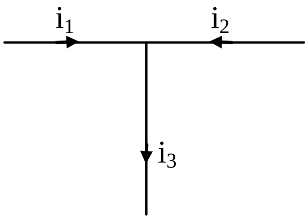
1. An 120 volt ac source is connected across a pure inductor of inductance 0.70 henry. If the frequency of the source is 60 Hz, the current passing through the inductor is

(a) 4.55 amps (b) 0.355 amps

(c) 0.455 amps (d) 3.55 amps

2. If $i_1 = 3 \sin \omega t$ and $i_2 = 4 \cos\omega t$, then i_3 is–



(a) 5 sin (ωt + 53°) (b) 5 sin (ωt + 37°)

(c) 5 sin (ωt + 45°) (d) 5 cos (ωt + 53°)

3. In an a.c. circuit V and I are given by

V = 100 sin (100 t) volts

I = 100 sin (100 t + π/3) mA

the power dissipated in the circuit is-

(a) 10^4 watt (b) 10 watt (c) 2.5 watt (d) 5.0 watt

4. $\frac{2.5}{\pi}\mu F$ capacitor and 3000-ohm resistance are joined in series to an ac source of 200 volt and $50\,sec^{-1}$ frequency. The power factor of the circuit and the power dissipated in it will respectively

(a) 0.6, 0.06 W (b) 0.06, 0.6 W

(c) 0.6, 4.8 W (d) 4.8, 0.6 W

5. A resistor *R*, an inductor *L* and a capacitor *C* are connected in series to an oscillator of frequency *n*. if the resonant frequency is n_r, then the current lags behind voltage, when

(a) $n = 0$ (b) $n < n_r$

(c) $n = n_r$ (d) $n > n_r$

6. The phase difference between the voltage and the current in an ac circuit is $\pi/4$. If the frequency is 50 *Hz* then this phase difference will be equivalent to a time of

(a) 0.02 *s* (b) 0.25 *s*

(c) 2.5 *ms* (d) 25 *ms*

7. A circuit connected to an *ac* source of *emf* $e_0 \sin(100t)$ with t in seconds, gives a phase difference of $\frac{\pi}{4}$ between the *emf* e and current i. Which of the following circuits will exhibit this ?

(a)RL circuit with R = 1 kΩ and L = 10 mH

(b)RL circuit with R = 1 kΩ and L = 1 mH

(c)RC circuit with R = 1 kΩ and C = 1 μF

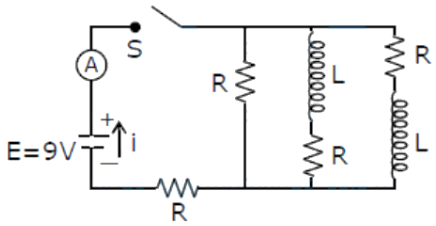
(d)RC circuit with R = 1 kΩand C = 10 μF

8. In a series LR circuit power of 400 W is dissipated from a source of 250V, 50 Hz. The power factor of the circuit is 0.8. In order to bring the power factor to unity, a capacitor of value of C is added in series to the L and R. Taking the value of C as $\left(\frac{n}{3\pi}\right)\mu F$, then value of n is:

9. In LC circuit the inductance $L = 40mH$ and capacitance $C = 100\mu F$. If a voltage $V(t) = 10\sin(314t)$ is applied to the circuit, the current in the circuit is given as:

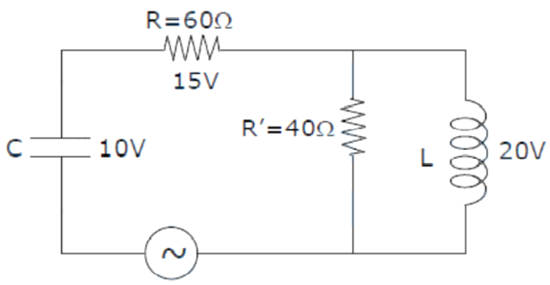
(a) $0.52\cos 314t$
(b) $10\cos 314\, t$
(c) $5.2\cos 314t$
(d) $0.52\sin 314t$

10. Figure shows a circuit that contains four identical resistors with resistance R = 2.0Ω. TWo identical inductorswith inductance L = 2.0mH and an ideal battery with emf E = 9.V. The current $'i'$ just after the switch $'s'$ isclosed will be:



(a) 9A (b) 3.0A
(c) 2.25A (d) 3.37A

11. The angular frequency of alterlating current in a $L - C - R$ circuit is 100rad/s. The components connected areshown in the figure. Find the value of inductance of the coil and capacity of condenser.

