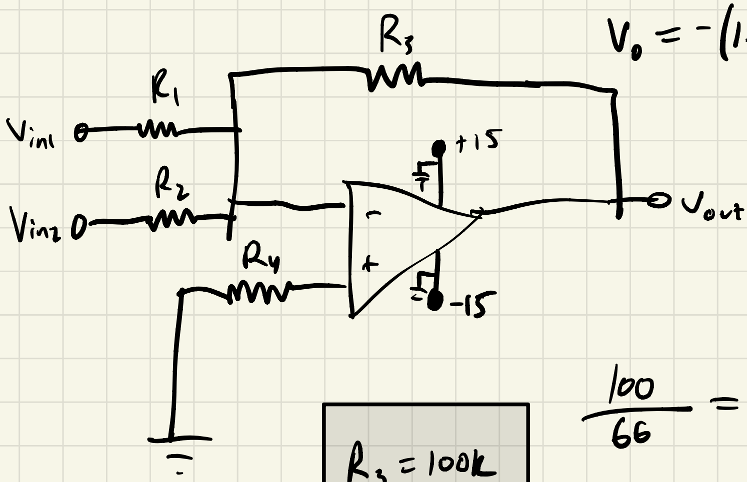
# Lab 3: operational Amplifier circuits

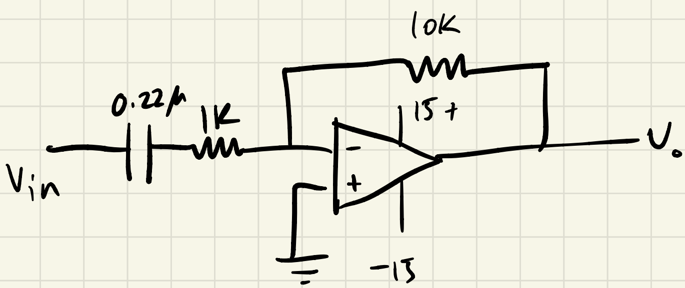
$$V_0 = -(1.5V_{in1} + 3V_{in2})$$




$$\frac{100}{66} = 1.5$$

$R_3 = 100k$
$R_1 = 66K$
$R_2 = 33k$

## Transfer function :




$$R_4 = \frac{1}{\frac{1}{100} + \frac{1}{33} + \frac{1}{66}} = 18K\Omega$$

# PART 1:

a) $R_1$ = two 33kΩ in series

$R_2$ = 33kΩ    $R_4$ = 10k and 8k in series

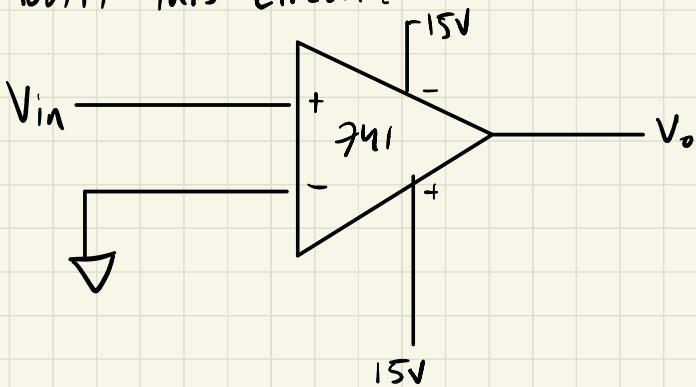
$R_3$ = 100kΩ

| Actual Value | Measured |
|---|---|
| $R_1 = 66k\Omega$ | 65.663 kΩ |
| $R_2 = 33k\Omega$ | 32.683 kΩ |
| $R_3 = 100k\Omega$ | 99.205kΩ |
| $R_4 = 18k\Omega$ | 18.011kΩ |
| Capacitor | capacitor |
| $C_1 = 0.1\mu F$ | 93.91nF |
| $C_2 = 0.1\mu F$ | 93.01nF |

