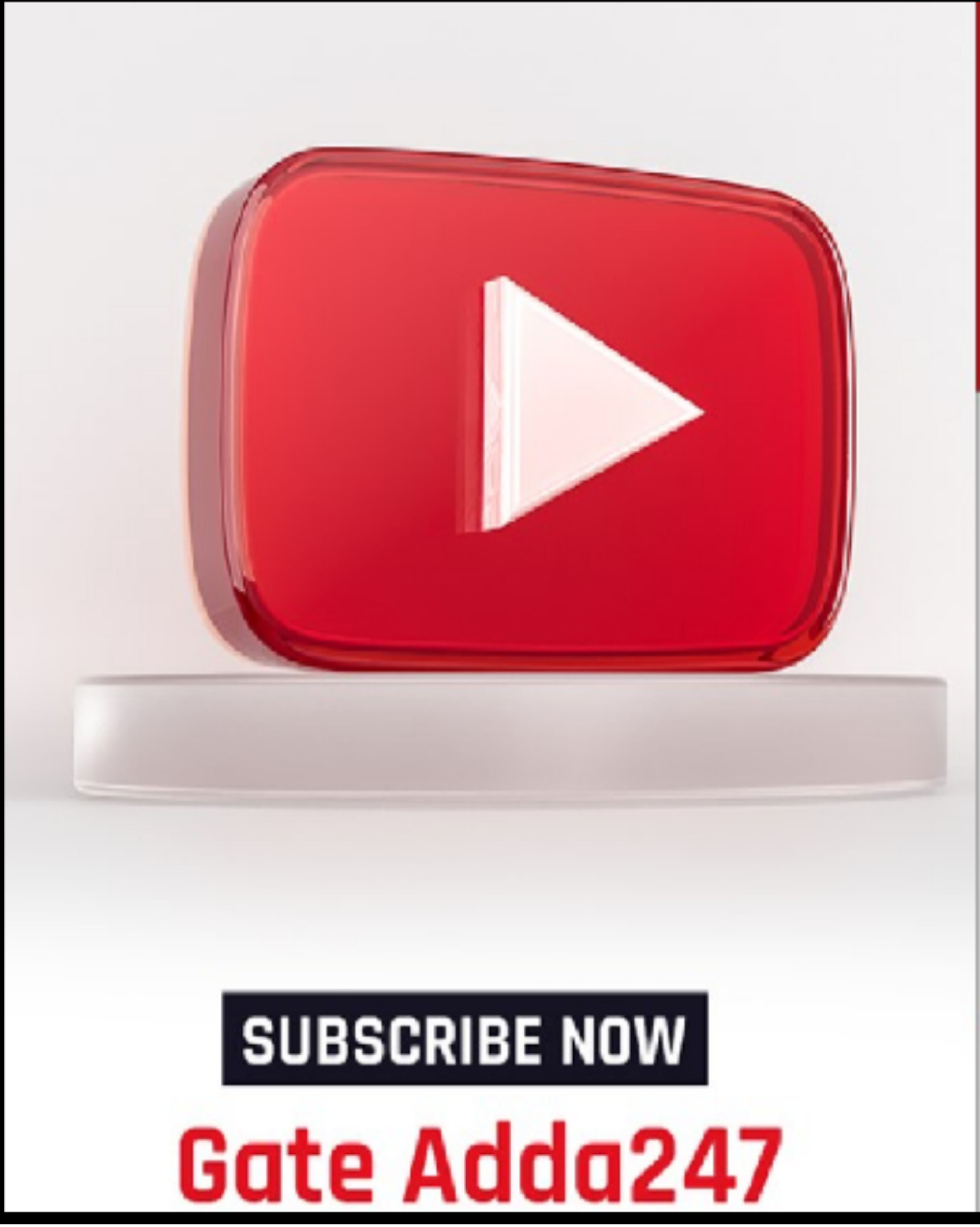
