FULL NAME (Printed): * SOLUTIONS *

Program: _____

You have the entire period to complete this examination. You are allowed your Sharp EL-516 calculator and the DC Formula Sheet from the text (provided). All of the questions are equally weighted

- **M/C Questions**
  - Circle the correct answer
  - NO partial credit will be awarded
- **Work the Problem Questions**
  - SHOW ALL your work in the space provided
  - BOX-IN your final answer
  - Partial credit may be awarded

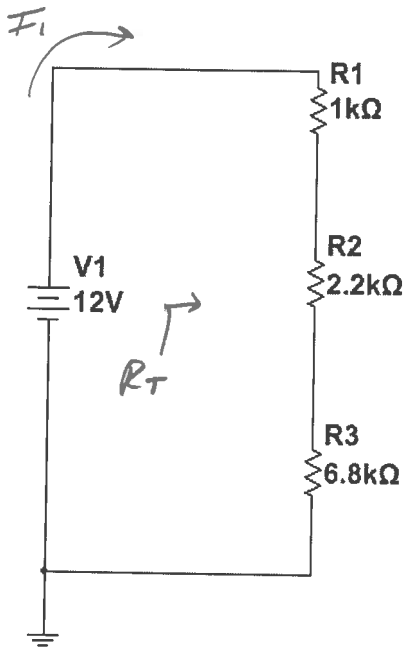


Figure 1- Schematic for Problems 1 - 3

1. See Figure 1. The total resistance in this circuit is (as seen by the source):

   a. 624 Ohms
   b. 1000 Ohms
   c. 10 k-Ohms
   d. 12 k-Ohms

$R_T = R_1 + R_2 + R_3$
$= 10k_\Omega$

2. See Figure 1. The total current flowing from the battery is

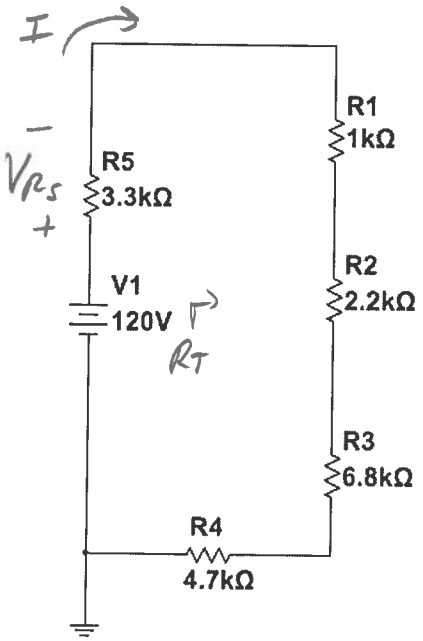
   a. 1.0 mA
   b. 1.2 mA
   c. 1.8 mA
   d. 12 mA

$I_1 = \frac{V_1}{R_T} = \frac{12V}{10k_\Omega} = 1.2mA$

3. See Figure 1. The total power dissipated by the 2.2 k-ohm resistor is

   a. 3.17 mW
   b. 14.4 mW
   c. 23.2 mW
   d. 144 mW

$P_{R2} = (I_{R2})^2 R_2$
$= (I_1)^2 R_2 = (1.2mA)^2 (2200_\Omega)$
$= 3.17mW$



$R_T = R_1 + R_2 + R_3 + R_4 + R_5$

$= 18k\Omega$

Figure 2- Schematic for Problems 4 through 6

4. See Figure 2. How much power is dissipated by R_5?
   a. 6.67 mW
   b. 36.4 mW
   c. 132.2 mW
   d. 146.7 mW

$P_{R5} = \frac{V_{R5}^2}{R_5}$, $V_{R5} = V_1 \frac{R_5}{R_T}$

$= 120V\left(\frac{3.3k\Omega}{18k\Omega}\right)$

$= 22V$

$P_{R5} = \frac{(22V)^2}{3300\Omega} = 146.7mW$

5. See Figure 2. If R_3 is open circuited, how much power is dissipated by R_5?
   a. 0 W
   b. 1.76 mW
   c. 6.76 mW
   d. 36.4 mW

$I = 0$

$\therefore P_{R5} = (I_{R5})^2 (R_5) = 0W$

6. See Figure 2. Which *one* of the following statements is true *if the 120V source is replaced by a 60V source*?
   a. The power dissipated by R5 will decrease to half of its original value ×
   b. The current in the circuit will reduce to half its original value ← $I = V/R$
   c. The power dissipated by R5 will decrease by 25% ×
   d. The voltage across R3 will decrease by 25% × ← V_{R3} would decrease 50%

