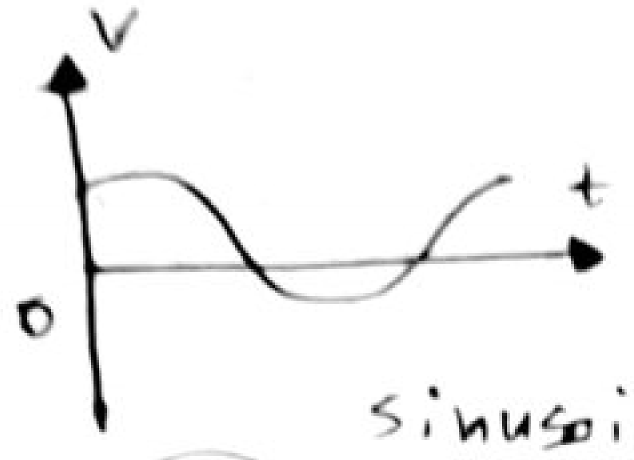
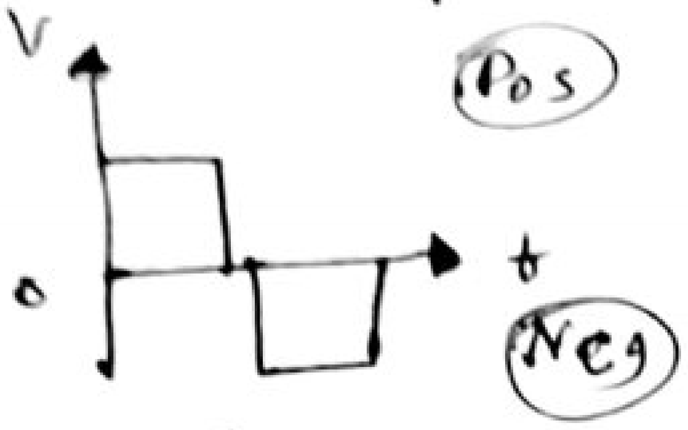
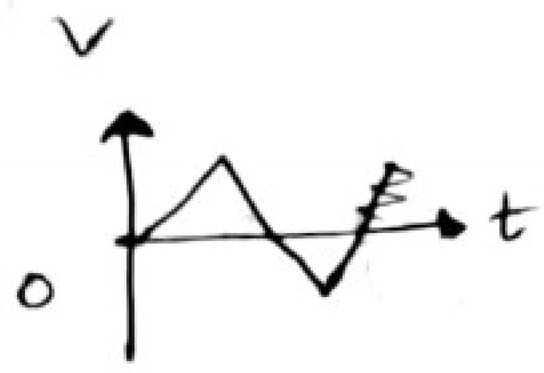
(13) Sinusoidal Alternating Waveforms



sinusoidal (সাইনবক্রীয়)



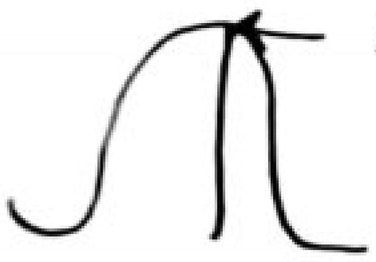
Square wave



Triangular Wave

Positive & negative half-cycle

cycle = pos + neg (1) time period



(ধনাত্মক +10 হলে বিয়োগ -10)

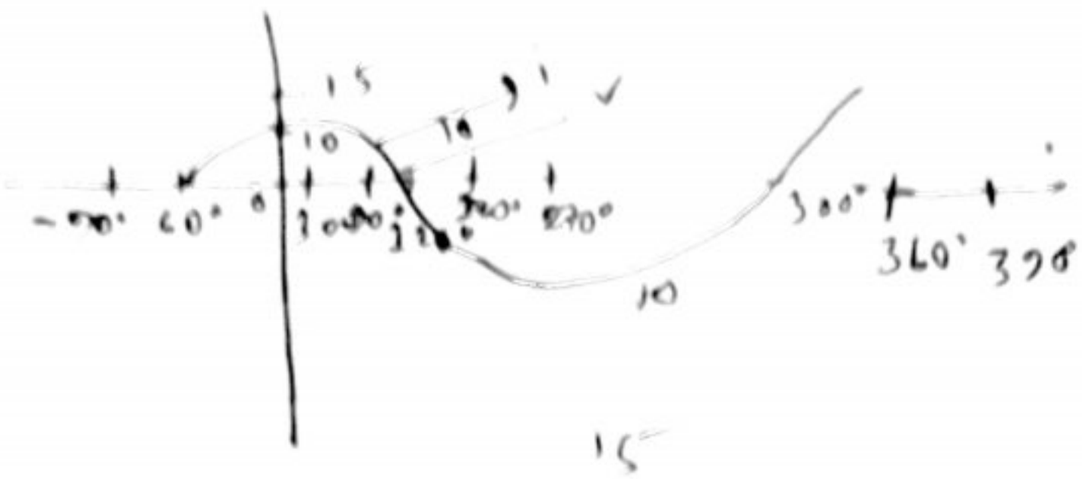
Peak to peak value = Amplitude × 2
↓

maximum = crest
minimum = trough

Time period = দুইটি crest (ক্রেস্ট/trough) অতিক্রম করতে
crest/trough এর মধ্যে সময় ব্যবধান হবে

frequency, $f = \frac{1}{T}$.

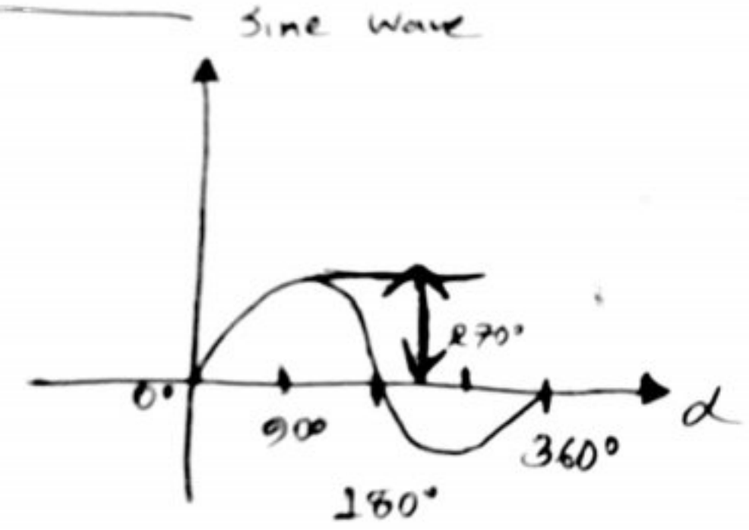
(1)



(a) Phase difference | (-60° - 30°) | = 90°

(b) i leads v by 90°

The Sine Wave



180° = π

360° = 2π

Radians: $\left(\frac{\pi}{180^\circ}\right) \times$ (degrees)

Degrees = $\left(\frac{180^\circ}{\pi}\right) \times$ (radians)

$\omega = \frac{2\pi}{T}$ (rad/s) | ω = angular frequency / velocity
T = time period

$\omega = 2\pi f$ (rad/s) | f = frequency

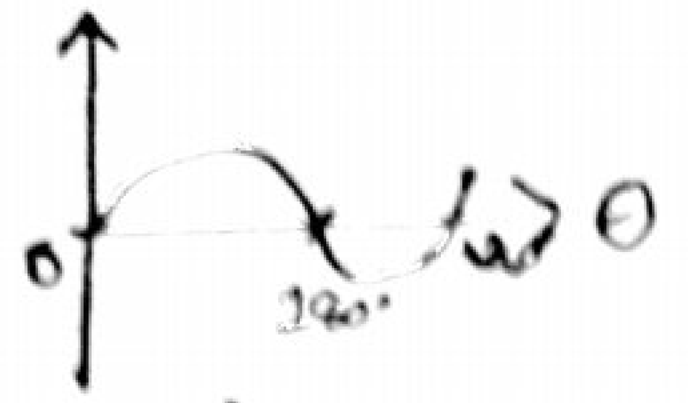
AC voltage frequency 50Hz in our country
বা বলা যায় আমাদের 50Hz দেয়া হয়ে থাকে