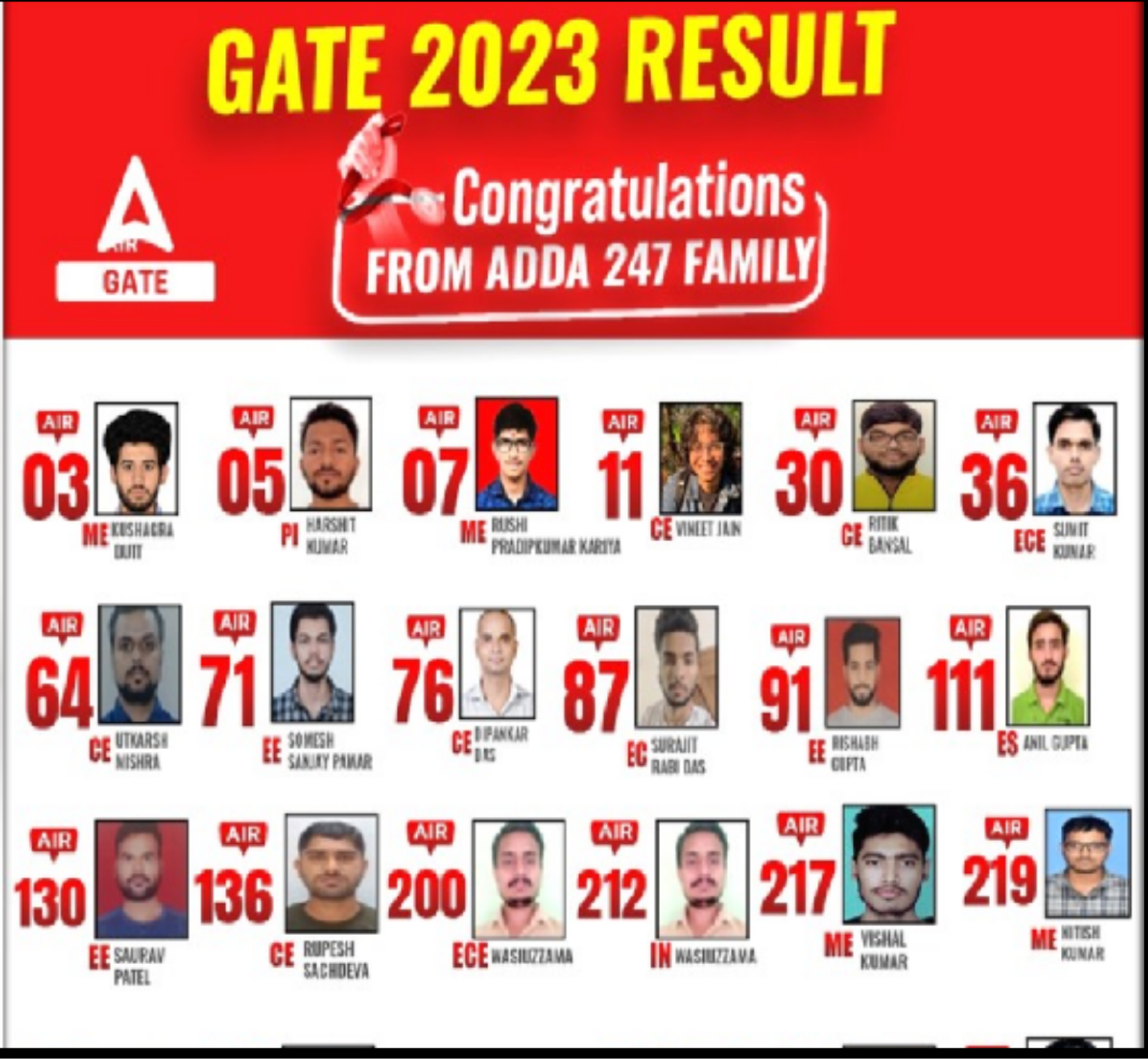

