Analog Electronics

Practice Questions

1) A load requires a constant current of 5mA and the voltage across the load can range from 0V to 12V. An op-amp-based current source circuit as shown in Fig. 1. , needs to be used for this purpose. If the op-amp can provide rail-to-rail output voltages. Determine the values of V_{in} and R to operate the circuit.

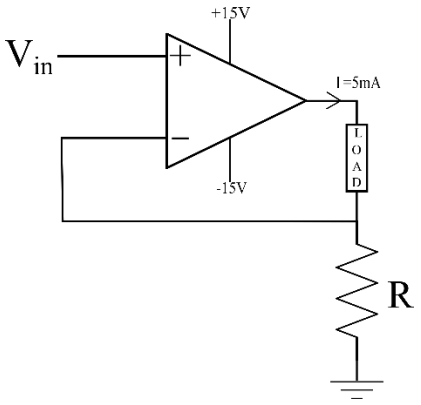

Fig. 1.

Ans(V_{in}<3V, R=$\frac{V_{in}}{5mA}$)

2) a) Whether the circuit shown in Fig. 2 will work as a current source for the load or not? If not then state the reason and suggest necessary changes required to make the circuit work as a current source.
b) If the load requires a constant current of 10mA and it's operating voltage can range from 0V to 10V then choose values of R2 and R3 and assume V_{CEsat} for BJTs =1V.

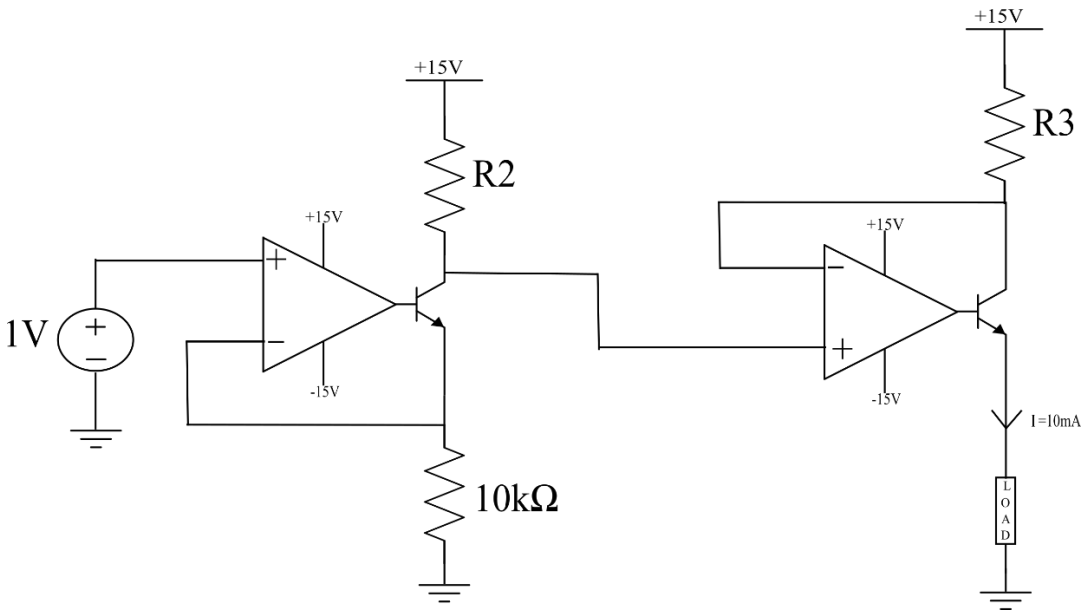

Fig.2

Ans(R2=40kΩ, R3=400Ω)

3) a) For the circuit shown in Fig.3 , what should be the range of load resistance R_L if the Op-Amp can supply a max output current of 10mA ?
b) What will be the output voltage for the given circuit if V_{in} = -2.5V and why?