Am Sinusoidal Graph এর General Equation
$A \sin(\omega t \pm \theta)$
↓
Phase

Am = Sinusoidal Graph এর Amplitude
t = যে যেকোন value বসাতে পারি

θ = 0 হলে এর Equation

Phase: পরিবর্তনশীল রাশির একটি কোন হতে শুরু হচ্ছে



↓

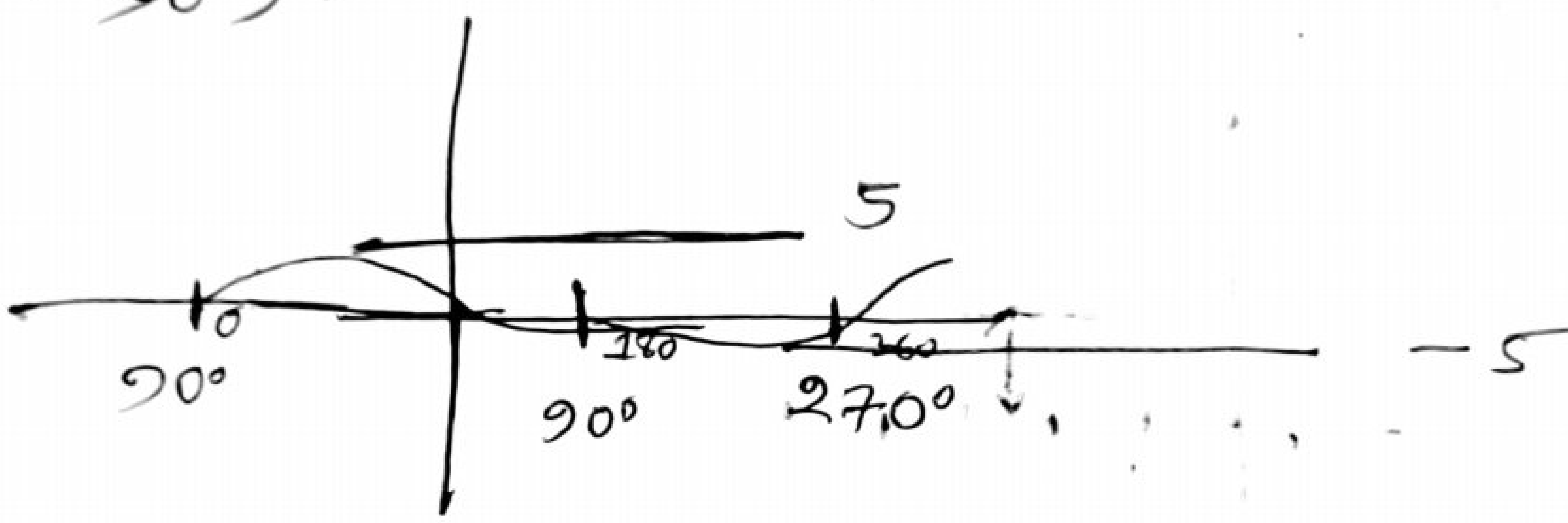
$A\sin\omega t$ θ = 0 থেকে শুরু তাই

$A\sin(\omega t+\theta)$ হলে → shift graph θ amount to the left.

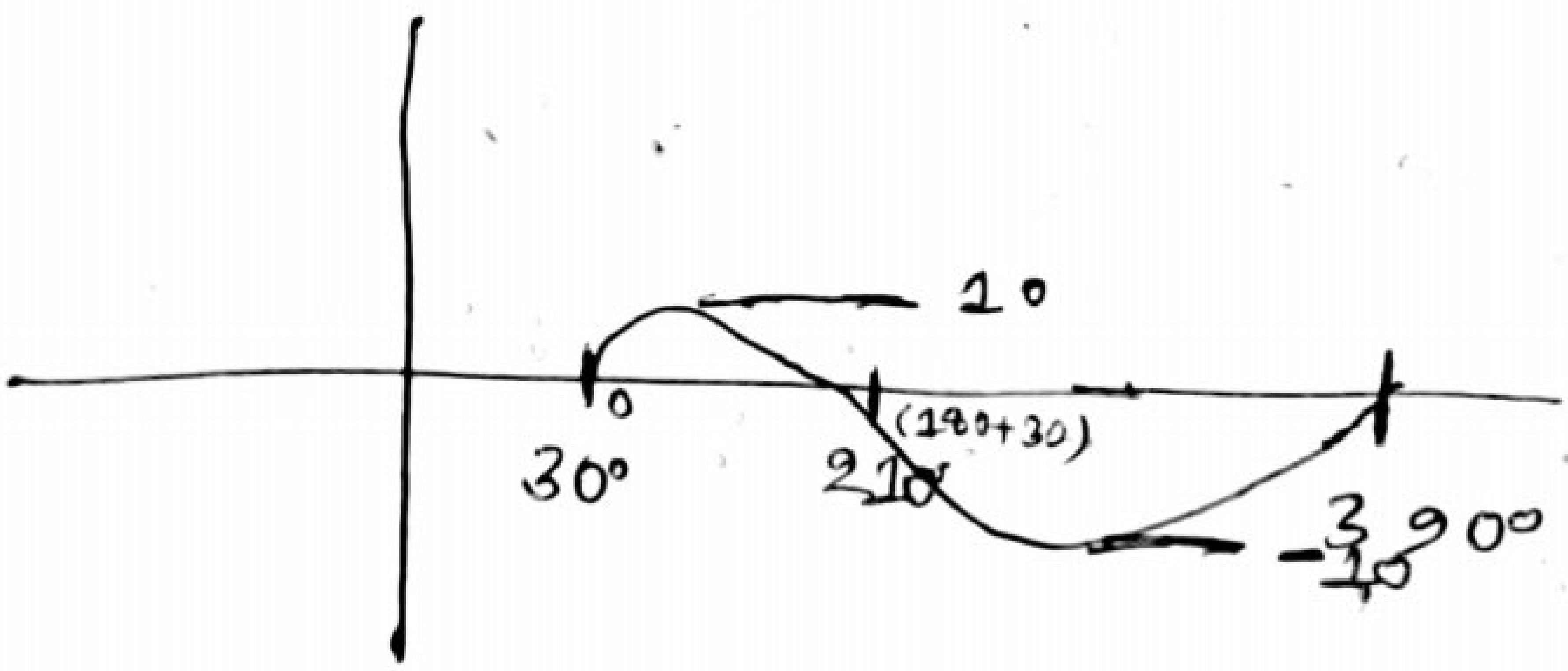
$A\sin(\omega t-\theta)$ হলে → " " " " right

Ex.

