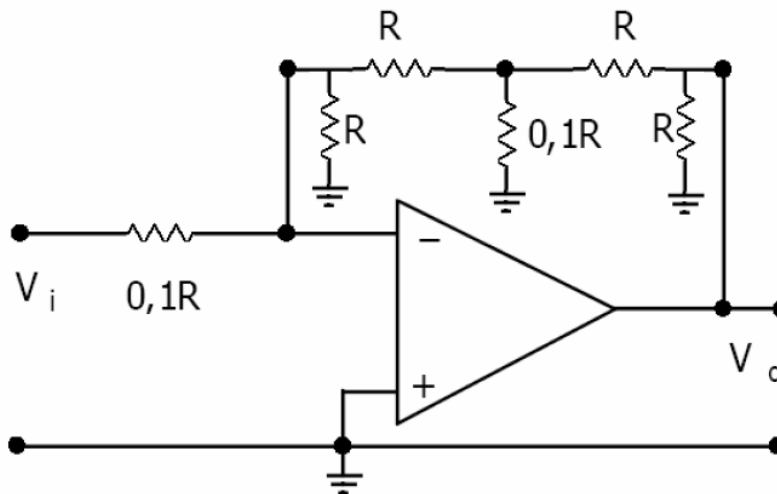


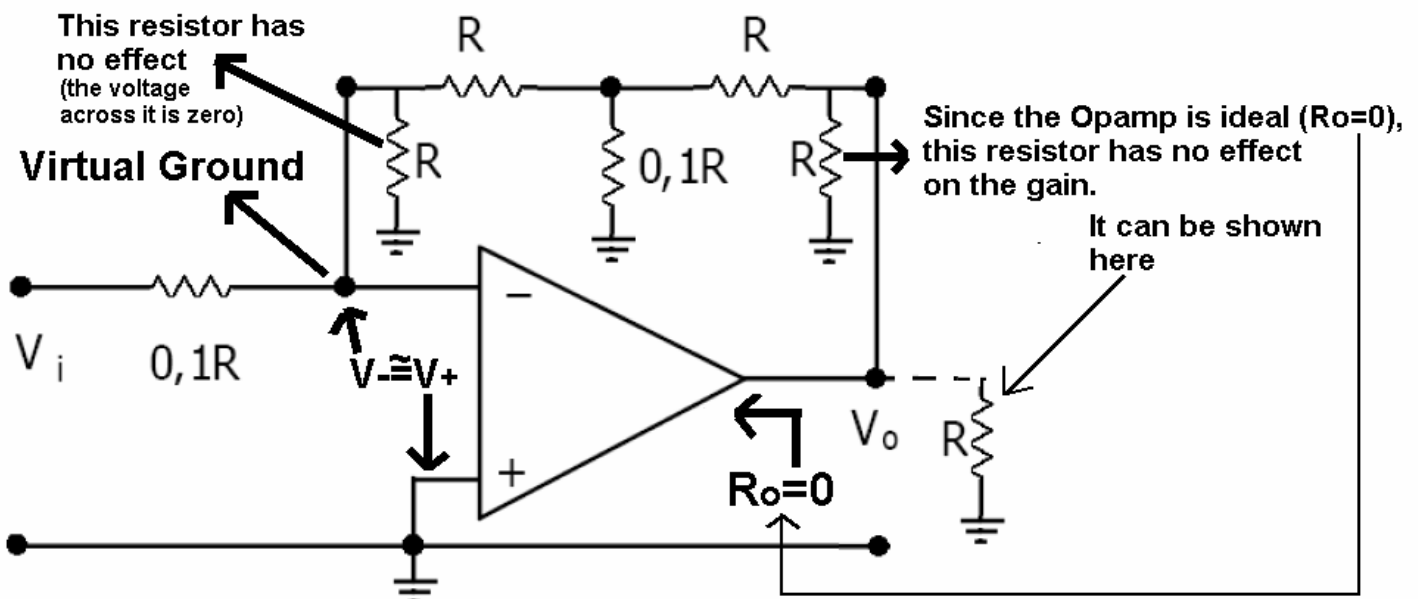
**EE232-INTRODUCTION TO ELECTRONICS**  
**EXERCISE-2.1**

