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UNIT NO 10

-: SIMPLE HARMONIC MOTION AND WAVES :-

OSCILLATORY MOTION: " The repeated back and forth motion about Certain Equilibrium (mean , Rest) position is Called Oscillatory Motion.

(OR)

" The to and fro motion of an object from its mean position (equilibrium position) is Called Oscillatory Motion.

Equilibrium position: " position where an object tends to Comes at Rest when no external force is applied.

(OR)

" A State of a body where neither the internal energy nor the motion of the body Changes With respect to time is Called Equilibrium Position.

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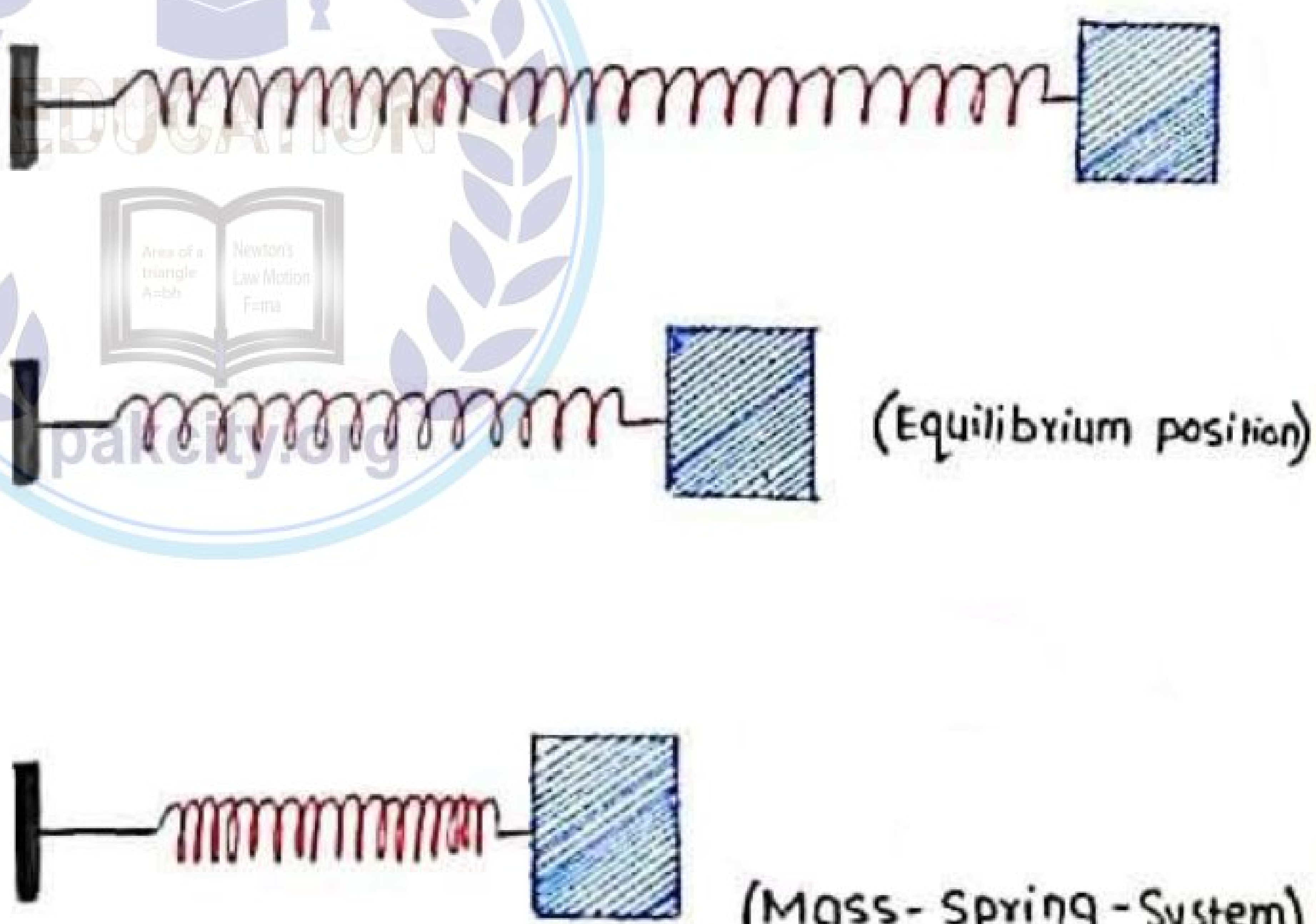
(a)

(Simple pendulum)

(B)



(Mass- Spring -System)

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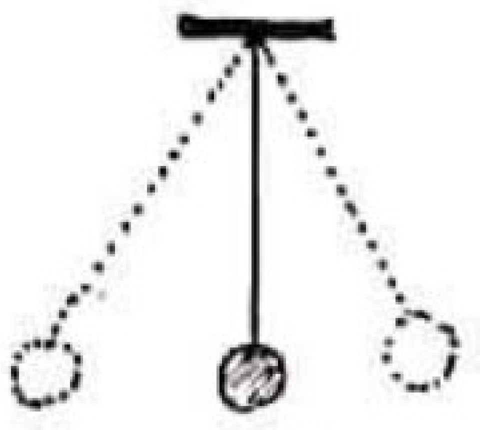
Examples Of Oscillatory Motion:

The Following are the examples of oscillatory Motion.

(1) Motion of a Simple pendulum.



(2) Motion of a mass attach to a Spring.