$A\sin(\omega t+90°)$, যদি A = 5 হয়



$A\sin(\omega t-30°)$, যদি A = 10 হয়

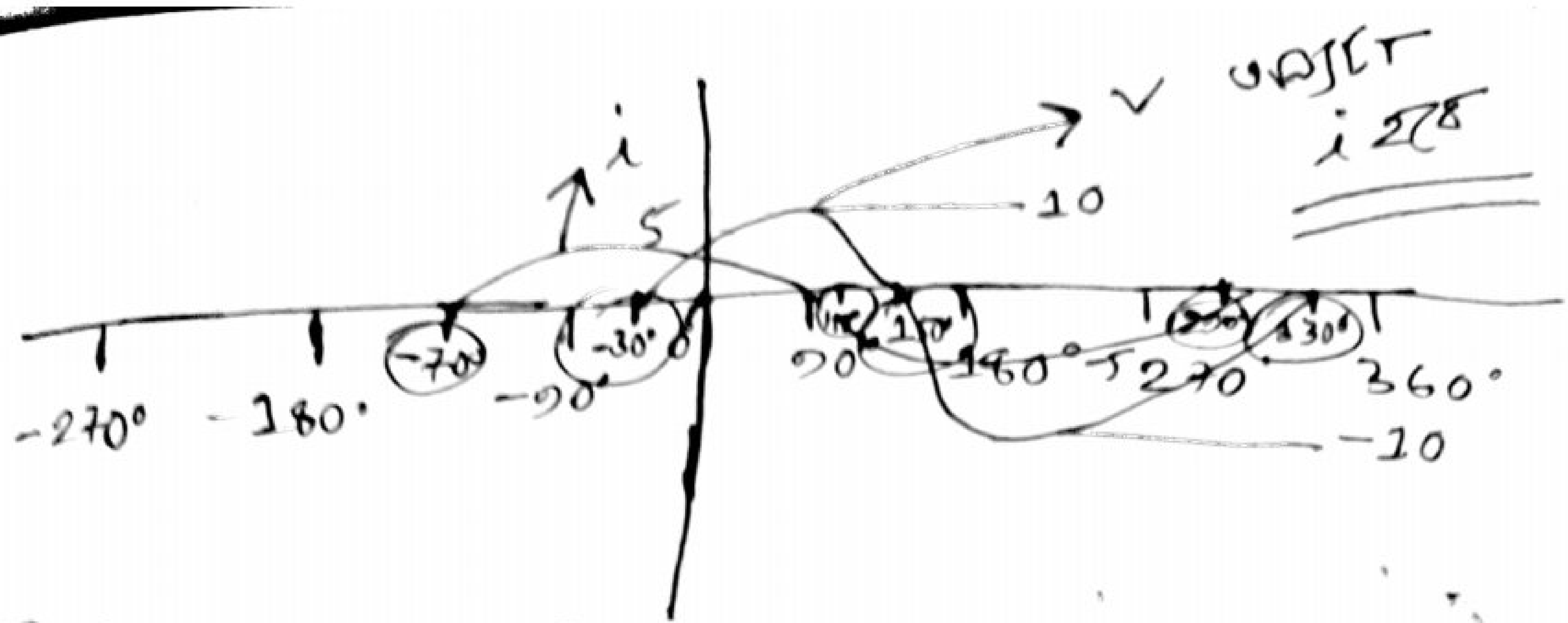


Ex-13.12

a) $v = 10\sin(\omega t+30°)$ V

$i = 5\sin(\omega t+70°)$ A

Scatch v & i on the same axis



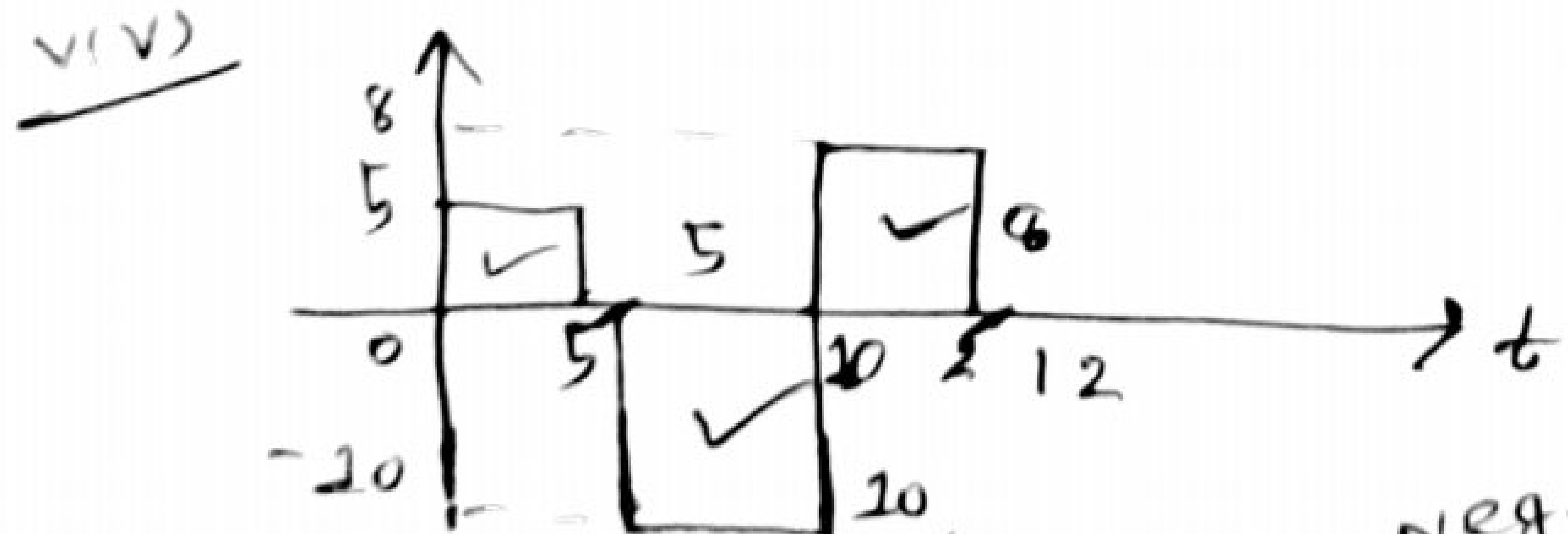
Find Phase difference between v & i
starting point থেকে -70, -30, 40°

Phase difference = |-70 - (-30)|
current voltage
= 40°

Find the phase relationship between v & i
Lead/Lag ; current leading by voltages
i lead v by 40°
v lags i by 40°

V=i হলে 0° হলে, V & i are in phase

Average Value

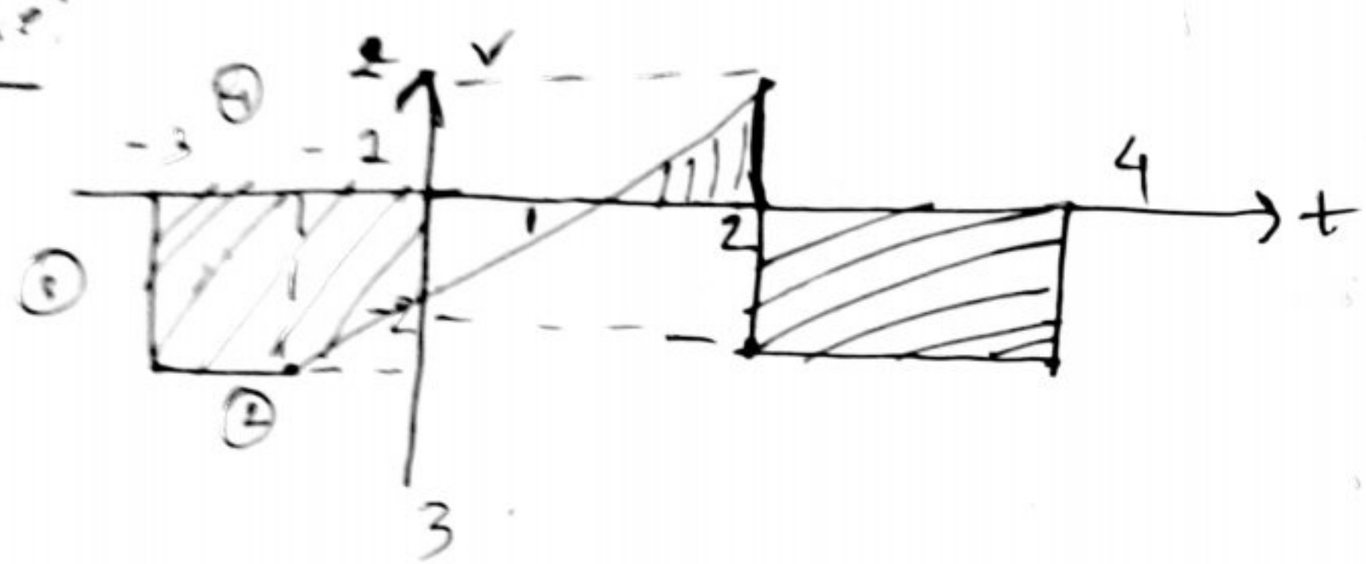


For pos. ← → For Neg. Area

Avg Value: $\frac{+(5\times5)-(5\times10)+(2\times8)}{12} = -0.75\,V$ (দৈর্ঘ্য × প্রস্থ)