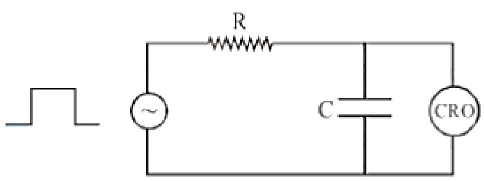


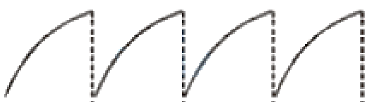
(a) 0.8H and 250μF (b) 0.8H and 150μF
(c) 1.33H and 250μF (d) 1.33H and 150μF

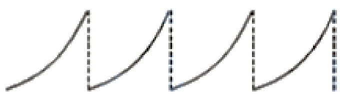
12. An alternating current is given by the equation $i = i_1 \sin\omega t + i_2$ coscot. The rms current will be:

(a) $\frac{1}{2}(i_1^2 + i_2^2)^{\frac{1}{2}}$ (b) $\frac{1}{\sqrt{2}}(i_1^2 + i_2^2)^{\frac{1}{2}}$
(c) $\frac{1}{\sqrt{2}}(i_1 + i_2)^2$ (d) $\frac{1}{\sqrt{2}}(i_1 + i_2)$

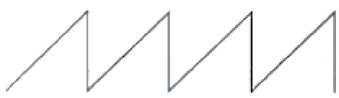
13. An RC circuit as shown in the figure is driven by a AC source generating a square wave. The output wavepattern monitored by CRO would look close to:



(a) 

(b) 

(c) 

(d) 

14. Match List-I with List II

List I	List II
(1)Phase difference between current and voltage in a purely resistive AC circuit	(i)$\frac{\pi}{2}$; current leads voltage
(2)Phase difference between current and voltage in a pure inductive AC circuit	(ii)Zero
(3)Phase difference between current and voltage in a pure capacitive AC circuit	(iii)$\frac{\pi}{2}$; current lags voltage
(4)Phase difference between current and voltage in an LCR series circuit	(iv)$\tan^{-1}\left(\frac{X_C-X_L}{R}\right)$

(a) (1) − (i),(2) − (iii),(3) − (iv),(4) − (ii)
(b) (1) − (ii),(2) − (iv),(3) − (iii),(4) − (i)
(c) (1) − (ii),(2) − (iii),(3) − (iv),(4) − (i)
(d) (1) − (ii),(2) − (iii),(3) − (i),(4) − (iv)

15. An AC source rated 220 V, 50 Hzis connected to a resistor. The time taken by the current to change from itsmaximum to the rms value is:

(a)2.5 ms (b)25 ms
(c) 2.5 s (d) 0.25 ms

16. What is The value of inductance L for which the current is a maximum in a series LCR circuit with

C =10 μ F and ω= 1000 radian/s?

(a) 10 mH (b) 100mH
(c) 1 mH (d) cannot be calculated unless R is Known

17. The value of power factor cosϕ in series LCR circuit at resonance is :

(a) zero (b) 1
(c) 1/2 (d) 1/2 ohm

18. A resistor R, an inductor L and a capacitor C are connected in series to an oscillator of frequency n. If the resonant frequency is n_r, then the current lags behind voltage, when :

(a) n = 0 (b) $n < n_r$
(c) $n = r_r$ (d) $n > n_r$

19. If resonance frequency is f and then the capacity is increased 4 times, then new resonance frequency becomes-

(a) $\frac{f}{2}$ (b) 2f
(c) f (d) $\frac{f}{4}$

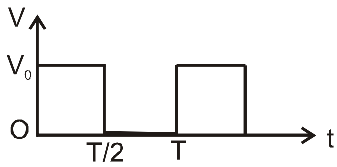
20. A transformer is used for a 100 watt, 20 volt electric bulb at a place where the A.C. mains potential is 200 volt and the current drawn is 0.6 A. The efficiency of the transformer is nearly