**E2.1** Find the gain expression of the circuit given in Figure in terms of  $R$ .

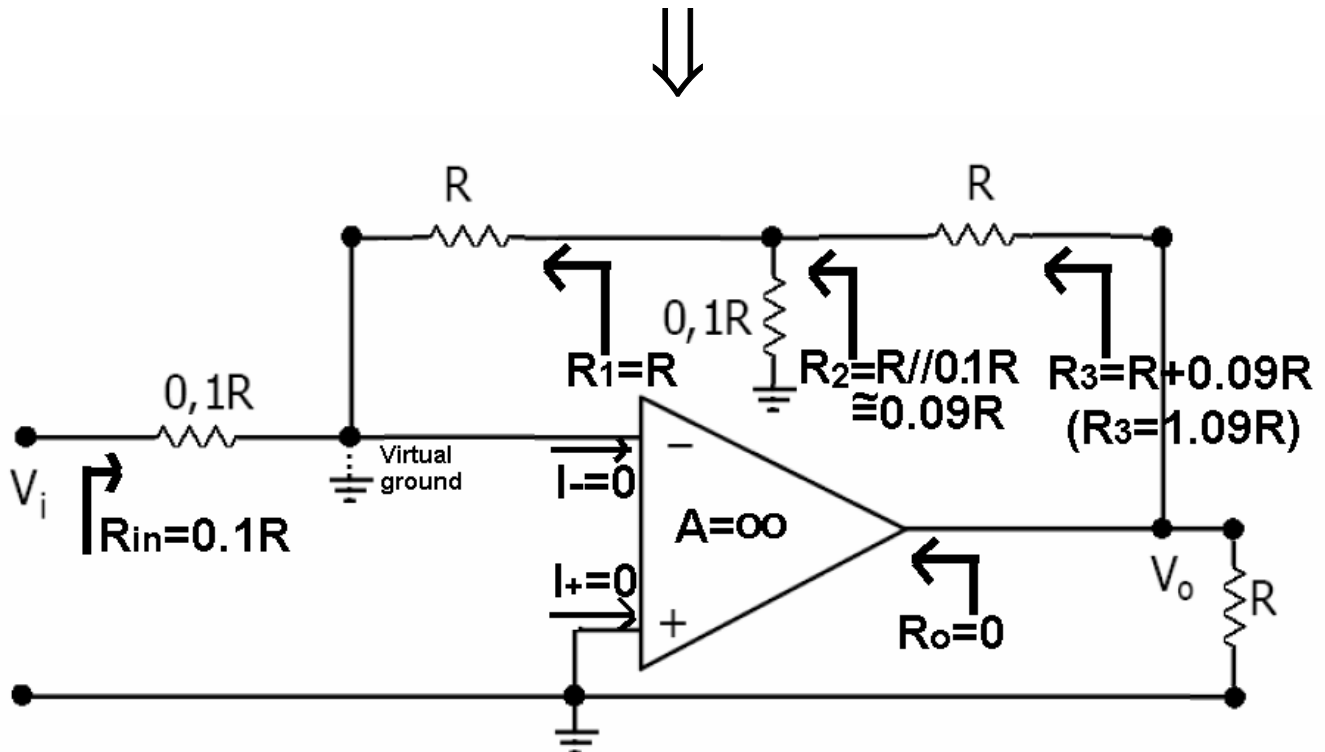
\*Assume that the operational amplifier is ideal



