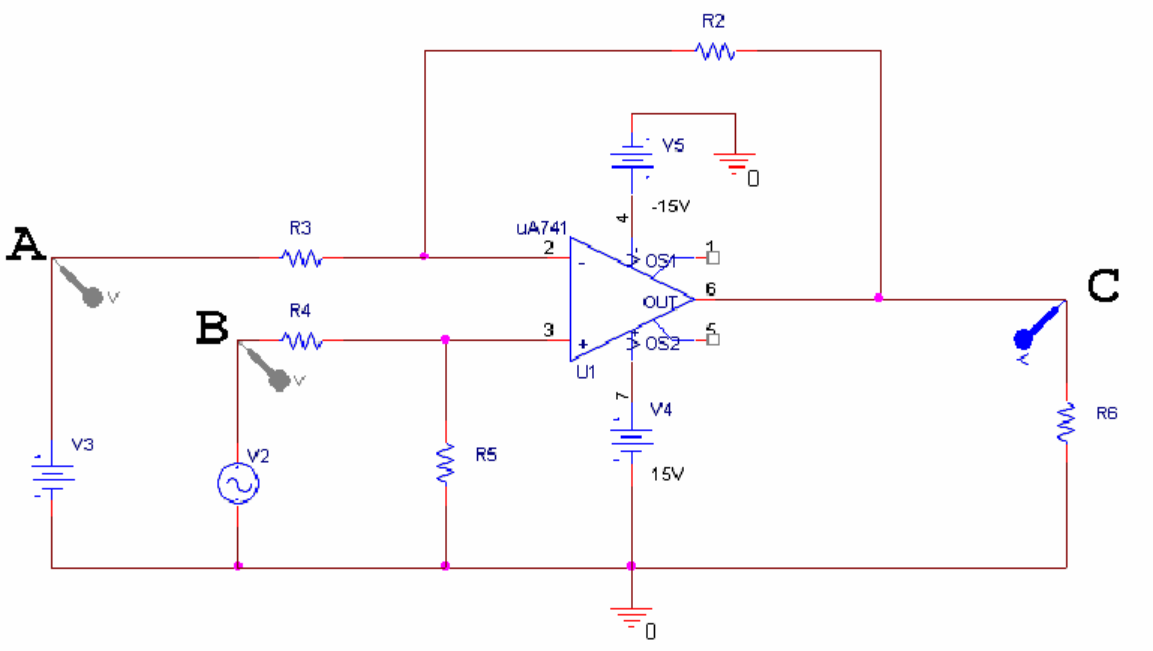
Questions about Op Amp Circuit Applications (Also see D/A Conversion.)

Fall 2004



Assume the following about the components in the above circuit:

V2: VOFF=500mV,VAMPL=100mV,FREQ=1K.

V3: VDC=300mV

R2=18K, R3=3K, R4=3K, R5=18K, R6=10K

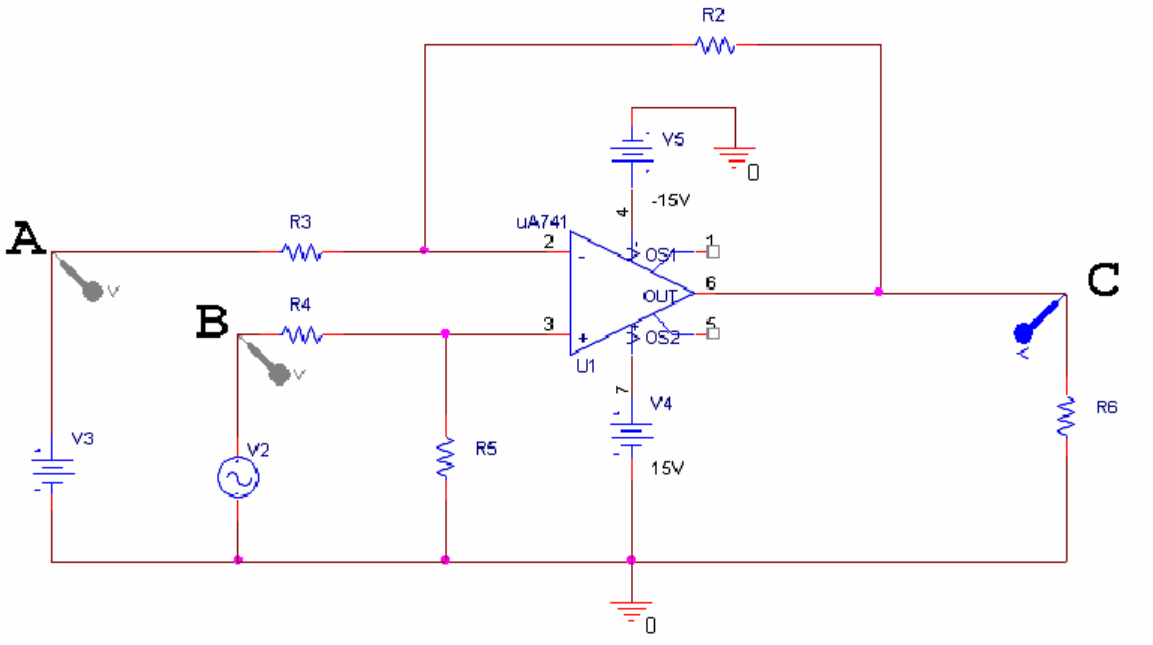
1. Above is a picture of a type of amplifier you have seen. What type of amplifier is it? (1 point)

