資工二 A 107502520 黃允誠

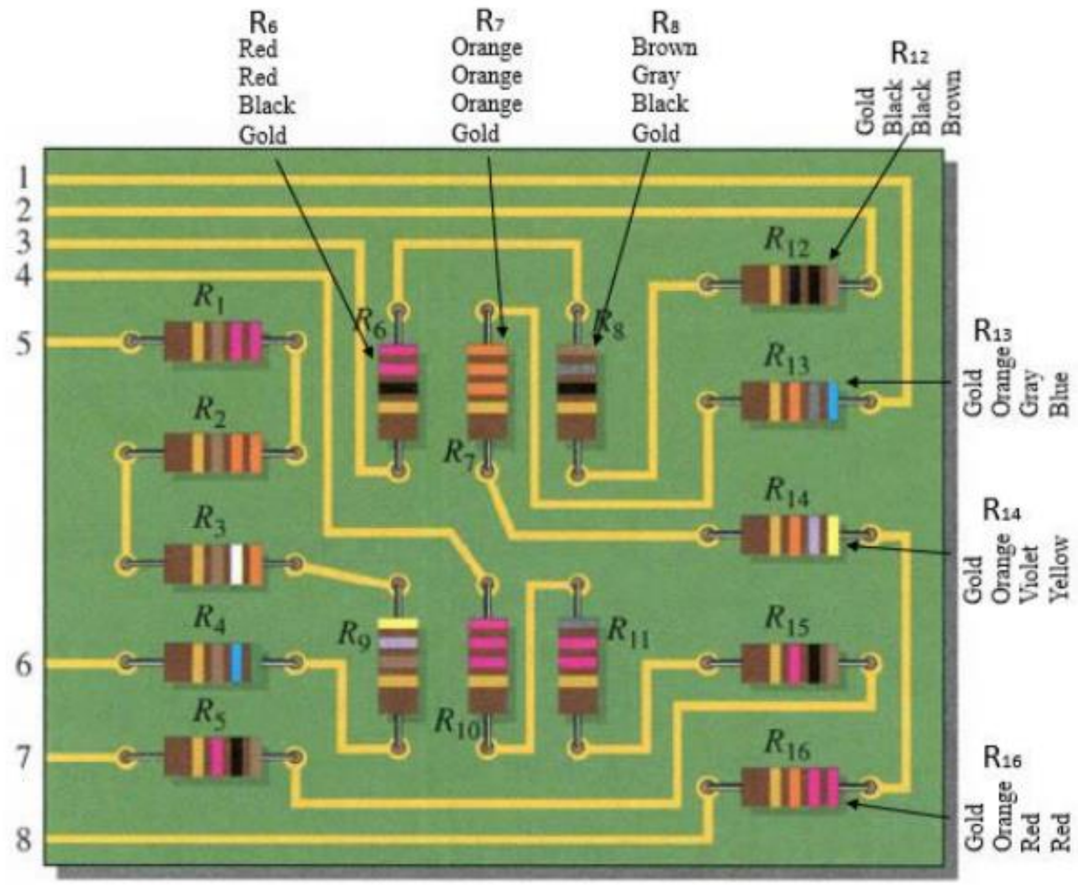
Electronic Circuits Homework 2

1. (a) Determine which resistance between pins 1 and 8 in the circuit board in Figure 1. (4-3)

   $68000 + 33000 + 47000 + 22000 = 170000\ (\Omega)$

   (b) Determine which resistance between pins 2 and 3 in the circuit board in Figure 1. (4-4)

   $10 + 18 + 22 = 50\ (\Omega)$



	Digit	Color
Resistance value, first three bands: First band—1st digit Second band—2nd digit *Third band—multiplier (number of zeros following the 2nd digit)	0	Black
	1	Brown
	2	Red
	3	Orange
	4	Yellow
	5	Green
	6	Blue
	7	Violet
	8	Gray
	9	White
Fourth band—tolerance	±5%	Gold
	±10%	Silver