WELCOME
TO Adda247
Download Now
Adda247 APP
APP FEATURES
Premium Study Material
Current Affairs
Job Alerts
Daily Quizzes
Subject-wise Quizzes
Magazines
Power Capsule
Notes & Articles
Videos

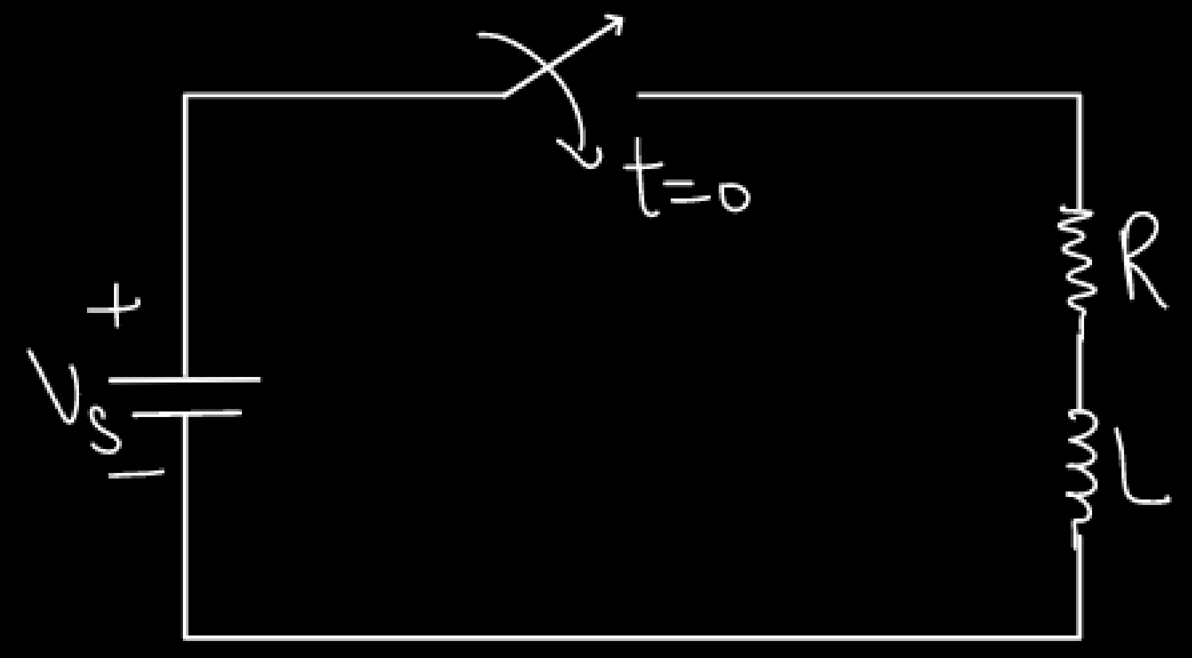

SUBSCRIBE NOW
Gate Adda247


GATE 2023 RESULT
GATE
Congratulations
FROM ADDA 247 FAMILY
AIR 03 ME KUSHAGRA DUTT
AIR 05 PI HARSHIT KUMAR
AIR 07 ME RUSHI PRADIPKUMAR KARIYA
AIR 11 CE VINEET JAIN
AIR 30 CE RITIK BANSAL
AIR 36 ECE SUMIT KUMAR
AIR 64 CE UTKARSH MISHRA
AIR 71 EE SOMESH SANJAY PAWAR
AIR 76 CE DIPANKAR DAS
AIR 87 EC SURAJIT RABI DAS
AIR 91 EE RISHABH GUPTA
AIR 111 ES ANIL GUPTA
AIR 130 EE SAURAV PATEL
AIR 136 CE RUPESH SACHDEVA
AIR 200 ECE WASIUZZAMA
AIR 212 IN WASIUZZAMA
AIR 217 ME VISHAL KUMAR
AIR 219 ME NITISH KUMAR

First order RL Network with initials value and DC excitation

⇒ If inductor is initially charged.

i.e. $i_{L0^-} \neq 0$ Amp.



* Direction of inductor current must be provided by teacher

* case ①

case ⑪

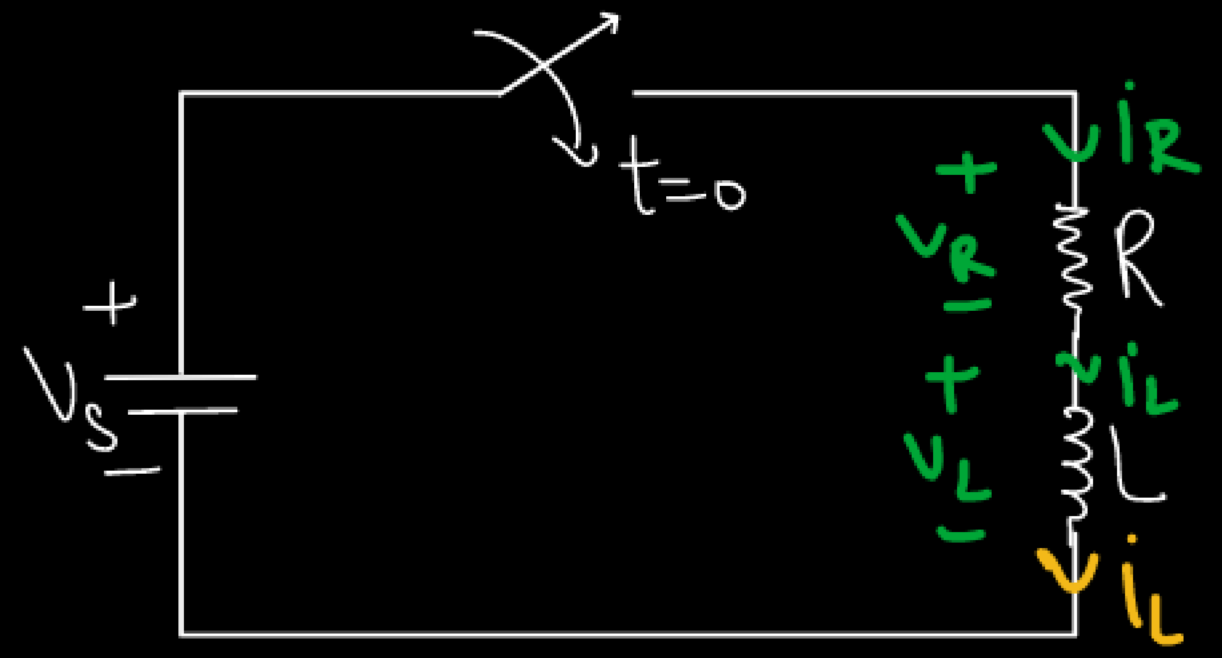
let the direction inductor's current for $t \le 0^-$, is as given in ckt-I.