2. Write an expression for the input signal at B in the form $v(t)=A\sin(\omega t) + V_{DC}$. (3 points)

3. Write an equation for the output at C (V_C) in terms of the input voltages V2 and V3. Simplify. Do not substitute for V2 and V3. (2 points)

4. Write an expression for the output signal at C in the form $v(t)=A\sin(\omega t) + V_{DC}$. (4 points)

Fall 2004 Solution



Assume the following about the components in the above circuit:

V2: VOFF=500mV,VAMPL=100mV,FREQ=1K.

V3: VDC=300mV

R2=18K, R3=3K, R4=3K, R5=18K, R6=10K

1. Above is a picture of a type of amplifier you have seen. What type of amplifier is it? (1 point)

Difference (or differential) amplifier

2. Write an expression for the input signal at B in the form $v(t)=A\sin(\omega t) + V_{DC}$. (3 points)

$v(t) = 100mV \sin(2K\pi t) + 500\ mV$

3. Write an equation for the output at C (V_C) in terms of the input voltages V2 and V3. Simplify. Do not substitute for V2 and V3. (2 points)

$Vc = [18K/3K](V2 - V3) = 6(V2-V3)$

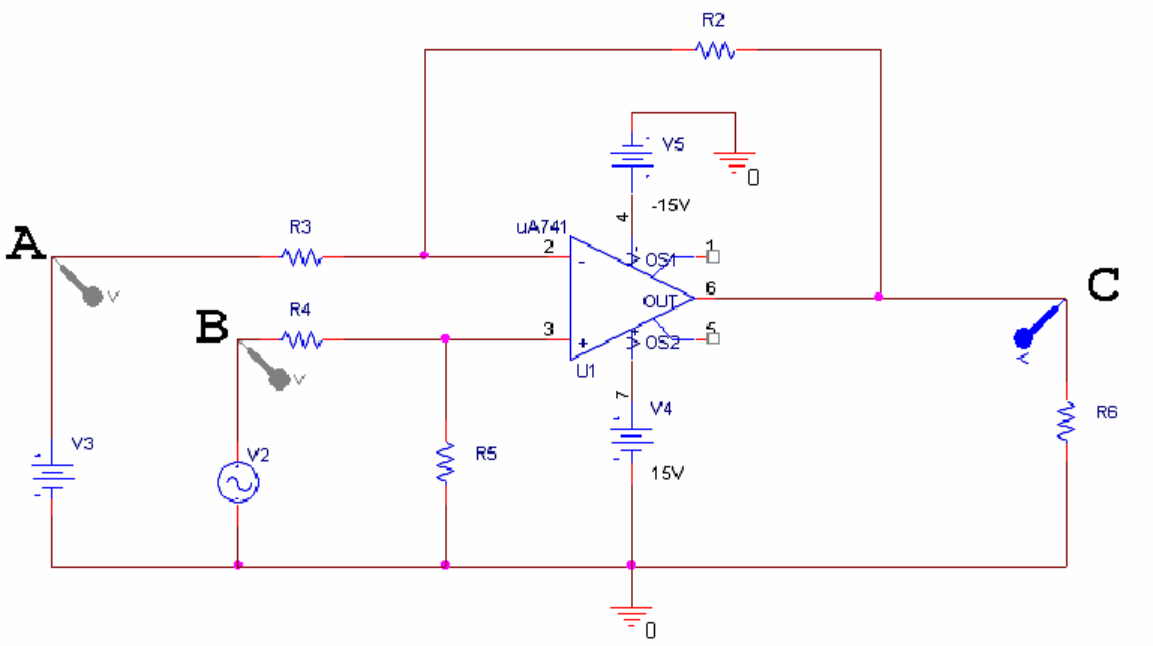
4. Write an expression for the output signal at C in the form $v(t)=A\sin(\omega t) + V_{DC}$. (4 points)

$Vc = 6[100mV \sin(2K\pi t) + 500\ mV - 300\ mV]$

$Vc = 600mV \sin(2K\pi t) + 1200\ mV$

Fall 2003

Question 4 -- Op-Amps (20 points)



Assume the following about the components in the above circuit:

V2: VOFF=2V,VAMPL=2V,FREQ=1K.