2. Determine the unspecified voltage drop(s) in each circuit of Figure 2. Show how to connect a voltmeter to measure each unknown voltage drop. (4-23)

$V_2 = 15 - 2 - 3.2 - 1 - 1.5 - 0.5 = 6.8\ (V)$

$V_s = 8 \times (1 + 1 + 2 + 3 + 4) = 88\ (V)$

伏特計應與待測電路並聯

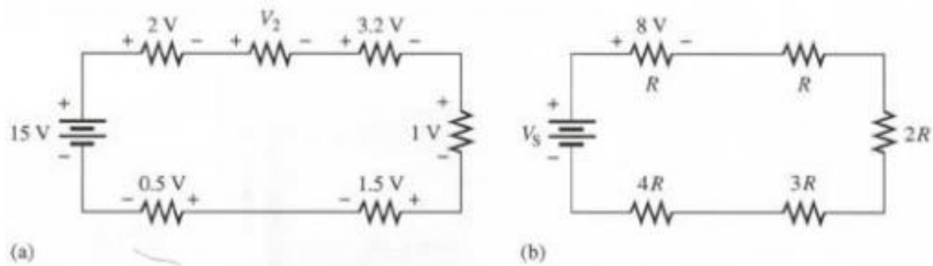


Figure 2

3. (a) Determine the voltage with respect to ground for output A, B, and C in Figure 3(a). (4-26)

A: $15\ (V)$

B: $15 \times \frac{10+3.3}{5.6+10+3.3} \approx 10.56\ (V)$

C: $15 \times \frac{3.3}{5.6+10+3.3} \approx 2.62\ (V)$

(b) Determine the minimum and maximum output voltage from the voltage divider in Figure 3(b). (4-27)

Minimum: $12 \times \frac{680}{470+1000+680} \approx 3.80\ (\mathrm{V})$

Maximum: $12 \times \frac{1000+680}{470+1000+680} \approx 9.38\ (\mathrm{V})$

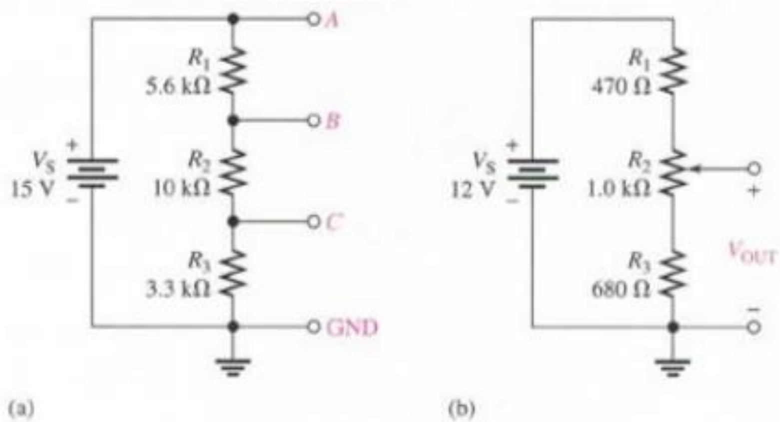


Figure 3

4. Find all the unknown quantities (shown in red) in Figure 4. (4-42)

$$\begin{cases} V_1 + V_2 + V_3 + V_4 + 6.6 + V_6 = 30 \\ V_2 + V_3 + V_4 + 6.6 = 20 \\ R_3 = R_4 \\ V_3 = V_4 \\ R_1 + 100 + R_3 + R_4 + R_5 + R_6 = \frac{30}{0.02} \\ 100 + R_3 + R_4 + R_5 = \frac{20}{0.02} \\ V_6 \times 0.02 = 0.112 \\ \frac{R_1}{V_1} = \frac{100}{V_2} = \frac{R_3}{V_3} = \frac{R_4}{V_4} = \frac{R_5}{6.6} = \frac{R_6}{V_6} \end{cases} \rightarrow \text{愉快(不)的數學時間} \rightarrow \begin{cases} R_1 = 220\ (\Omega) \\ V_1 = 4.4\ (\mathrm{V}) \\ V_2 = 2\ (\mathrm{V}) \\ R_3 = 285\ (\Omega) \\ V_3 = 5.7\ (\mathrm{V}) \\ R_4 = 285\ (\Omega) \\ V_4 = 5.7\ (\mathrm{V}) \\ R_5 = 330\ (\Omega) \\ R_6 = 280\ (\Omega) \\ V_6 = 5.6\ (\mathrm{V}) \end{cases}$$

