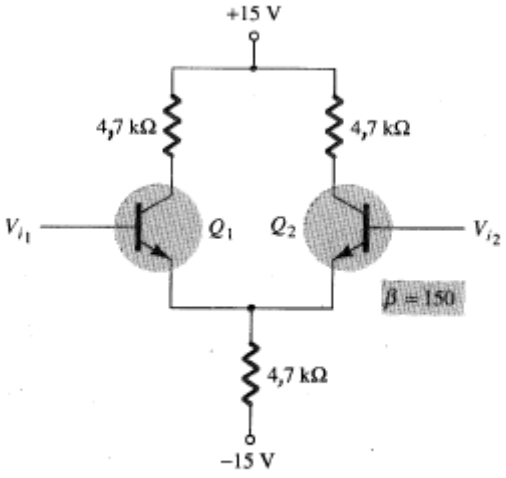
**Lista 3 EN2709 Prof Marcelo Perotoni**

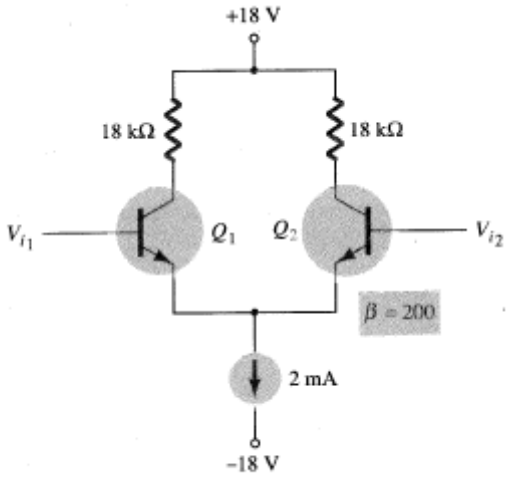
**cap 12**




26. Calcule os valores dc de $I_C$ e $V_C$ para o transistores casados da Fig. 12.76.

**Fig. 12.76** Problema 26.

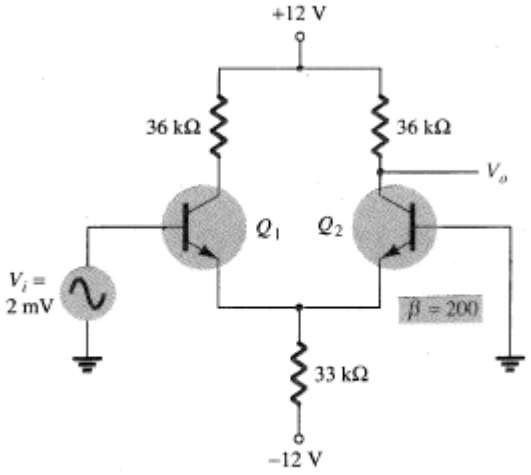
**R: (Ic=1.5mA, Vc=7.95V)**




27. Calcule os valores dc de $I_C$ e $V_C$ para os transistores casados da Fig. 12.77.

**Fig. 12.77** Problema 27.

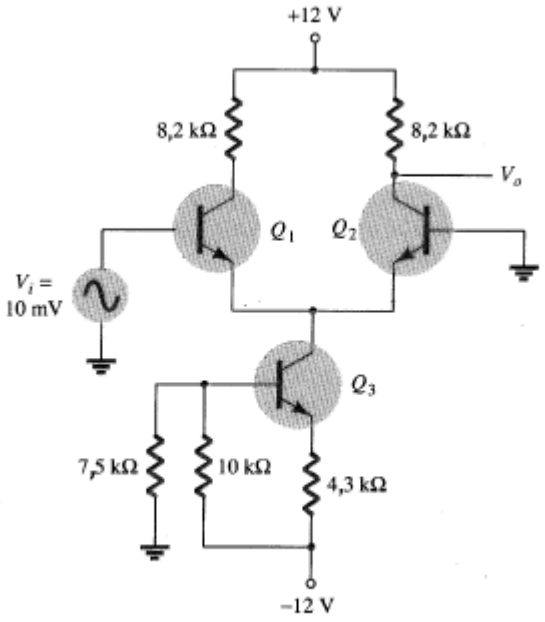
**R: (Ic=1mA, Vc=0V)**




*28. Calcule $V_o$ no circuito da Fig. 12.78.