$P_{R5\ NEW} = \frac{V_{R5}^2}{R_5} = \frac{(11V)^2}{3300\Omega} = 36.7mW$, 25% of P_{R5} original

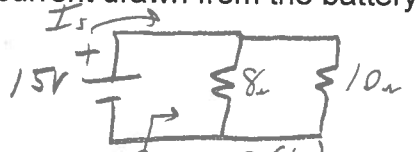
7. The total *resistance* of a 10 ohm resistor and a 100 ohm resistor in parallel is

a. 0.110 Ohms
b. 7.07 Ohms
c. 9.09 Ohms
d. 1010 Ohms

$R_T = \frac{10(100)}{10+100} = 9.09\Omega$

8. A 10 ohm resistor and an 8 ohm resistor are connected in parallel across a 15 V battery. What is the total current drawn from the battery?

a. 0.830 A
b. 1.50 A
c. 1.88 A
d. 3.38 A



$R_T = \frac{8(10)}{10+8} = 4.44\Omega$

$I_s = \frac{15V}{R_T} = \frac{15V}{4.44\Omega} = 3.38A$

9. What is the total conductance of a parallel circuit with three resistors with values of 80, 120 and 220 ohms?

a. 25.4 mS
b. 39.4 mS
c. 53.8 mS
d. 39.4 S

$R_T = \frac{1}{\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}} = \frac{1}{\frac{1}{80}+\frac{1}{120}+\frac{1}{220}} = 39.4\Omega$

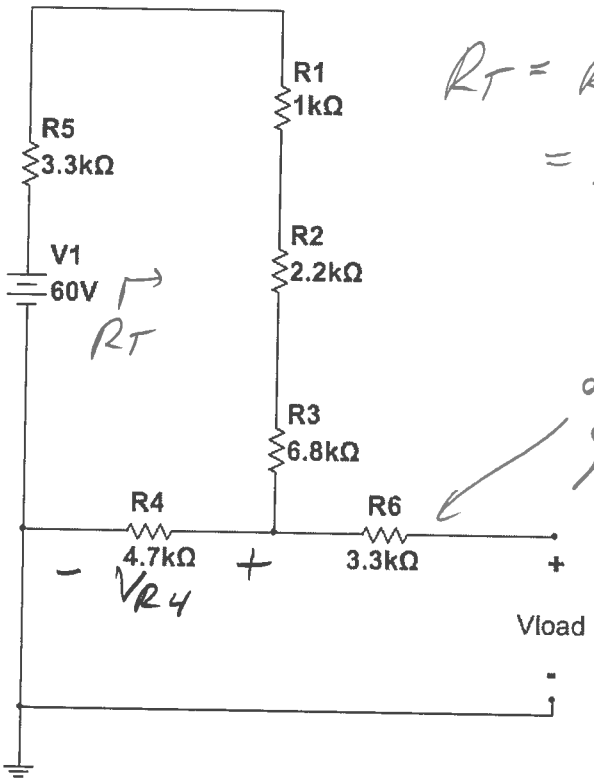
$\therefore G_T = \frac{1}{R_T} = 25.4\,mS$

or $G_T = \frac{1}{80\Omega}+\frac{1}{120\Omega}+\frac{1}{220\Omega} = 25.4mS$

10. As additional resistors are added (in parallel) to a parallel circuit, what will happen to the total conductance of the circuit?

$R_T \downarrow \therefore G_T \uparrow$

a. The total conductance will decrease
b. The total conductance will increase
c. The total conductance will remain the same ×
d. It depends on the number of resistors added whether the conductance will increase or decrease ×



$R_T = R_1 + R_2 + R_3 + R_4 + R_5$
$= 18k\Omega$

o/c ∴ NO CURRENT HENCE NO VOLTAGE DROP

Figure 3 - Schematic for Questions 11, 12 and 13

11. See Figure 3. What is the open circuit output voltage Vload?

a. 0 V
b. 15.7 V
c. 21.2 V
d. 60 V

$V_{R4} = V_1\left(\frac{R_4}{R_T}\right) = 60V\left(\frac{4700\Omega}{18k\Omega}\right) = 15.67V$

