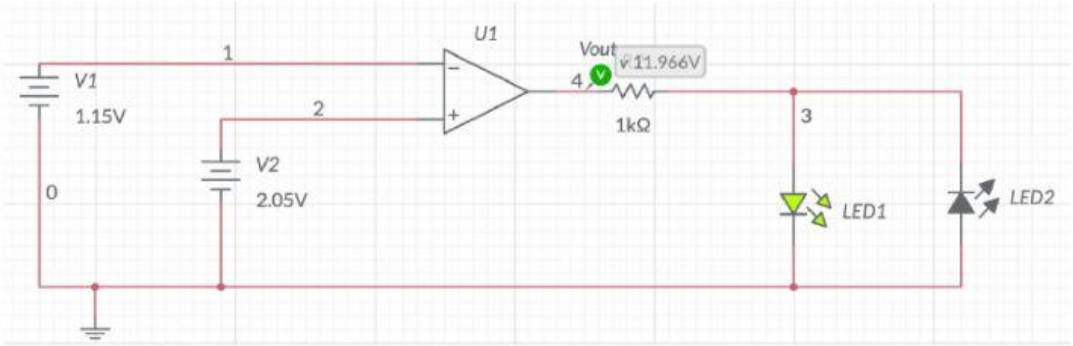
The operational Amplifier can be precisely used to compare between two input values. this has many applications such as level detector of water, sound, or speed where the input values coming from the sensor are compared with set values. one good application is security code checker.

This Worksheet provides evidence for PC6.3.

PC6.3	Build a **comparator** op-amp circuit using 741 IC to demonstrate its operation, and measure the output voltage using the multimeter for different inverting input and reference input voltages. Compare the measured and calculated theoretical values.	Application
PC6.4	Build a **differential** op-amp circuit using 741 IC to demonstrate its operation, and measure the output voltage using the multimeter for different inputs voltages. Compare the measured and calculated theoretical values.	Application

Part 1: For the Comparator operational amplifier shown below, answer questions a to h.

Ana



a) What is the output Voltage V_{out} if V_1=2V and V_2=3V?
   a. 0V
   b. 1V
   c. +12V (V_+)
   d. -12V (V_-)

App

b) What is the output Voltage V_{out} if V_1=3V and V_2=2V?

c) What is the output Voltage V_{out} if V_1= V_2=3V?

EV-CT

d) What is the status of LED1 when V_1= -3V and V_2=2V?

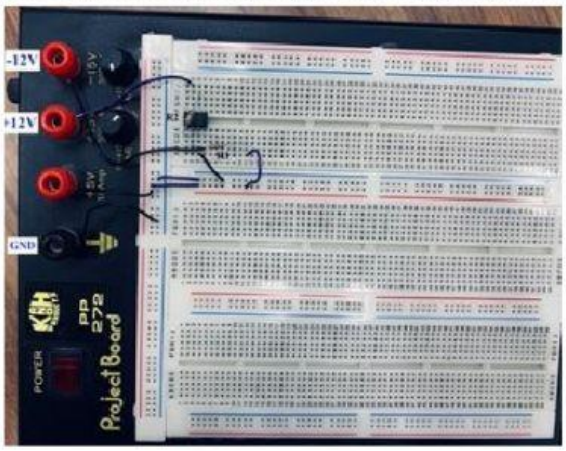
e) What is the status of LED1 when V_1= -3V and V_2=- 2V?

f) Use www.MultiSim.com to simulate the circuit, use the setup in the table below, what is the value of $\mathbf{V_{out}}$? insert the link of your circuit in the box below:

Hint: All your evidence, circuit pictures, videos and screen shots should be saved in Teams-General-Term 3 Practicals - Your group- PC6.3

C/Re

g) Build the circuit in step **e** and tabulate your readings in the table below:



Hint: remove all resistors

V_1 (V)	V_2 (V)	Expected $\mathbf{V_{out}}$	Simulated V_{out}	Practically measured V_{out}	% Error
12	12				
12	5				
5	-12				
0	5				

Und

h) examine the summing amplifier circuit you have built and tested in step g. What is your conclusion? select the correct answers.

a. positive values dominate
b. it compares the magnitudes of the signals
c. the output is V- if the inverting input is higher
d. the output is V+ if the non-inverting input is higher
e. the output is 0 when both inputs are equal.