(3)

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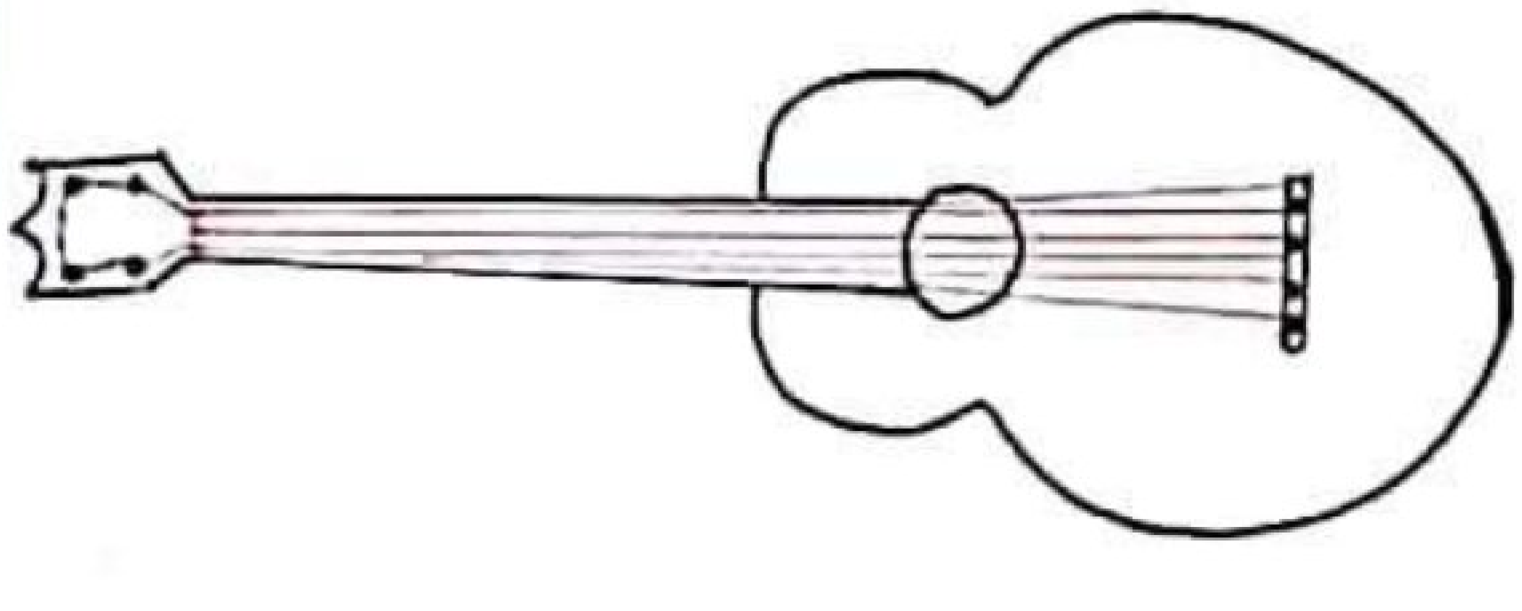
(4) A plastic Ruler held firmly over the edge of a table and gently Struck.

(5) The String of a guitar or piano.



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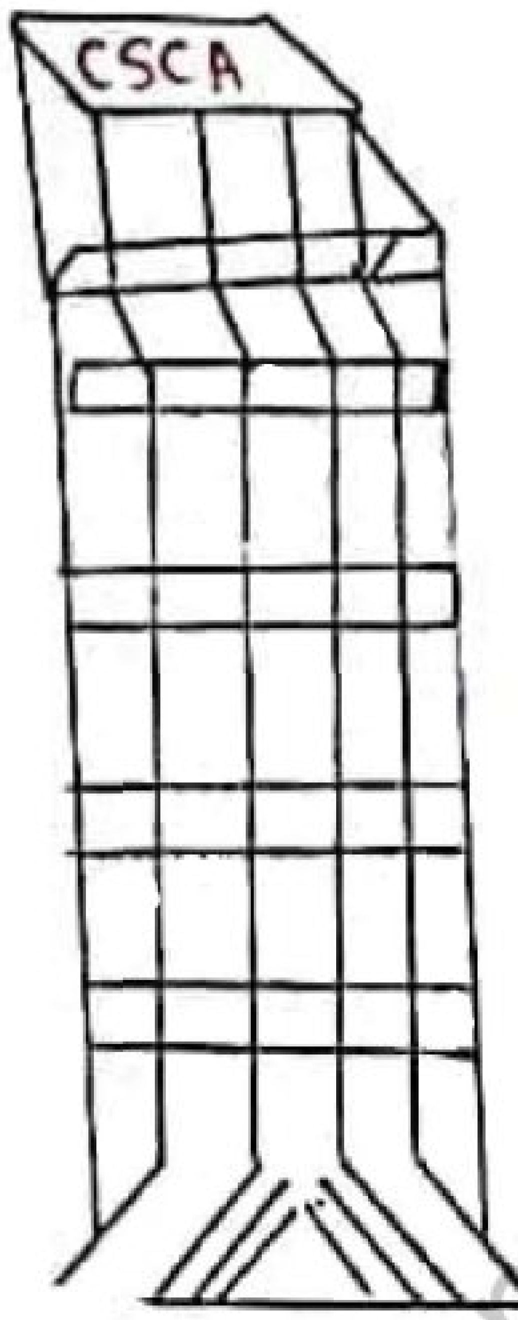
(6) vehicles Oscillate up and down when they hit a bump.

(7) Building and bridges vibrate during an earth quack.



Terminologies Of Oscillatory motion:

A) Cycle/vibration: " One Complete round trip of vibrating body about Certain Equilibrium position is Called Cycle or vibration.

Explation:

Consider a Simple pendulum as shown in the figure.
Starting from point "A" and Cross point "B" and reach point " C" and than Start back motion from point "C" and Cross point "B" and reach point "A". So, this is a one

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Complete rotation.

i.e

A ⟶ B ⟶ C } Half Cycle ⎤
A ⟵ B ⟵ C } Half Cycle ⎦ one Cycle

(OR)

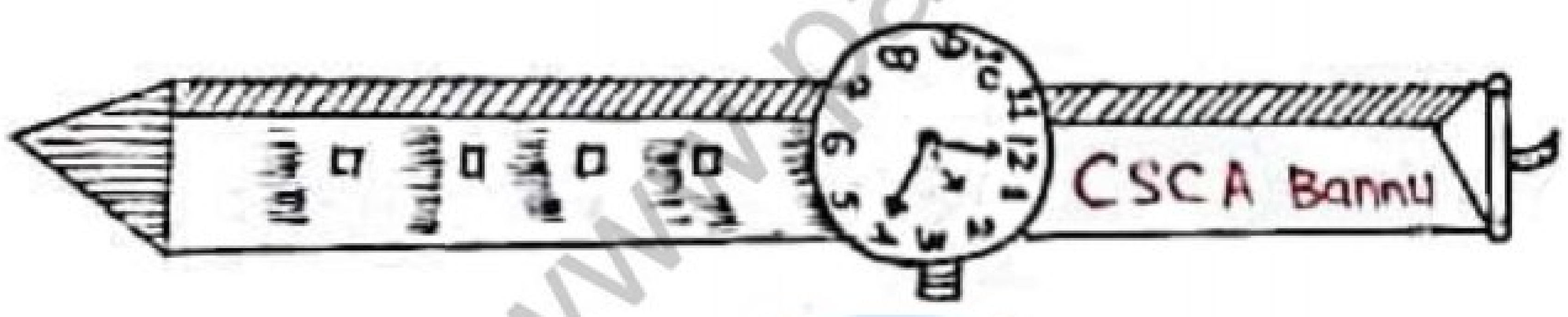
A ⟶ B ⟶ C one vibration | cycle
⟵ ⟵

(B) **Time Periode: (T):**

" The time required to Complete One Cycle or vibration is Called time periode.