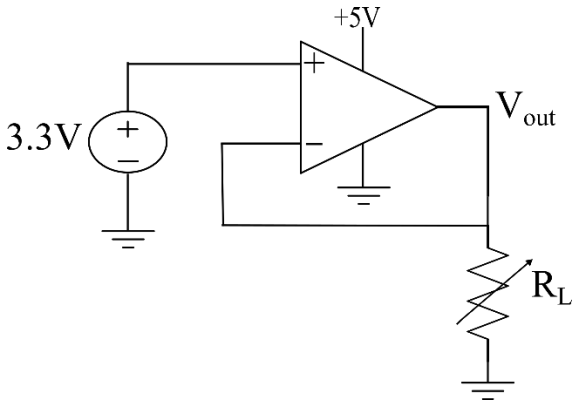

Fig. 3

Ans((a)330Ω<R_L, b)0V)

4) A voltage regulator circuit needs to be designed as shown in Fig. 4 which provides a regulated output voltage of 12V. The input voltage to circuit varies from 24V to 30V.
A Zener diode of V_Z =3.3V is used for providing the control voltage.
   a) Determine the values of R1 & R2 such that V_{out} =12V and not more than 4mW of power is dissipated across the series combination of R1 & R2.
   b) If the Zener diode can dissipate max 50mW of power then determine the min. value of R_Z for the given circuit.
   c) For a max. load current of 2A , determine the max. power loss in transistor Q1.

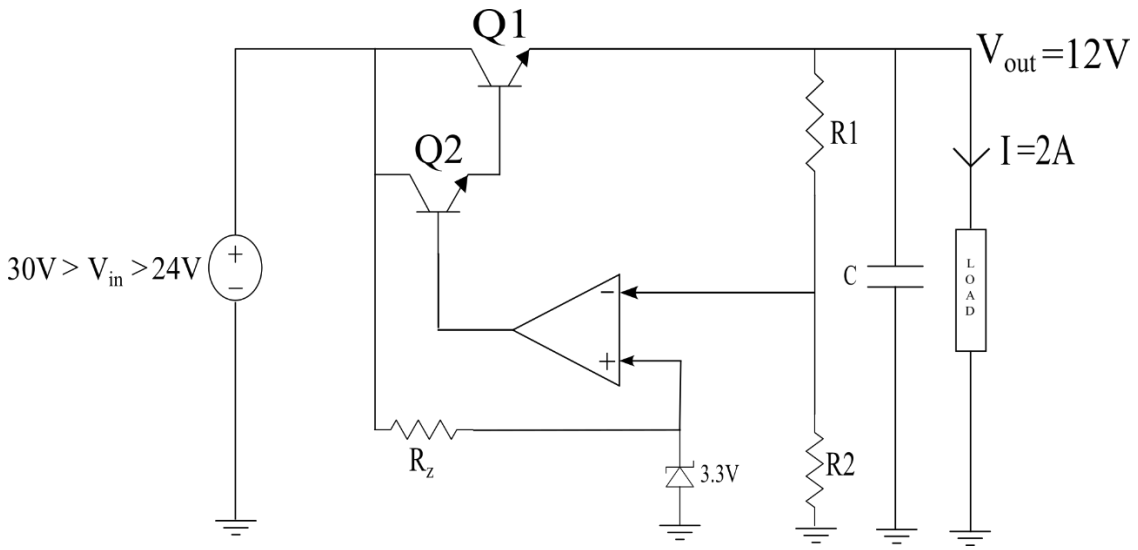

Fig. 4

Ans((a)R2=9.9kΩ,R3=26.1kΩ b)1.76kΩc)36W)

5) A circuit is shown in Fig. 5 which is to be used to measure the current flowing through the 10mΩ shunt resistor. Determine the values of R3 & R4 such that the circuit gives an output voltage =100mV when 1A of current flows through the shunt.