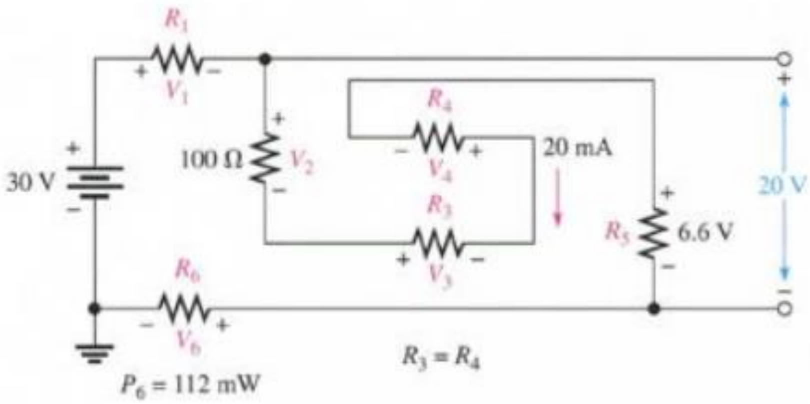


Figure 4

5. On the double-sided PC board in Figure 5, identify each group of series resistors and determine its total resistance. Note that many of the interconnections feed through the board from the top side to the bottom side. (4-49)