**Fig. 12.78** Problema 28.

**R: Vo=236.8mV**




*29. Calcule $V_o$ no circuito da Fig. 12.79.

**Fig. 12.79** Problema 29.

**R:2.25V**

**Dica: Q3 se comporta como fonte de corrente. Calcule, via divisor de tensão (7K5 e 10K) a tensão na base de Q3. Em seguida, aplique KVL na malha Base – Junção BE – fonte negativa Vee, achando a tensão no emissor de Q3. Sabendo essa tensão, calcule a corrente no resistor de 4K3, determinando assim a corrente fixa que é puxada do par diferencial.*

## cap 14

1. Calculate the CMRR (in dB) for the circuit measurements of $V_d = 1$ mV, $V_o = 120$ mV, and $V_C = 1$ mV, $V_o = 20$ μV.

**R: CMRR=75.56dB**

2. Determine the output voltage of an op-amp for input voltages of $V_{i_1} = 200$ μV and $V_{i_2} = 140$ μV. The amplifier has a differential gain of $A_d = 6000$ and the value of CMRR is:
   (a) 200.
   (b) $10^5$.

**R: (a)365mV (b) 360mV**

3. What is the output voltage in the circuit of Fig. 14.44?

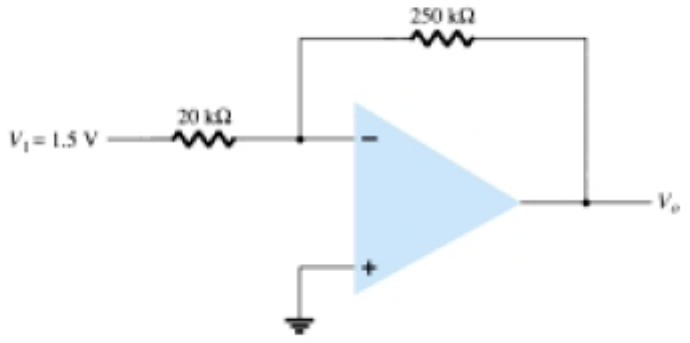
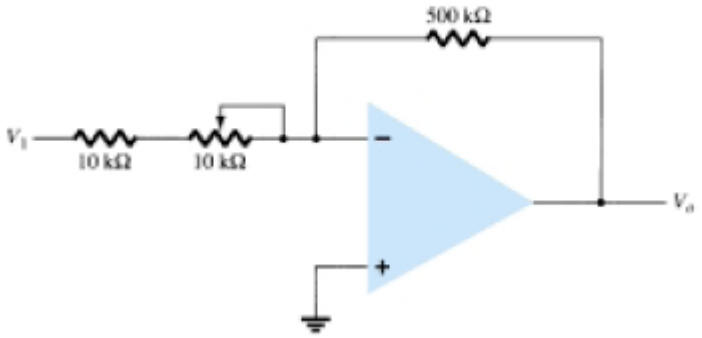