Task ⇒ $i_R(t) = ?$

$i_L(t) = ?$

$V_L(t) = ?$ &

$V_R(t) = ?$



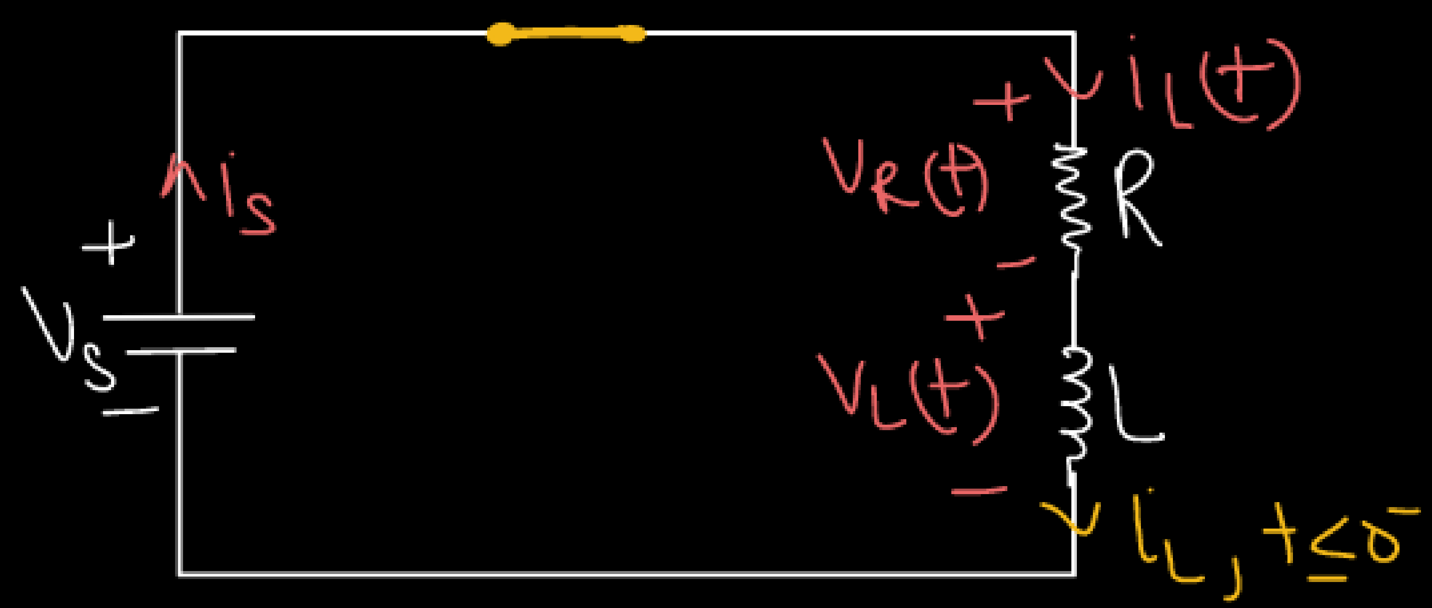
$i_L, t \leq 0^-$

for $t \geq 0$, switch is closed.