$1-4(10,1,7,8): 1000+2200+560+470=4230\ (\Omega)$

$2-3(6,2,4,11): 3300+4700+5600+10000=23600\ (\Omega)$

$5-6(5,3,9,12): 3900+1000+8200+6800=19900\ (\Omega)$

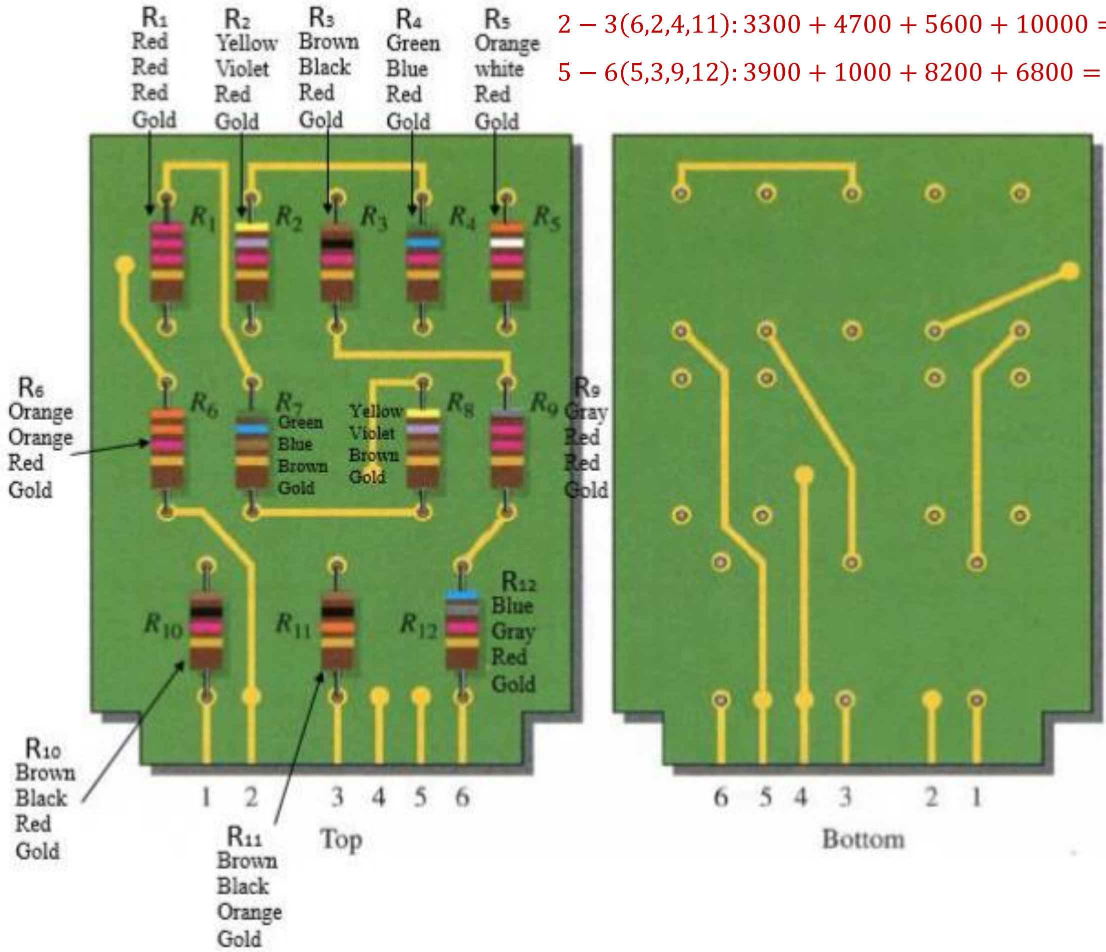


Figure 5

6. Calculate R_T for each circuit in Figure 6. (5-6)

(a) $\frac{1}{\frac{1}{4.7}+\frac{1}{2.2}} \approx 1.5\ (k\Omega)$

(b) $\frac{1}{\frac{1}{27}+\frac{1}{56}} \approx 18\ (\Omega)$

(c) $\frac{1}{\frac{1}{1.5}+\frac{1}{2.2}} \approx 0.89\ (k\Omega)$

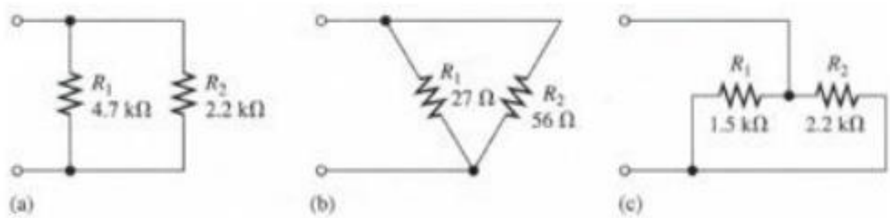


Figure 6

7. How much current is through R_2 and R_3 in Figure 7 if R_2 and R_3 have the same resistance? Show how to connect ammeters to measure these currents. (5-17)

$(50 - 10 - 25) \times 0.5 = 7.5\ (\text{mA})$

安培計應與待測電路串聯

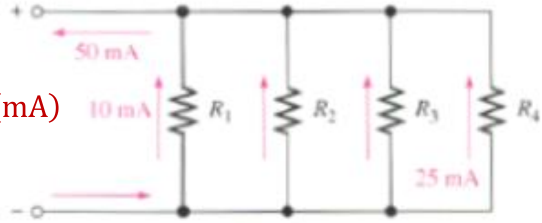
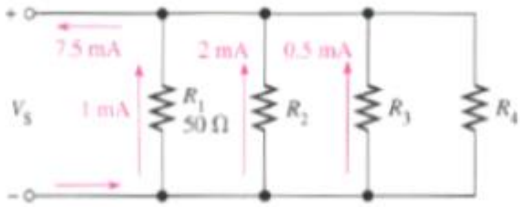


Figure 7

8. In the circuit of Figure 8, determine resistance R_2, R_3, and R_4. (5-31)



$R_2: 1 \times 50 \div 2 = 25\ (\Omega)$

$R_3: 1 \times 50 \div 0.5 = 100\ (\Omega)$

$R_4: 1 \times 50 \div (7.5 - 1 - 2 - 0.5) = 12.5\ (\Omega)$

Figure 8

9. Identify which groups of resistors are in parallel on the double-sided PC board in Figure 9. Determine the total resistance of each group. (5-41)