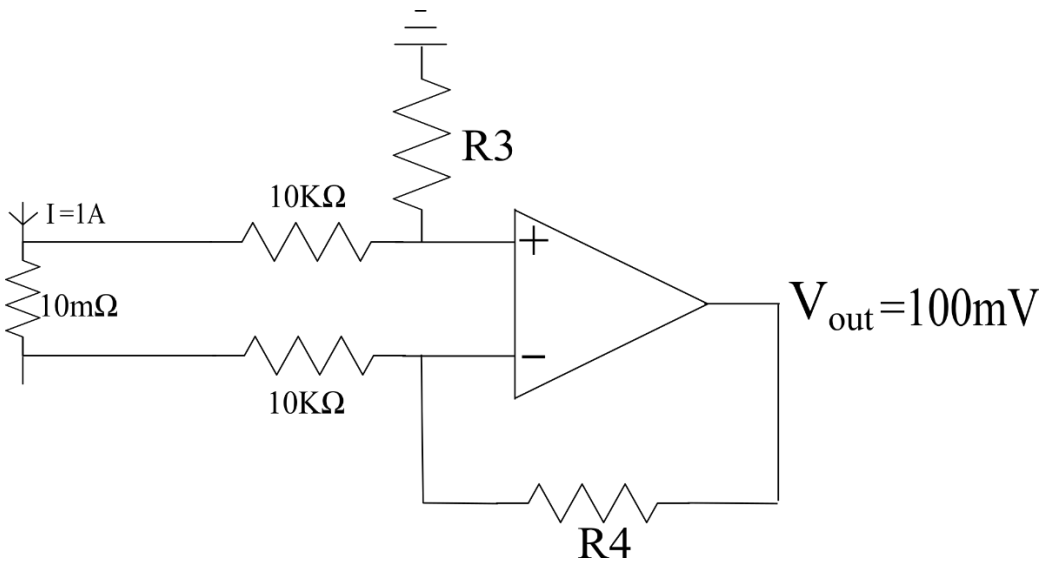

Fig. 5

Ans(R3=100kΩ,R4=100kΩ)

6) For the circuit shown in Fig. 6, if the input voltage is as shown below then find out the voltage gain of this circuit and draw the waveform of the output voltage for the given input.

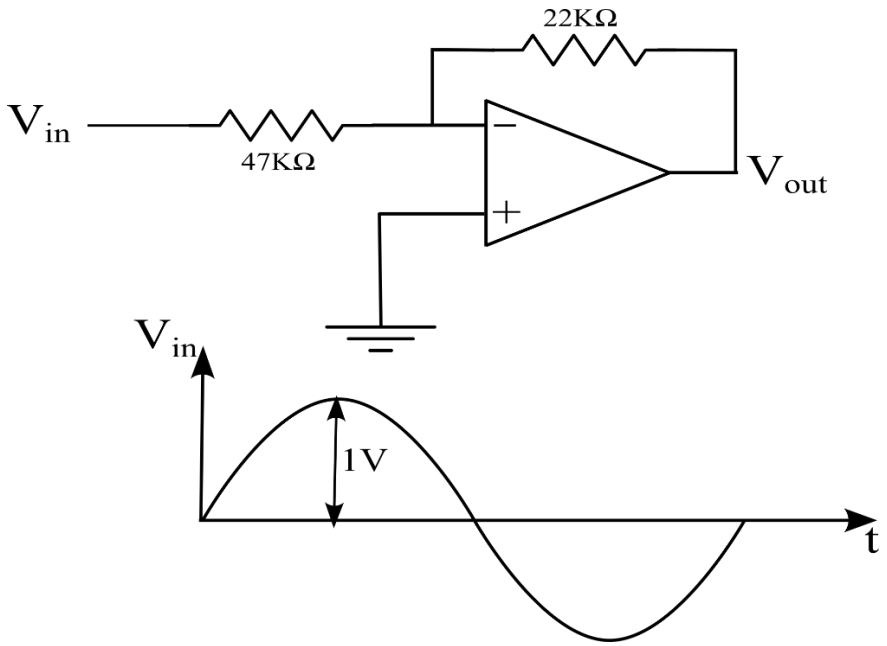

Fig. 6

Ans(Gain=-0.468V/V)

7) For the circuit shown in Fig. 7, find out the values of R1, R2 , R3 & R4 such that