(a) 48% (b) 68%
(c) 30 % (d) 83%

21. A transformer is used to light a 140 watt, 24 volt lamp from 240 V AC mains. The current in the main cable is 0.7 amp. The efficiency of the transformer is :

(a) 48% (b) 63.8%
(c) 83.3% (d) 90%

22. The r.m.s. value of potential difference V shown in the figure is :



(a) V_0 (b) $V_0/\sqrt{2}$
(c) $V_0/2$ (d) $V_0/\sqrt{3}$

23. In an electrical circuit R,L, C and an a.c. voltage source are all connected in series. When L is removed from the circuit, the phase difference between the voltage the current in the circuit is $\pi/3$. If instead, C is removed from the circuit, the phase difference is again $\pi/3$. The power factor of the circuit is :

(a) 1/2 (b) $1/\sqrt{2}$
(c) 1 (d) $\sqrt{3}/2$

24. A transformer having efficiency of 90% is working on 200 V and 3 kW power supply. If the current in the secondary coil is 6 A the voltage across the secondary coil and the current in the primary coil respectively are :
(a) 300 V, 15 A (b) 450 V, 15 A
(c) 450 V, 13.5 A (d) 600 V, 15A

25. A small signal voltage $V(t) = V_0 \sin\omega t$ is applied across an ideal capacitor C :

(a) Current I(t), leads voltage V(t) by 180°
(b) Current I(t), lags voltage V(t) by 90°
(c) Over a full cycle the capacitor C does not consume any energy from the voltage source.
(d) Current I(t) is in phase with voltage V(t)

26. A inductor 20 mH a capacitor 100 μF and a resistor 50 Ω are connected in series across a source of emf, V = 10 sin 314 t. The power loss in the circuit is :

(a) 0.79 W (b) 1.13 W
(c) 2.74 W (d) 0.43 W

27. A coil is suspended in a uniform magnetic field, with the plane of the coil parallel to the magnetic lines of force. When a current is passed through the coil it starts oscillating; it is very difficult to stop. But if an aluminium plate is placed near to the coil, it stops. This is due to :

(a) developement of air current when the plate is placed.
(b) induction of electrical charge on the plate
(c) shielding of magnetic lines of force as aluminium is a paramagnetic material.

(d) Electromagnetic induction in the aluminium plate giving rise to electromagnetic damping.

28. In an a.c circuit, the instantaneous e.m.f and current are given by

e = 100 sin 30t

i = 20 sin $\left(30t - \frac{\pi}{4}\right)$

In one cycle of a.c the average power consumed by the circuit and the wattless current are, respectively :

(a) $\frac{50}{\sqrt{2}}, 0$ (b) 50,0

(c) 50,10 (d) $\frac{1000}{\sqrt{2}}, 10$

29. A series AC circuit containing an inductor (20 mH), a capacitor (120 μF) and a resistor (60Ω) is driven by an AC source of $\frac{24\,V}{50\,Hz}$. The energy dissipated in the circuit in 60 s is :

(a) 3.39×10^3 J (b) 5.65×10^2 J

(c) 5.17×10^2 J (d) 2.26×10^3 J

30. A LCR circuit behaves like a damped harmonic oscillator. Comparing it with a physical spring-mass damped oscillator having damping constant 'b', the correct equivalence would be:

(a) $L \leftrightarrow \frac{1}{b}, C \leftrightarrow \frac{1}{m}, R \leftrightarrow \frac{1}{k}$ (b) $L \leftrightarrow k, C \leftrightarrow b, R \leftrightarrow m$

(c) $L \leftrightarrow m, C \leftrightarrow \frac{1}{k}, R \leftrightarrow b$ (d) $L \leftrightarrow m, C \leftrightarrow k, R \leftrightarrow b$

1. (c)

$$i_{rms} = \frac{V_{rms}}{X_L} = \frac{V_{rms}}{2\pi\nu L} = \frac{120}{2\pi \times 60 \times 0.7} = 0.455\,A.$$

2. (a)

From Kirchoff's current law,

$i_3 = i_1 + i_2 = 3 \sin \omega t + 4 \sin (\omega t + 90^0)$

$= \sqrt{3^2 + 4^2 + 2(3)(4)\cos 90^o}\ \sin(\omega t + \phi)$

where $\tan \phi = \frac{4\sin 90^o}{3 + 4\cos 90^o} = \frac{4}{3}$

$\therefore\ i_3 = 5\sin(\omega t + 53^0)$

3. (c)