⊛ **Representation:** " Time periode is represented By Capital "T"

⊛ **S.I unit:** " The S.I unit Of time periode is second.



(C) **Frequency: (f):**

" The Number of Cycle that the Particle Complete per Unit time is Called frequency(f).

⊛ **Representation:** " Frequency is Represented By "f".

⊛ **S.I unit:** " S.I Unit Of frequency is Cycle per second (S^{-1}) or hertz (Hz)

Note:-

$$f = \frac{1}{T} = \frac{1}{\text{Second}} = \frac{1}{S} = S^{-1} = \text{hertz}$$

So,

$$\boxed{f = S^{-1} \text{ or hertz (Hz)}}$$

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(D) Relation Between time periode (T) and Frequency (f) :

↳ Time periode and Frequency are reciprocal to each other.
↓(inversely propotional)

Formula: $\boxed{T = \frac{1}{f}}$ or $\boxed{\text{frequency} = \frac{1}{\text{periode}}}$

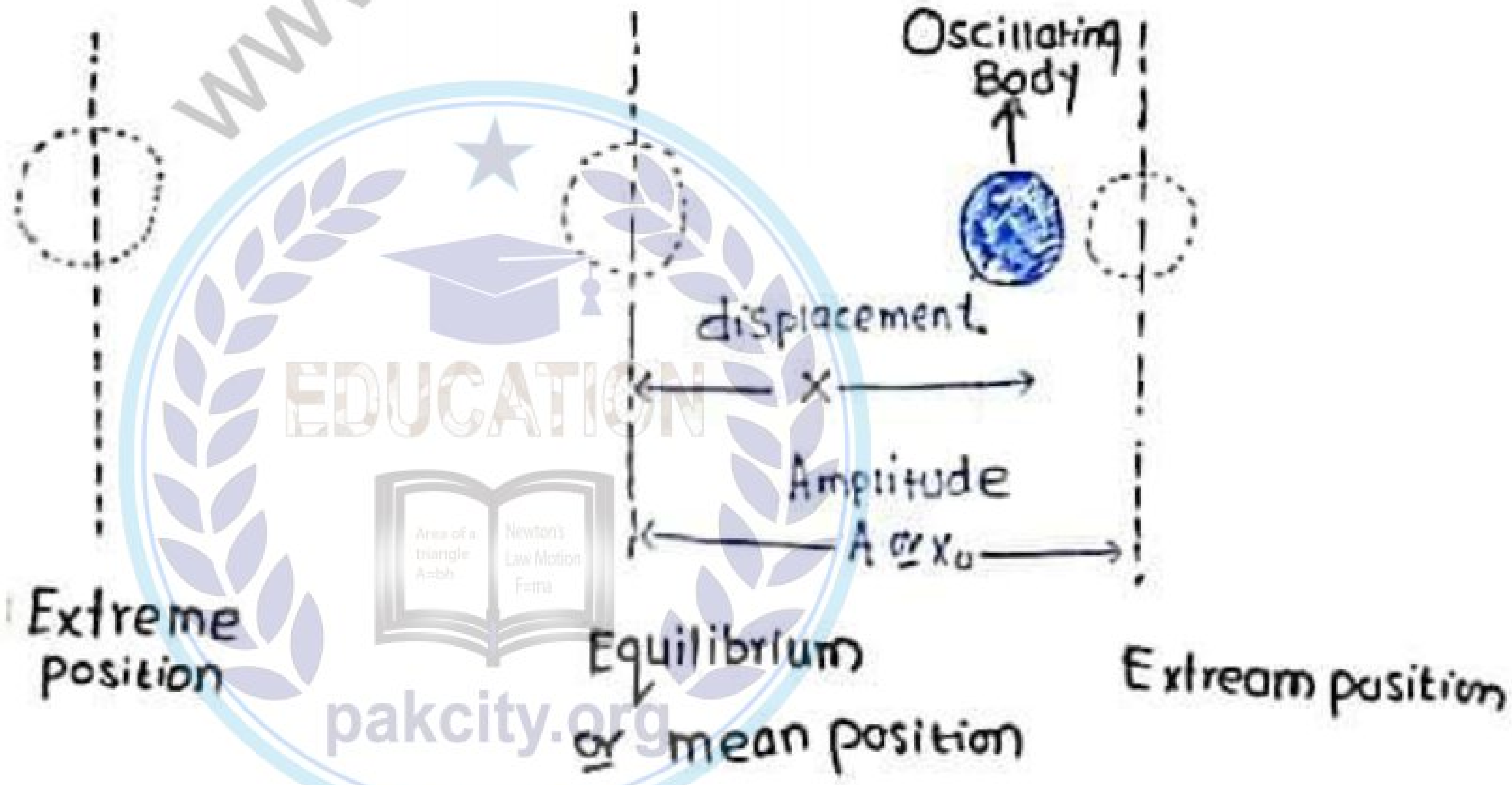
↳ if you double the period the frequency is halved

(E) Displacement: " The distance of oscillating body from mean position at any instant of time is Called displacement.

Representation :- displacement is represented By "x".

Unit :- Displacement is measured in meter(m).