Figure 14.44 Problems 3 and 25

**R: -18.75V**

4. What is the range of the voltage-gain adjustment in the circuit of Fig. 14.45?




**R: ganho entre -25 e -50**

5. What input voltage results in an output of 2 V in the circuit of Fig. 14.46?

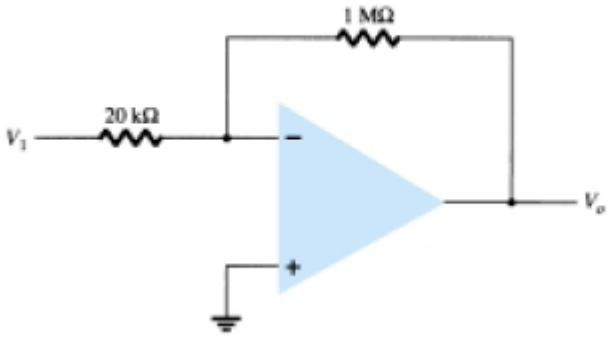



Figure 14.46 Problem 5

**R: -40mV**

6. What is the range of the output voltage in the circuit of Fig. 14.47 if the input can vary from 0.1 to 0.5 V?

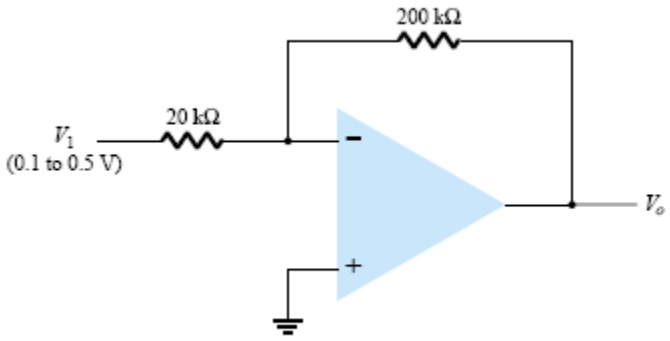



Figure 14.47 Problem 6

**R: Vo esta entre [-5, -1] V**

7. What output voltage results in the circuit of Fig. 14.48 for an input of $V_1 = -0.3$ V?

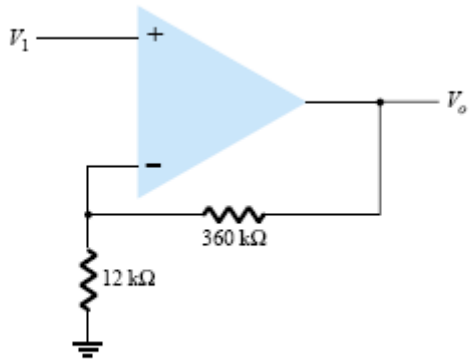



Figure 14.48 Problems 7, 8, and 26

**R: Vo=-9.3V**

**8.** What input must be applied to the input of Fig. 14.48 to result in an output of 2.4 V?

**R: Vi=77.42mV**

**9.** What range of output voltage is developed in the circuit of Fig. 14.49?

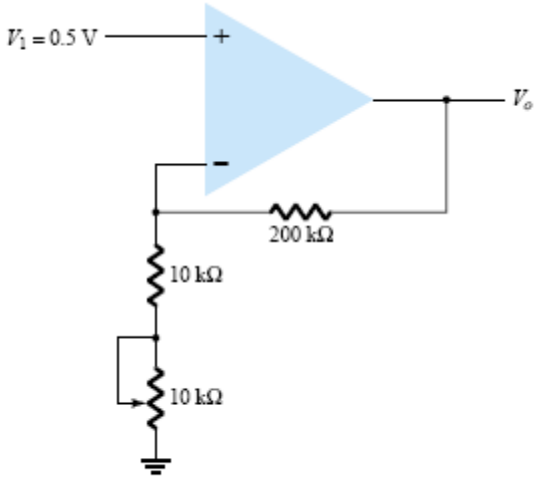



Figure 14.49 Problem 9

**R: Vo entre [5.5, 11.5] V**

**10.** Calculate the output voltage developed by the circuit of Fig. 14.50 for $R_f = 330$ kΩ.

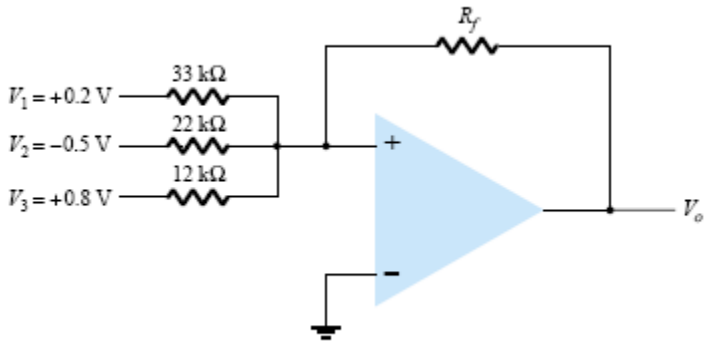



Figure 14.50 Problems 10, 11, and 27

**R: Vo -16.5V**

***Nota: Os terminais estão invertidos no desenho! A entrada inversora e não inversora devem ser intercambiadas (+ vira menos e vice versa)!!***