$P = V_{rms}\, I_{rms} \cos \phi$

$= \left(\frac{100}{\sqrt{2}}\right)\left(\frac{100}{\sqrt{2}}\right) \times 10^{-3} \cos \frac{\pi}{3}$

$= 2.5$ W

4. (c)

$$Z = \sqrt{R^2 + \left(\frac{1}{2\pi\nu C}\right)^2} = \sqrt{(1000)^2 + \frac{1}{\left(2\pi \times 50 \times \frac{2.5}{\pi} \times 10^{-6}\right)^2}}$$

$\Rightarrow Z = \sqrt{(3000)^2 + (4000)^2} = 8 \times 10^3\,\Omega$

So power factor $\cos\phi = \frac{R}{Z} = \frac{3000}{5 \times 10^3} = 0.6$ and power

$$P = V_{rms} i_{rms} \cos\phi = \frac{V_{rms}^2 \cos\phi}{Z} \Rightarrow P = \frac{(200)^2 \times 0.6}{5 \times 10^3} = 4.8W$$

5. (d) The current will lag behind the voltage when reactance of inductance is more than the reactance of condenser. Thus, $\omega L > \frac{1}{\omega C}$ or $\omega > \frac{1}{\sqrt{LC}}$

or $n > \frac{1}{2\pi\sqrt{LC}}$ or $n > n_r$ where n_r = resonant frequency.

6. (c) Time difference $= \frac{T}{2\pi} \times \phi = \frac{(1/50)}{2\pi} \times \frac{\pi}{4} = \frac{1}{400} s = 2.5\, m\text{-}s$

7. (d) **JEE Main 2019**

$\omega = 100 \text{rad/s}$

We know that

$\tan\phi = \frac{X_C}{R} = \frac{1}{\omega CR}$

Or $\tan 45^\circ = \frac{1}{\omega CR}$

Or $\omega CR = 1$

LHS: $\omega CR = 10 \times 10 \times 10^{-6} \times 10^3 = 1$

8. 400 JEE main 2020

$P = \frac{(250)^2}{Z}\cos\phi$

$500 = \frac{(250)^2}{Z}$

$Z = 125\Omega$

$R = 100\Omega$

$X_L = 75\Omega$

$75 = \frac{1}{2\pi fC}$

$C = \frac{1}{2\pi \times 75 \times 50} = \frac{1}{7500\pi}$

$C = \left(\frac{10^6}{2500} \times \frac{1}{3\pi}\right)\mu F$

$$C = \frac{400}{3\pi}\mu F$$

9. (a) JEE main 2020

$z = \sqrt{R^2 + (X_C - X_L)^2}$

$R = 0$

$Z = 0$

$Z = X_C - X_L$

$= \frac{1}{\omega C} - \omega L$

$= \frac{1}{314 \times 100 \times 10^{-6}} - 314 \times 40 \times 10^{-3}$

$= 31.84 - 12.56$

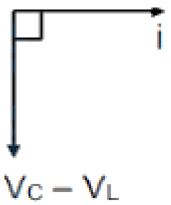
$= 19.28\Omega$

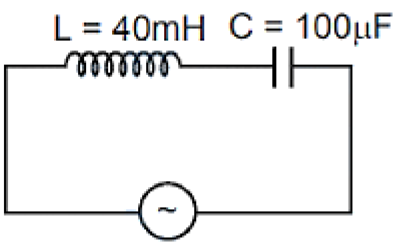
$X_C > X_L$

$i = \frac{V_0}{Z}\sin\left(314t + \frac{\pi}{2}\right)$

$\therefore i = \frac{V_0}{Z}\cos(314t) \Rightarrow i = \frac{10}{19.28}\cos(314t)$