Figure :-



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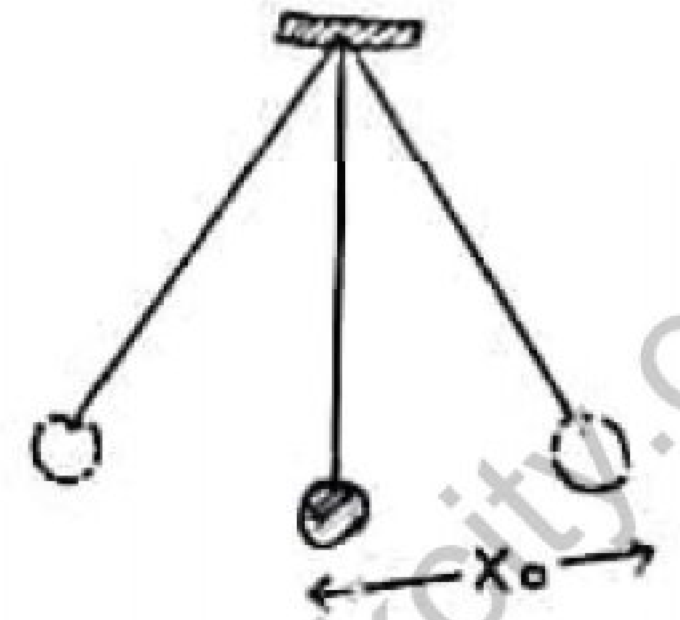
(F) **Amplitude($A|X_0$):** "The maximum displacement of the body from its mean position in a cycle is called amplitude (X_0). Amplitude being a length, is measured in meter (m).

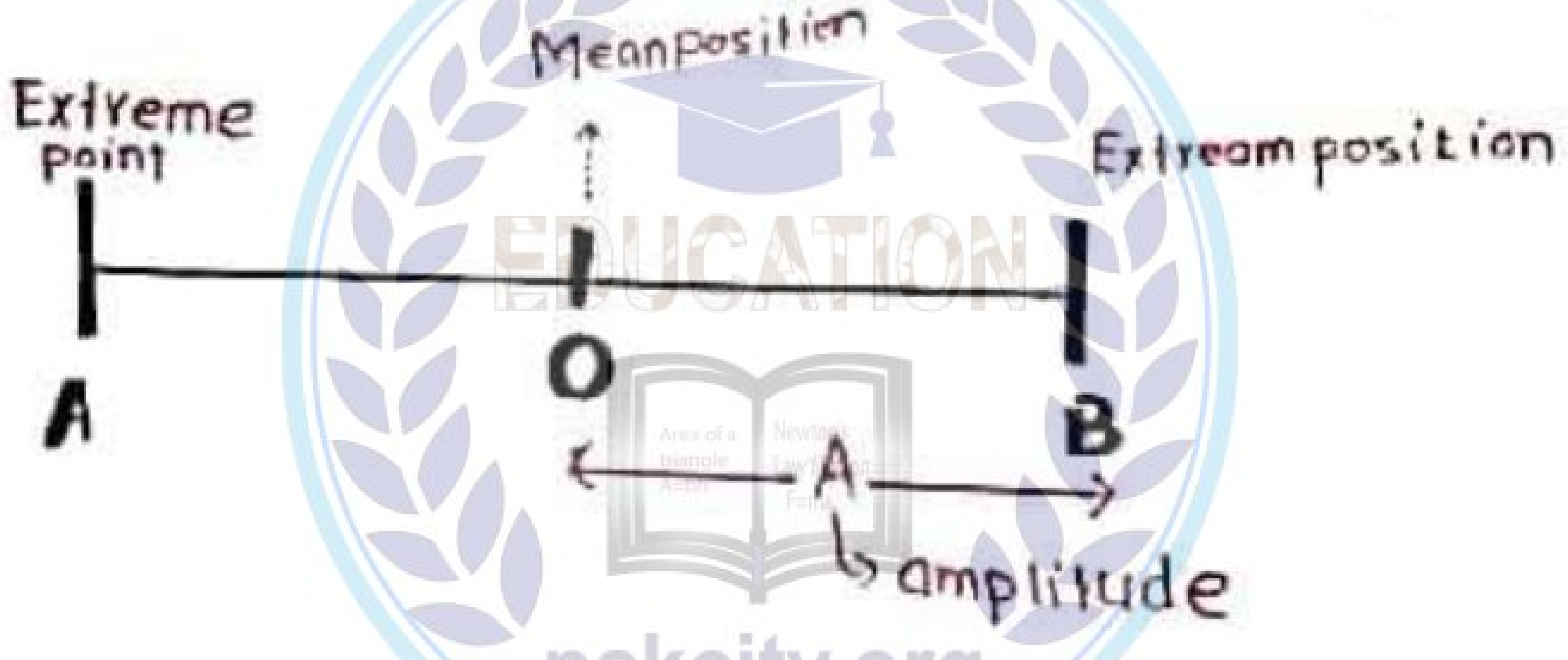
Representation:- amplitude is represented BY A or X_0.

Unit of amplitude: " Amplitude is being a length so, it unit is meter (m).

Figure:



in waves:-



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Difference Between

‹1› Period Motion:

‹2› Oscillation Motion:

‹3› Simple Harmonic Motion:

‹1› **Periodic Motion:** "A motion repeats itself after an equal interval of time is called periodic motion.

Main points: (1) There is no equilibrium position.

(2) There is no restoring Force.

(3) There is no stable Equilibrium position.

Example:- Uniform Circular motion.

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‹2› **Oscillation Motion:** " To and fro motion of a particle a mean position is Called an oscillatory motion. in oscillatory motion a particle move on either side of Equilibrium (or) mean position is an Oscillatory motion.

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Main points:- (1) it is a kind of periodic motion bounded Between two extreme points

(2) The object will keep on moving Between two extreme points about a Fixed points is called mean position or Equilibrium Position along any path. (the path is not Constraint).

(3) there will be a restoring force directed towards equilibrium position (or) mean position.

(4) in an oscillatory motion, the net (total) force on the particle is zero at mean position (equilibrium position).

(5) Mean position in Simple harmonic Motion is stable equilibrium.

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Condition for SHM:

① $\vec{F} \propto -\vec{x}$

② $\vec{a} \propto -\vec{x}$

Example of Simple Harmonic Motion:

① Oscillation of Simple pendulum

② Mass - Spring System.