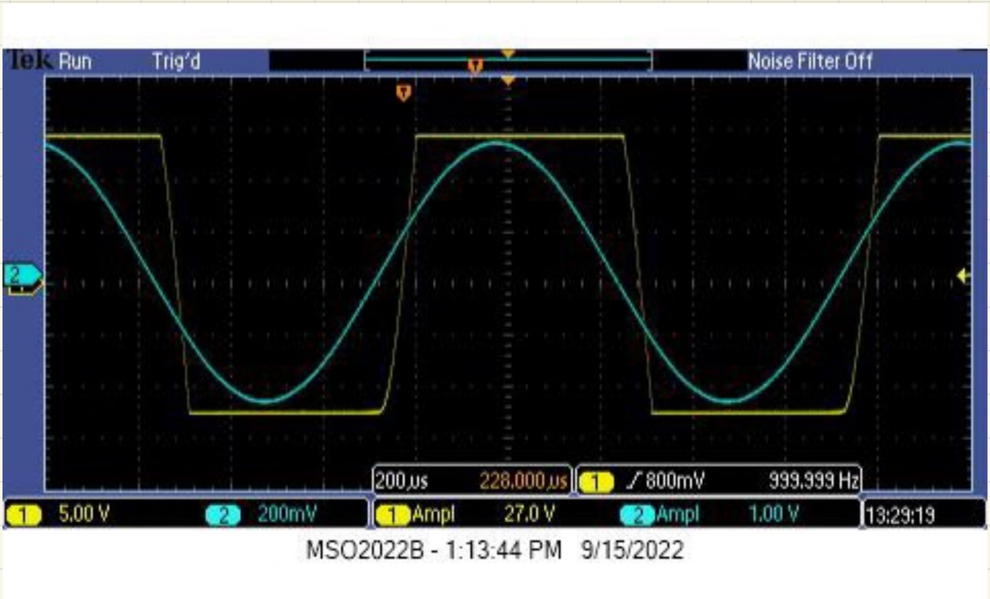
| Expected Value | Measured |
|---|---|
| $V_{out} = -(1.5(3) + 3(3)) = -13.5$ | -12.5V (potential saturation) |
| $V_{out} = -(1.5(1) + 3(1)) = -4.5$ | -4.5372V |
| $V_{out} = -(1.5(2) + 3(2)) = -9$ | -9.0822V |

b)

Built this circuit:

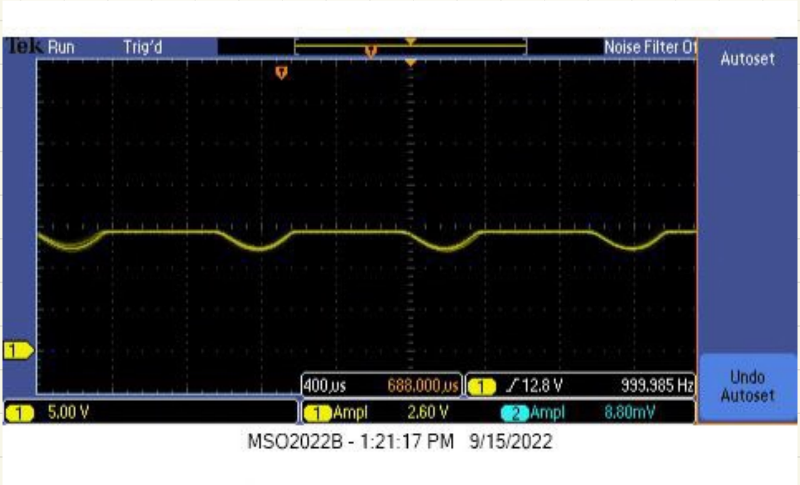



Applied a 1kHz, 1$V_{p\text{-}p}$ Sine Wave Signal to the non-inverting input. This is what we got as our input and output Signals.



