# CSE251- Electronic Devices and Circuits
# Spring 2023

Name: Faiyaz Morshed Khan

Student ID: 21301040

Experiment No: 01

Experiment Name: Study of Op-Amp : Comparator
Inverting Amplifer, Non-Inverting Amplifer

Group Number : 06

Date of Performance : 31.01.23

Date of Submission : 06.02.23

## Data Sheet

### Task-02:

Input Amplitude from oscilloscope, $v_I$ = 0.98
Output Amplitude from equation, $v_O = -(\frac{R_2}{R_1}) \times v_I$ = -2.576
Output Amplitude from oscilloscope, $v_O$ = -2.54

### Task-03:

Input Amplitude from oscilloscope, $v_I$ = 1.92
Output Amplitude from equation, $v_O = (1 + \frac{R_2}{R_1}) \times v_I$ = 3.628
Output Amplitude from oscilloscope, $v_O$ = 3.72

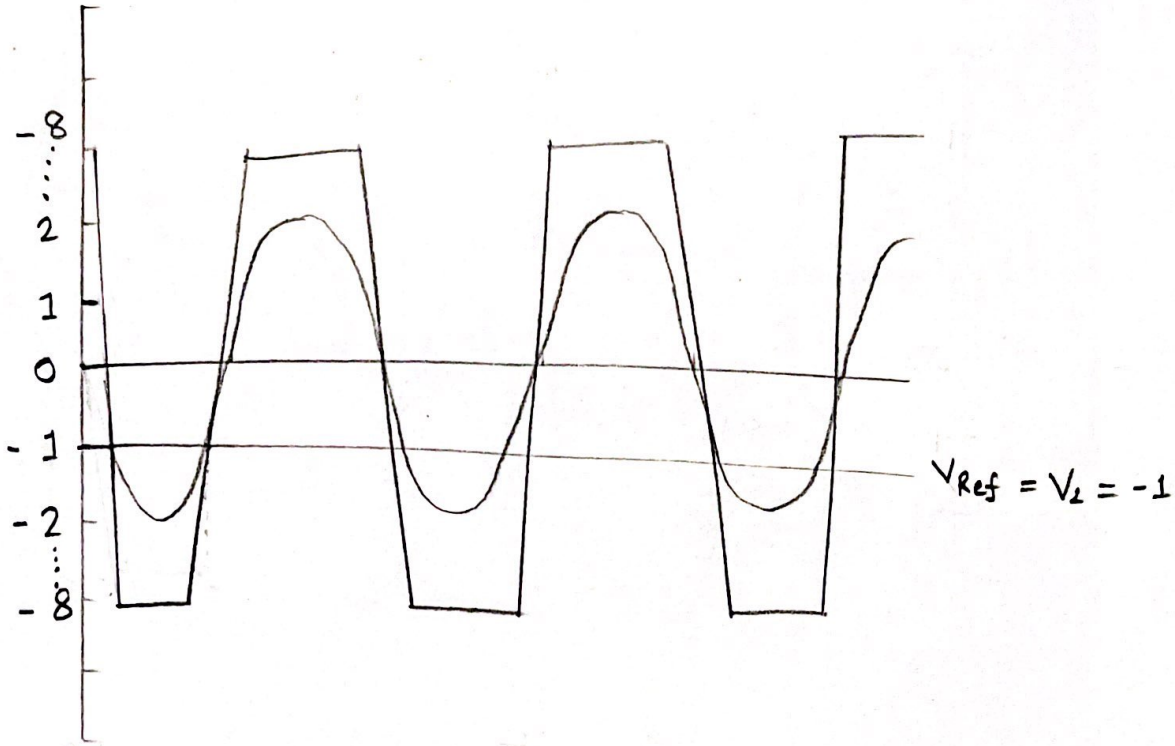
## Test Your Understanding

Answer the following questions:

1. You are given an Op-Amp comparator with $v_1 = 4$ V (p-p), sine wave and $v_2 = V_{REF} = -1$ V. Draw the waveform of $v_1$, $v_2$ and $v_O$ in the same graph with proper labels.
2. You are given an inverting amplifier with $v_I = 4$ V (p-p), $R_1 = 1\ k\Omega$, $R_2 = 2.2\ k\Omega$. Draw the waveform of $v_I$ and $v_O$ in the same graph with proper labels.
3. You are given a non-inverting amplifier with $v_I = 4$ V (p-p), $R_1 = 1\ k\Omega$, $R_2 = 2.2\ k\Omega$. Draw the waveform of $v_I$ and $v_O$ in the same graph with proper labels.