By KVL ⇒

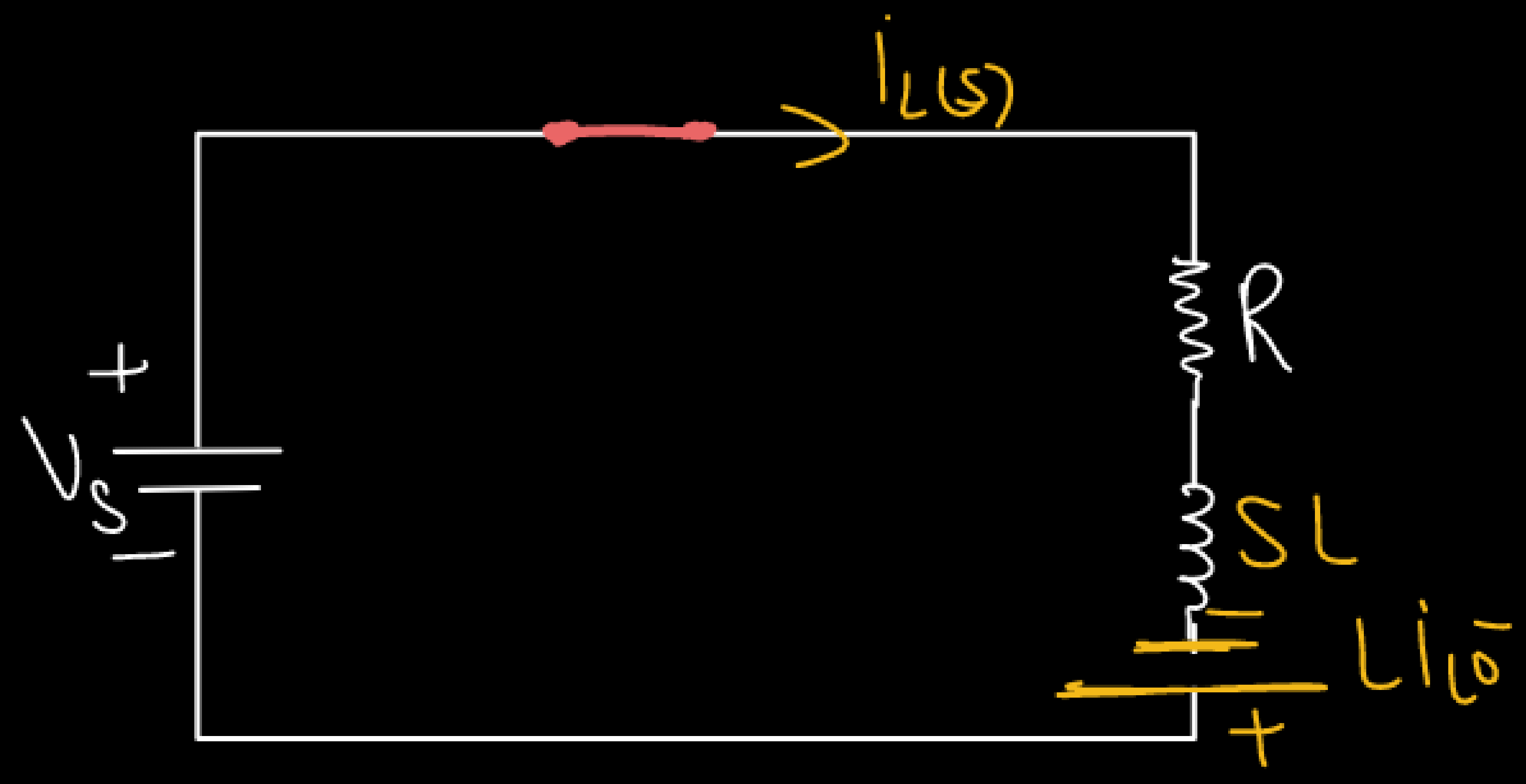
$$V_S = V_R(t) + V_L(t) \quad (1)$$

$$i_R(t) = i_L(t) = i_S(t) \quad (2)$$



⇒ diff^n eq^n OR lap. trafm are best mathematical tool to handle this ckt.