12 → time

(y axis এর মান এর একক)



3

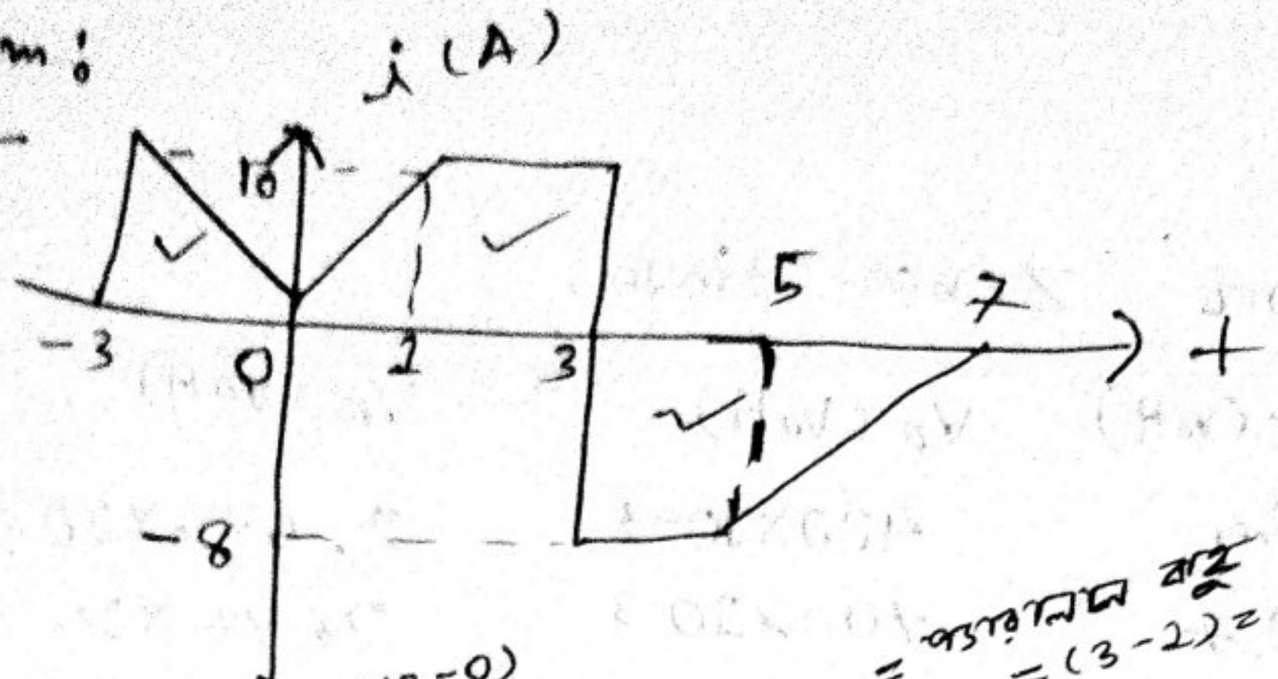
Average $= \dfrac{-1/2\ (4+2) \times 3 + (1/2 \times 1 \times 2) - (2 \times 2)}{7}$

$= -1.72$

Rms $= \sqrt{\dfrac{1/2(4+2) \times 3^2 + (1/2 \times 1 \times 2^2) + 2 \times 2^2}{7}}$

$= 2.299$

Mixed Problem:



Avg value = $\frac{1}{2} \times 3 \times 10 + \frac{1}{2} \times (3+2) \times 10$

[ত্রিভুজ] [ট্রাপিজিয়াম]

length = time

height = value (distance)

$= \frac{1}{2} \times (4+2) \times 8$

$= \frac{15 + 25 - 24}{10}$

$= 1.6\ A$

Root mean square (RMS): $\sqrt{\frac{5 \times 5^2 + 5 \times 10^2 + 2 \times 8^2}{12}}$

$= 7.22\ A$

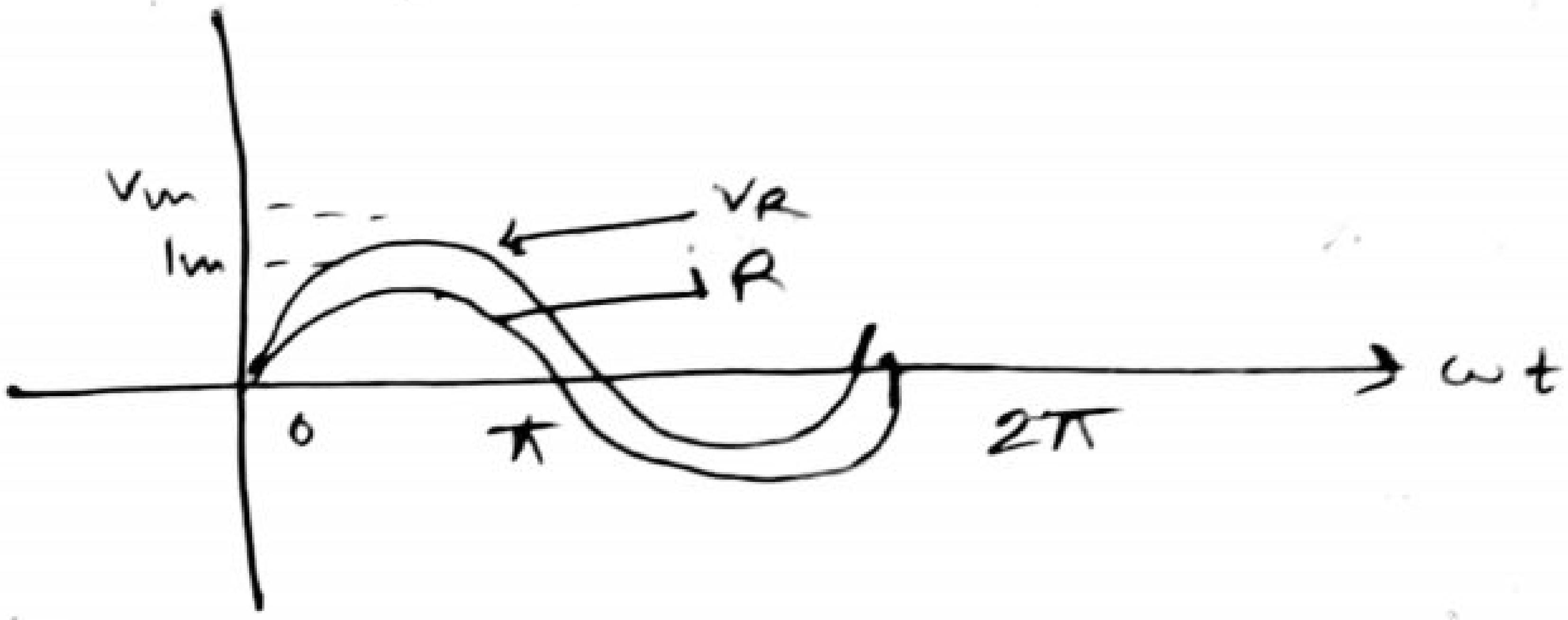
RMS $= \sqrt{\frac{\frac{1}{2} \times 3 \times 10^2 + \frac{1}{2}(3+2) \times 10^2 + \frac{1}{2} \times (4+2) \times 8^2}{10}}$

