ECT150
Homework #2 Key
Sr. Professor Wheeler

Chapter 3 problems 1-24
Total Points: 24

All work must be shown, and final answers boxed or underlined. No credit if work is not shown.

1. If voltage is doubled (2x) and resistance is halved (1/2x), the new current will be 4 times the original value.

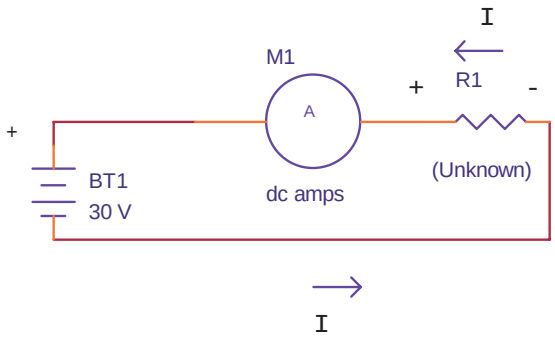
2. If the current triples but the resistance stays the same, what happens to the power?

$P_1 = I^2 R$ describes the original power, and
$P_2 = (3I)^2 R$ describes the power with the current tripled; therefore:

$$\frac{P_2}{P_1} = \frac{(3I)^2 R}{I^2 R} = \frac{9I^2 R}{I^2 R} = \underline{9}$$

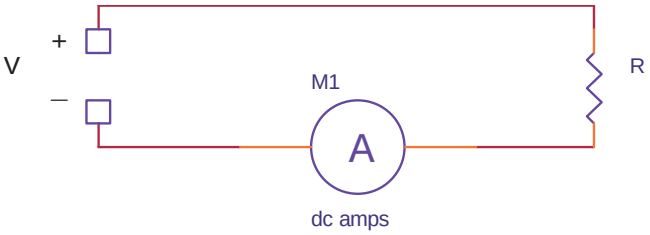
The power increases by a factor of 9.

3. The circuit looks like this:



The resistance is found by:

$$R = \frac{V}{I} = \frac{30V}{2mA} = \underline{\underline{15k\Omega}}$$



(Figure 3-17, used for questions 4-21)

4. Given: V=50V, R=33K; Find: I

$$I = \frac{V}{R} = \frac{50V}{33K} = \underline{\underline{1.52mA}}$$

5. Given: I=3 mA, R=12K; Find V

$$V = IR = (3mA)(12K) = \underline{\underline{36V}}$$

6. How will the items change if the voltage in question 5 were doubled?

a) V will double ("Who is buried in Grant's tomb?")
b) R will remain the same
c) I will double since current is directly proportional to voltage

7. Given I=50 mA and V=41 V; Find R

$$R = \frac{V}{I} = \frac{41V}{50mA} = \underline{\underline{820\Omega}}$$

8. Given: P=100 mW, I=12.5 mA; Find V

$$P = V \times I$$

$$\therefore V = \frac{P}{I} = \frac{100mW}{12.5mA} = \underline{\underline{8V}}$$

9. Given: R=10 Ω, P=100W; Find: I

$$P = I^2 R$$

$$\therefore I = \sqrt{\frac{P}{R}} = \sqrt{\frac{100W}{10\Omega}} = \underline{\underline{3.16A}}$$

10. Given: $P_{original}$=180 W, and the current falls to 1/3 its original value; Find P_{new}

$$P_1 = I_1^2 R = 180W$$
$$P_2 = I_2^2 R = ???$$
$$\frac{P_1}{P_2} = \frac{I_1^2 R}{I_1^2 R} = \left(\frac{I_1}{I_2}\right)^2$$
$$I_2 = \frac{I_1}{3}$$
$$\therefore P_2 = P_1\left(\frac{I_2}{I_1}\right)^2 = 180W\left(\frac{(I_1/3)}{I_1}\right)^2 = 180W\left(\frac{1}{3}\right)^2 = \underline{\underline{20W}}$$

Note to students: This looks complicated, but it is really just demonstrating that power is proportional to the *square* of current.

11. Given: V=100 V; Find the value of R that will "limit" the current to 8.5 mA

$$R = \frac{V}{I} = \frac{100V}{8.5mA} = \underline{\underline{11.764K\Omega}}$$

12. Given: Original voltage = 100 V, original resistance = 25k.
Find: The current if V is doubled and R is tripled.

$$V_{new} = V \times 2 = 200V$$
$$R_{new} = R \times 3 = 75k$$
$$I_{new} = \frac{V_{new}}{R_{new}} = \frac{200V}{75k} = \underline{\underline{2.67mA}}$$

13. The power will increase if V and R are both doubled; the reason is that power is $\frac{V^2}{R}$; if both V and R are doubled, the power becomes (4/2) or *twice* its original value.

14. Given: V=150 V, R=8k; Find: I

$$I = \frac{V}{R} = \frac{150V}{8K} = \underline{\underline{18.75mA}}$$

15. Find the power dissipated by the circuit of problem 14.

$$P = \frac{V^2}{R} = \frac{150V^2}{8K\Omega} = \underline{\underline{2.81W}}$$

16. Given the data of problem 14, express the energy (in Watt-Hours) that the circuit will consume over a period of 3 hours.

Energy = Power x Time = (2.81W) x (3 Hr) = 8.43 W-H

17. Given: V=250 V, R=12 k; Find: I

$$I = \frac{V}{R} = \frac{250V}{12K} = \underline{\underline{20.83mA}}$$

18. Find the power under the conditions of problem 17.

$$P = \frac{V^2}{R} = \frac{250V^2}{12K\Omega} = \underline{\underline{5.21W}}$$

19. Given the data of problem 17, express the energy (in Watt-Hours) that the circuit will consume over a period of 6.5 hours.

Energy = Power x Time = (5.21W) x (6.5 Hr) = 33.87 W-H

20. Given: V=100 V, P=50 mW; Find: R

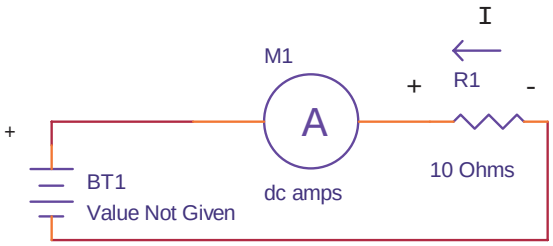
$$P = \frac{V^2}{R}$$

$$\therefore R = \frac{V^2}{P} = \frac{100V^2}{50mW} = \underline{\underline{200K\Omega}}$$

21. Given: P=100 mW, R=10k. Find; V

$$V = \sqrt{PR} = \sqrt{(100mW)(10k\Omega)} = \underline{\underline{31.6V}}$$

22. Draw a schematic diagram showing a source, a resistor, and an ammeter. Assume the power dissipation is 1000W and the resistance is 10 Ohms. Solve for the current I.



$$P = I^2 R$$

$$I = \sqrt{\frac{P}{R}} = \sqrt{\frac{1000W}{10\Omega}} = \underline{\underline{10A}}$$

23. Calculate the applied voltage for problem 22.

$$V = IR = (10A)(10\Omega) = \underline{\underline{100V}}$$

24. Label all the parameters on the circuit diagram for question 22 and indicate the direction of current flow throughout the circuit, and the polarity of voltages across each component.