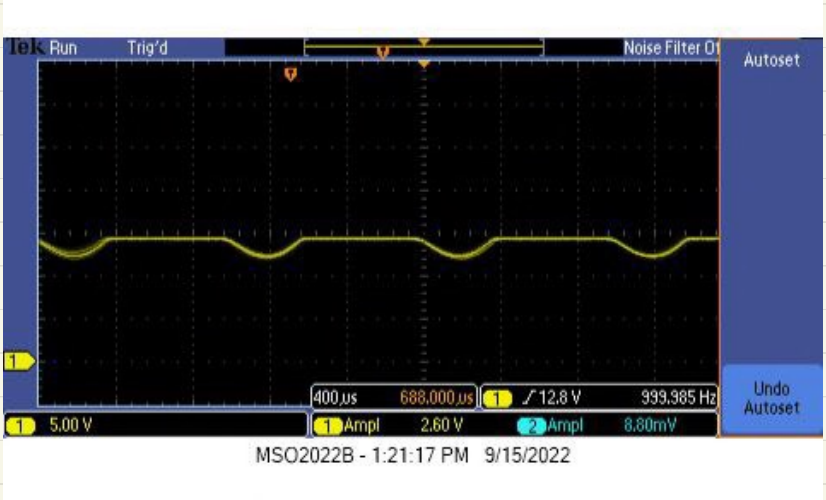
Does the output change if 0.1V p-p?

yes the output does Change, the output is a different looking wave that is less Saturated. This is what it looked like.

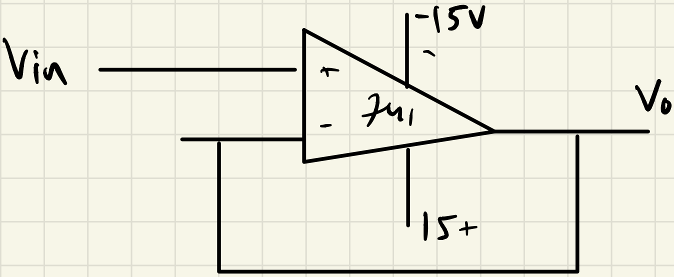



What happens if the ^signal is connected to inverting input and non inverting is grounded

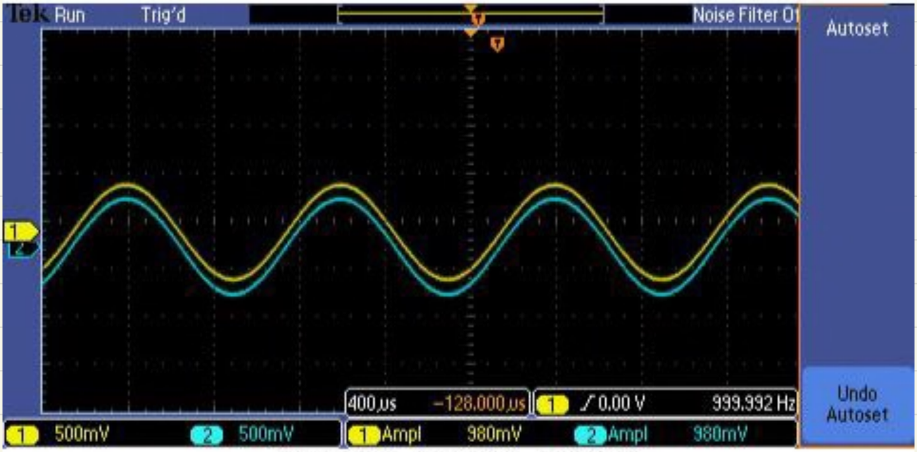
The Signal does not Change after Swapping the inverting and non inverting inputs.



c) Same Signal Applied to this circuit




It Appears that the input and output Signal are the same.