**11.** Calculate the output voltage of the circuit in Fig. 14.50 for $R_f = 68$ kΩ.

**R: Vo -3.39V**

**12.** Sketch the output waveform resulting in Fig. 14.51.

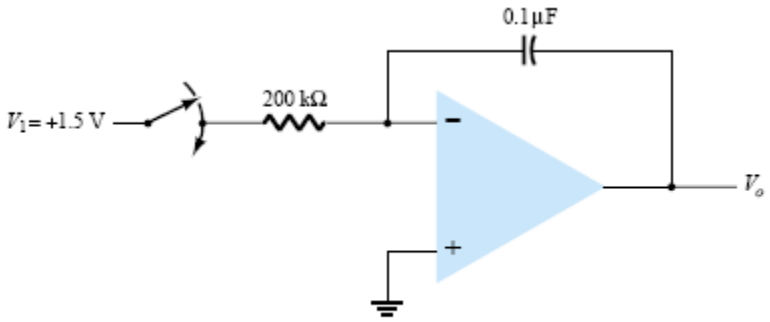



Figure 14.51 Problem 12

**R: Vo = -75t (considere em t=0 a chave fechada, logo input=1.5V constante).**

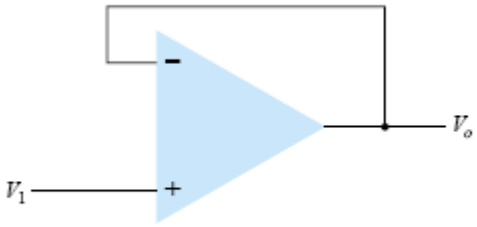



Figure 14.52 Problem 13

**13.** What output voltage results in the circuit of Fig. 14.52 for $V_1 = +0.5$ V?

**R: Vo = 0.5 (configuração buffer)**

**14.** Calculate the output voltage for the circuit of Fig. 14.53.

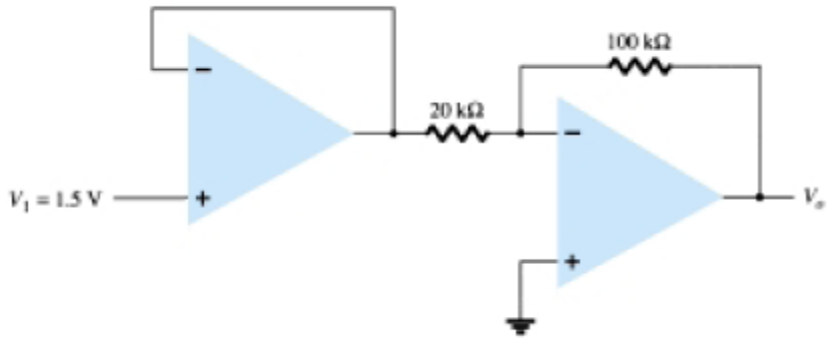