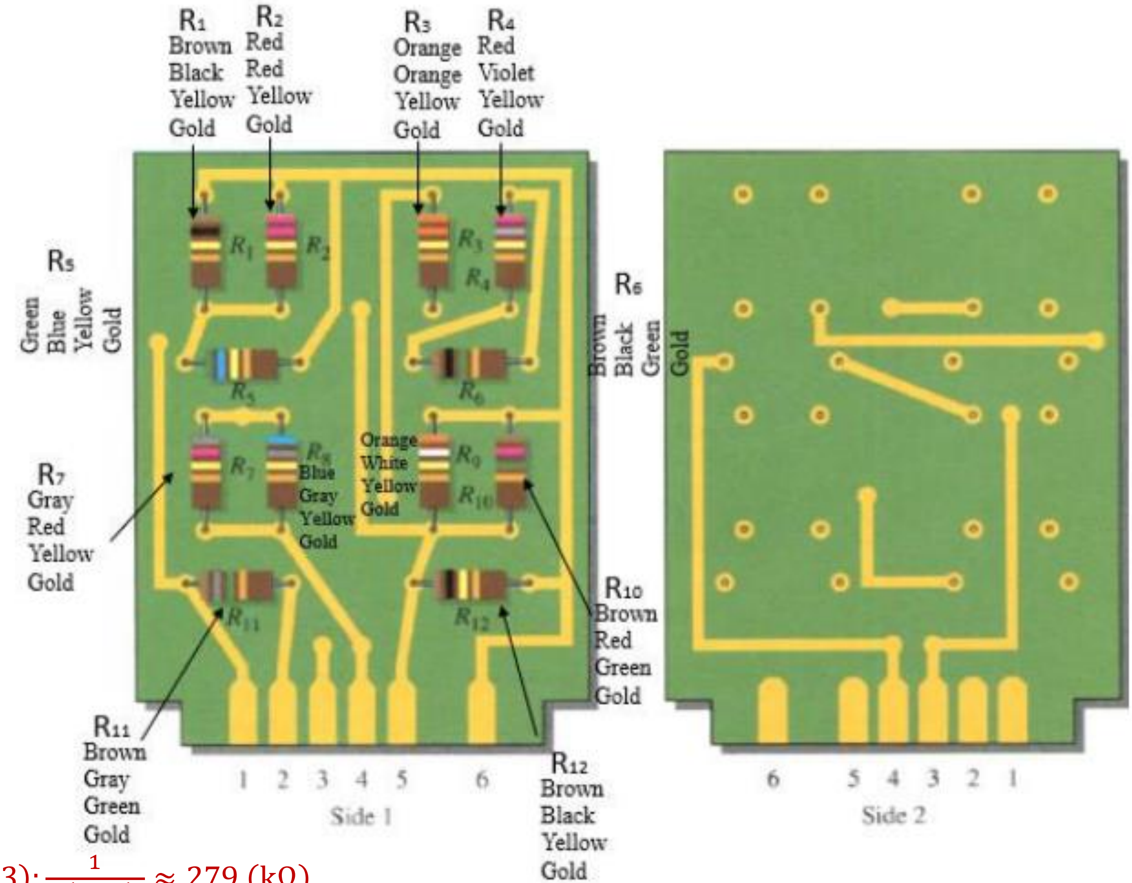


Figure 9

$1-2(11,3): \frac{1}{\frac{1}{1800}+\frac{1}{330}} \approx 279\ (\text{k}\Omega)$

$3-4(7,8,6,4): \frac{1}{\frac{1}{820}+\frac{1}{680}+\frac{1}{1000}+\frac{1}{270}} \approx 135\ (\text{k}\Omega)$

$5-6(12,9,10,2,1,5): \frac{1}{\frac{1}{100}+\frac{1}{390}+\frac{1}{1200}+\frac{1}{220}+\frac{1}{100}+\frac{1}{560}} \approx 34\ (\text{k}\Omega)$