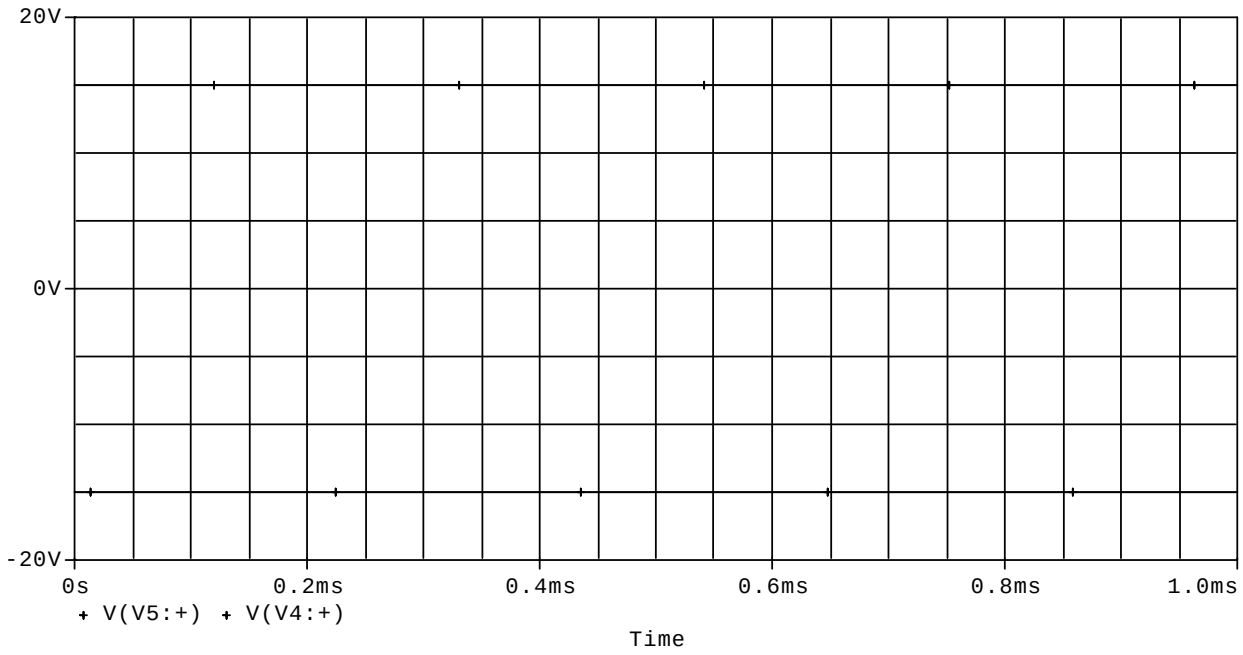
V3: VDC=2V

R2=16K, R3=2K, R4=2K, R5=16K, R6=1K

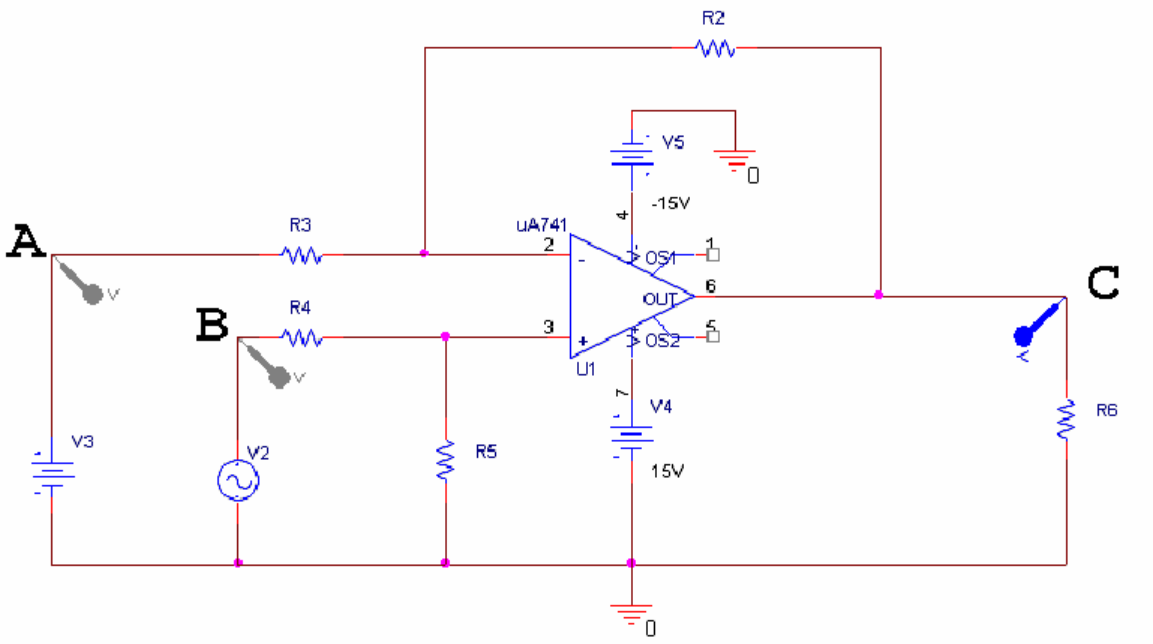
a. Above is a picture of a type of amplifier you have seen. What type of amplifier is it? *(1 point)*

b. Write an equation for the output at C (V_C) in terms of the input voltages V2 and V3. Simplify. *(3 points)*

c. Sketch and label one cycle of the input at V2 (point B), the input at V3 (point A) and the output at C (V_C) on the plot below. *(16 points)*