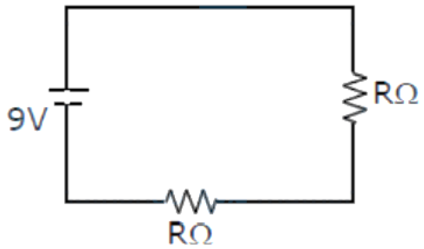
$\Rightarrow i = 0.52\cos(314t)$





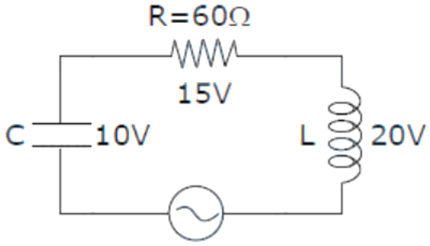
10. c **JEE Main 2021**

When switch S is closed-



Given: $v = 9v$
From $V = IR$
$I = \frac{V}{R}$
$R_{eq.} = 2 + 2 = 4\Omega$
$I = \frac{9}{4} = 2.25\text{A}$

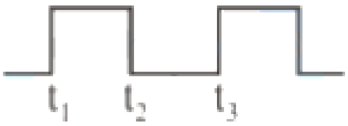
11. a **JEE Main 2021**



Since key is open, circuit is series
$15 = i_{rms}(60)$
$\therefore i_{rms} = \frac{1}{4}\text{A}$
Now, $20 = \frac{1}{4}X_L = \frac{1}{4}(\omega L)$
$\therefore L = \frac{4}{5} = 0.8\text{H}$
$\& 10 = \frac{1}{4}\frac{1}{(100C)}$
$C = \frac{1}{4000}F = 250\mu F$

12. b **JEE Main 2021**
$I_0 = \sqrt{I_1^2 + I_2^2 + 2I_1I_2\cos\,\theta}$
$I_0 = \sqrt{I_1^2 + I_2^2 + 2I_1I_2\cos\,90°}$
$I_0 = \sqrt{I_1^2 + I_2^2 + 2I_1I_2(0)}$
$\Rightarrow \sqrt{I_1^2 + I_2^2}$
We, know that
So,
$I_{rms} = \frac{I_0}{\sqrt{2}}$
$I_{rms} = \frac{\sqrt{I_1^2 + I_2^2}}{\sqrt{2}}$

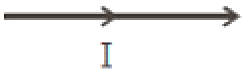
13. (c) JEE Main 2021



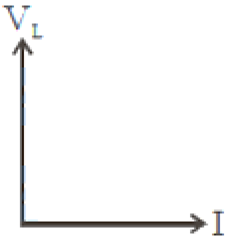
For $t_1 - t_2$ Charging graph $t_2 - t_3$ Discharging graph

14. (d) JEE Main 2021

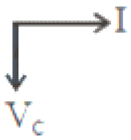
(a) $V = V_R$



(b)



(c)



(d) $\tan\phi = \frac{V_L - V_C}{V_R} = \frac{X_L - X_C}{R}$

15. (a) JEE Main 2021

$i = i_0 \cos(\omega t)$

$i = i_0$ at $t = 0$

$i = \frac{i_0}{\sqrt{2}}$ at $\omega t = \frac{\pi}{4}$

$$t = \frac{\pi}{4\omega} = \frac{\pi}{4(2\pi f)} = \frac{1}{8f}$$

$$t = \frac{1}{400} = 2.5 \text{ ms}$$

16. (b)

17. (b)

18. (d)If ;fn $n > n_r$ $\omega L > \frac{1}{\omega C}$ $X_L > X_C$

So, current lags behind voltage.

19. (a)

20. (d) $P_{out} = 100$ watt

$p_{in} = 200 \times 0.6$ watt.

$= 120$ watt

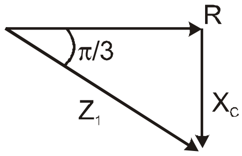
so $\eta = \frac{100}{120} \times 100\% = \frac{5}{6} \times 100\% = \frac{500}{6}\% = 83.33\%$

21. (c) $\eta\% = \frac{E_2 I_2}{E_1 I_1} \times 100$

22. (b) $V_{rms} = \sqrt{\frac{(T/2)V_0^2 + 0}{T}} = \frac{V_0}{\sqrt{2}}$.