- ckt in freq. domain:-



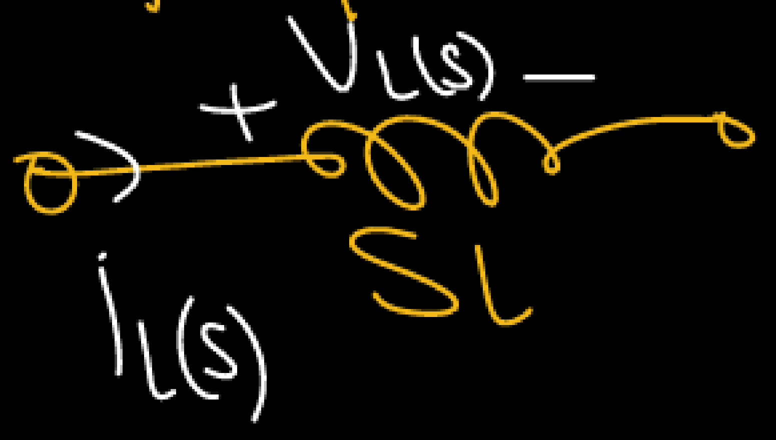
* supply Vol. = V_s, $t \geq 0$

$$L(\text{supply vol}) = \frac{V_s}{S}$$

* 

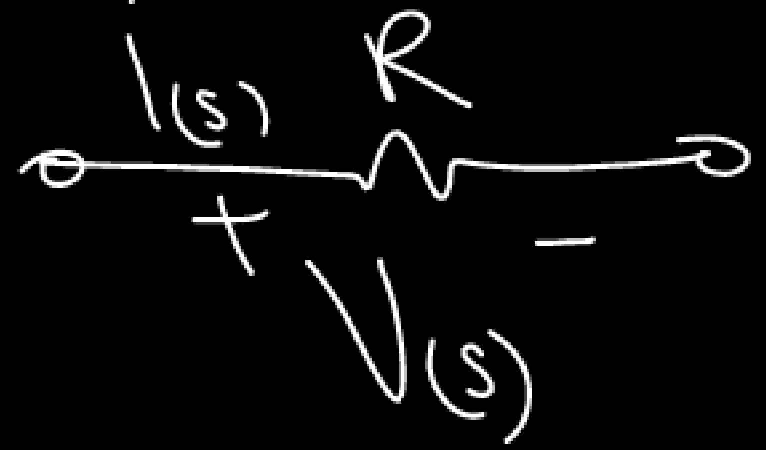
, $i_L(0^-) = 0A$

in freq. domain



* 

in freq. domain

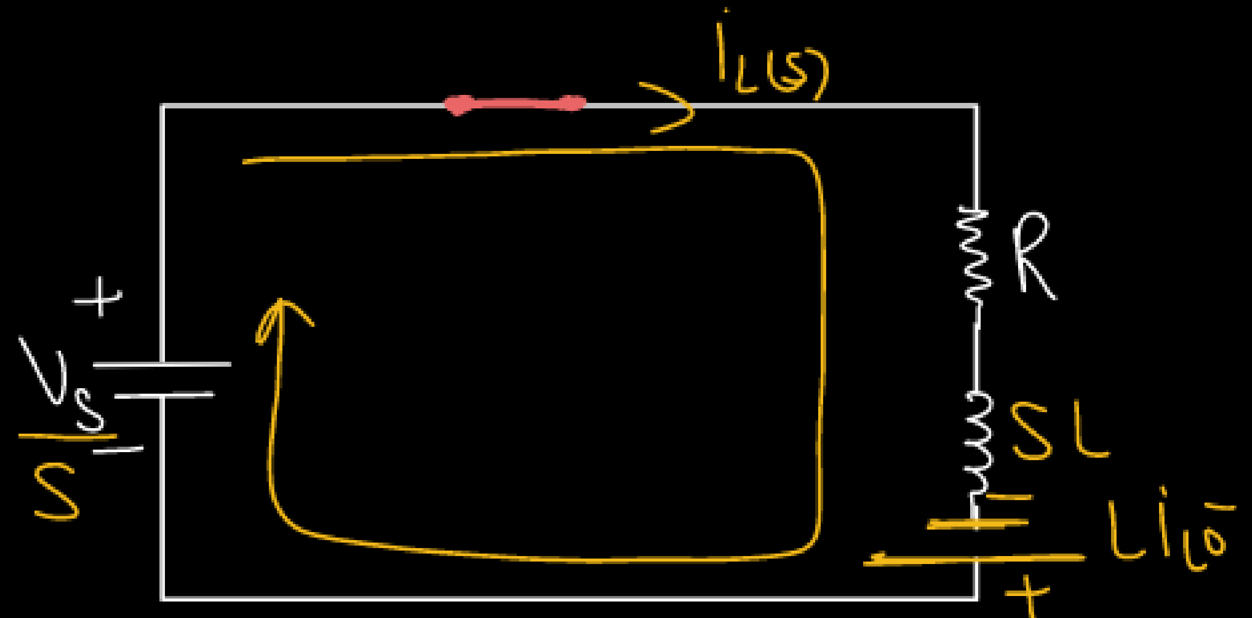


* if inductor's current, $i_L(0^-) \neq 0A$

i.e. $i_L(0^-) = I$ Amp.

$$\left[v_L(t) = L \frac{di_L(t)}{dt} \right]$$

KVL for given ckt :-



$$\frac{V_s}{S} = i_L(s)(R+SL) - L i_{L0^-}$$

$$i_L(s)(S+R/L)L = \frac{V_s}{S} + L i_{L0^-}$$

$$i_L(s) = \frac{V_s}{L}\left[\frac{1}{S(S+R/L)}\right] + \frac{i_{L0^-}}{(S+R/L)}$$; Break by partial fraction.

$$i_L(s) = \frac{V_s}{R}\left[\frac{1}{S} - \frac{1}{(S+R/L)}\right] + \frac{i_{L0^-}}{(S+R/L)}$$; take invl Lap. trfm.