Group

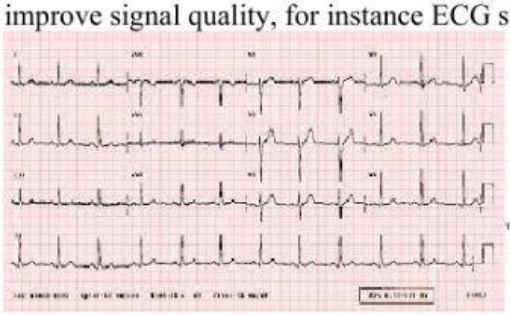
i) Record a video for your circuit. Store the video in the class team and past the link of your video below.

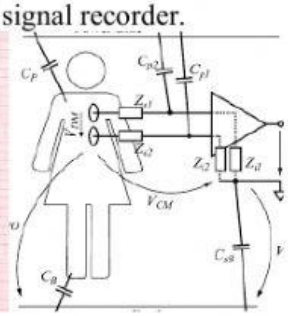
Ana

Part 2: The differential amplifier

The differential amplifier works like mathematical subtractor but with very high precision. It is used to detect the difference between two signals with high sensitivity.

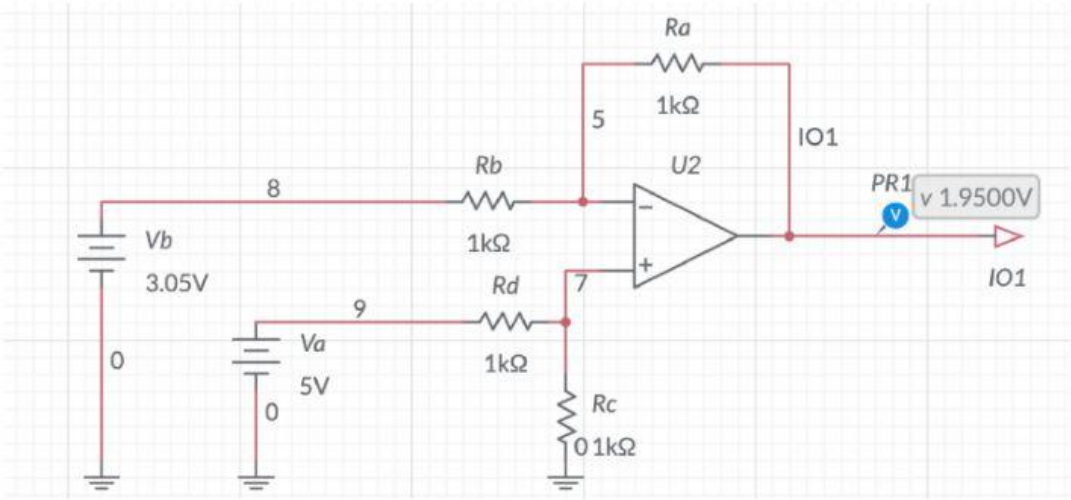
this amplifier is applied when very low signals are examined to reduce the noise and improve signal quality, for instance ECG signal recorder.





This Worksheet provides evidence for PC6.4.

For the differential amplifier shown below, answer questions j to r.



j) What is the output expression of the operation amplifier configuration?

a. $V_{out} = R_c \frac{V_a}{R_d} - R_a \frac{V_b}{R_b}$

b. $V_{out} = R_c \frac{V_a}{R_d} + R_a \frac{V_b}{R_b}$

c. $V_{out} = \frac{V_a}{R_d} - R_a \frac{V_b}{R_b}$

d. $V_{out} = R_a \frac{V_a}{R_d} + R_a \frac{V_b}{R_b}$

k) If $R_a = R_b = R_c = R_d = 10K\Omega$, $V_a = V_b = 2.5V$. Calculate the voltage Gain A?

l) If $R_a = R_b = R_c = R_d = 10K\Omega$, $V_a = V_b = 2.5V$. Calculate V_{out}?

m) If $R_a = R_b = R_c = R_d = 10K\Omega$, $V_a = 4V$, $V_b = 5V$. Calculate V_{out}?

n) If $R_a = R_b = R_c = R_d = 10K\Omega$, $V_a = 6V$, $V_b = 2V$. Calculate V_{out}?

o) If $R_a = R_c = 10K\Omega$ and $R_b = R_d = 5K\Omega$, $V_a = 6V$, $V_b = 2V$. Calculate V_{out}?