KVL: $V_{R4} - V_{R6} - V_{LOAD} = 0$

$\therefore V_{LOAD} = V_{R4}$

12. See Figure 3. What is the new voltage Vload *if R4 is shorted*?

a. 0 V
b. 14.9 V
c. 21.2 V
d. 60 V

$V_{LOAD} = V_{R4} = 0V$

13. See Figure 3. What is the new voltage V_{load} *if R4 is open-circuited*?

a. 0 V
b. 14.9 V
c. 21.2 V
d. 60 V

$V_{R4} = V_1 = 60V$ (∴ NO CURRENT ∴ NO VOLTAGE DROPS)

$\therefore V_{LOAD} = 60V$

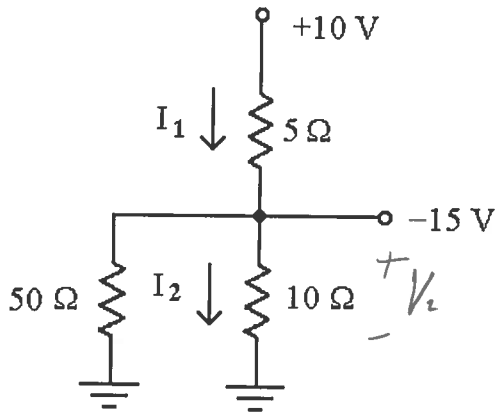


Figure 7.6

14. See Figure 7.6. What is the current I_2?

a. -2.0 A
b. -1.5 A
c. 1.5 A
d. 5.0 A

$$I_2 = \frac{V_2}{10\Omega} = \frac{-15V}{10\Omega} = -1.5A$$

15. See Figure 7.6. What is the power dissipated by the 50 ohm resistor?

a. 1.5 W
b. 2.0 W
c. 4.5 W
d. 22.5 W

$$P_{50\Omega} = \frac{(V_2)^2}{50\Omega} = \frac{(-15V)^2}{50\Omega} = 4.5W$$

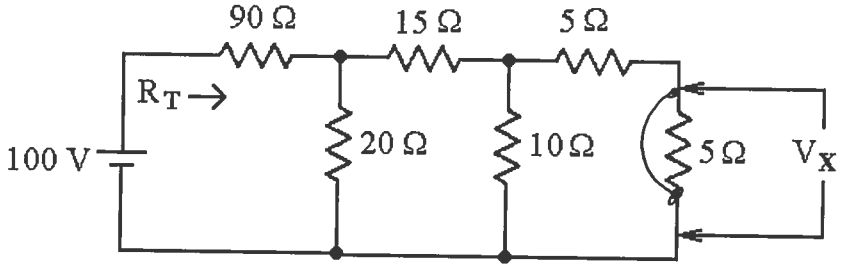


Figure 7.5

16. See Figure 7.5. What is R_T *if the 5 ohm resistor on the far right is short-circuited*?

a. 18.7 Ohms
b. 90.0 Ohms
c. 99.6 Ohms
d. 110 Ohms

$$R_T = \left([5\Omega // 10\Omega] + 15\Omega\right) // 20\Omega + 90\Omega$$
$$18.33\Omega // 20\Omega + 90\Omega$$
$$R_T = 99.6\Omega$$

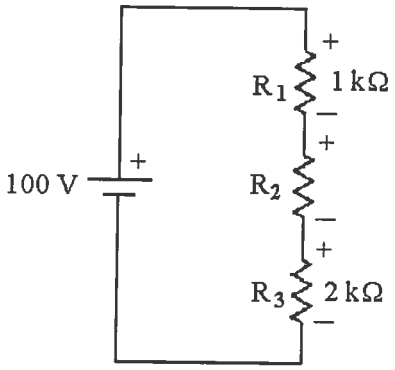


Figure 5.6

17. See Figure 5.6. Use voltage divider to *choose R_2 such that V_{R3} = 30 V (polarity as shown)*

$V_{R3} = 100V\left(\frac{R_3}{R_T}\right) = 30V$, $R_T = R_1 + R_2 + R_3$
$= 3k\Omega + R_2$