$$V_{out} + 0.5V_1 + 0.1V_2 + 2.5V_3 + 1.25V_4 = 0$$

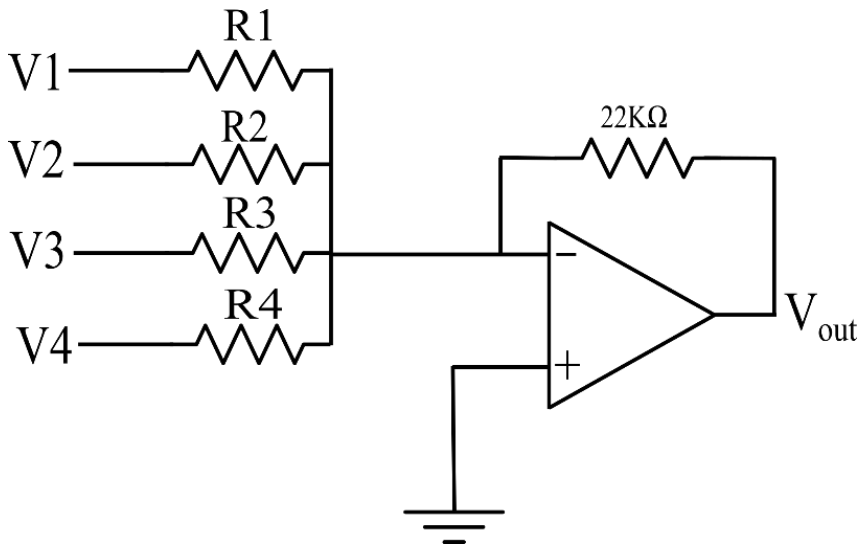

Fig. 7

Ans(R1=44kΩ,R2=220kΩ,R3=8.8kΩ,R4=17.6kΩ)

8) a) For the circuit shown in Fig. 8 , what will be the output voltage and why?
b) Find the output voltage if the positions of R1 & R2 are swapped in the circuit.

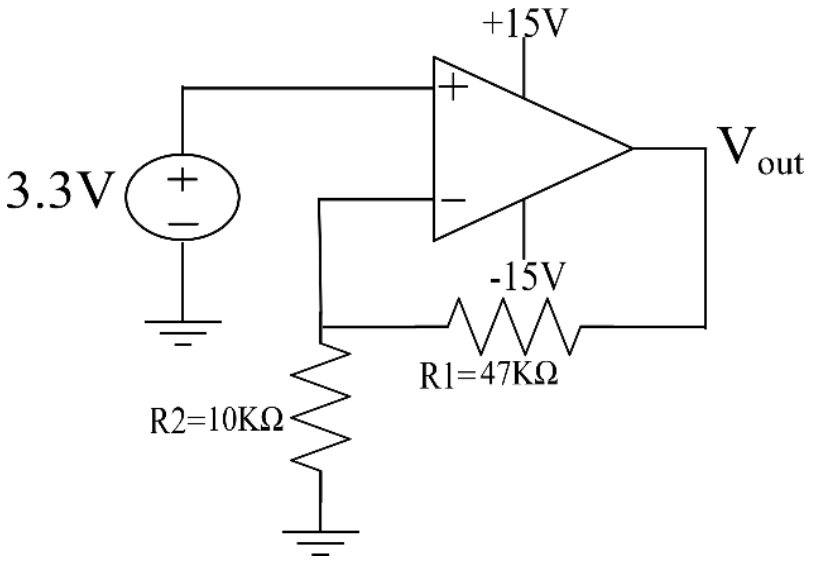

Fig. 8

Ans(a)15V b)4V)

9) Determine the ratio $\frac{R_1}{R_2}$ if it is required that the upper threshold voltage $V_{UT} = 0.6V$ and lower threshold voltage $V_{LT} = -0.6V$ for the Schmitt trigger circuit shown in Fig. 9

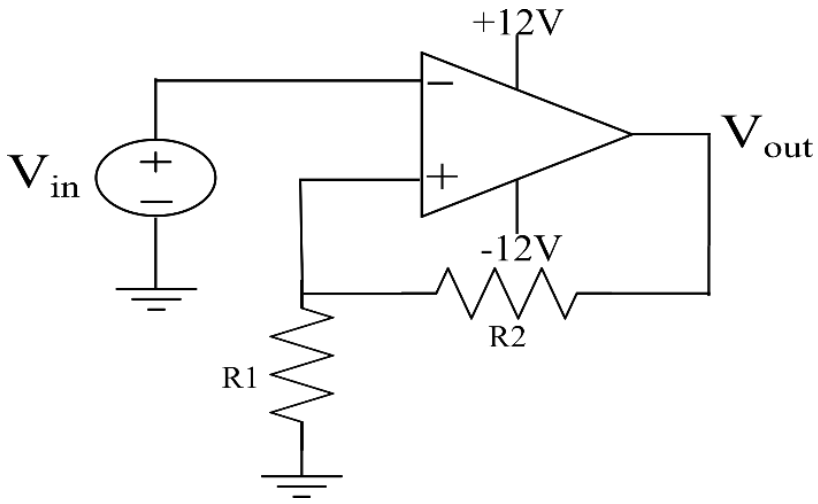

Fig. 9 **Ans($\frac{R1}{R2} = \frac{1}{19}$)**

10) For the circuit shown in Fig. 10 , find out the relation between V_{out} and V_{in} . Also draw the output voltage waveform for the given V_{in}.