Evl.

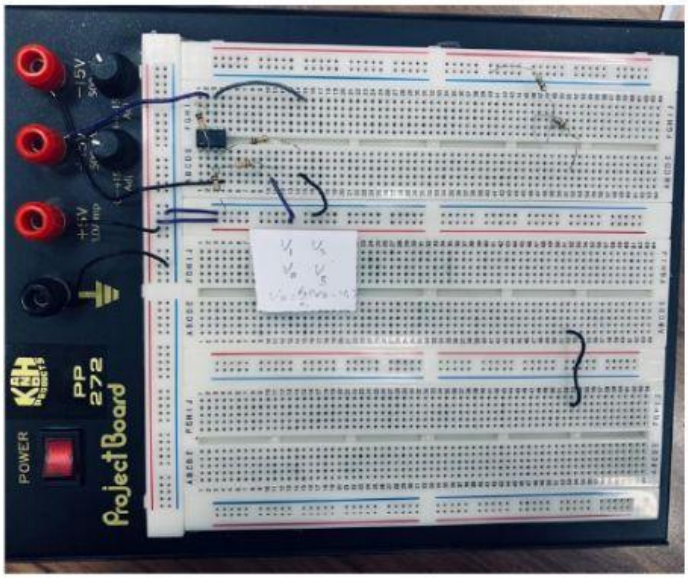
p) Use www.MultiSim.com to simulate the circuit of part 2, insert the link of your circuit simulation in the box below:

Hint: All your evidence, circuit pictures, videos and screen shots should be saved in Teams-General-Term 3 Practicals - Your group- PC6.4

C/Re

q) Build the circuit in step **e** and tabulate your readings in the table below:

Hint: you need to add the resistors to the comparator circuit



Und

r) examine the built circuit and complete the below table.

V_2 (V)	V_b (V)	Expected **V_{out}**	Simulated V_{out}	Practically measured V_{out}	% Error
12	12				
12	5				
5	12				

s) what is your conclusion? Select the correct answers.

a. the output voltage of the differential amplifier is the difference between the two inputs.

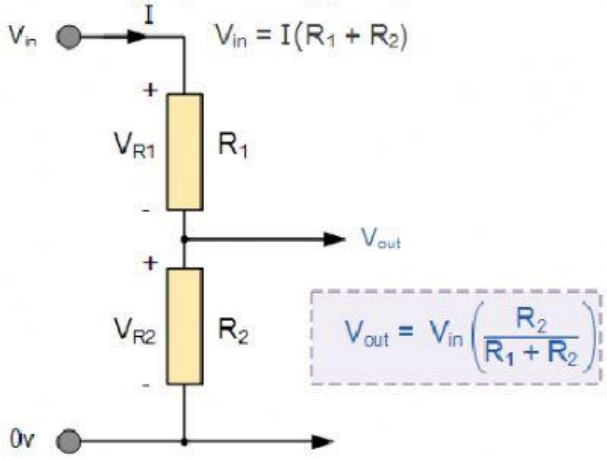
b. the sensitivity of the differential amplifier depends on the gain that controlled by the resistor connected to the amplifier.

c. it is possible to design unity gain difference amplifier where the output is V_2-V_1 where V_2 is the non-inverting input voltage and V_1 is the inverting input voltage value.

Group

t) Record a video for your circuit. Store the video in the class team and past the link of your video below.

To create multiple power supplies you can use the voltage divider circuit.



- % error formula

$$\%\ \text{Error} = \left| \frac{\text{Theoretical Value} - \text{Experimental Value}}{\text{Theoretical Value}} \right| \times 100$$

Theoretical Value = Actual ... Known ...True Value

Theoretical value is also the calculated value.