$= 7.69\ A$

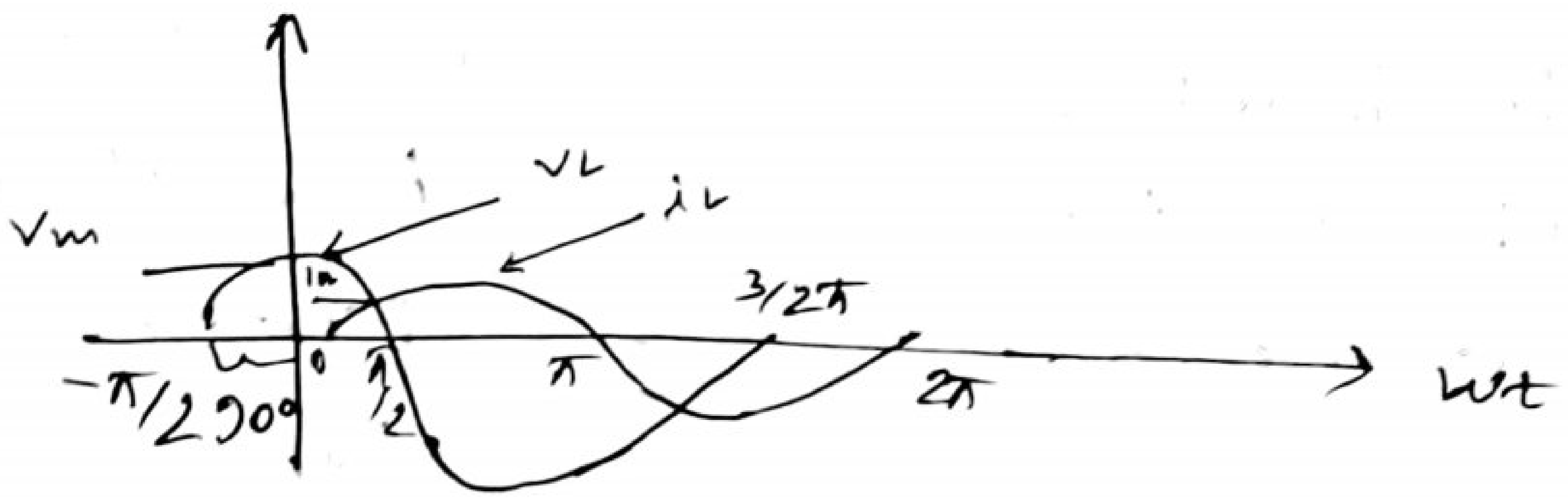
(14) The Basic Elements & Phasors

যদি কোন সার্কিটে শুধু Resistor থাকে তাহলে current এবং voltage সর্বোচ্চে পৌঁছাবে, Current এবং voltage একই সময়ে শূন্য থেকে শুরু হবে। v and i are in phase।

$$I_m = \frac{V_m}{R} \quad \text{[Ohm's Law]}$$



Inductor এর জন্য [90° Fixed]

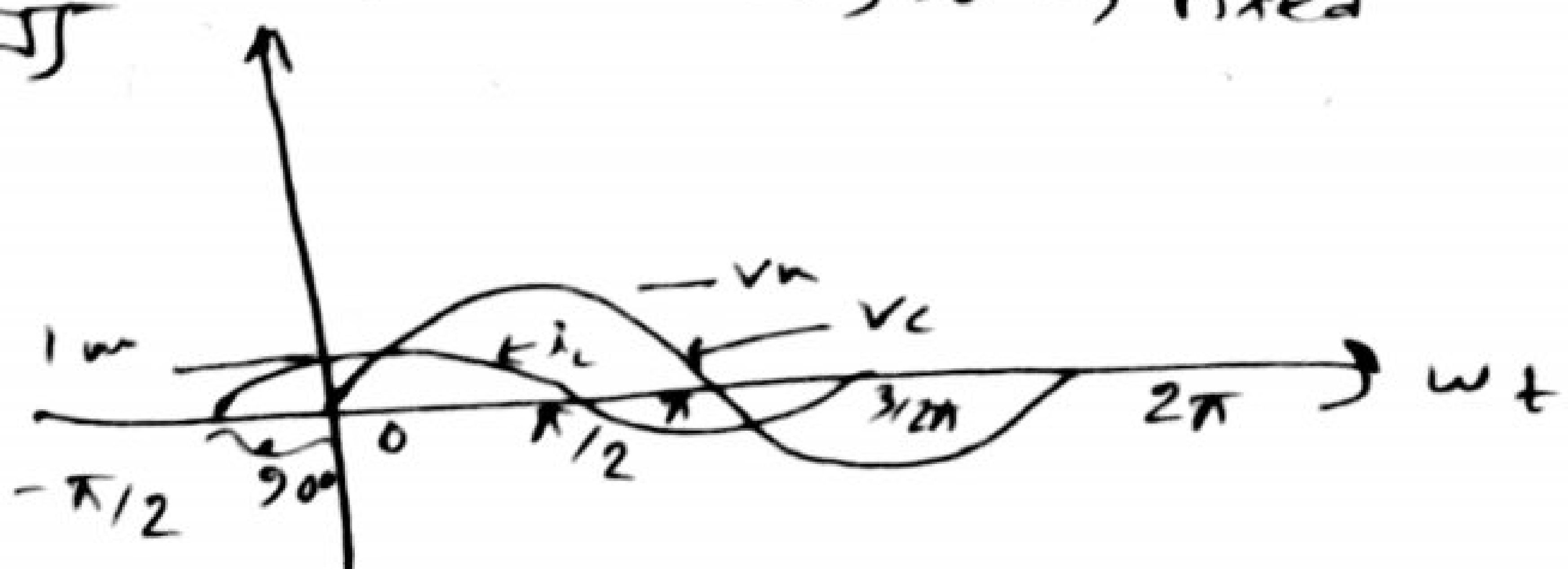


Phase difference: 90°

relationship: v leads i by 90°

Capacitor এর জন্য

i leads v by 90° → Fixed



ELI the ICE Man

E L I → emf: inductor voltage leads current

I C E → capacitor current leads voltage

for inductor: Inductive reactance

$$X_L = \omega L \quad \text{ohm, } (\Omega)$$

$$X_L = \frac{V_m}{I_m}$$

ω = angular velocity/ " frequency
L = inductance (H)
f = frequency
এটা সবসময় 50 Hz এর নিচে হবে।

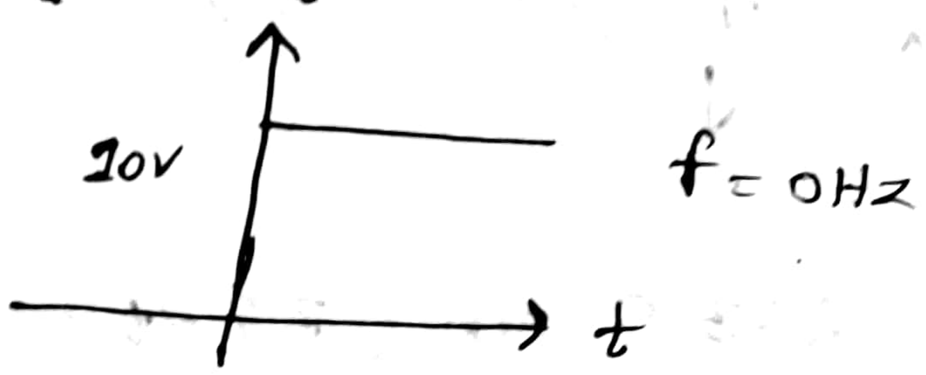
" capacitor: capacitive

$$X_c = \frac{1}{\omega C} \quad \text{ohm, } (\Omega)$$

$$X_c = \frac{V_m}{I_m}$$

ω = angular velocity/ frequency

* DC source এর frequency



$\therefore X_L = 2\pi \times 0 \times L = 0\Omega$ [short circuit এর Resistance 0]