Fall 2003 Solution
Question 4 -- Op-Amps (20 points)



Assume the following about the components in the above circuit:
V2: VOFF=2V,VAMPL=2V,FREQ=1K.
V3: VDC=2V
R2=16K, R3=2K, R4=2K, R5=16K, R6=1K

a. Above is a picture of a type of amplifier you have seen. What type of amplifier is it? *(1 point)*

differential (or difference) amplifier

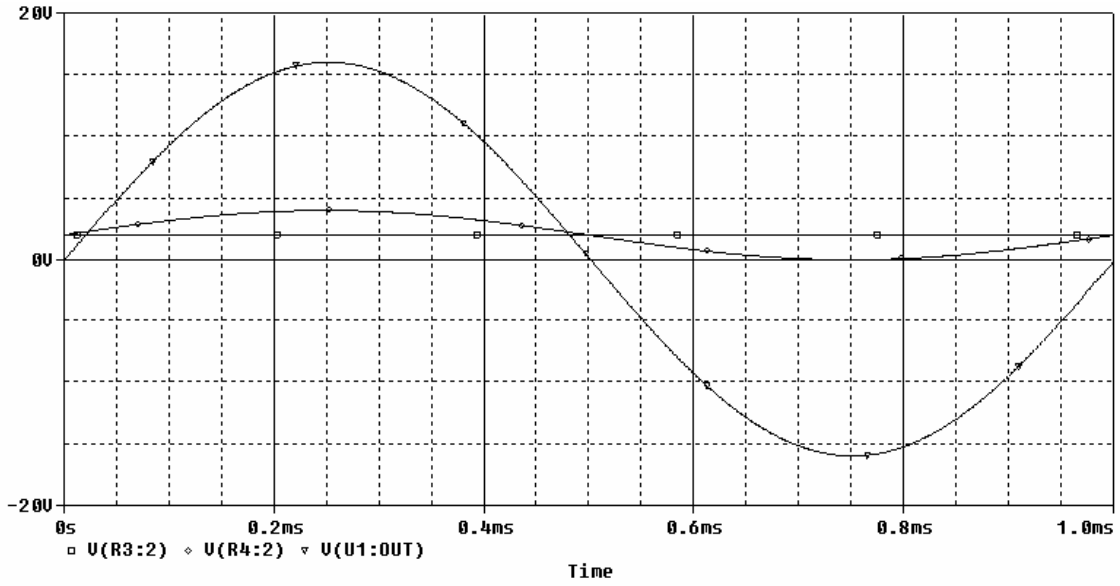
b. Write an equation for the output at C (V_C) in terms of the input voltages V2 and V3. Simplify. *(3 points)*

Test 1: Vout=(Rf/Rin)(V+-V-)=(16K/2K)(V2-V3)=8(V2-V3) ***Vout=8(V2-V3)***

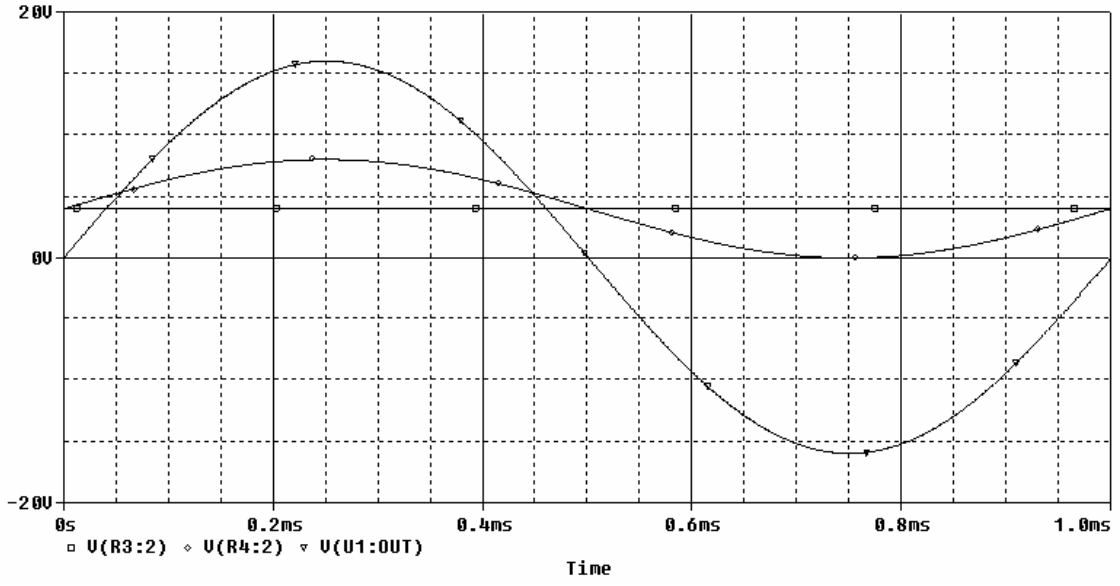
Test 2: Vout=(Rf/Rin)(V+-V-)=(12K/3K)(V2-V3)=4(V2-V3) ***Vout=4(V2-V3)***

c. Sketch and label one cycle of the input at V2 (point B), the input at V3 (point A) and the output at C (V_C) on the plot below. *(16 points)*

