \boxed{5.4V}$

(c) $I_T = I_{470\Omega} = 0.014A$

$I_{680\Omega} = V_{680\Omega}/R = 5.4V/680\Omega = \boxed{.0079A}$ $\quad I_{820\Omega} = \frac{V_{820\Omega}}{R} = \frac{5.4V}{820\Omega} = \boxed{.0066A}$

8. Calculate the terminal voltage for a battery with an internal resistance of 0.90Ω and an emf of 8.50V when the battery is connected in series with *(a)* an 81.0-Ω resistor, and *(b)* a 810.0-Ω resistor.

9. What is the internal resistance of a 12.0-V car battery whose terminal voltage drops to 8.4 V when the starter draws 75 A? What is the resistance of the starter?

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8. Calculate the terminal voltage for a battery with an internal resistance of 0.90Ω and an emf of 8.50V whe[n] the battery is connected in series with (a) an 81.0-Ω resistor, and (b) a 810.0-Ω resistor.

(a) $V_T = \mathcal{E} - Ir \qquad \mathcal{E} = I_T R_T \Rightarrow I_T = \frac{\mathcal{E}}{R_T} = \frac{\mathcal{E}}{R+r} = \frac{8.50V}{81+.9} = .1038A$

$= 8.50 - (.1038A)(.9\Omega) \qquad \boxed{V_T = 8.4V}$ (a)

9. What is the internal resistance of a 12.0-V car battery whose terminal voltage drops to 8.4 V when the starter draws 75 A? What is the resistance of the starter?

(b) $V_T = \mathcal{E} - Ir \qquad I_T = \frac{8.50}{810+.9} = .01048A$

$= 8.50 - (.01048A)(.9)$

$= 8.49V \Rightarrow \boxed{V_T = 8.5V}$ (b)

10. A 5.0-ohm resistor, a 20.0-ohm resistor, and a 24-volt source of potential difference are connected in parallel. A single ammeter is placed in the circuit to read the total current.

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9. What is the internal resistance of a 12.0-V car battery whose terminal voltage drops to 8.4 V when the starter draws 75 A? What is the resistance of the starter?

$\mathcal{E} = 12.0V$

$\Delta V_T = 8.4V$

$I = 75A$

$\mathcal{E} = I_T R_T$

$\mathcal{E} = I_T(R+r)$

$\therefore R = \frac{\mathcal{E}}{I_T} - r = \left(\frac{12.0V}{75A}\right) - .048\Omega = .112\Omega = \boxed{.11\Omega}$ (ii)

$V = \mathcal{E} - Ir$

$\therefore r = \frac{V - \mathcal{E}}{-I} = \frac{(8.4V)(12.0V)}{-(75A)} = \boxed{.048\Omega}$ (i)

10. A 5.0-ohm resistor, a 20.0-ohm resistor, and a 24-volt source of potential difference are connected in parallel. A single ammeter is placed in the circuit to read the total current.

- On the diagram below, draw in wires connecting the components shown to make a complete circuit that will function as described above.

5.0 Ω

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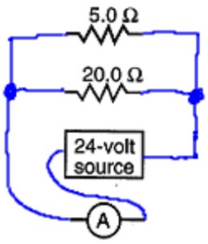
10. A 5.0-ohm resistor, a 20.0-ohm resistor, and a 24-volt source of potential difference are connected in parallel. A single ammeter is placed in the circuit to read the total current.

- On the diagram below, draw in wires connecting the components shown to make a complete circuit that will function as described above.



(a) $R_T = \left(\frac{1}{5}+\frac{1}{20}\right)^{-1} = 4.0\Omega$

(b) $I_T = \frac{V_T}{R_T} = \frac{(24V)}{(4.0\Omega)} = 6.0A$

- Determine the total resistance. (a)
- Determine the total current measured by the ammeter. (b)

11. Three 240-Ω resistors can be connected together in four different ways, making combinations of series and/or parallel circuits. What are these four ways, and what is the net resistance in each case?