Figure 14.53 Problems 14 and 28

**R: Vo = -7.5V**

**15.** Calculate the output voltages $V_2$ and $V_3$ in the circuit of Fig. 14.54.

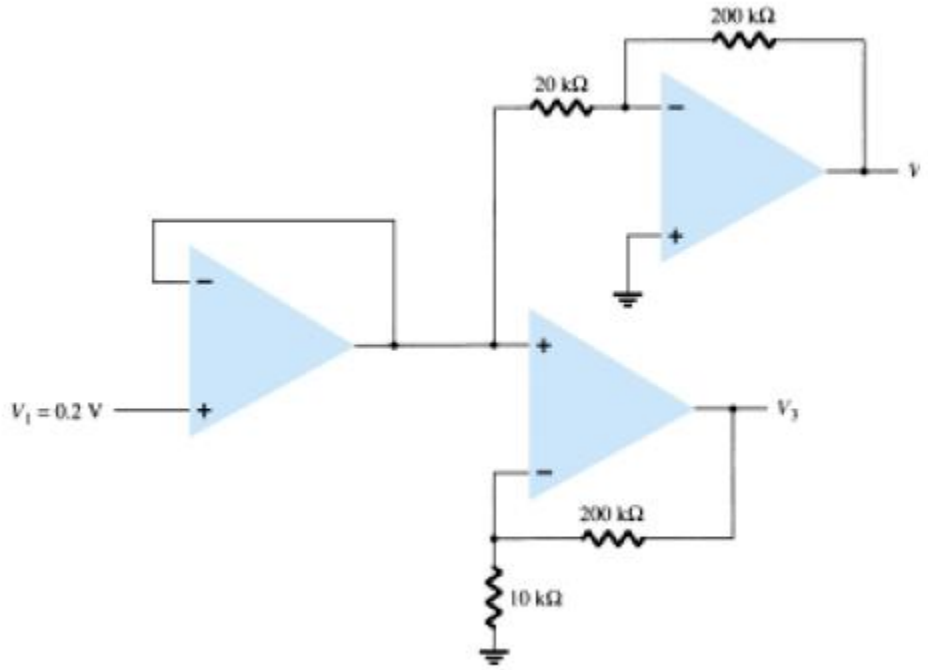



Figure 14.54 Problem 15

**R: V2 = -2V e V3=4.2V**

**16.** Calculate the output voltage, $V_o$, in the circuit of Fig. 14.55.

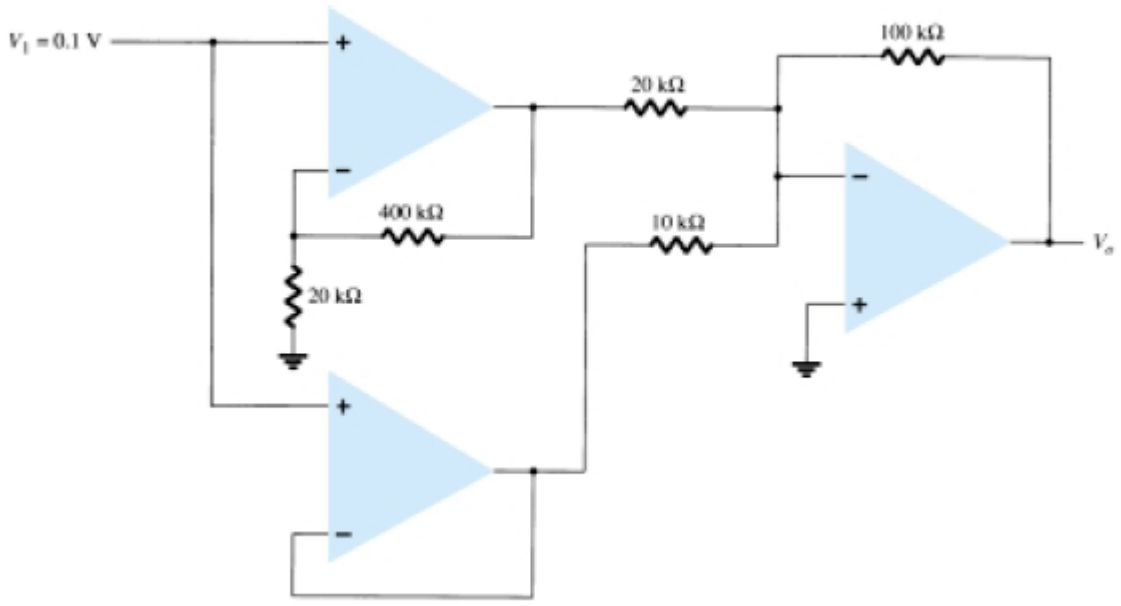



Figure 14.55 Problems 16 and 29

**R: Vo = -11.5V**

**17.** Calculate $V_o$ in the circuit of Fig. 14.56.

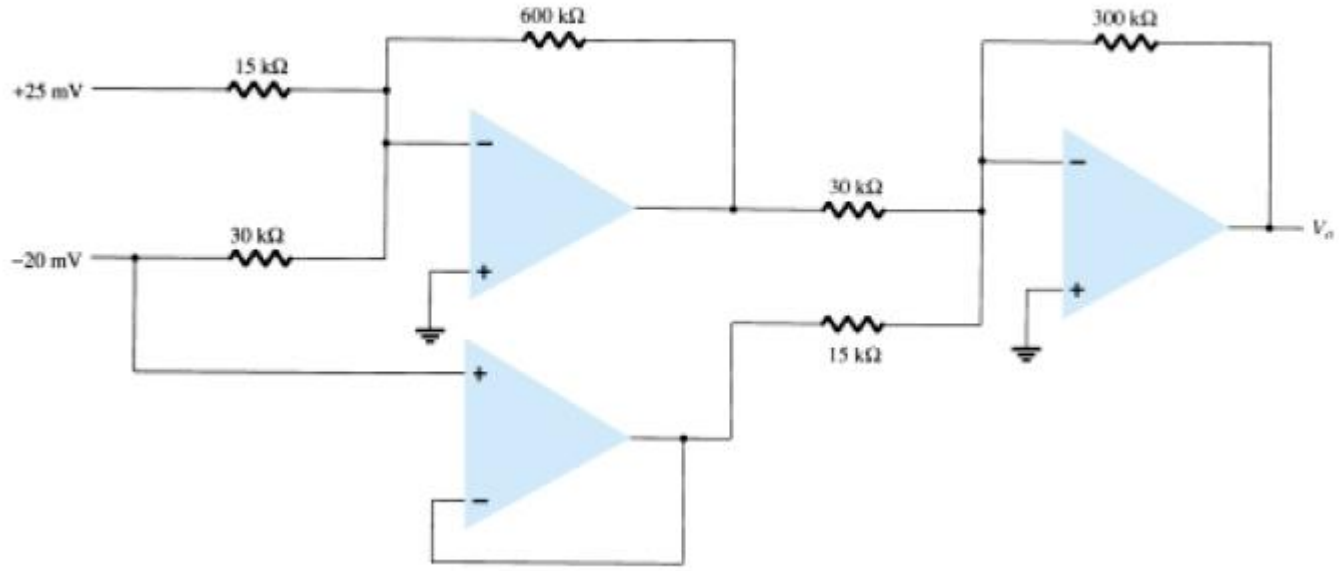



Figure 14.56 Problem 17

**R: Vo = 6.4V**

**20.** Determine the cutoff frequency of an op-amp having specified values $B_1$ = 800 kHz and $A_{VD}$ = 150 V/mV.

**R: fc = 5.3Hz**

**21.** For an op-amp having a slew rate of SR = 2.4 V/$\mu$s, what is the maximum closed-loop voltage gain that can be used when the input signal varies by 0.3 V in 10 $\mu$s?

**R: Av closed loop maximo = 80**

**22.** For an input of $V_1$ = 50 mV in the circuit of Fig. 14.57, determine the maximum frequency that may be used. The op-amp slew rate SR = 0.4 V/$\mu$s.