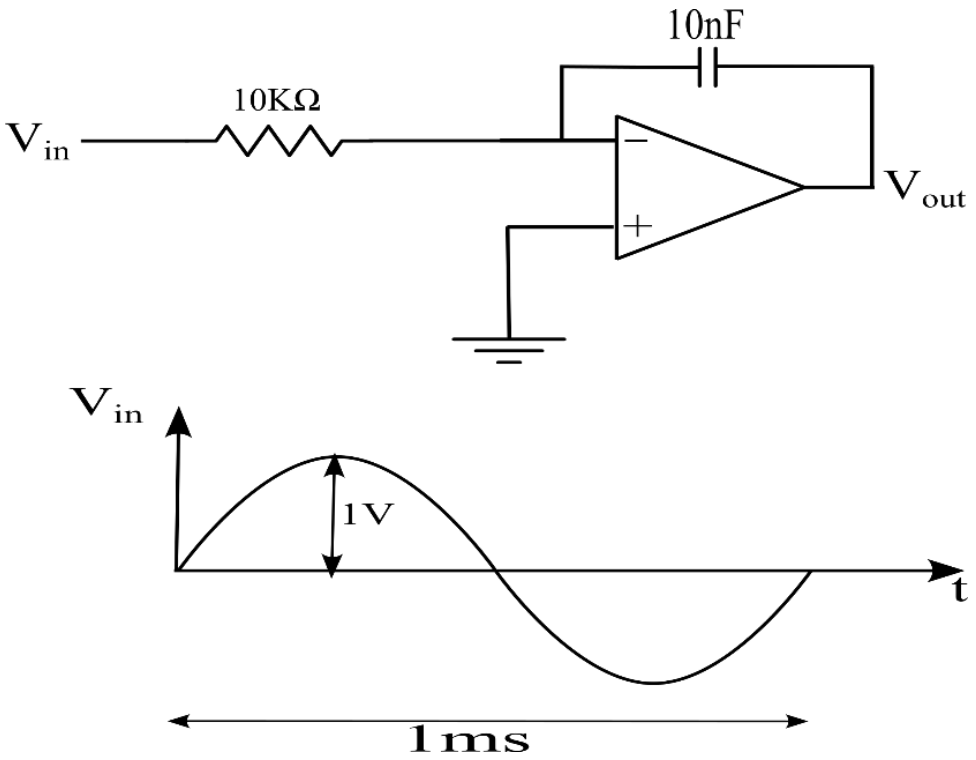

Fig. 10 **Ans($V_{out} = -\frac{1}{RC}\int V_{in} dt$)**

11) Considering silicon-based diodes for the two circuits shown in Fig. 11 , draw the output voltage waveforms for both of them if the input voltage has a waveform as shown. Is there any difference between the output voltages of both the circuits?