Ans to the ques No. (3)

1)

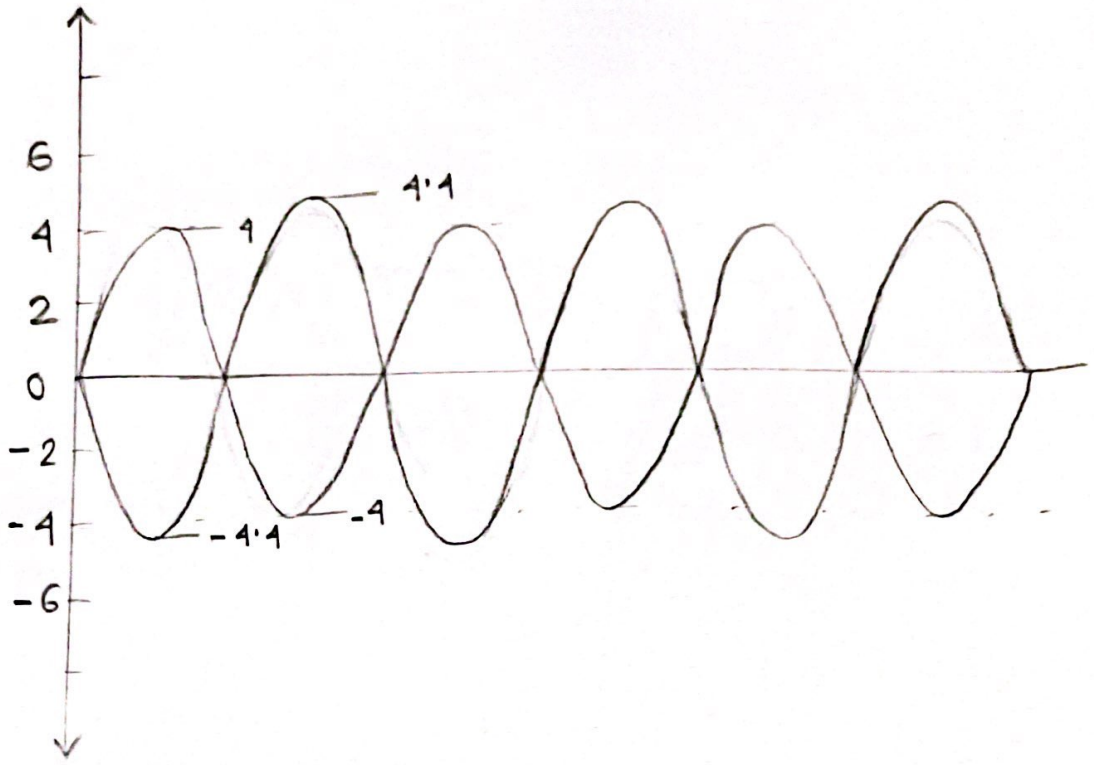



The op amp is set up as an non-inverting comparator, the output waveform of the comparator will be square wave that switches between the positive and negative power supply rails ($V_+$ and $V_-$) in response to the input sine wave crossing the referencee voltage of -1V.

The waveform of v1 will be a sine wave with 4V (P-P)

The waveform of v2 will be a constant voltage at -1V.

2)




The op-amp is set up as an inverting amplifier.

The waveform of the input voltage $V_I$ will be sine wave with of 4V (P-P).

$$\text{Gain} = -\frac{R_2}{R_1} = -\frac{2.2}{1} = -2.2$$

$$\therefore V_o = -8.8\,V$$

Therefore, the waveform of the output will be equal to the product of gain and input voltage (P-P) of $-8.8\,V$ and phase shift of 180 degrees relative to the input waveform.