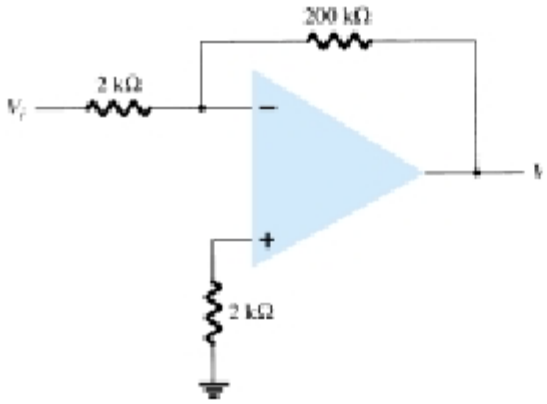



Figure 14.57 Problems 18, 22, 23, and 24

**R: 12.73kHz**

*Nota: verifique a equação 14.24 para resolver este exercicio*

**cap 15**

7. Determine the output voltage for the circuit of Fig. 15.52.

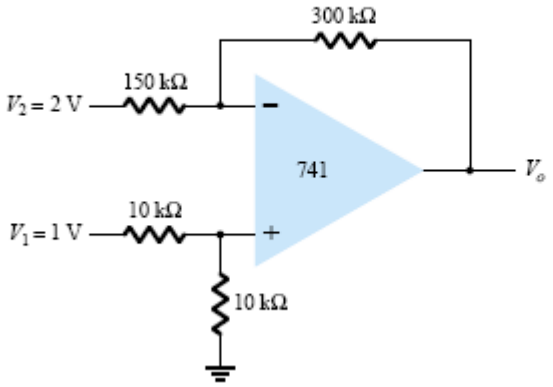



Figure 15.52 Problem 7

**R: -2.5V**

8. Determine the output voltage for the circuit of Fig. 15.53.

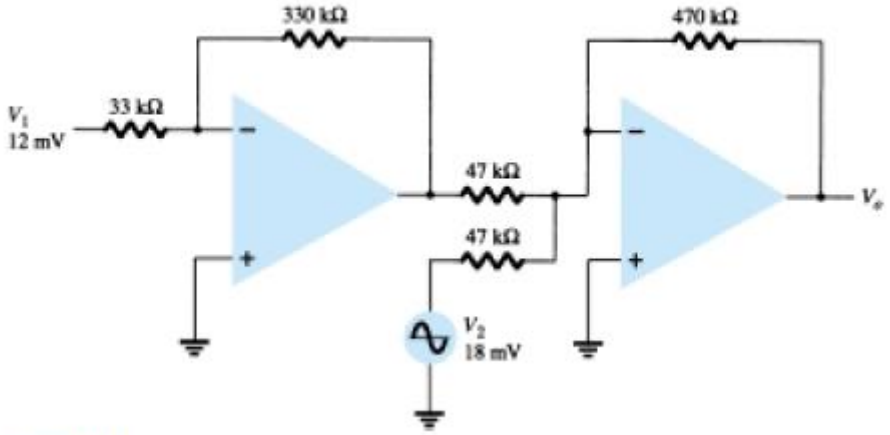
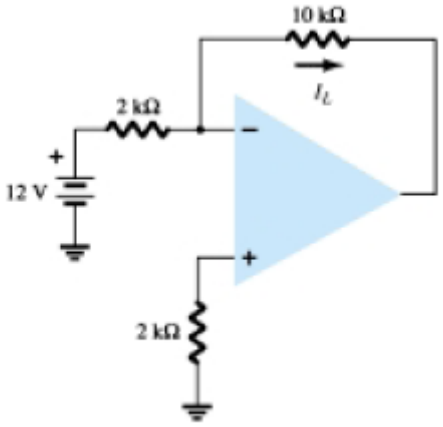



Figure 15.53 Problem 8

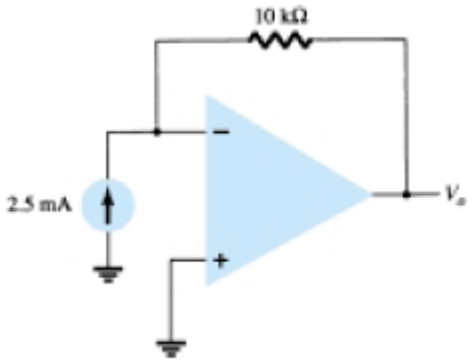
**R: 1.02V**




11. For the circuit of Fig. 15.54, calculate $I_L$.

Figure 15.54 Problem 11

**R: 6mA**




**12.** Calculate $V_o$ for the circuit of Fig. 15.55.

Figure 15.55 Problem 12

**R: -25V**

**13.** Calculate the output current $I_o$ in the circuit of Fig. 15.56.

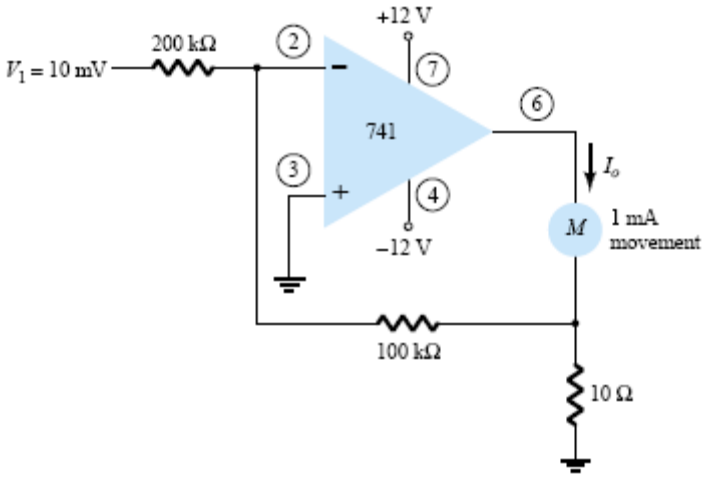



Figure 15.56 Problem 13

**R: 0.5mA**

*14. Calculate $V_o$ in the circuit of Fig. 15.57.