$$\left[i_L(t) = \frac{V_s}{R}\left(1-e^{-R/Lt}\right) + i_{L0^-}\cdot e^{-R/Lt}\right] ; t \geq 0$$

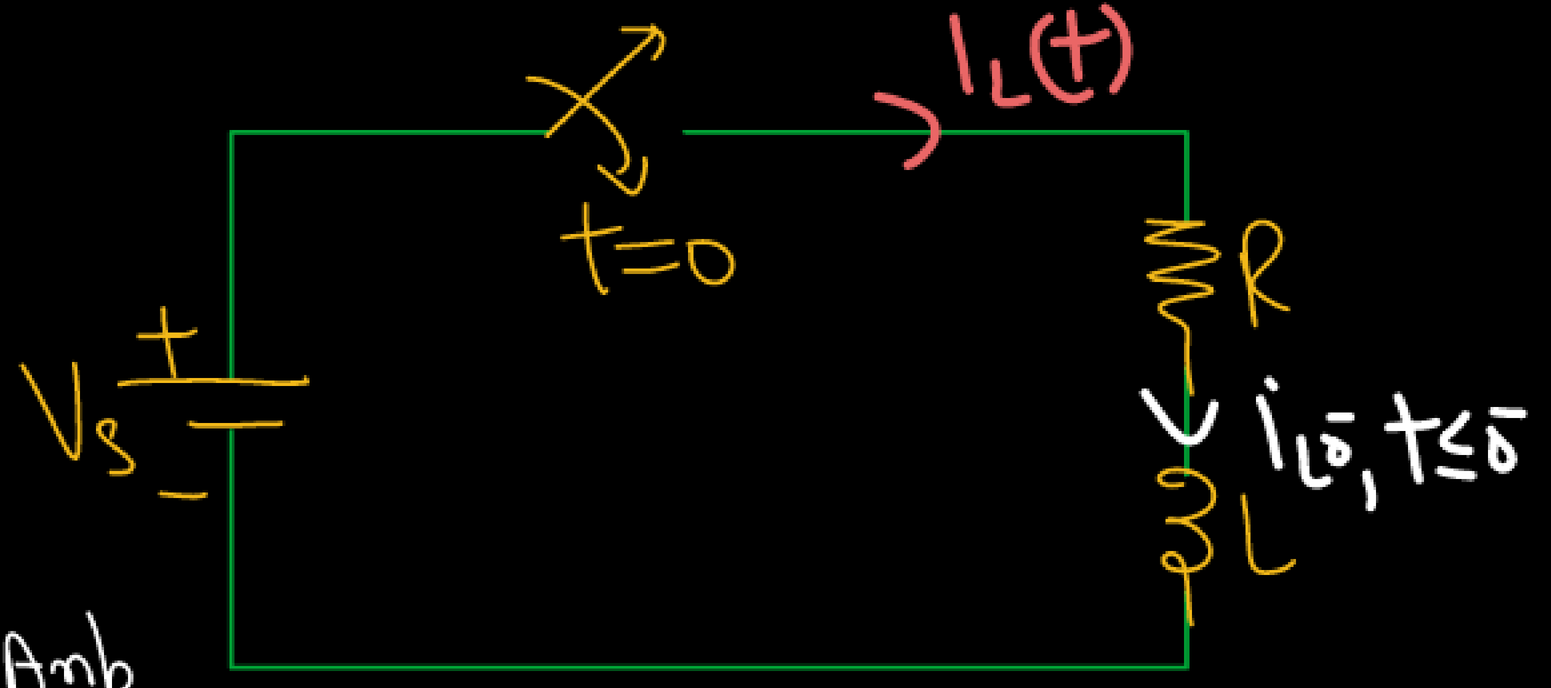
$$\left[i_L(t) = \frac{V_s}{R}\left(1-e^{-R/L\,t}\right) + i_{L0^-}\cdot e^{-R/L\,t}\right];\ t \geq 0$$

We know that, $\tau = L/R$; for first order RL Network

$$i_L(t) = \frac{V_s}{R}\left(1-e^{-t/\tau}\right) + i_{L0^-}\cdot e^{-t/\tau}$$

⇒ here

$i_{L0^-} = I$ Amp



$$i_L(ss) = i_L(t)\Big|_{t=\infty} = i_L(\infty) = \frac{V_s}{R}\ \text{Amp}$$

* current direction of inductor is same for both cases (i) $t \leq 0^-$ (ii) $t \geq 0$

$[-\infty \leq t \leq \infty]$

$$\left[i_L(t) = \frac{V_s}{R}(1 - e^{-R/L\,t}) + i_{L0^-} \cdot e^{-R/L\,t}\right];\ t \geq 0$$

here $\tau = L/R$, $i_{L0^-} \Rightarrow$ intial current through inductor

$i_{L(\infty)} \Rightarrow$ s.s. current of inductor.