10. In Figure 10, find the following: (6-10)

(a) Total resistance between terminals A and B

4 跟 5 並聯，然後跟 3 串聯，之後全部跟 2 和 1 並聯。

$$\frac{1}{\frac{1}{\frac{1}{\frac{1}{4.7}+\frac{1}{4.7}}+3.3}+\frac{1}{2.7}+\frac{1}{10}} \approx 1.5\ (\mathrm{k\Omega})$$ ←數學真美(P)

(b) Total current drawn from a 6 V source connected from A to B

$$I = \frac{V}{R} \approx \frac{6}{1.5} = 4\ (\mathrm{mA})$$

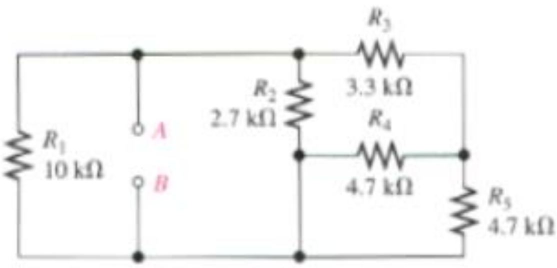


Figure 10

11. Determine the value of R_X in the balanced in Figure 11. (6-25)

Thevenin's theorem:

$$\frac{R_V}{R_V+R_X} = \frac{R_4}{R_4+R_2} \rightarrow \frac{5}{5+R_X} = \frac{1.5}{1.5+2.2}$$

$$\rightarrow R_X \approx 7.3\ (\mathrm{k\Omega})$$

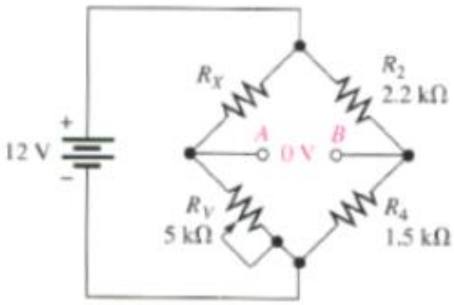


Figure 11

12. Determine the output voltage of the unbalanced bridge in Figure 12 for a temperature of 65°C. The thermistor has a nominal resistance of 1 k Ω at 25°C and a positive temperature coefficient. Assume that its resistance changes 5 Ω for each C° change in temperature. (6-26)

$$R_1 = 1 + 0.005 \times (65 - 25) = 1.2\ (\mathrm{k\Omega})$$

Thevenin's theorem:

$$V_{out}(\text{from A to B}) = 9 \times \frac{1}{1+1.2} - 9 \times \frac{1}{1+1} =$$

$$= -\frac{9}{22} \approx -0.4\ (\mathrm{V})$$

$$\rightarrow V_{out} = 0.4\ (\mathrm{V})\ (\text{from B to A})$$

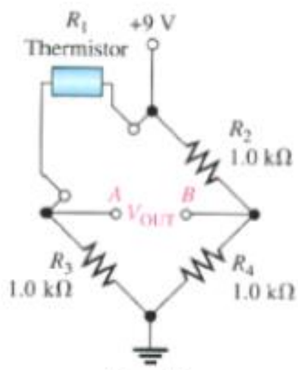


Figure 12

13. For each circuit in Figure 13, determine the Thevenin equivalent as seen from terminals A and B. (6-28)

(a) $V_{TH} = 2.5 \times \frac{78}{100+78+47} \approx 0.87\ (V)$ $\quad R_{TH} = 22 + \frac{1}{\frac{1}{100+47}+\frac{1}{78}} = 72.96\ (\Omega)$

(b) $V_{TH} = 3 \times \frac{100}{100+270} \approx 0.81\ (V)$ $\quad R_{TH} = \frac{1}{\frac{1}{100}+\frac{1}{270}} = 72.97\ (\Omega)$