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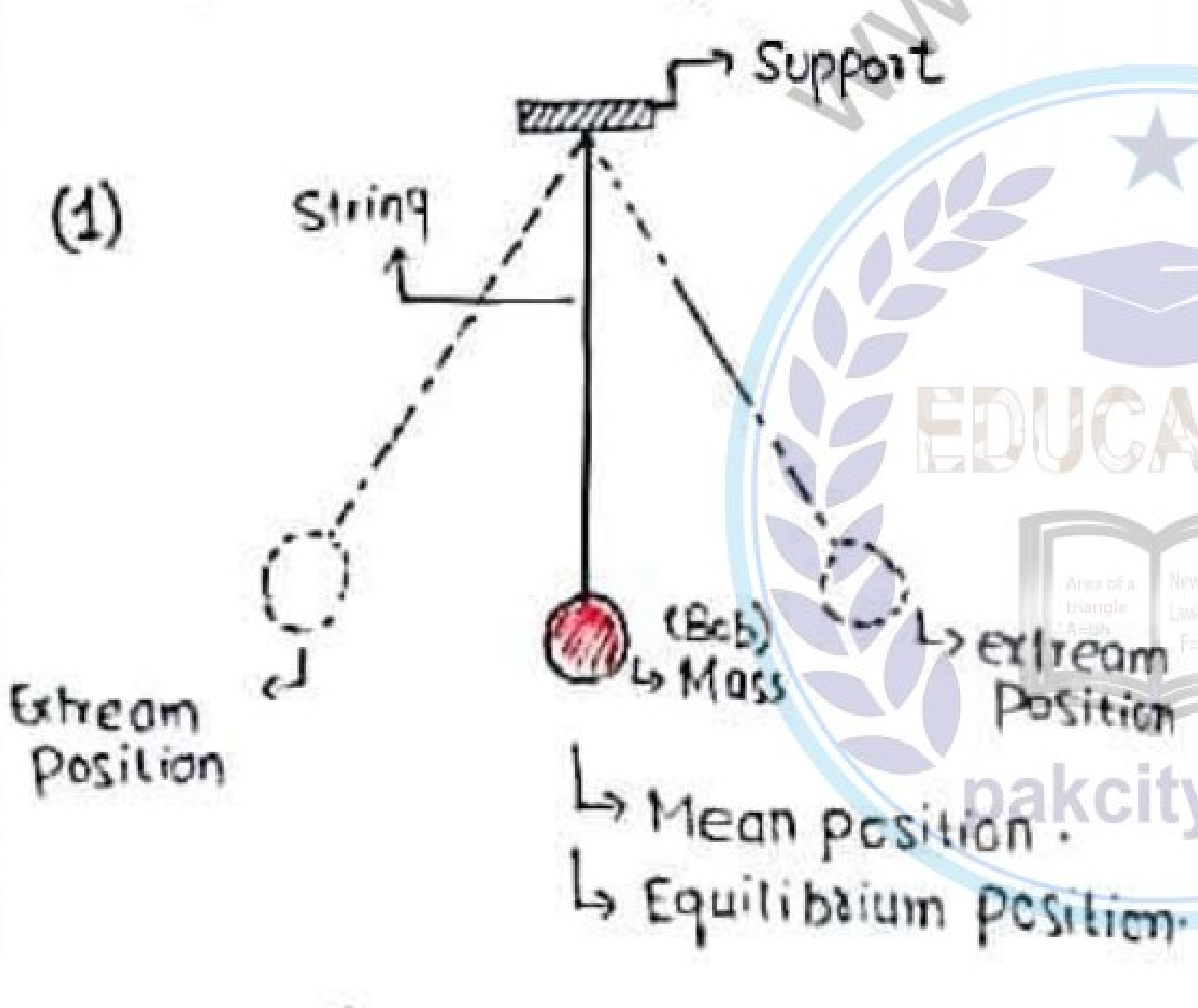
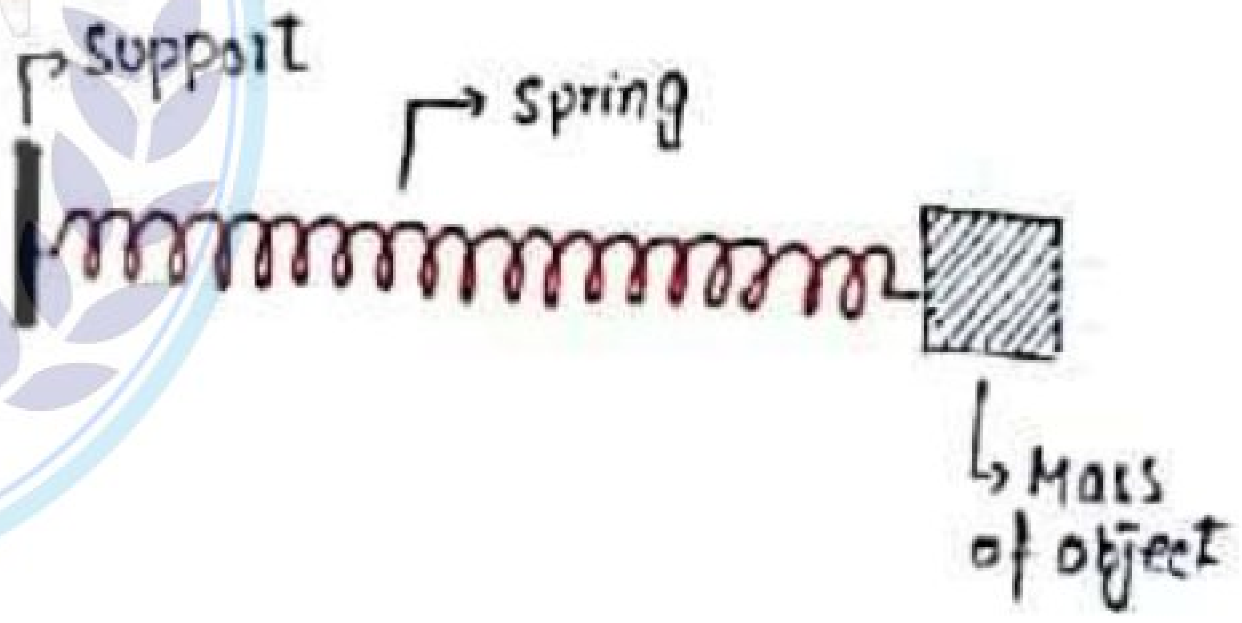
(1)



(Simple pendulum)

(2)



(Mass Spring System)

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Simple Harmonic Motion (S·H·M)

Definition: Such Type of motion in which object performe periodic motion under the influence of Restoring force is Called simple Harmonic Motion. (S·H·M).

