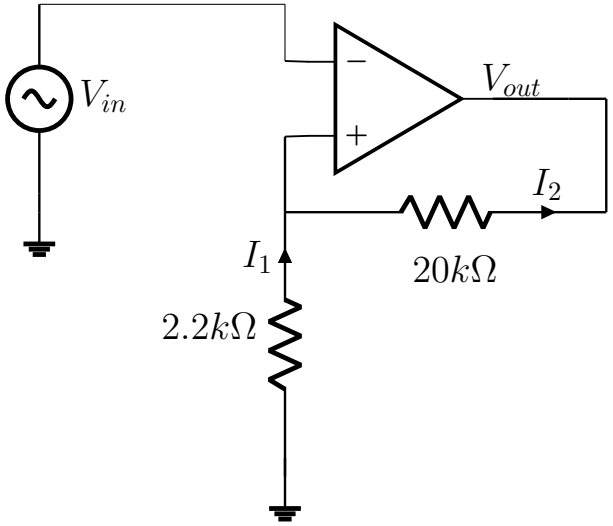
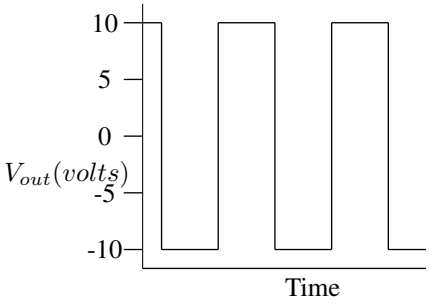
# GATE 2022-PH

EE23BTECH1205 - Avani Chouhan*

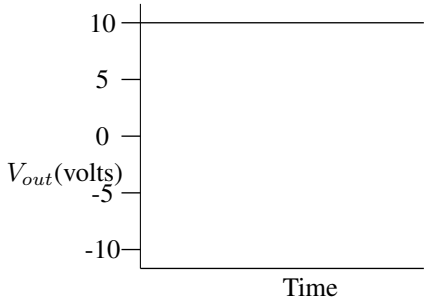
**Question : 11**

For the Op-Amp circuit shown below, choose the correct output waveform corresponding to the input $V_{\text{in}} = 1.5\sin(20\pi t)$ (in Volts). The saturation voltage for this circuit is $V_{\text{sat}} = \pm 10$ V.

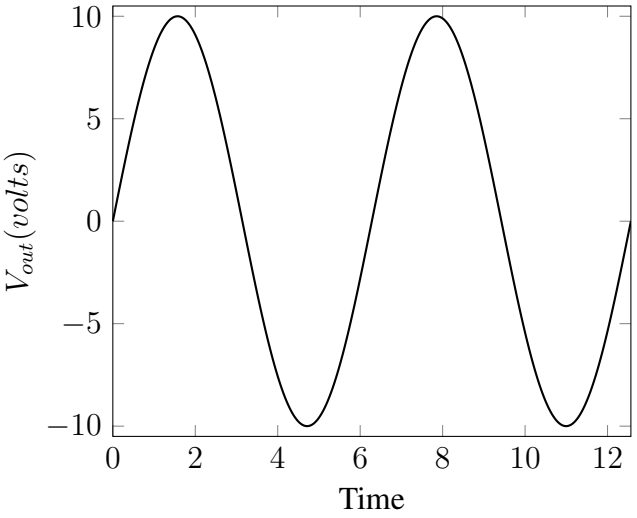


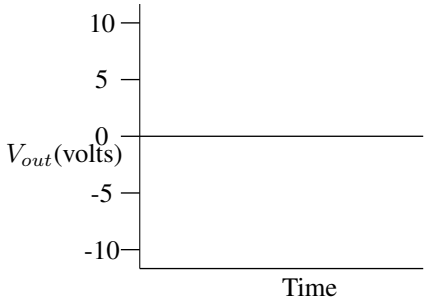

(A)




(B)




(C)




(D)

(GATE PH 2022)

**Solution:**

| Parameter | Value | description |
|---|---|---|
| $Vin$ | $1.5\sin(20\pi t)$ | input at inverting terminal |
| $V_{sat}$ | $\pm 10$ V | saturation voltage |
| $V_o$ | $-$ | output voltage of the op-amp |
| $I_1$ | - | Current through $2.2k\Omega$ |
| $I_2$ | - | Current through $20k\Omega$ |

TABLE 0
INPUT PARAMETERS

$$V_{in} = 1.5\sin(20\pi t) \tag{1}$$

$$V_{\text{sat}} = \pm 10\,\text{V} \tag{2}$$

Due to the virtual short voltage at the non-inverting terminal, which is$V_{\text{in}}$ and $I_1 = I_2$,

$$\frac{0 - V_{\text{in}}}{2.2\,\text{k}\Omega} = \frac{V_{\text{in}} - V_o}{20\,\text{k}\Omega} \tag{3}$$

$$\frac{-20}{2.2} = \frac{V_{\text{in}} - V_o}{V_{\text{in}}} \tag{4}$$

$$\frac{-20}{2.2} = 1 - \frac{V_o}{V_{\text{in}}} \tag{5}$$

$$\frac{V_o}{V_{\text{in}}} = 1 + \frac{20}{2.2} \tag{6}$$

$$V_o \sim 10V_{\text{in}} \tag{7}$$

$$V_o = 10 \times 1.5\sin(20\pi t) \tag{8}$$

Output amplitude is greater than $V_{\text{sat}}$, so the voltage saturates at $V_{\text{sat}}$.
Therefore, correct answer is (A).