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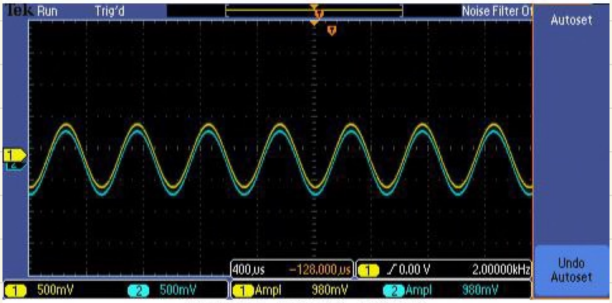
We increaced the input signal to 2KHz and Both inputs and outputs are identical.

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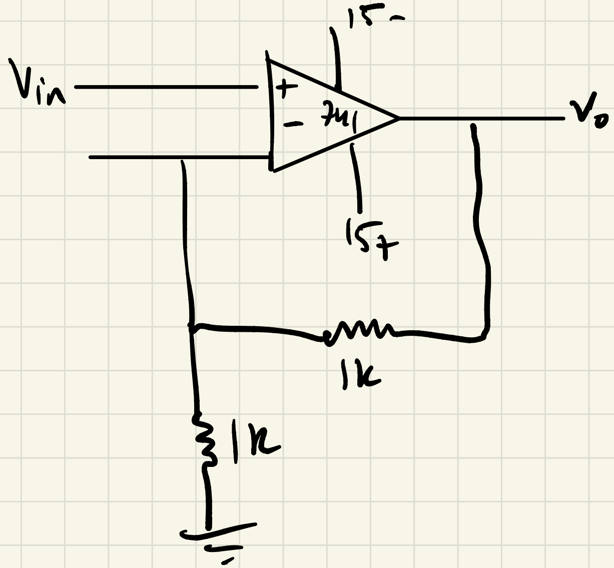
What is the 3dB frequency?
you cannot get the 3dB frequency because both waves are identical

What is the input Resistance of the follower?
Infinity, because the nature of this circuit, also there are no Resistors.

d) The circuit below was created. The same input Voltage as part B was used.



The input (Blue wave), and output (yellow wave), are shown below


What is the voltage gain of the Amp?

$$V_o = V_i\left(1 + \frac{R_2}{R_1}\right)$$

$$V_o = 1 + \frac{1000}{1000} = 2 \qquad \text{Voltage gain} = 2$$

What happens when the Amplitude of the Amplitude of the input Signal is to large?

The output Stops Being a Square wave

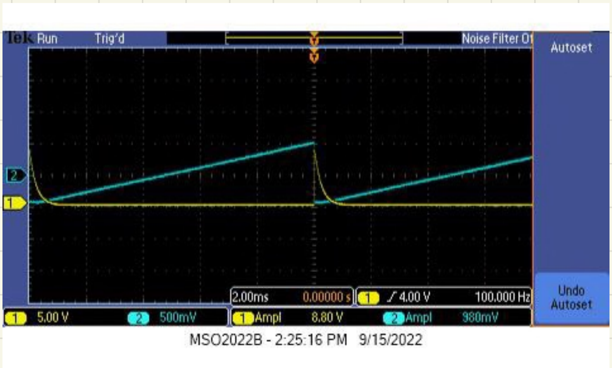
what do you need to do to have a voltage gain of 10?

Change the value of $R_2$ and $R_1$ Such that...

$$\frac{R_2}{R_1} = 10.$$

e) The circuit shown below was built. A $1V_{p-p}$ triangular wave was inputted, The output waveform is then captured for 100 Hz, 500 Hz, 700 Hz, 1 KHz, and 10 KHz.