OR

"A Special oscillatory motion in which restoring force is directly proportional to the Displacement(x) of the particle from the mean or Equillibrium position.

i.e $F_{res} \propto -x$

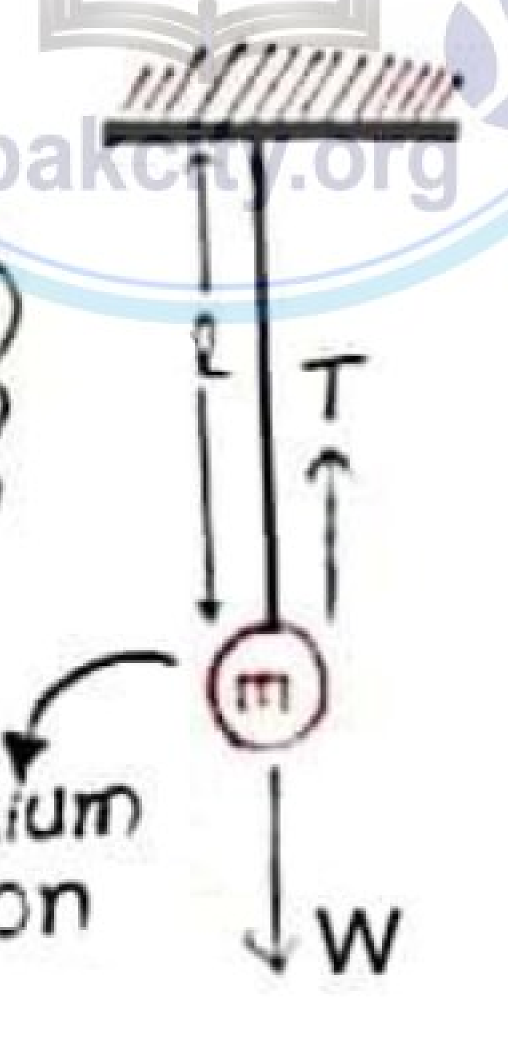
$$\boxed{F_{res} = -Kx}$$

Explanation:- vibration or oscillation is repeated Back and forth motion along the same path. vibration occure in the vicinity of a point. of Stable equillibrium.

Equilibrium point: "A Point at which the net force acting on the body is zero.

i.e

" The Tension and weight have same megnitude but opposite direction So, net force is equal to zero.



$F_{net} = W + (-T)$

$F_{net} = W - T$

$\boxed{F_{net} = 0}$

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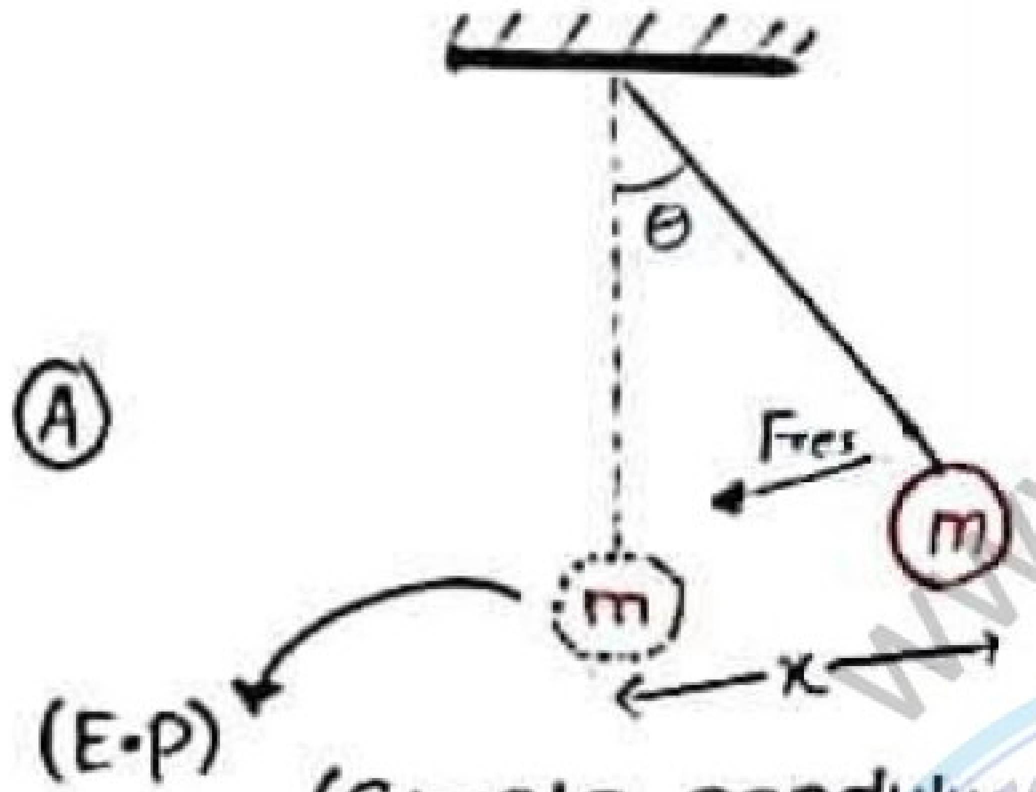
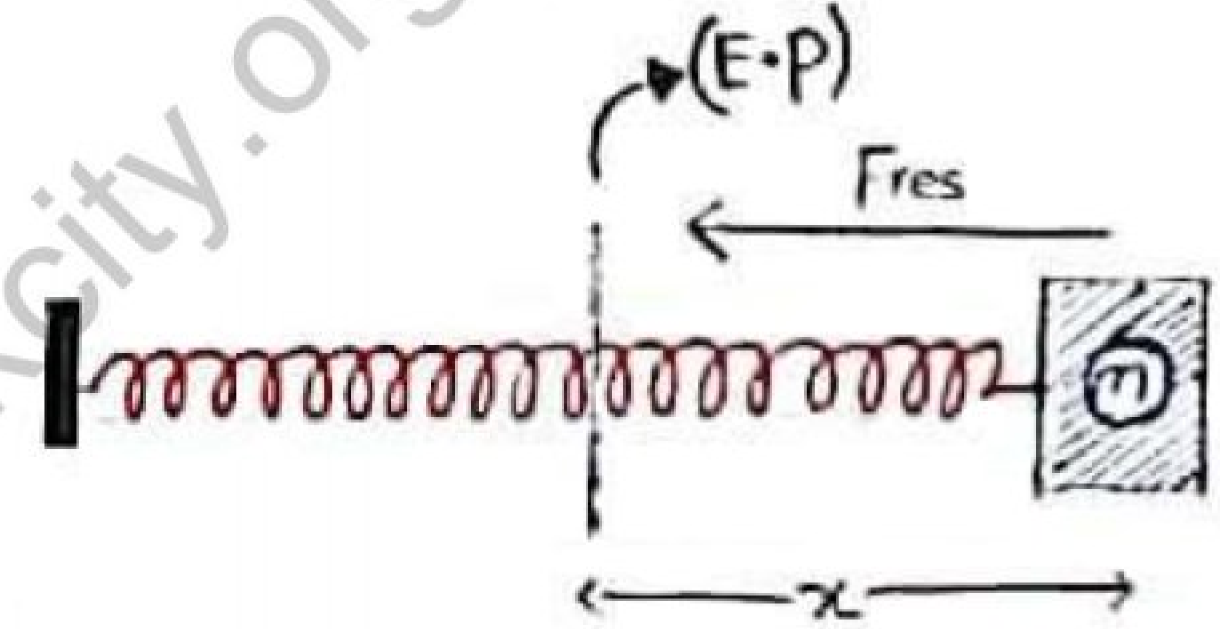
→ an equillibrium point is also Called Stable point. When a body is displaces from mean position By any external force (F_{ext}) to some extream position. then the net force pushes the body back to the equillibrium position. Such a force is Called Restoring Force (F_{res}).