$i_{L(\infty)} = \frac{V_s}{R}$ Amp.

we can modify →

$$i_L(t) = i_{L(\infty)}(1 - e^{-t/\tau}) + i_{L0^-} e^{-t/\tau}$$

$$i_L(t) = i_{L(\infty)} - i_{L(\infty)} \cdot e^{-t/\tau} + i_{L0^-} \cdot e^{-t/\tau}$$

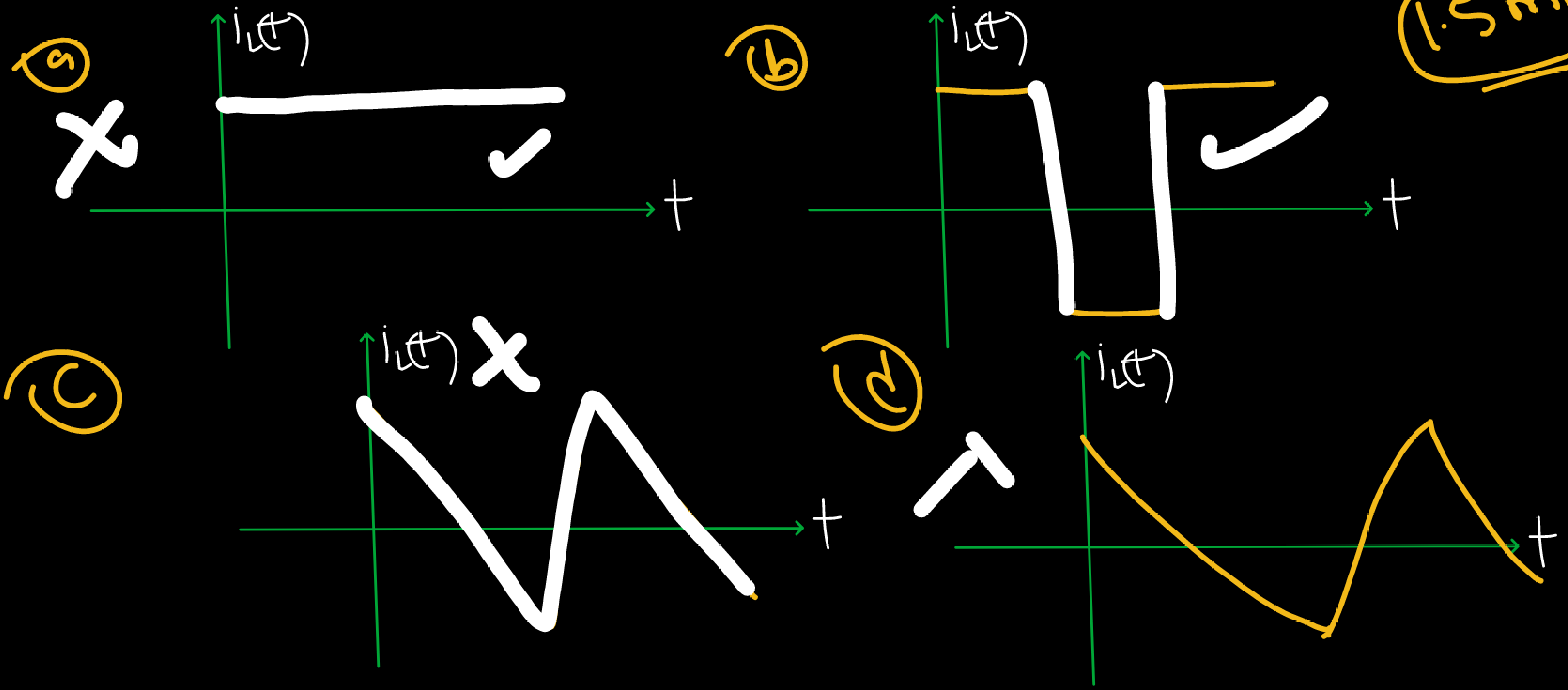
$$\boxed{i_L(t) = i_{L(\infty)} + [i_{L0^-} - i_{L(\infty)}]\, e^{-t/\tau}};\ t \geq 0$$

V.V. - - - ∞ imp)

→ $-\infty \leq$ directions of ind. current is same $\leq \infty$

ex in general, which of the following current response will not represent inductor's current ?

(1.5 mints)



response of Inductor's current :-