100 HZ



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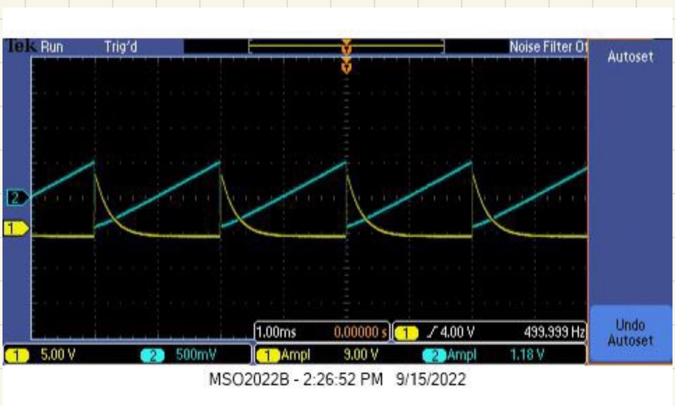
500 HZ



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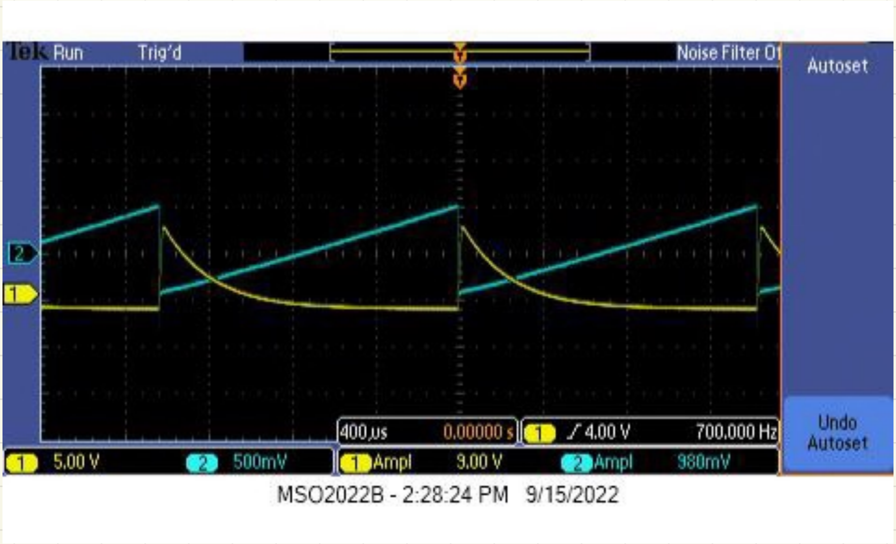
700 Hz


Tek Run
Trig'd
Noise Filter Of
Autoset
400 µs
0.00000 s
1
4.00 V
700.000 Hz
Undo Autoset
1 5.00 V
2 500mV
1 Ampl 9.00 V
2 Ampl 980mV
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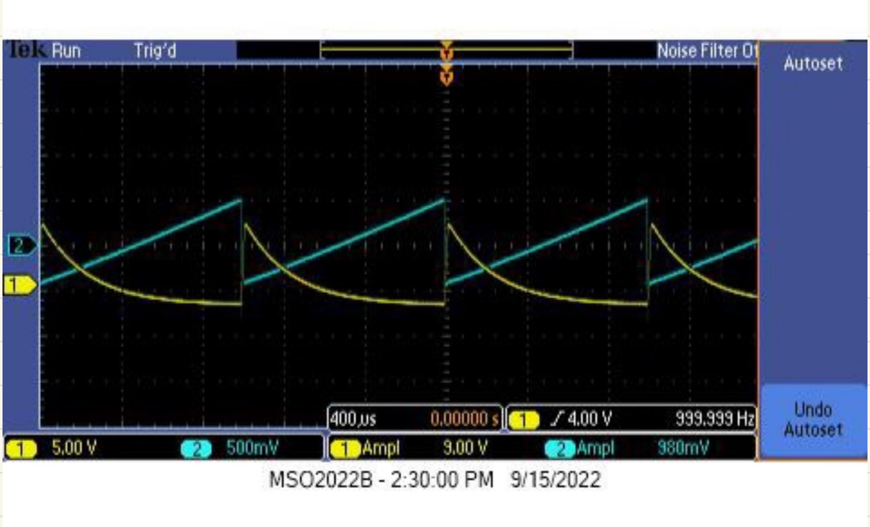
1kHz