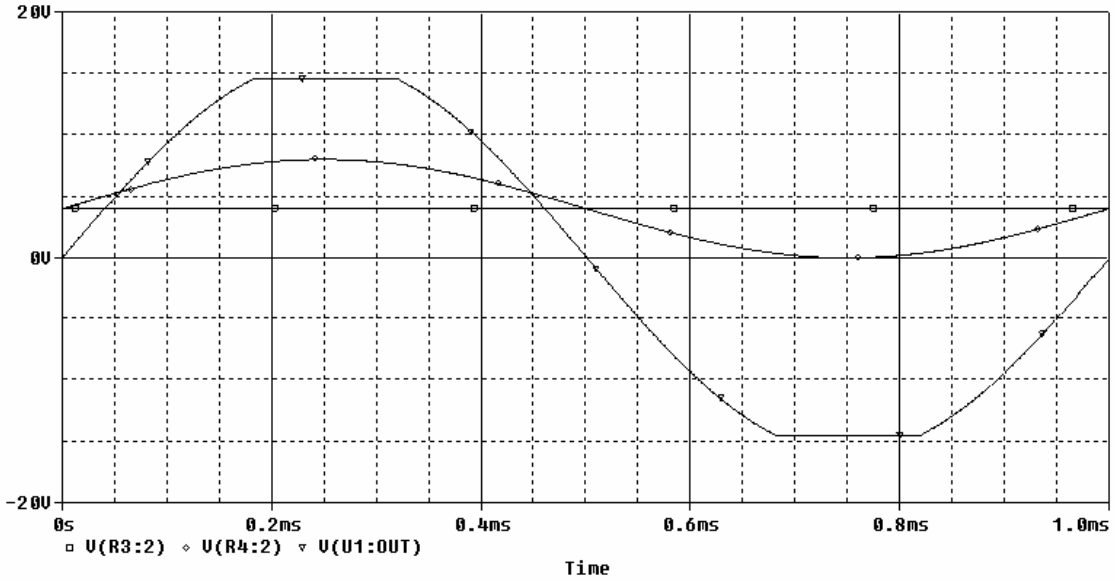
Test 1:



Test 2:

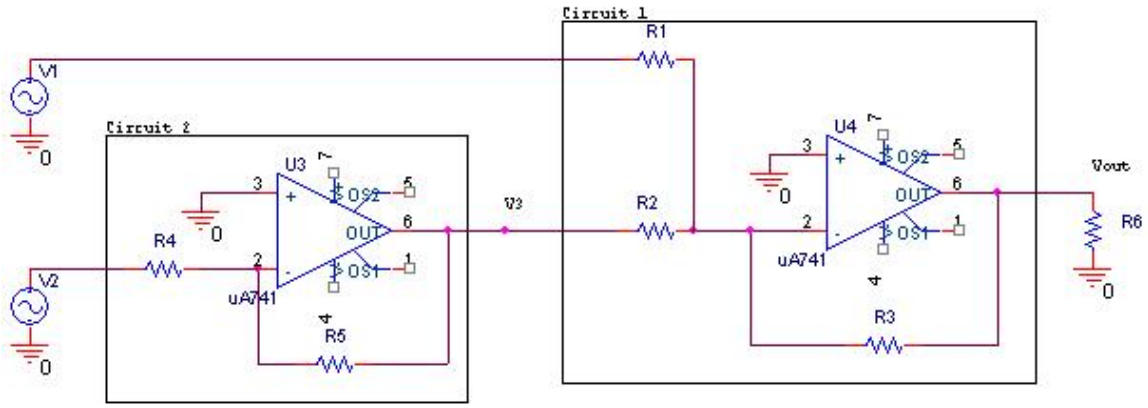


More correct for both would cut off at 15 volts like this:



Spring 2003

1. Op-Amp Circuits (25 pts)



a) What type of Op-Amp circuit is "Circuit 1"? (2 pts)

b) What is the Vout as a function of R1, R2, R3, V1 and V3? (2 pts)

c) What type of Op-Amp circuit is "Circuit 2"? (2 pts)