Restoring Force (F_{res}): " Restoring Force is a Force (F_{res}) is a Force an oscillating System that always points toward the equillibrium position.

Diagram:-



(Simple pendulum)



: E·P = Equillibrium position

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→ Simple Harmonic Motion obey two Condition.

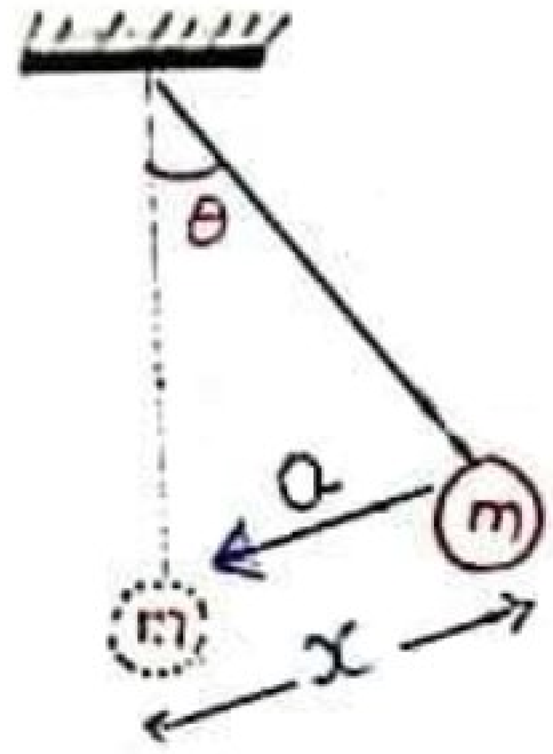
① $\boxed{F_{res} \propto -x}$

the restoring Force is directly propotional to the displacement but Opposite in direction. Here the negative sign show that restoring Force is opposite to displacement.

②

$\boxed{a \propto -x}$

the accelation is directly propotional to the displacement.



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Imp

Motion Of Mass Attached to A Spring

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Consider a block of mass (m) attached to one end of elastic Spring which Can move Freely on a Frictionless horizental Surfaces as shown below.

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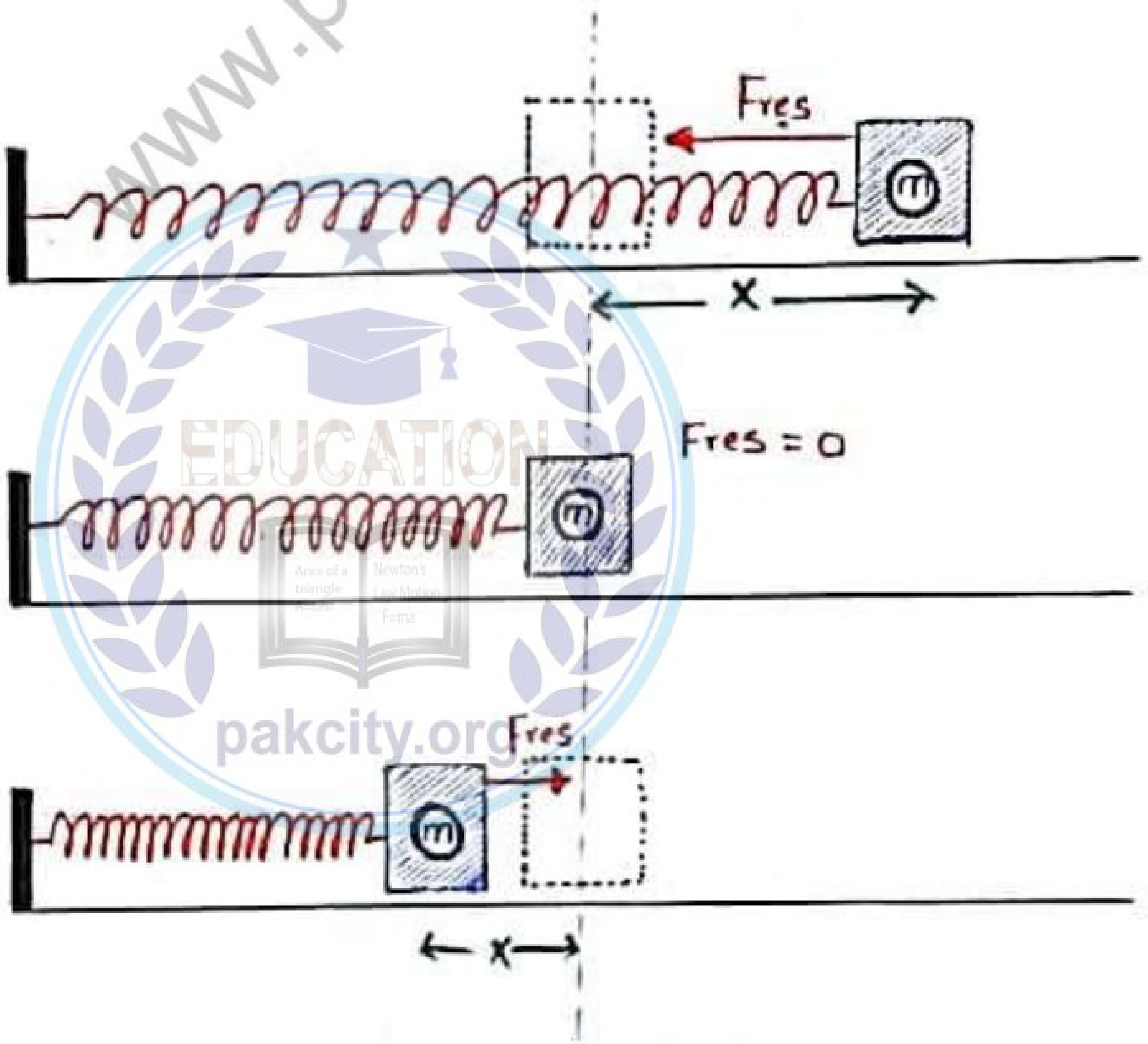