$\therefore 100V\left(\frac{2k\Omega}{R_2 + 3k\Omega}\right) = 30V$

$\boxed{R_2 = 3.67k\Omega}$

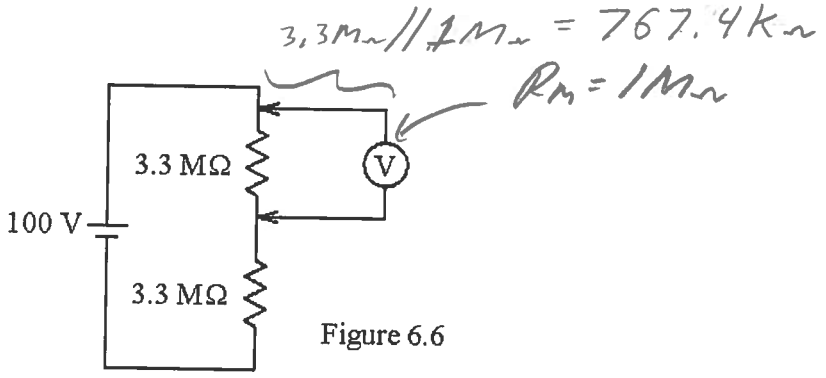


Figure 6.6

18. See Figure 6.6. Compute the voltage reading if a digital multimeter with 1 M-ohm of internal resistance is used.

$V = 100V\left(\frac{767.4k\Omega}{767.4k\Omega + 3,3M\Omega}\right) = \boxed{18.9V}$

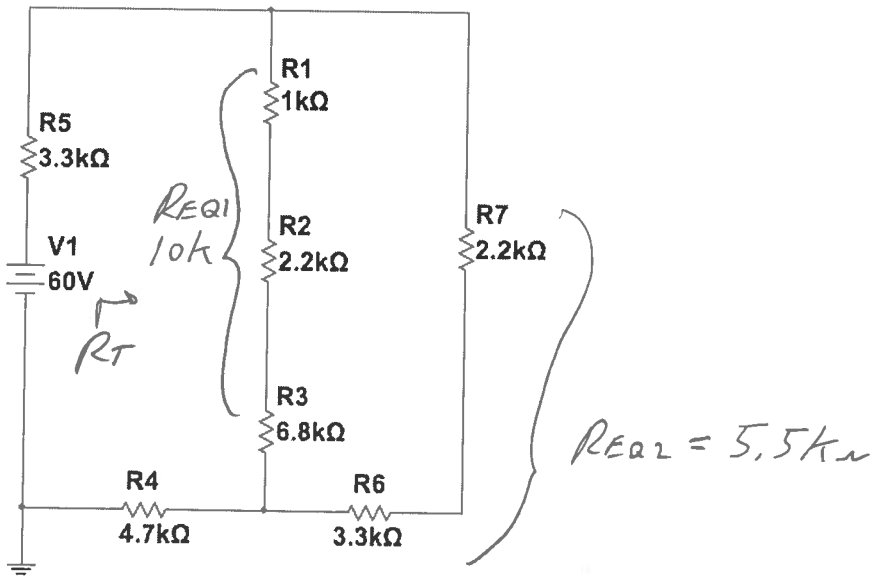


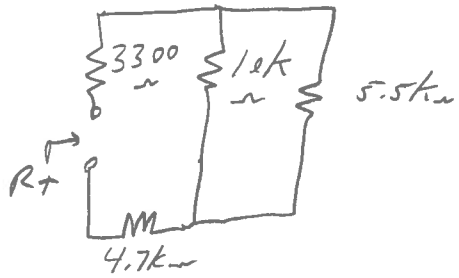
Figure 4 - Schematic for Questions 19 and 20

19. See Figure 4. What is the total resistance seen by the source?

$R_T = 5.5k\Omega // 10k\Omega + 3300\Omega + 4700\Omega$

$3.548k\Omega$

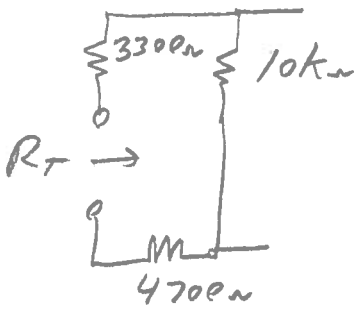
$\boxed{R_T = 11.55k\Omega}$



20. See Figure 4. If R6 is replaced by an open-circuit, what is the total resistance seen by the source?

$R_T = 3300\Omega + 10k\Omega + 4700\Omega$

$= \boxed{18k\Omega}$



KEY

1. C
2. B
3. A

4. D
5. A
6. B

7. C
8. D
9. A
10. B

11. B
12. A
13. D

14. B
15. C
16. C

17. 3,667 Ohms
18. 18.87 V

19. 11,548 Ohms
20. 18,000 Ohms