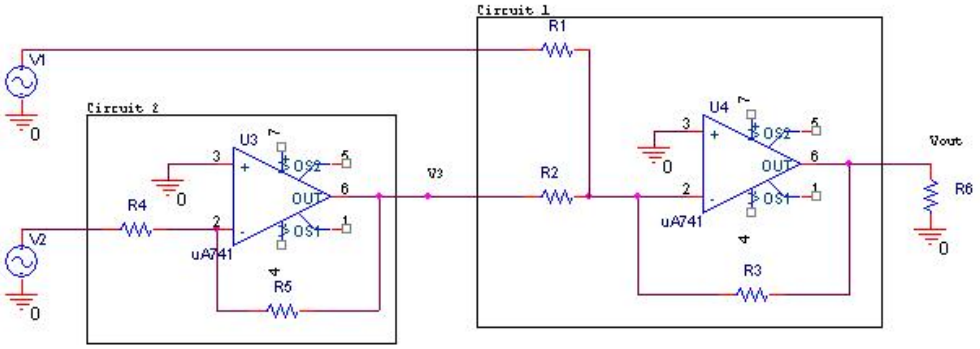
d) What is the V3 as a function of R4, R5 and V2? (2 pts)

e) Given R1 = 1kΩ, R2 = 5kΩ, R5 = 15kΩ and R6 = 1MΩ, find R3 and R4 such that Vout = 10(V2-V1). (12 pts)

f) Given the design in part e, find the current in R6, if V1 = 1vSin(2πft), and V2 = 2v Sin(2πft). (5 pts)

Spring 2003 solution

1 Op-Amp Circuits (25 pts)



a) What type of Op-Amp circuit is "Circuit 1"? (2 pts)

Adder

b) What is the Vout as a function of R1, R2, R3, V1 and V3? (2 pts)

$$V_{out} = -\frac{R3}{R1}V1 - \frac{R3}{R2}V3$$

c) What type of Op-Amp circuit is "Circuit 2"? (2 pts)

Inverting Amplifier

d) What is the V3 as a function of R4, R5 and V2? (2 pts)

$$V3 = -\frac{R5}{R4}V2$$

e) Given R1 = 1kΩ, R2 = 5kΩ, R5 = 15kΩ and R6 = 1MΩ, find R3 and R4 such that Vout = 10(V2-V1). (12 pts)

$$V_{out} = -\frac{R3}{R1}V1 + \frac{R3R5}{R2R4}V2 = \frac{R3 \times 15K\Omega}{5K\Omega \times R4}V2 - \frac{R3}{1K\Omega}V1 = 10(V2 - V1)$$

$$\Rightarrow \begin{cases} \frac{R3}{1K\Omega} = 10 \\ \frac{R3 \times 3}{R4} = 10 \end{cases}$$

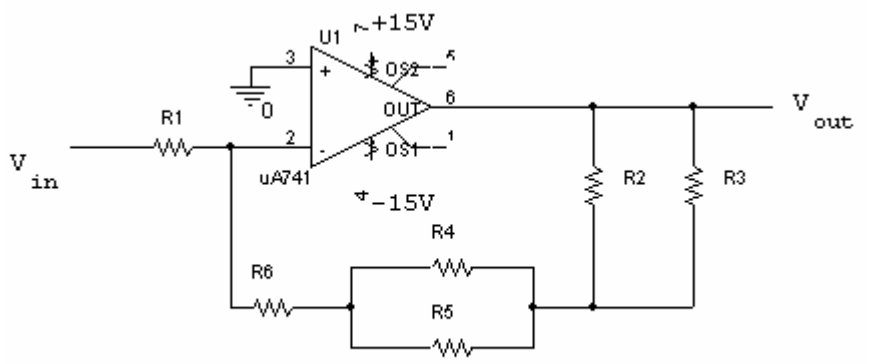
$$\Rightarrow \underline{R3 = 10K\Omega}, \underline{R4 = 3K\Omega}$$

f) Given the design in part e, find the current in R6, if V1 = 1vSin(2πft), and V2 = 2v Sin(2πft). (5 pts)

$$V_{out}(t) = 10(2vSin(2\pi f) - 1vSin(2\pi f)) = 10vSin(2\pi f)$$

$$I_{R6} = \frac{V_{out}}{R6} = \frac{10vSin(2\pi f)}{1M\Omega} = 10\mu ASin(2\pi f)$$

