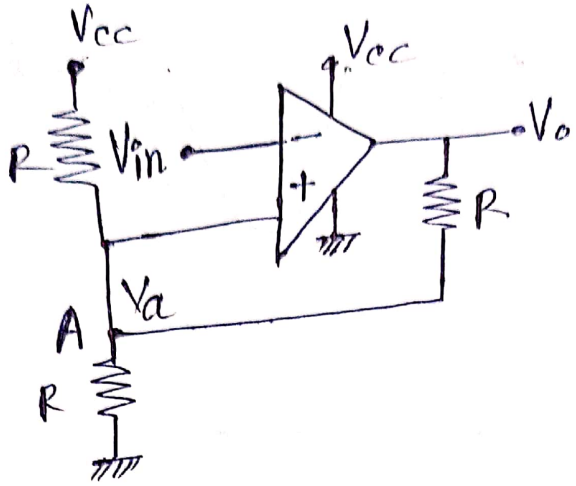
Tutorial-7

Ans ①:



Apply KCL at node 'A' —

$$\frac{V_a - V_{cc}}{R} + \frac{V_a}{R} + \frac{V_a - V_o}{R} = 0$$

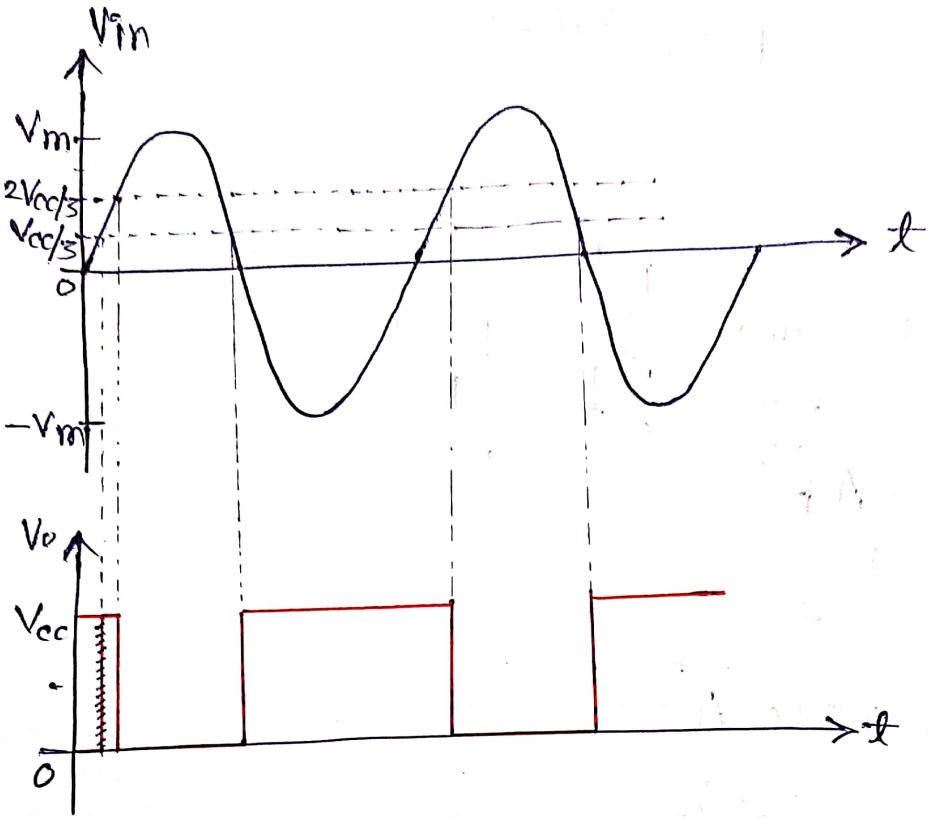
$$\frac{3V_a}{R} = \frac{V_o + V_{cc}}{R}$$