3)

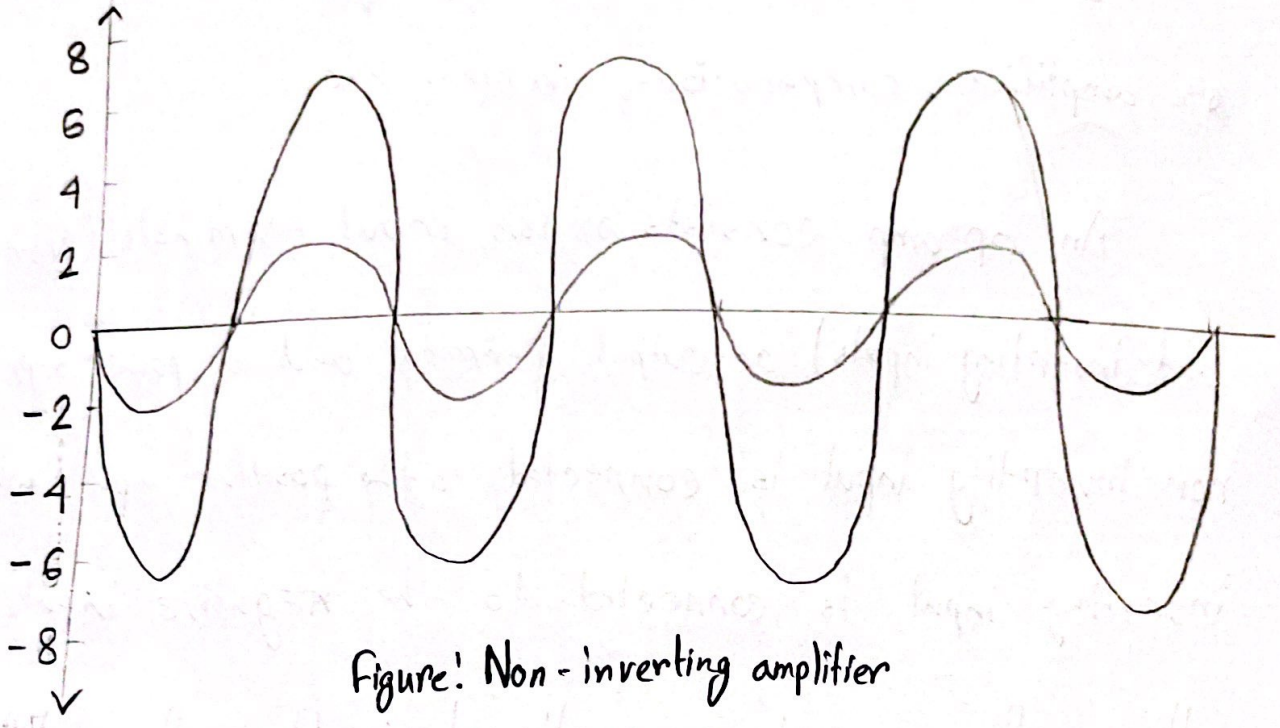



Figure: Non-inverting amplifier

The equation for a non-inverting amplifier is given by

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

$$= \left(1 + \frac{2.2}{1}\right) \times 4$$

$$= 12.8\ V\ (P\text{-}P)$$

The waveform of $V_I$ will be a sine wave of 4V (P-P)

The " " $V_o$ " " " " " of 12.8 V (P-P)

Discussion: An op-amp is a type of amplifier of electrical signals which is voltage-controlled voltage source that can amplify the difference between two input signals. Op-amp can be used as amplifiers, comparators, inverters etc.

An op amp consists of two input terminals (Non-inverting and inverting inputs) an output terminal and a power supply. The non-inverting input is connected to the positive input, while the inverting input is connected to the negative input. The output voltage of op amp is proportional to the voltage difference between the two inputs, multiplied by the gain of the op amp.

Op amps are widely used in a variety of applications, including electrical components etc. They are typically available in IC form and widely used for high performance and low cost.