$X_c = \frac{1}{2\pi \times 0 \times C} = \infty$ [open " " " ∞]

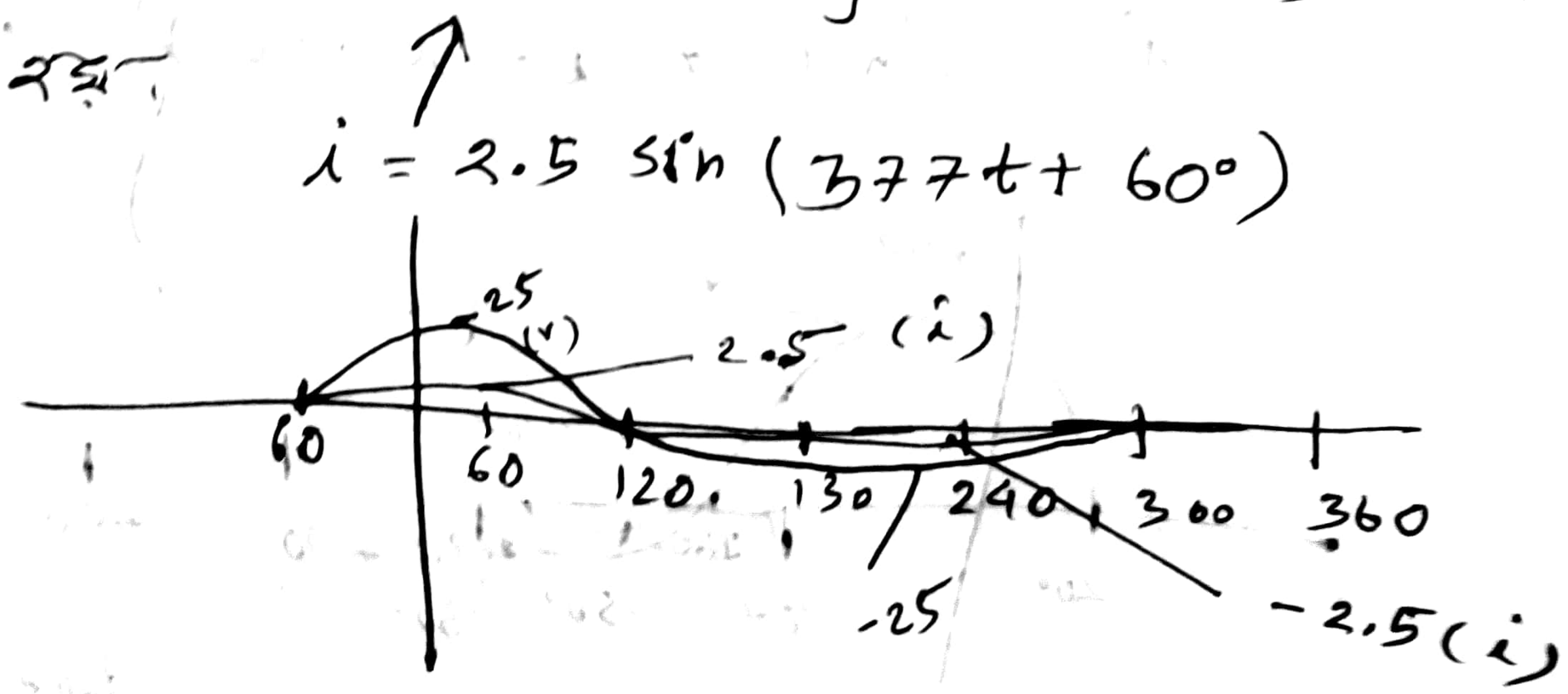
Ex 14.1

b) $v = 25 \sin(377t + 60°)$, across resistor

$R = 10\Omega$

$I_M = \frac{V_M}{R} = \frac{25}{10}$ M = maximum
$= 2.5A$

Resistor এর ক্ষেত্রে current ও voltage একই কোণে থাকে



Ex - 14.3

b) $L = 0.1H$

$i = 7\sin(377t - 70°)A$

$A\sin(\omega t - \theta)$

Scatch v & i on the same axis

$V_M = I_M X_L \quad [\because X_L = \frac{V_M}{I_M}]$

$X_L = \omega L = 2\pi f L$

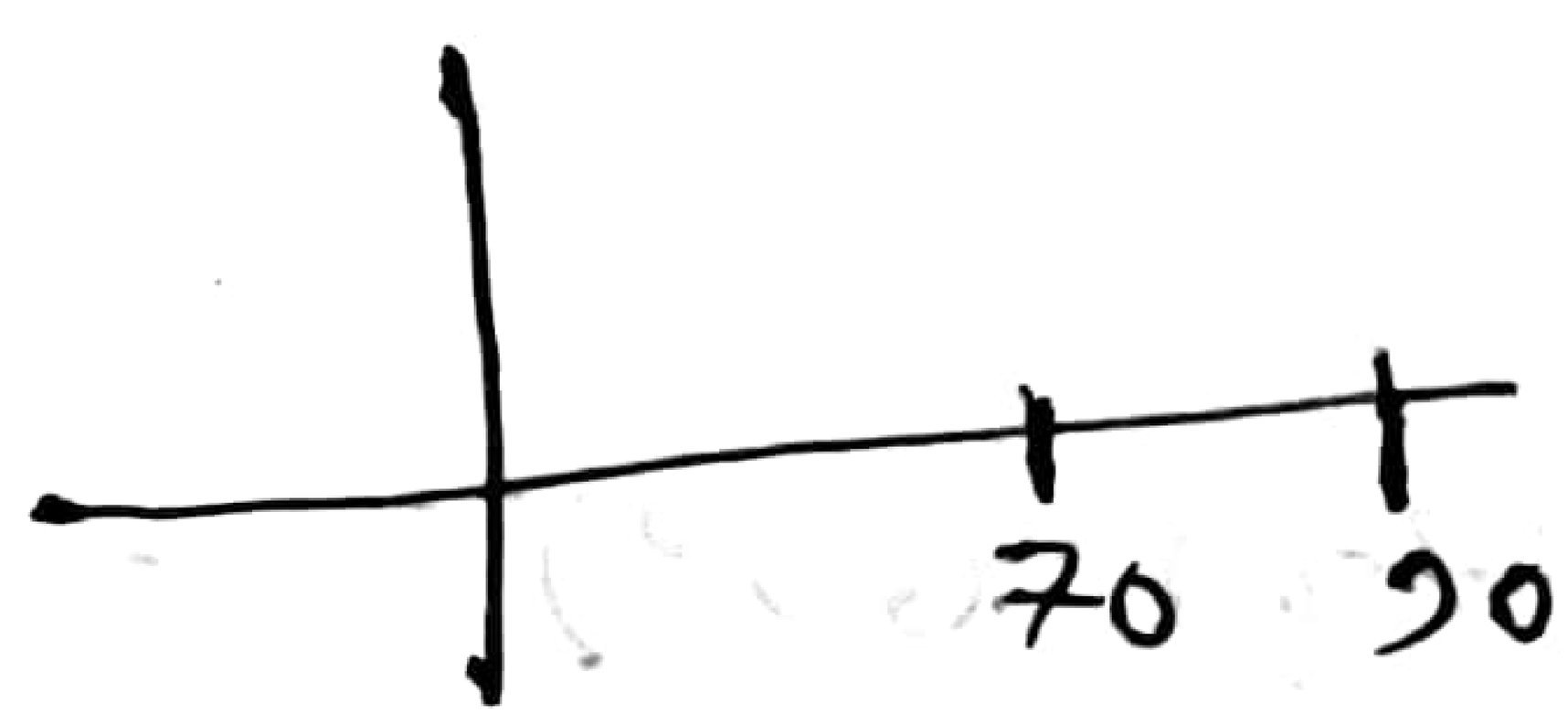
$= 377 \times 0.1 = 37.7\Omega$

$V_M = I_M X_L = 7 \times 37.7 = 263.9V$

(I_M ↓ A)