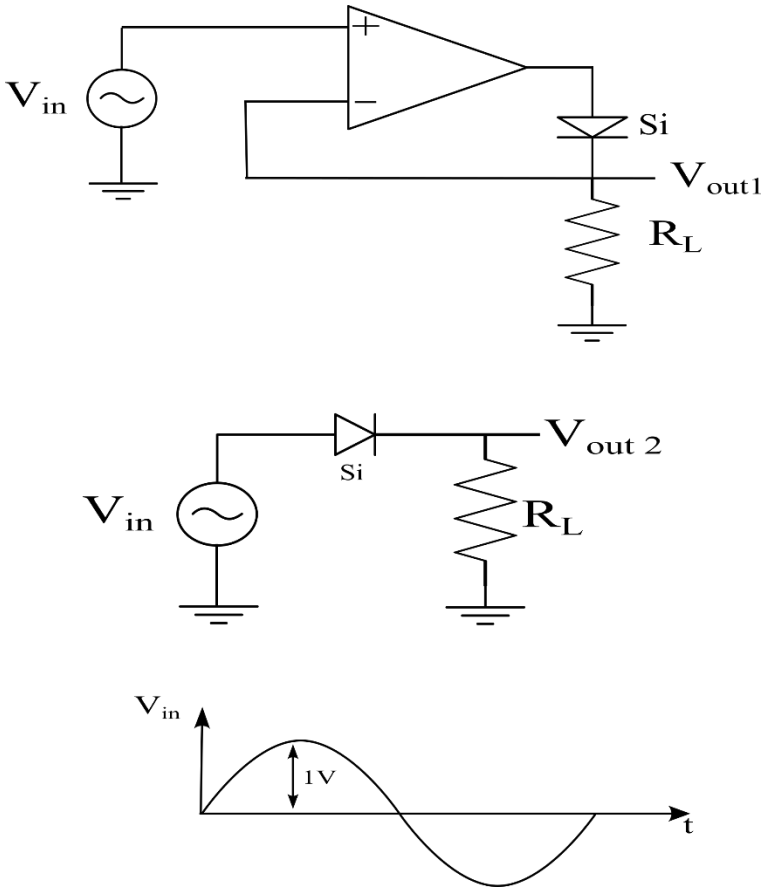

Fig. 11

12) Find out the relation between V_{out} and V_{in} for the circuit shown in Fig. 12.

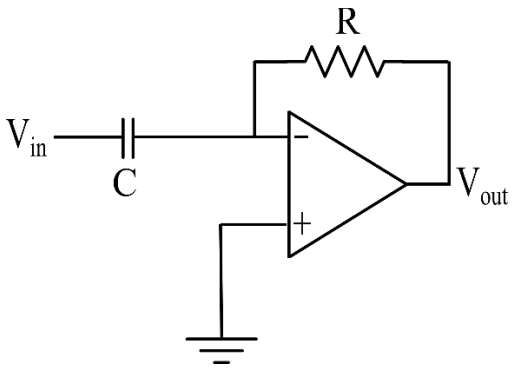

Fig. 12

Ans($V_{out} = -RC\frac{dV_{in}}{dt}$)

13) Find the output voltage for the circuit shown in Fig. 13

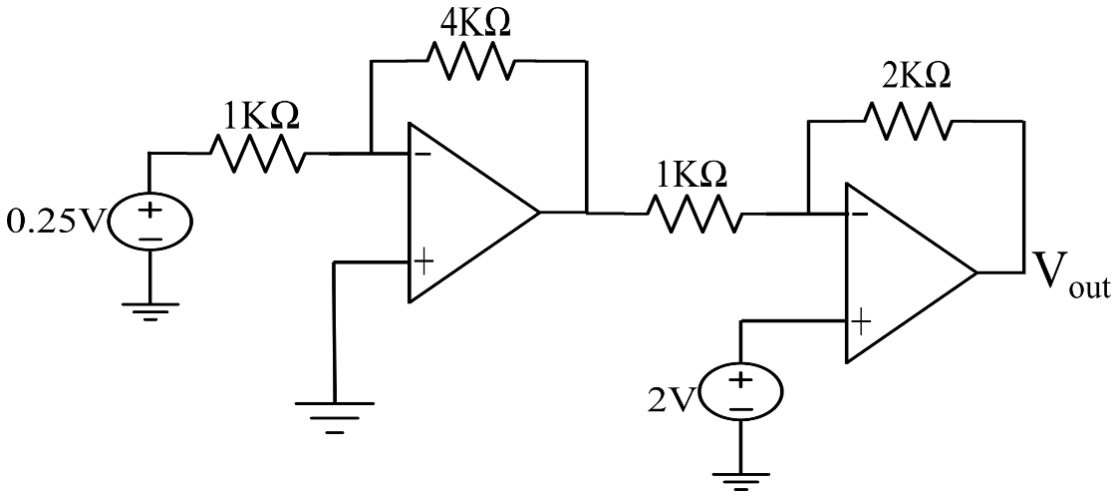

Fig. 13

Ans($V_{out} = 8V$)

14) Find out the expression for V_{out} in terms of V_1 & V_2 for the circuit shown in Fig. 14