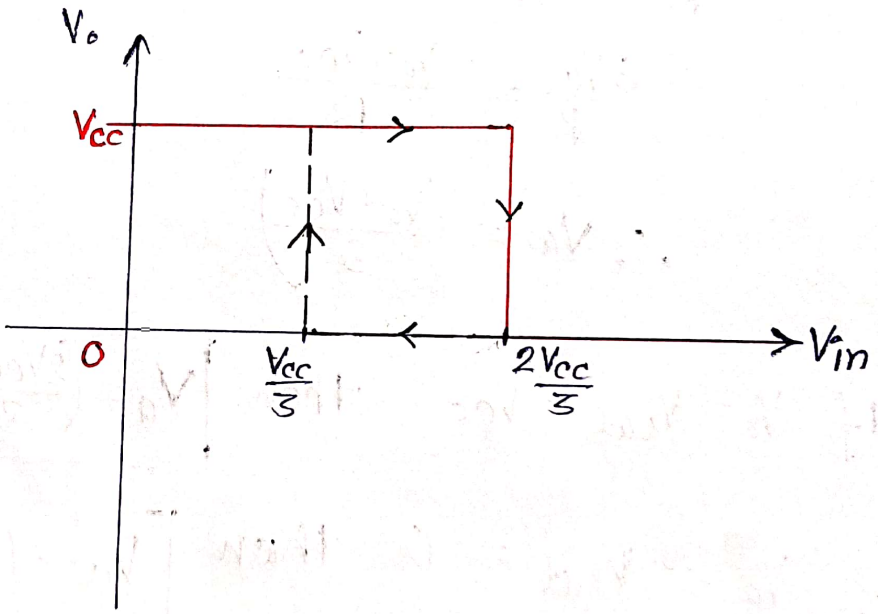
$$\therefore V_a = \left(\frac{V_o + V_{cc}}{3}\right)$$

If $V_o = V_{sat} = V_{cc}$ then $\boxed{V_a = \left(\frac{2V_{cc}}{3}\right)}$

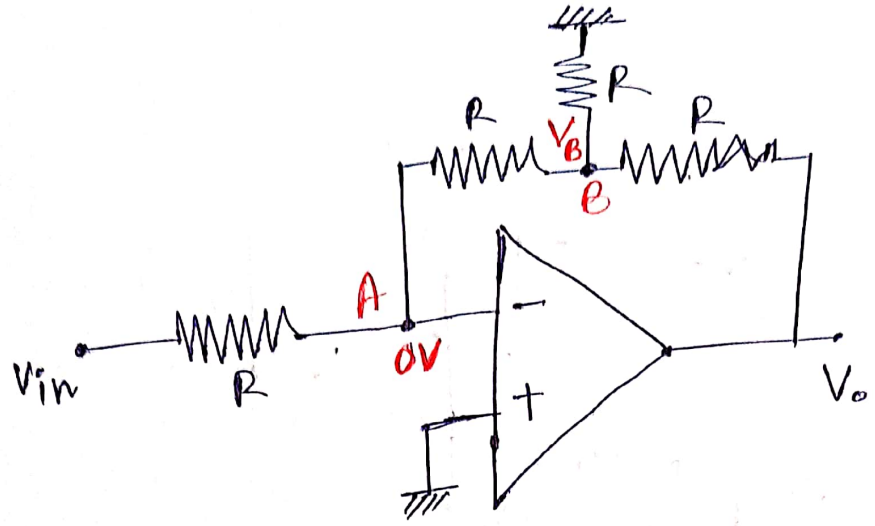
If $V_o = -V_{sat} = 0$ then $\boxed{V_a = \left(\frac{V_{cc}}{3}\right)}$

V_{in}


Vin
Vm
2Vcc/3
Vcc/3
0
-Vm
t
Vo
Vcc
0
t


Vo
Vcc
0
Vcc/3
2Vcc/3
Vin

Ans ②:



KCL at node A —

$$\frac{0-V_{in}}{R}+\frac{0-V_B}{R}=0$$

$$\therefore V_B=-V_{in}$$

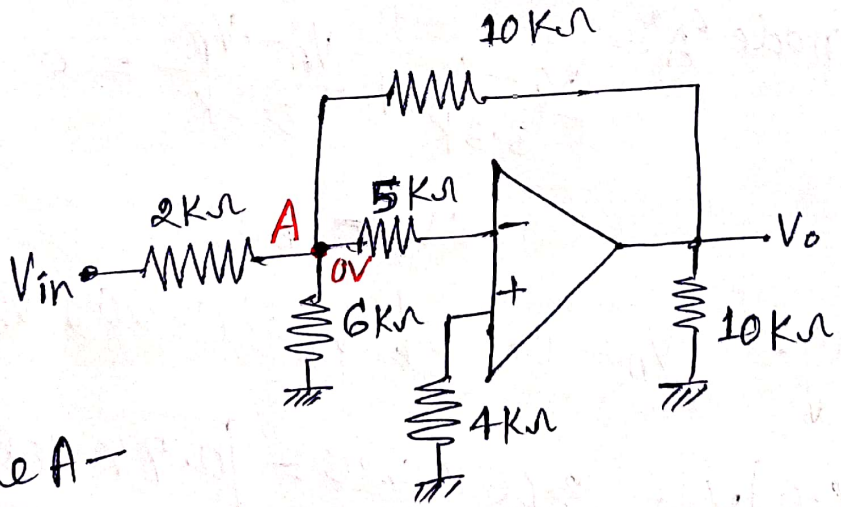
KCL at node B —

$$\frac{V_B-0}{R}+\frac{V_B-0}{R}+\frac{V_B-V_o}{R}=0$$

$$\frac{3V_B}{R}=\frac{V_o}{R}$$

$$\therefore \boxed{V_o=-3V_{in}}$$

Ans ③:

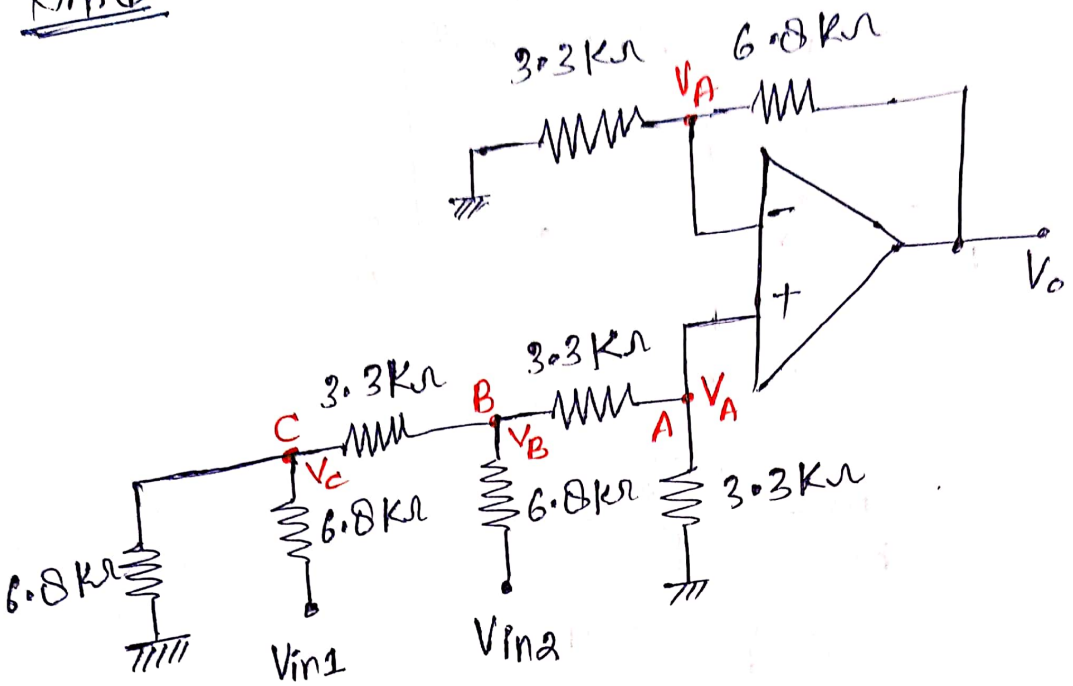


KCL at node A —

$$\frac{0-V_{in}}{2K}+\frac{0-V_o}{10K}=0$$

$$\therefore \boxed{V_o=-5V_{in}}$$

Ans ④



Case ④ : $V_{in1} = V_{in2} = 1V$

apply KCL at node 'C' — $\frac{V_C - 0}{6.8K} + \frac{V_C - 1}{6.8K} + \frac{V_C - V_B}{3.3K} = 0$

$13.4 V_C - 6.8 V_B = 3.3$ — (1)

apply KCL at node 'B' — $\frac{V_B - V_C}{3.3K} + \frac{V_B - 1}{6.8K} + \frac{V_B - V_A}{3.3K} = 0$

$16.9 V_B - 6.8 V_C - 6.8 V_A = 3.3$ — (2)

apply KCL at node 'A' — $\frac{V_A - 0}{3.3K} + \frac{V_A - V_B}{3.3K} = 0$

$2V_A - V_B = 0$ — (3)

after solving — $\boxed{V_A = 0.25}$, $V_B \cong 0.50$, $V_C \cong 0.50$

$\therefore V_o = \left(1 + \frac{6.8}{3.3}\right) V_A = 3.06 \times 0.25 = \boxed{0.77 \text{ volt}}$

Similarly do for other cases.