$V = 263.9\sin(377t - 70 + 90)$

current ধরে −70 (right shift)



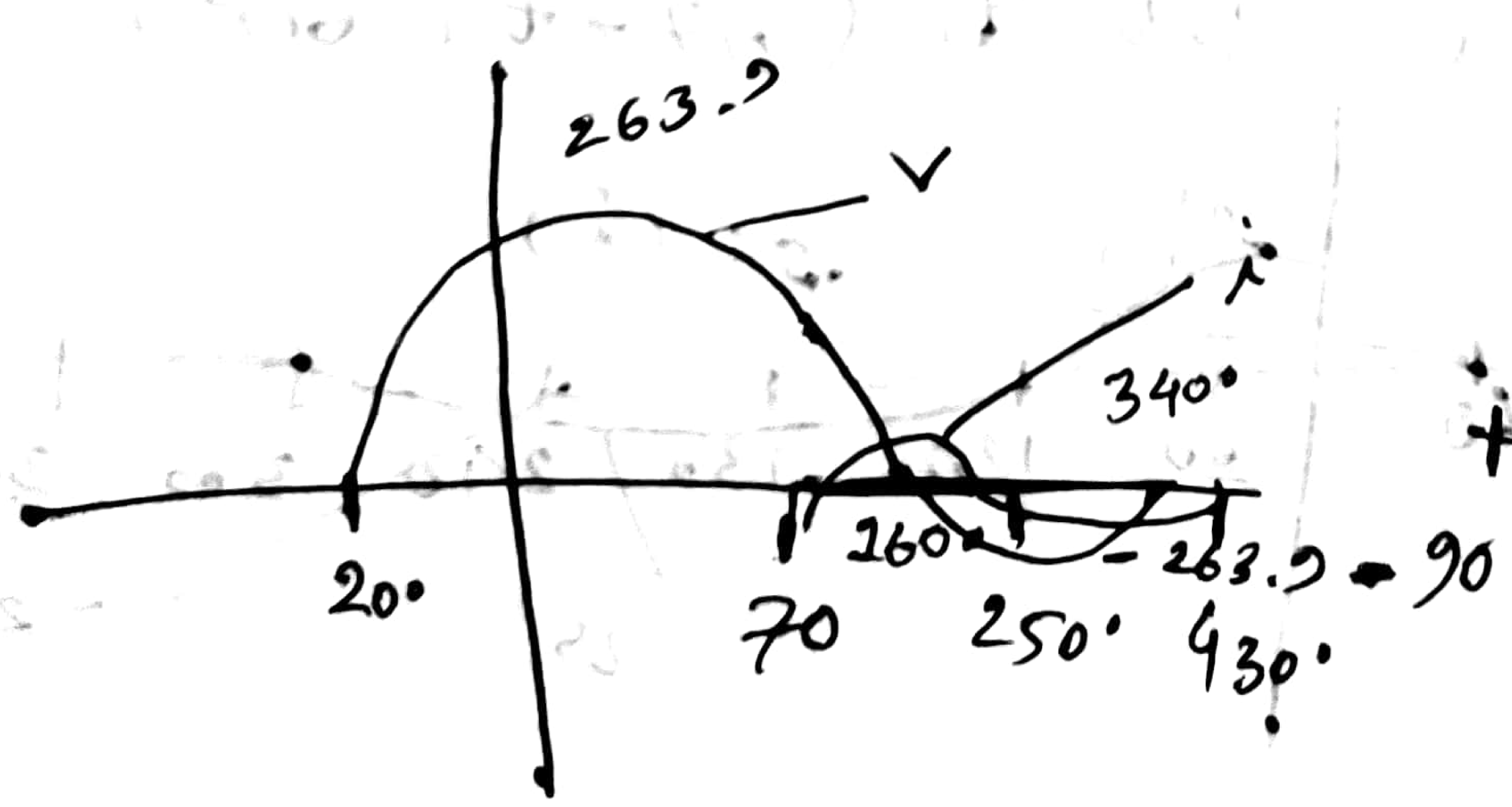
$(90 - 70) = 20$

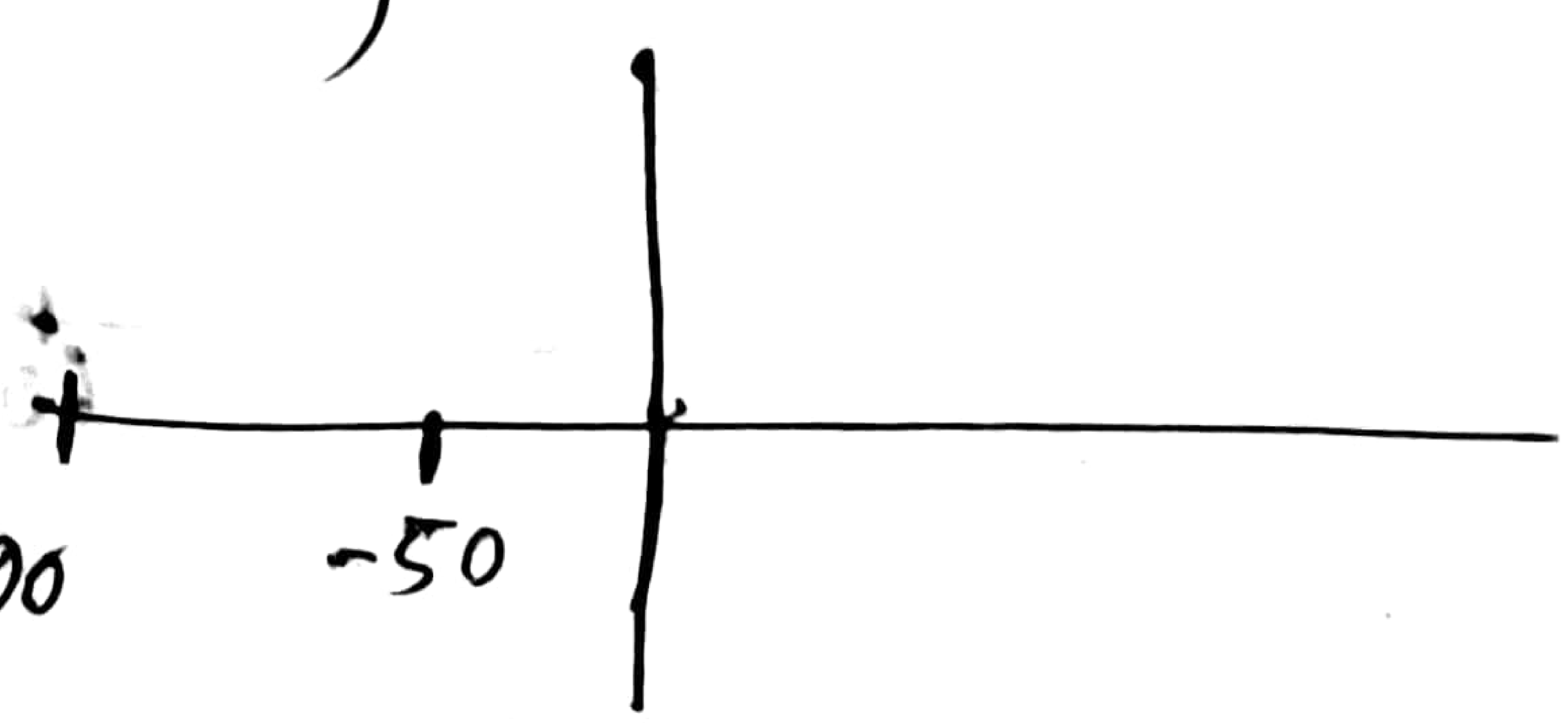
Example

$v = 50\sin(377t + 50°)$

$i = 5\sin(377t + 50 - 90°)$

} inductor এর ক্ষেত্রে Voltage leads current





60708090

↓

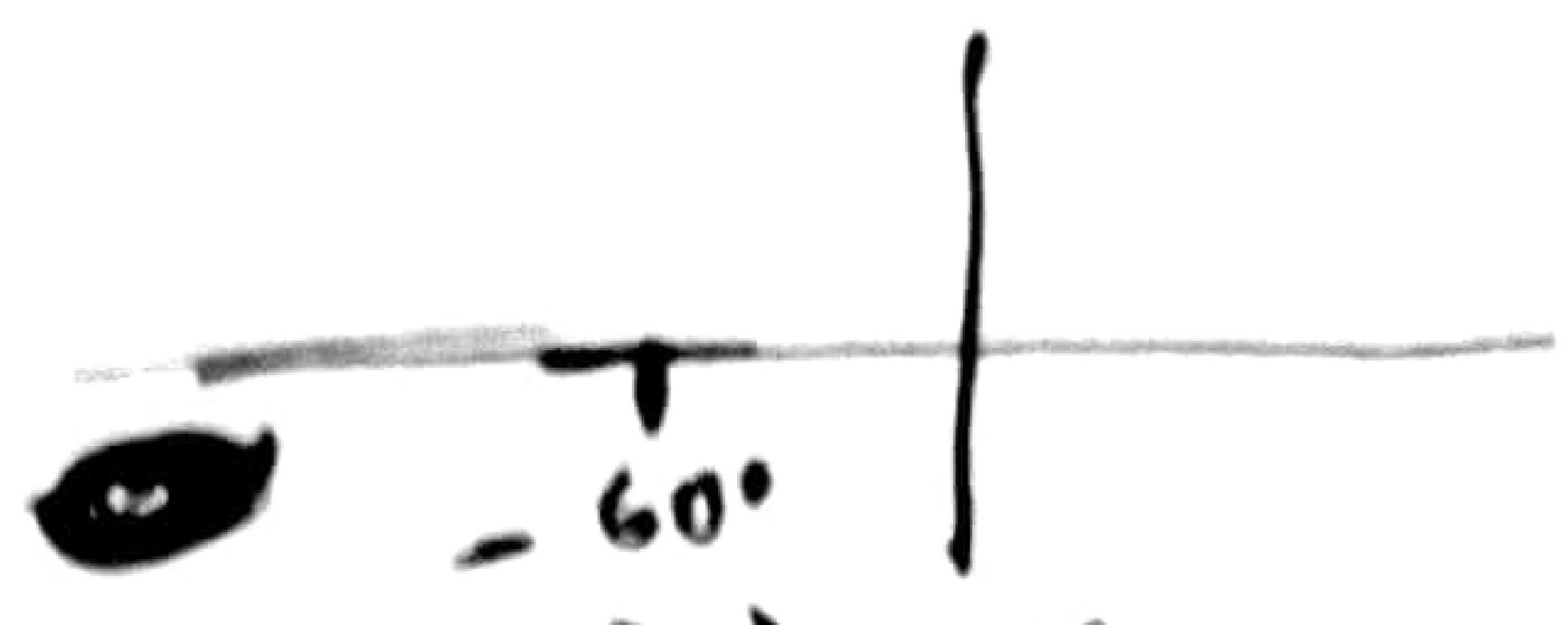
40

Ex-14.4 (inductor)