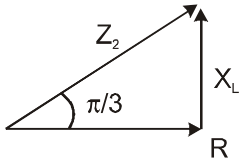
23. (c) 

$\frac{X_C}{R} = \tan\frac{\pi}{3}$



$X_C = R\tan\frac{\pi}{3}$ ....(a)

$\frac{X_L}{R} = \tan\frac{\pi}{3}$



$X_C = R\tan\frac{\pi}{3}$ ....(c)

net impedence $Z = \sqrt{R^2 + (X_L - X_C)^2} = R$

power factor $\cos\varphi = \frac{R}{Z} = 1$

24. (b)Current in primary coil = $\frac{P}{V} = \frac{3000}{200}$ = 15A

$= \frac{P}{V} = \frac{3000}{200}$ = 15A

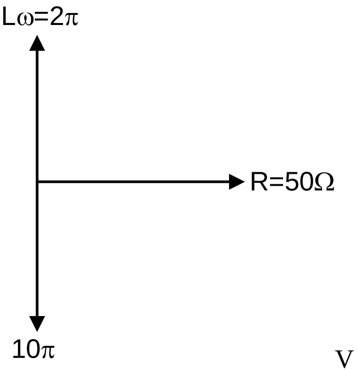
P_{out} = η % of P_{in}

$V_2 i_2 = \frac{90}{100} \times (3000)$

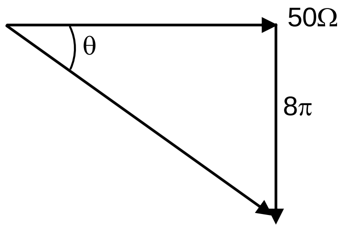
$(v_2)(6) = 2700$

V_2 = 450 volt

25. (c)Capacitor does not consume energy effectively over full cycles



26. (a) V = 10 sin (100 πt)



$\omega = 100\,\pi$

$x_L = L\omega = (20\times10^{-3})100\pi = 2\pi$

$x_C = \dfrac{1}{L\omega} = \dfrac{1}{(100\times10^{-6})\times100\pi} = 10\,\pi$

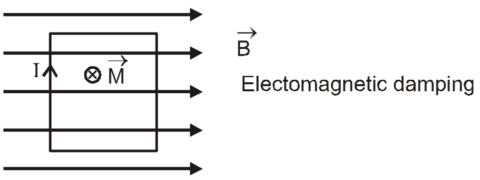
$|z| = \sqrt{(x_L - x_C)^2 + R^2}$

$|z| = \sqrt{(8\pi)^2 + (50)^2}$

$|z| = \sqrt{3140} \approx 56\Omega$

$i_0 = \dfrac{V_0}{|z|} = \dfrac{10}{56} = 0.18\text{ A}$

$P = i^2_{rms} = \dfrac{i_0^2 R}{2} = \dfrac{(0.18)^2\times50}{2} = 0.81\text{ watt}$



27. **(d)**

28. (d) e = 100 sin30t

$i = 20\sin\left(30t - \dfrac{\pi}{4}\right)$

$P_{av} = e_{rms}\, i_{rms} \cos\phi \quad = \dfrac{100}{\sqrt{2}}.\dfrac{20}{\sqrt{2}}.\dfrac{1}{\sqrt{2}} = \dfrac{1000}{\sqrt{2}}W$

wattless current 'kfDrghu /kkjk = $\dfrac{I_0\sin\phi}{\sqrt{2}} = \dfrac{20}{\sqrt{2}}.\dfrac{1}{\sqrt{2}} = 10A$

29. (c)= $2\pi f = 100\pi$

$X_L = \omega L = 6.28\Omega$

$X_C = \dfrac{1}{\omega C} = \dfrac{250}{3\pi}$

$X = X_C - X_L$

$= 20.25$

$Z = \sqrt{R^2 + X^2}$

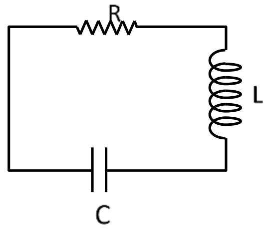
$I_{rms} = V_{rms} / Z$

Energy dissipated = $i_{rms}^2 \times R \times t$, t = 60 sec = 3000T $\left(T = \frac{1}{f} = 0.02s\right)$

$= 5.17 \times 10^2$ J

30. (c)In damped oscillation voefUnr nksyu esa

ma + bv + kx = 0



$m\frac{d^2x}{dt^2} + b\frac{dx}{dt} + kx = 0$ ...(i)

In the circuit ifjiFk esa

$-iR - L\frac{di}{dt} - \frac{q}{c} = 0$

$L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{1}{c}.q = 0$ ...(ii)

Comparing equation (i) and (ii) rqyuk djus ij

$m = L,\ b = R,\ k = \frac{1}{c}$