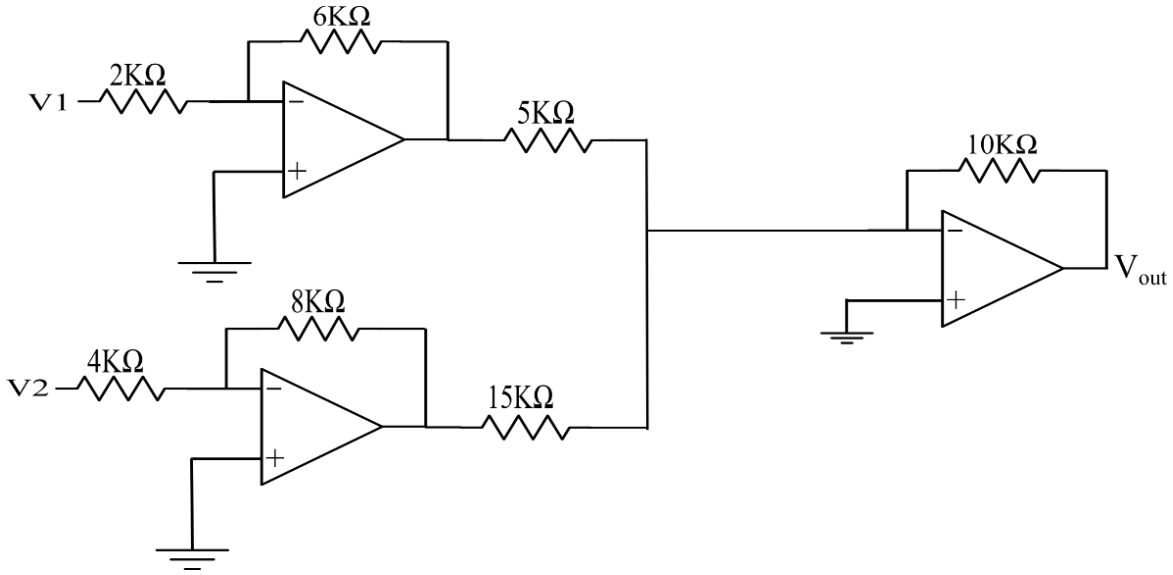

Fig. 14

Ans($V_{out} = -6V_1 - \frac{4}{3}V_2$)

15) For the circuit shown in Fig. 15 , find out the values of R1 & R2 such that 9V is obtained at the output of the circuit.

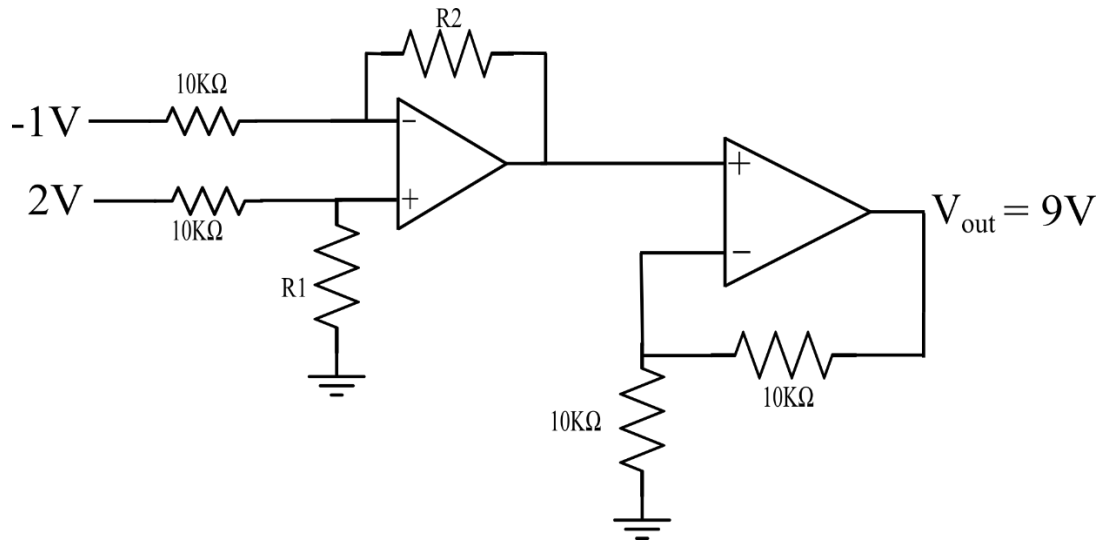

Fig. 15

Ans(R1=R2=15kΩ)