(c) $V_{TH} = 1.5 \times \frac{56}{100+56} \approx 0.54\ (V)$ $\quad R_{TH} = \frac{1}{\frac{1}{100}+\frac{1}{56}} = 35.90\ (k\Omega)$

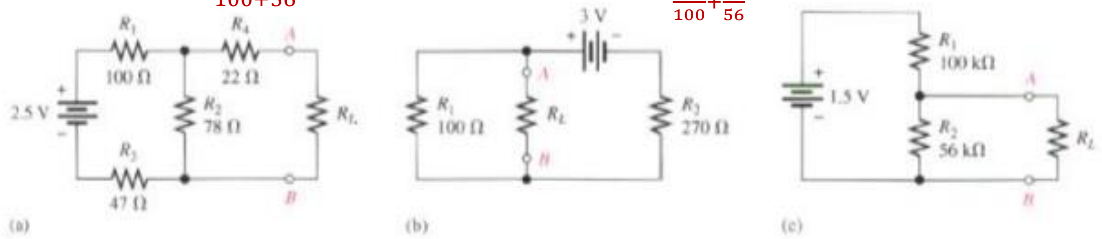


Figure 13

14. (a) In Figure 14, use the superposition theorem to find the current in R_3.
(b) In Figure 14, what is the current through R_2. (6-34)

(a) $\frac{1}{100+\frac{1}{\frac{1}{56}+\frac{1}{27}}} \times \frac{56}{56+27} + \frac{1.5}{56+\frac{1}{\frac{1}{100}+\frac{1}{27}}} \times \frac{100}{100+27} \approx 0.021\ (A) = 21\ (mA)$

(b) $\frac{1}{100+\frac{1}{\frac{1}{56}+\frac{1}{27}}} \times \frac{27}{56+27} - \frac{1.5}{56+\frac{1}{\frac{1}{100}+\frac{1}{27}}} \approx -0.017\ (A) = -17\ (mA) \rightarrow 17\ (mA)$ (direction: ↓)

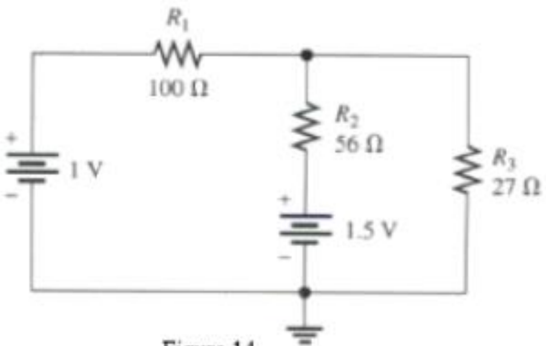


Figure 14

15. Using Thevenin's theorem, find the voltage across R_4 in Figure 15. (6-53)

$V_{answer} = 50 \times \frac{R_{answer}}{R_{answer}+R_3}$

$\rightarrow R_{answer} = \frac{1}{\frac{1}{R_4}+\frac{1}{R_6}+\frac{1}{\frac{1}{\frac{1}{R_2}+\frac{1}{R_5}}+R_1}}$

$= \frac{1}{\frac{1}{10}+\frac{1}{4.7}+\frac{1}{\frac{1}{\frac{1}{3.3}+\frac{1}{3.3}}+1}} \approx 1.45\ (k\Omega)$

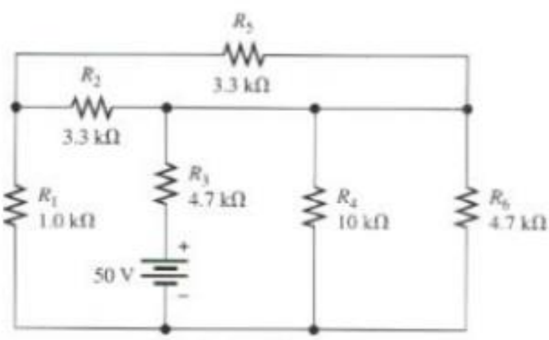


Figure 15

$\rightarrow V_{answer} \approx 50 \times \frac{1.45}{1.45+4.7} \approx 11.79\ (V)$