I-1 (10 pts) 2 points each part.
True (T) or False (F). One point each. Circle your selected response.
Respond to the statements as written. Do not edit them before responding.

1) Amplifier power gain G_P is defined in decibels as $10 \log_{10} (G_P)$. 1) (T) or F

2) A passive high-pass RC filter has a voltage gain of +3 dB at its break frequency. 2) T or (F)

3) For the 741 IC op amp, unity gain bandwidth f_t is the product of its DC gain A_o and its 3-dB break frequency f_B. 3) (T) or F

Multiple choice. Circle your response.

4) The conductivity of silicon can be increased by introducing into it an appropriate impurity element in a process called:

a) drift (b) doping c) diffusion d) biasing

5) Silicon and germanium are elemental semiconductors. By contrast, GaAs is a _____ semiconductor.

a) bipolar b) doped (c) compound d) type IV

I-2 (10 pts)

a) A single time constant RC low pass filter is to have a break frequency of 10 [kHz]. Calculate the required value of capacitance C if a 10 [kΩ] resistor is to be used.

b) Draw a schematic for this filter. Label V_{in}, V_{out} and both components with values.

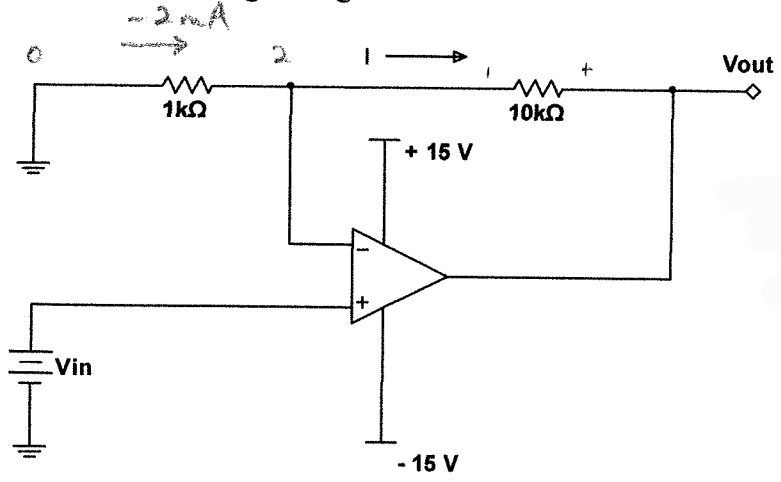
a) C = 1.59 nF

b) schematic

Please do not mark in this box ==========>>

I-3 (10 pts)

For the circuit shown, $V_{in} = 2$ [V]. Assuming an ideal op amp, calculate the values of V_{out} and the current I flowing through the 10 kΩ resistor.

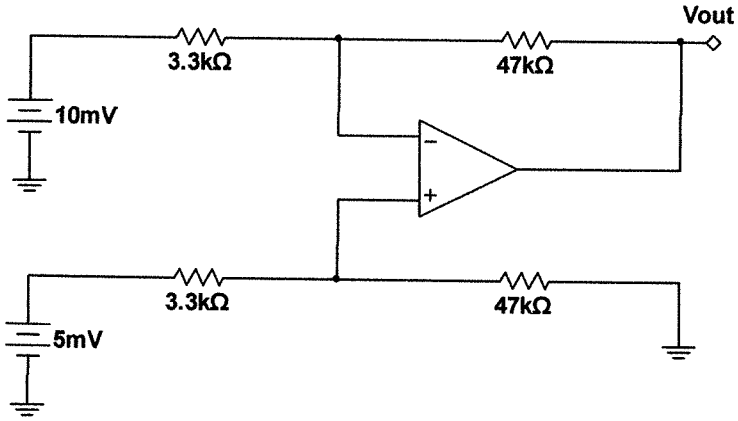


$V_{out} =$ 15 [V]

$I =$ -1.3 [mA]

I-4 (10 pts)

Calculate the value of V_{out} in the circuit below. Assume an ideal op amp.



$V_{out} = \left(\frac{47}{3.3}\right)(5 - 10)$ [mV]

$= 14.24(-5)$

$V_{out} =$ -71.2 [mV]

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II-1 (30 pts)

Consider a circuit consisting of these three parts connected in cascade: 1) a power supply with a Thevenin equivalent model of 1.0 [mVDC] and 100 Ω; 2) a voltage amplifier with input resistance of 5 MΩ, open loop voltage gain A_v of 55 dB, and output resistance of 75 Ω; 3) a load resistor of 3 kΩ.

a) Draw a clearly labeled schematic of this complete circuit. Use a voltage-controlled voltage source in the amplifier stage. Label every component with its value.
b) Calculate the closed loop voltage gain G_v in [dB].
c) Calculate the current gain G_I in [dB].
d) Calculate the power delivered by the supply.
e) Calculate the power delivered to the load resistor.
f) Calculate the power gain G_P in [dB].

Note: All gains assume a comparison of load value to respective power supply value.

a) schematic

b) G_v = 54.8 dB

c) G_I = 119 dB

d) P_S = 200 fW

e) P_L = 100 μW

f) G_P = 87.0 dB

* 2 (10-13)
.2 pW

Please do not mark in this box ==========>>

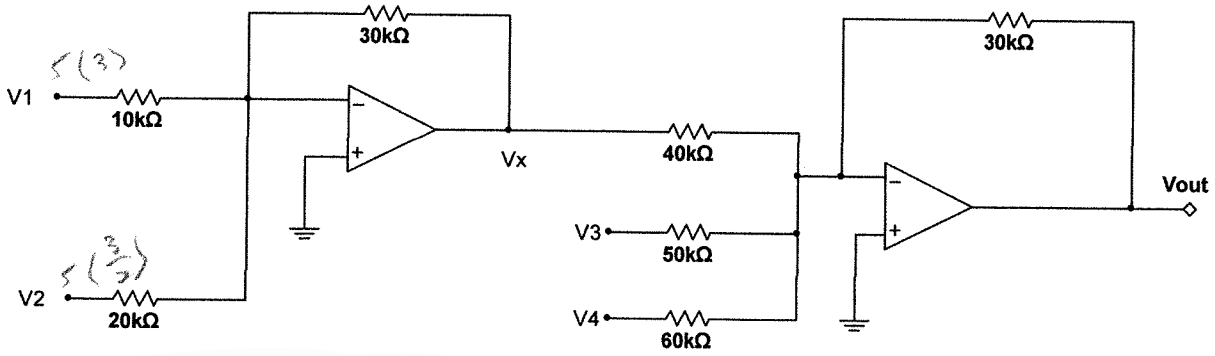
II-2 (30 pts)

In the circuit below both op amps are ideal.

a) Find V_x in terms of V_1 and V_2. Box your answer.

b) Find V_{out} in terms of V_x, V_3, and V_4. Box your answer.

c) Let $V_1 = V_2 = 5$ [mV], and $V_3 = V_4 = 4$ [mV] . Find the value of V_{out}.



a) Box answer

b) Box answer

c) V_{out} = 12.5 mV

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