Ex-14.6 (capacitor)

$C = 100\mu F$

$i = 40 \sin(500t + 60°)$



[illegible]

ICE

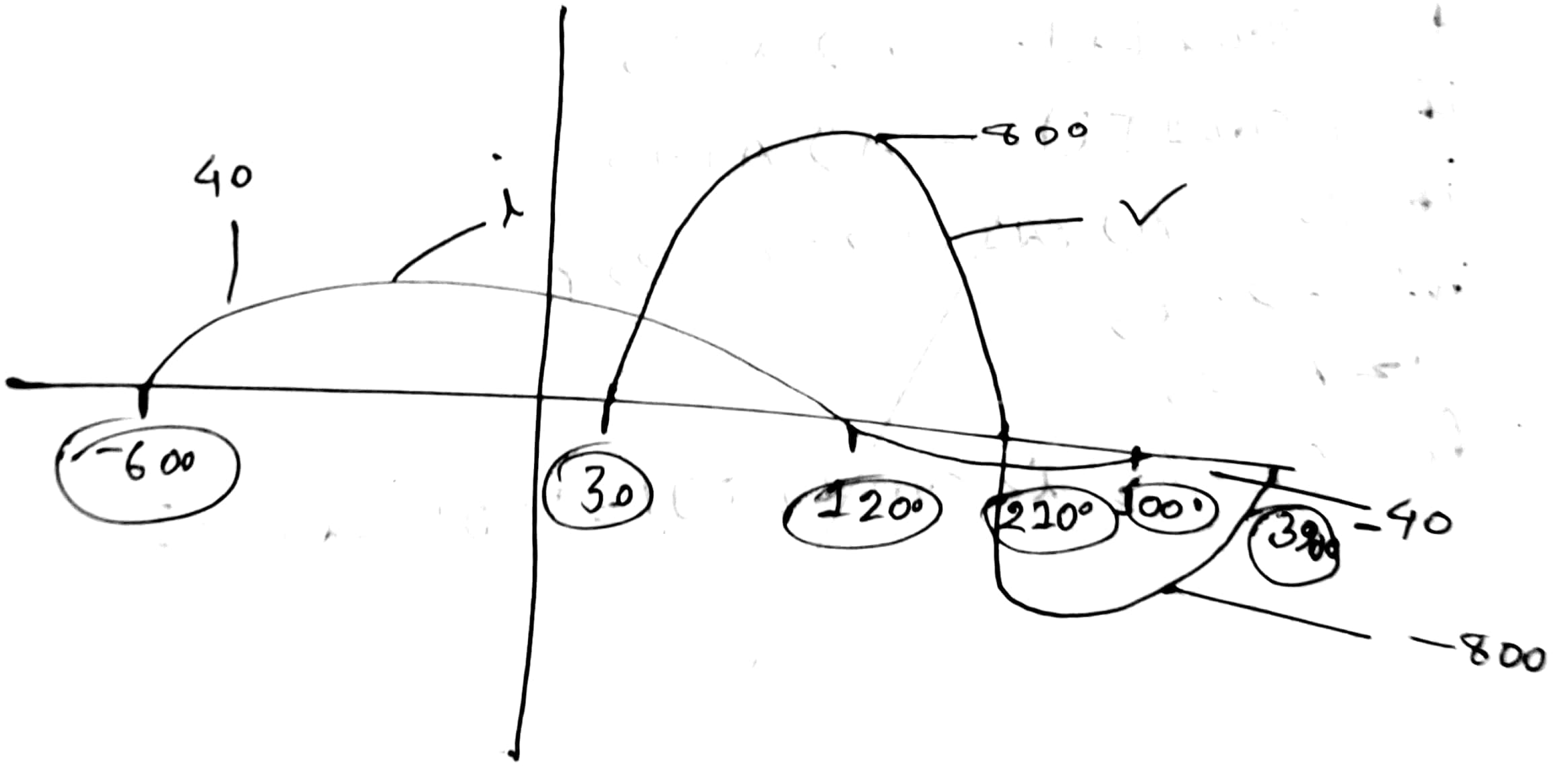
current leads voltage

$I_m = 40A$

$V_m = I_m X_C = 40 \times 20 = 800$ → $[V = IR]$

$X_C = \frac{1}{\omega C} = \frac{1}{500 \times 100 \times 10^{-6}} = 20\Omega$

$V = 800 \sin(500t - 30°)$



$0° + 30$

$180° + 30$

$360° + 30$