Tek Run
Trig'd
Noise Filter Of
Autoset
400 µs
0.00000 s
1
4.00 V
999.999 Hz
Undo Autoset
1 5.00 V
2 500mV
1 Ampl 9.00 V
2 Ampl 980mV
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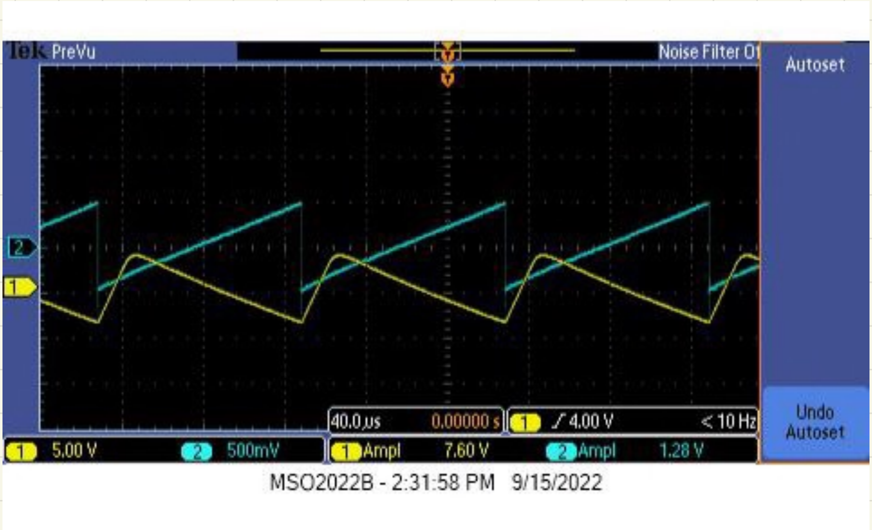
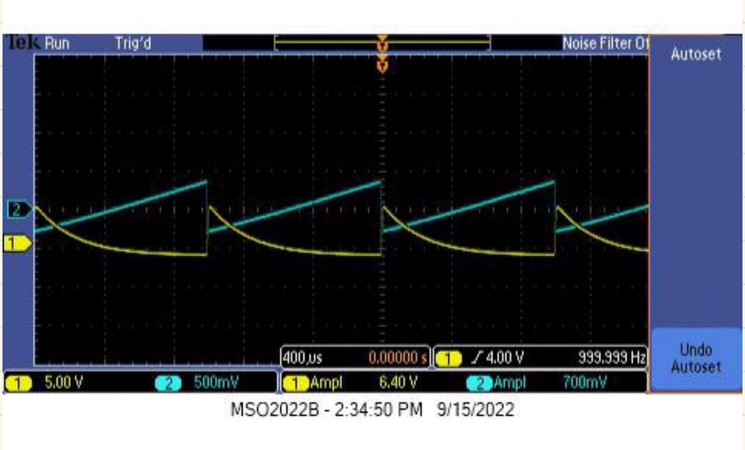
10kHz




Vary the input frequency until the output reaches 70% of its high frequency magnitude.

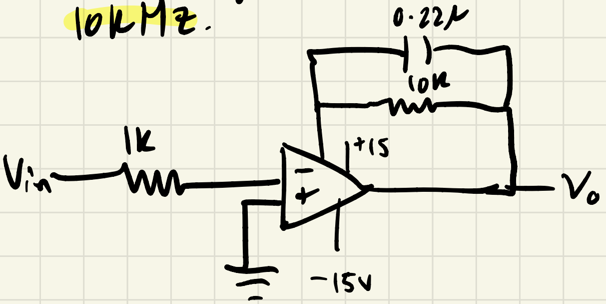
$20\log_{10}(A) = -3dB$ , $A = 0.707$




find the 3dB frequency.

We used 1kHz

f) The circuit shown below is constructed. A 0.5$V_{p-p}$ Square wave was Applied. The output is then captured with frequencies of 10HZ, 100HZ, 500HZ, 700HZ, 1KHZ, 10KHZ.




10HZ