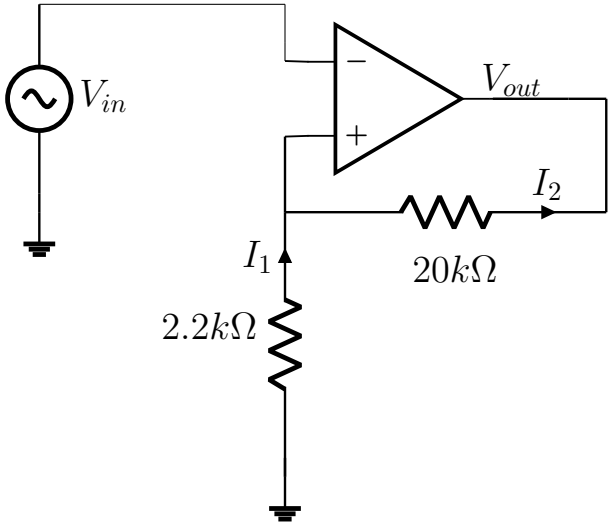
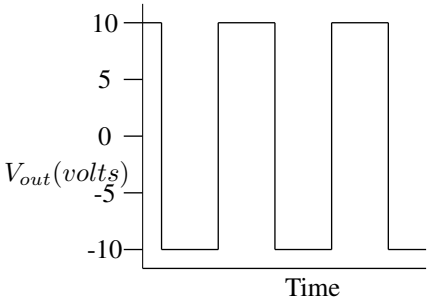
GATE 2022-PH

EE23BTECH1205 - Avani Chouhan*

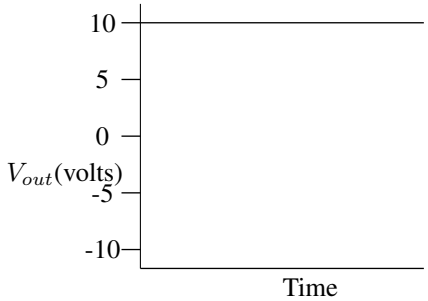
Question : 11

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.

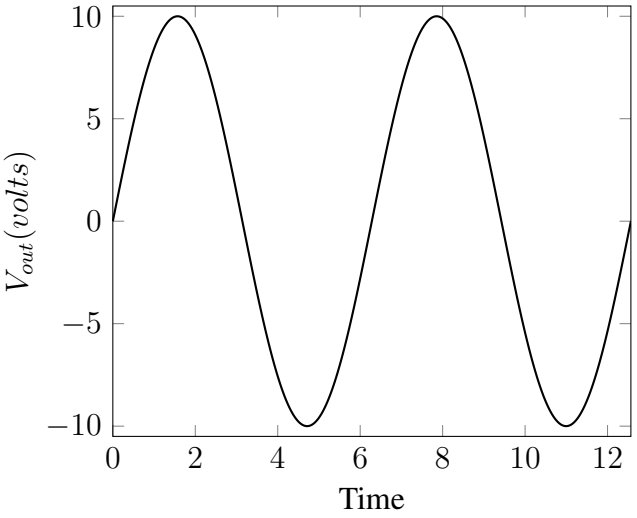




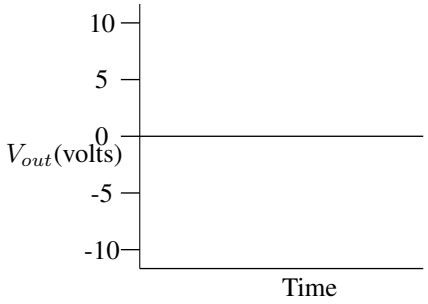
(A)



(B)



(C)



(D)

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Solution:

Parameter	Value	description
Vin	$1.5\sin(20\pi t)$	input at inverting terminal
V_{sat}	± 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 virtual short, voltage at non-inverting terminal is V_{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_{sat}, so the voltage saturates at V_{sat}.
Therefore, correct answer is (A).