Fall 2002



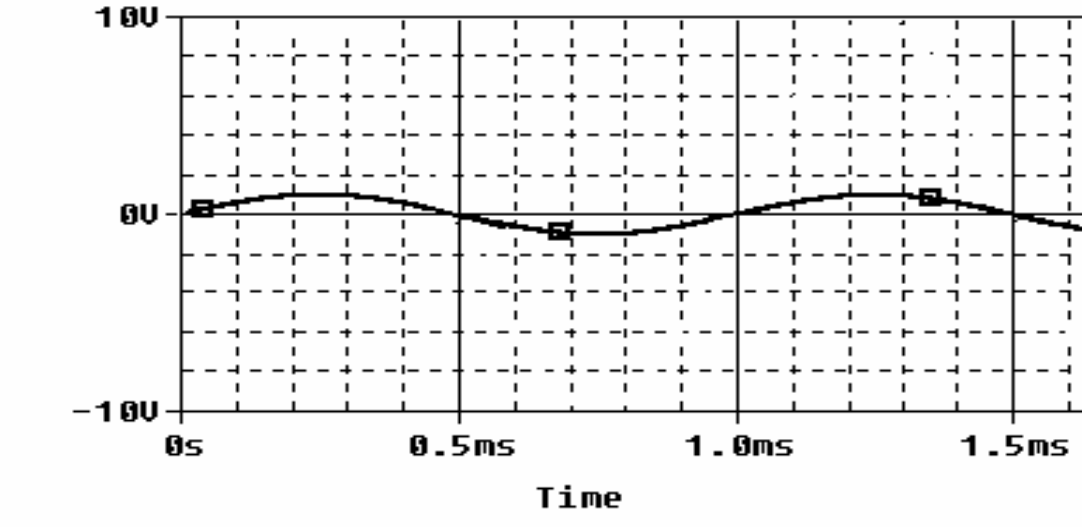
Above is a figure of an op amp circuit where R1=1K, R2=3K, R3=4K, R4=2K, R5=2K and R6=4K.

a) (4 points) Is this an Inverting, Non-inverting, or Differential Amplifier?

b) (7 points) Calculate the value of the feedback resistance, R_f, in this circuit.

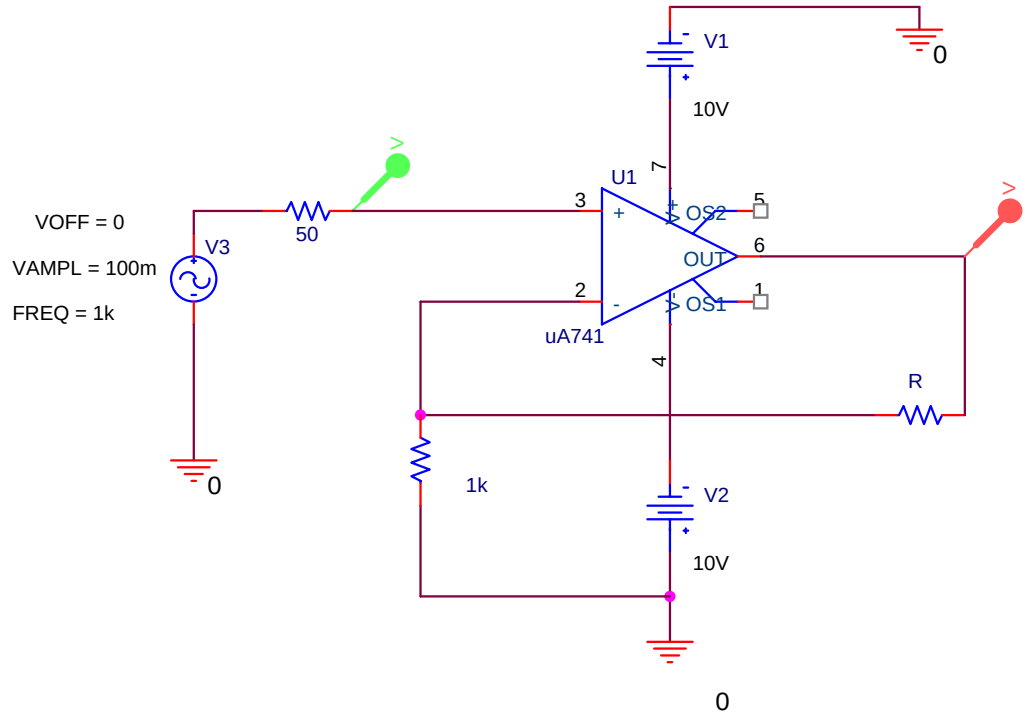
c) (7 points) What is the gain of this circuit?