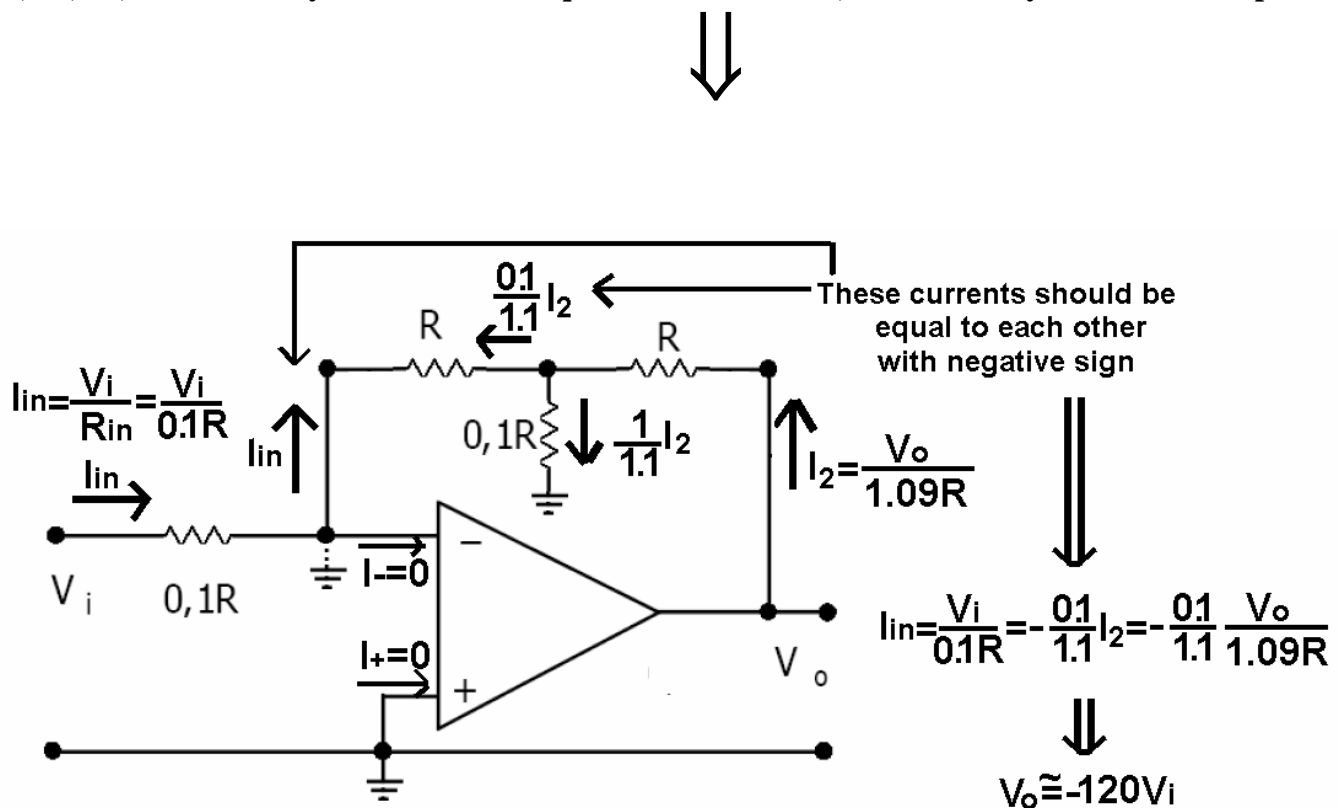
**S2.1** The opamp is used in the closed-loop configuration with negative feedback. Thus, as long as that the output is not saturated, voltages at the inputs of the opamp track each other, that is, the inverting input-voltage is equal to the noninverting-input voltage. As seen from the figure, the noninverting input is grounded. Therefore, the inverting input is said to be virtual ground.



If you carefully look at the circuit, you can see that some resistors in the circuit are unnecessary for the analysis.



For simplicity, before starting the analysis, it is useful to find some equivalent resistances which are called  $R_{in}$ ,  $R_1$ ,  $R_2$ ,  $R_3$  and  $R_4$ . By means of these equivalent resistances, one can easily find current expressions.



Finally, we obtain a high gain ( $A_v = -120$ ) without using a large resistor.