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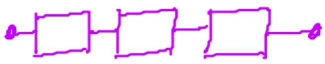
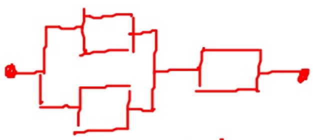
8. Three 240-Ω resistors can be connected together in four different ways, making combinations of series and/or parallel circuits. What are these four ways, and what is the net resistance in each case?



(1) $R_T = 240+240+240 = 720\Omega$

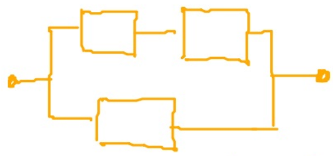
(2) $R_T = \left(\frac{1}{240}+\frac{1}{240}+\frac{1}{240}\right)^{-1} = 80\Omega$

(3)



$R_T = \left(\frac{1}{240}+\frac{1}{240}\right) + 240 = 360\Omega$

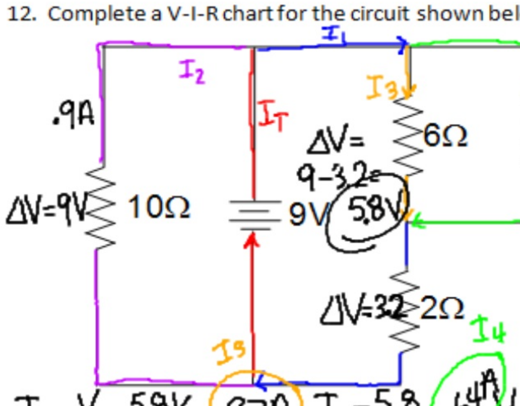
(4)



$R_T = \left(\frac{1}{240}+\frac{1}{240+240}\right)^{-1} = 160\Omega$

11. Three 240-Ω resistors can be connected together in four different ways, making combinations of series and/or parallel circuits. What are these four ways, and what is the net resistance in each case?

12. Complete a V-I-R chart for the circuit shown below.



$$R_T = \left(\frac{1}{10} + \frac{1}{2 + \left(\frac{1}{6} + \frac{1}{9}\right)^{-1}}\right)^{-1}$$

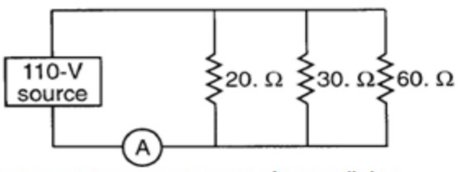
$R_T = 3.6\,\Omega$

$I_T = \frac{V_T}{R_T} = \frac{9V}{3.6\Omega} = 2.5A$

$V_T = V_{10\Omega} = 9V \Rightarrow I_{10\Omega} = \frac{V_T}{R} = \frac{9.0V}{10\Omega} = .9$ (I_2)

$I_1 = I_T - I_2 = 2.5 - .9 = 1.6A$ (I_1)

$I_3 = \frac{V}{R} = \frac{5.8V}{6\Omega} = .97A$ $\quad I_4 = \frac{5.8}{9.0\Omega} = .64A$ $\quad V_{2\Omega} = I_1 R = (1.6A)(2\Omega) = 3.2V$

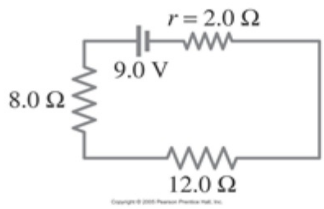


13. Three resistors are connected in parallel as shown above. What is the total power dissipated?

$V_T = 110V$

$R_T = 10\Omega$

$P = \frac{V^2}{R} = \frac{(110V)^2}{(10\Omega)} = 1210W$



14. Three resistors are connected in series as shown above. What is the total power dissipated?

$V_T = 9.0V$

$R_T = 8.0\Omega + 2.0\Omega + 12.0\Omega = 22\Omega$

$P = \frac{V^2}{R} = \frac{(9.0V)^2}{22\Omega} = 3.7W$