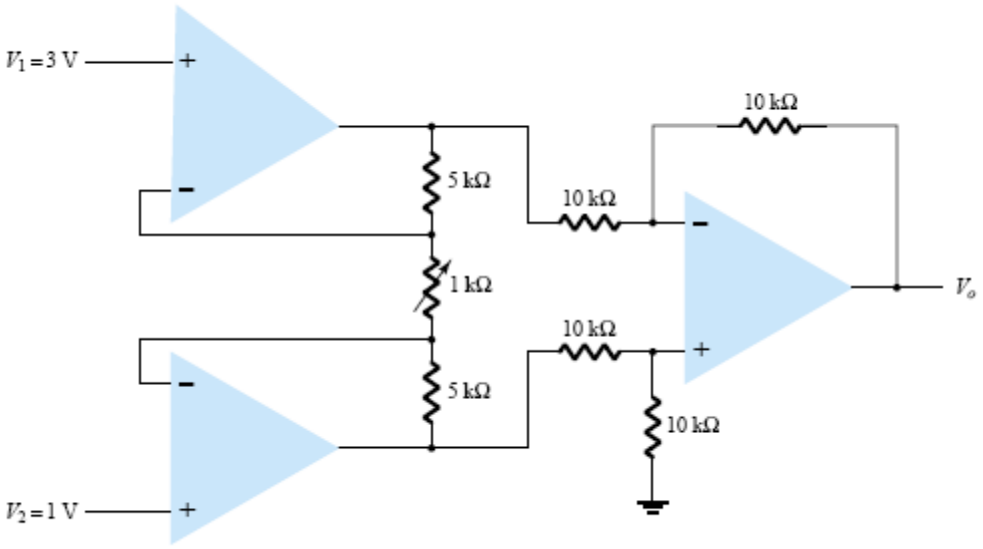


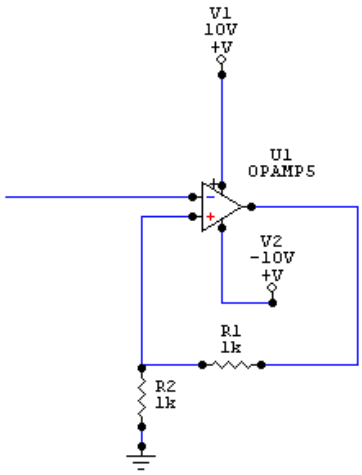

Figure 15.57 Problem 14

**R: -22V**

*Nota: Não pode usar a fórmula pronta apresentada no livro; o circuito é diferente. Ache a equação calculando as*

*tensões na saida dos dois opamps de entrada (lembre que a corrente entrando na porta dos opamps é nula para chegar nas equações). Depois basta usar a configuração subtratora do opamp final.*

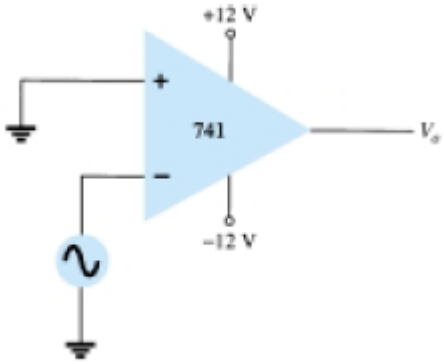
## Outras fontes




O1. Determine a saída em formato de gráfico vout (eixo y) vs. Vin (eixo x) do circuito. Considere a entrada sendo aplicada no terminal inversor.

**R: Curva histerese simétrica em torno do eixo vout, com transições em ei=-5 e -5**

## cap 17




2. Sketch the output waveform for the circuit of Fig. 17.39. Figure 17.39 Problem 2

**R: onda quadrada oscilando entre 12 e -12, com polaridade invertida a senoide que é aplicada a entrada inversora**