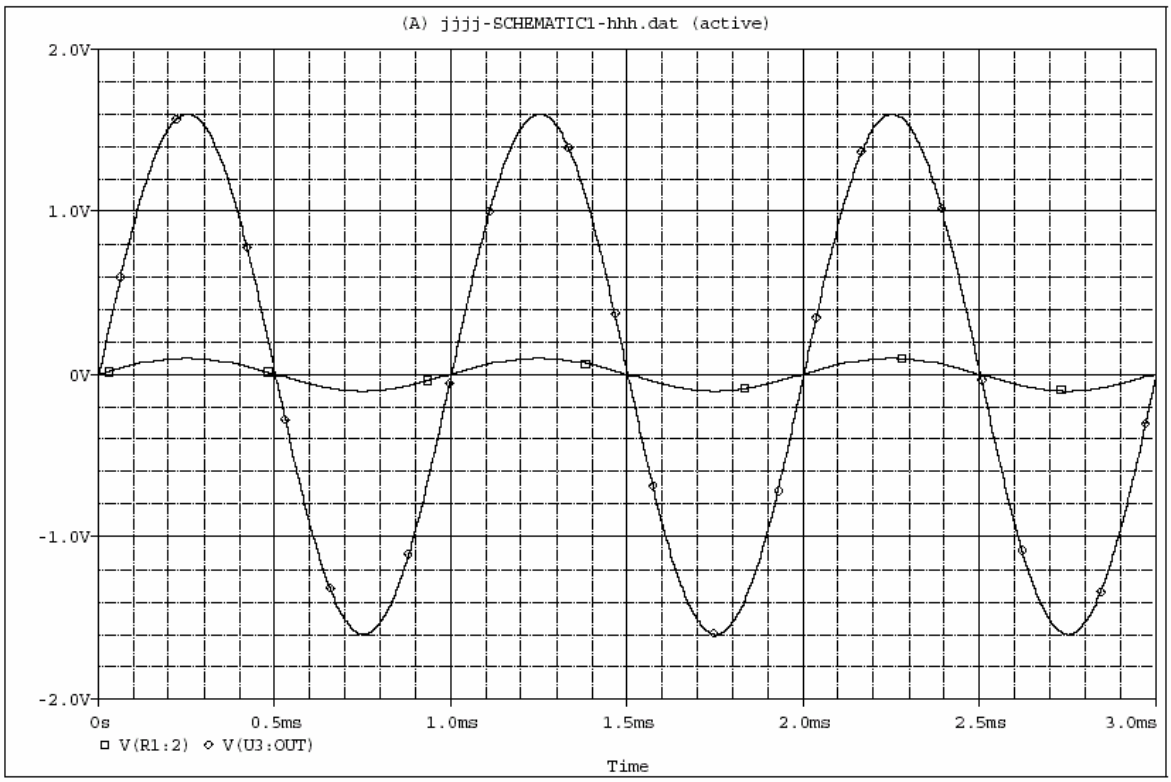
d) (7 points) Sketch the output voltage (Vout) for the input voltage (Vin) shown below.



Spring 2002

Question 4 Op-Amps (25 points)





Above is a figure of an Op Amp Circuit and its input and output voltage as seen in Pspice.

a) Is this an Inverting, Non inverting, or Differential Op Amp?

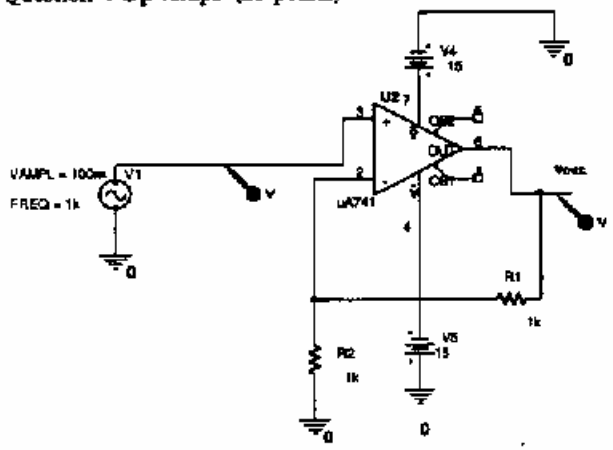
b) Calculate the value of resistor “R” to produce the PSPICE Graph above.

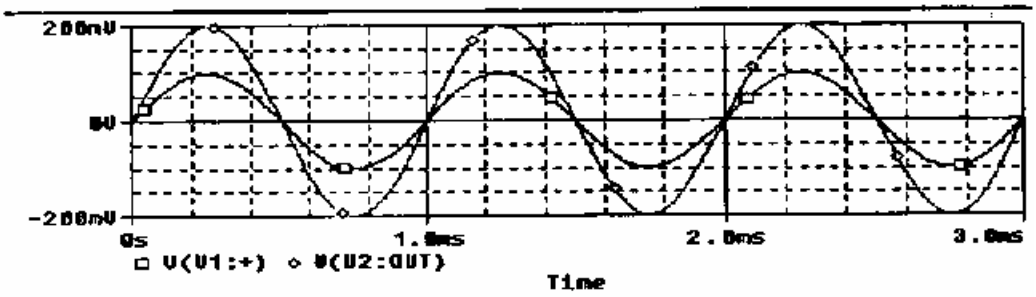
c) What is the Maximum amount of voltage that can *ever* be read at the Output of the Circuit?

Fall 2001 solution

ENGR4300 Test 2A Fall 2001 Name_____Section_____

Question 4 Op-Amps (25 points)





Above is a figure of an Op Amp Circuit and its input and output voltage as seen in Pspice.

a) Is this an Inverting, Non inverting, or Differential Op Amp Circuit?

Non - Inverting

b) If the Gain shown on the graph is 2, Calculate the resistance needed for R2 to give the Op Amp Circuit a Gain of 10.

$$A_V = \frac{V_{out}}{V_{in}} = \left(1 + \frac{R_1}{R_2}\right) = 10 \Rightarrow \frac{R_1}{R_2} = 9 \Rightarrow R_2 = \frac{R_1}{9} \Rightarrow \boxed{R_2 = \frac{1}{9}\,k\Omega}$$

c) What is the Maximum amount of voltage that can *ever* be read at the Output of the Circuit?

$V_{max} = V_{cc} = 15\,V$