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when the block is displaces From equillibrium position to extream position then elastic restoring Force pulls the block towards Equillibrium position.

So, here Fres is directly propotional to the displacement (x) From equillibrium position.

$$\boxed{F_{res} \propto -x}$$

$$F_{res} = -Kx \longrightarrow ①$$

K = Stiffness of the spring or Spring Constant

Restoring Force will produce acceleration in the body given by newton's second law of motion as

$$F_{res} = ma \longrightarrow ②$$

Comparing equation (1) and equation (2) we get

$$F_{res} = F_{res}$$

$$-Kx = ma$$

Divide Both side By m

$$\frac{-Kx}{m} = \frac{\cancel{m}a}{\cancel{m}}$$

$$-\frac{K}{m}x = a$$

$$a = -\frac{K}{m}x$$

the spring Constant "K" and mass "m" does not Change during oscillation of mass attached to

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Spring therefore they are regarded as Constants.

$$a = -\frac{K}{m} x$$

$$\left\{ \boxed{\frac{K}{m} = \text{Constants}} \right.$$

$$a = -\text{Constants } x$$

$$\boxed{a \propto -x}$$

So, Mass Spring System obey Both Conditions

① $F_{res} \propto -x$

② $a \propto -x$

So, It is a Simple Harmonic Motion.

Unit OF Spring Constant (K):

We Know that

$$F_{res} = -Kx$$

we also write as

$$\frac{F_{res}}{x} = K$$

$$K = \frac{F}{x}$$

$$K = \frac{\text{newton}}{\text{meter}}$$

$$\boxed{K = \frac{N}{m} = Nm^{-1}}$$

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Time Period "T" and frequency "f" of mass Spring System.

Calculation For Time Period (T) :-

We know that the accelaration in SHM.

$$\boxed{a = -\text{Constant}\ x} \rightarrow ⊛ \quad \text{Here} \quad \boxed{\text{Constant} = \frac{4\pi^2}{T^2}}$$

So, put value of Constant in equation ⊛

$$a = -\frac{4\pi^2}{T^2}x \longrightarrow ①$$

We also know that

$$a = -\frac{K}{m}x \longrightarrow ②$$

Comparing equation ① and equation ②

$$a = a$$

$$-\frac{4\pi^2}{T^2}x = -\frac{K}{m}x$$

Cancel same Terms from both side

$$\cancel{-}\frac{4\pi^2}{T^2}\cancel{x} = \cancel{-}\frac{K}{m}\cancel{x}$$

$$\frac{4\pi^2}{T^2} = \frac{K}{m}$$

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By Crossmultiplication

$$\frac{4\pi^2}{T^2} = \frac{K}{m}$$

$$T^2 \times K = 4\pi^2 \times m$$

$$T^2 K = 4\pi^2 m$$

Divide Both side By "K"

$$\frac{T^2 \cancel{K}}{\cancel{K}} = \frac{4\pi^2 m}{K}$$

$$T^2 = 4\pi^2 \frac{m}{K}$$

Take square root on Both side

$$\sqrt{T^{\cancel{2}}} = \sqrt{4\pi^2 \frac{m}{K}}$$

Note

$\sqrt{T^{\cancel{2}}}$ B/c

∵ $\boxed{\sqrt{\ } = \frac{1}{2}}$

$(T^{\cancel{2}})^{\frac{1}{\cancel{2}}} = T$

$$T = \sqrt{4\pi^2}\sqrt{\frac{m}{K}}$$

$$T = \sqrt{(2)^2 \pi^2}\sqrt{\frac{m}{K}}$$

$$T = \sqrt{(2\pi)^{\cancel{2}}}\sqrt{\frac{m}{K}}$$

$$\boxed{T = 2\pi\sqrt{\frac{m}{K}}}$$

Where :-

- m = mass ⟶ (Kg)
- K = Spring Constant (N/m^2)
- T = Time periode (s)

Note :- Time peroid does not depend upon " Amplitude
A / x_0

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"Calculation For Frequency"

A we Know that Frequency is Reciprocal OF Time peroide.

$$\boxed{f = \frac{1}{T}} \longrightarrow Ⓐ$$

put $T = 2\pi\sqrt{\frac{m}{K}}$ in equation Ⓐ

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$$f = \frac{1}{2\pi\sqrt{\frac{m}{K}}}$$

$$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$$

$$\boxed{f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}}$$

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SiMPLE PENDULUM:-

DEFINITION:- " The simple pendulum is Mechanical System that moves in an oscillatory motion.

(OR)

A simple pendulum is a device where its point mass is attached to a Light inextensible string and Suspended from a fixed point.

IDEALIZED MODEL: " A Simple pendulum is an idealized model Consisting of

- ↳ point Mass
- ↳ Weightless, in extendable string
- ↳ Supported From a Fixed Frictionless Supported

REAL MODEL:- "A Real model (pendulum) approximates a simple pendulum if

- ↳ The bob is small Compare with the length (l).
- ↳ Mass of the string is much less than the bob's mass
- ↳ the Cord or string remains straight and does not stretch.

Construction of Simple Pendulum:- Consist of

- ↳ point Mass (m)
- ↳ inextensible string of Length (L)
- ↳ Fixed Support.

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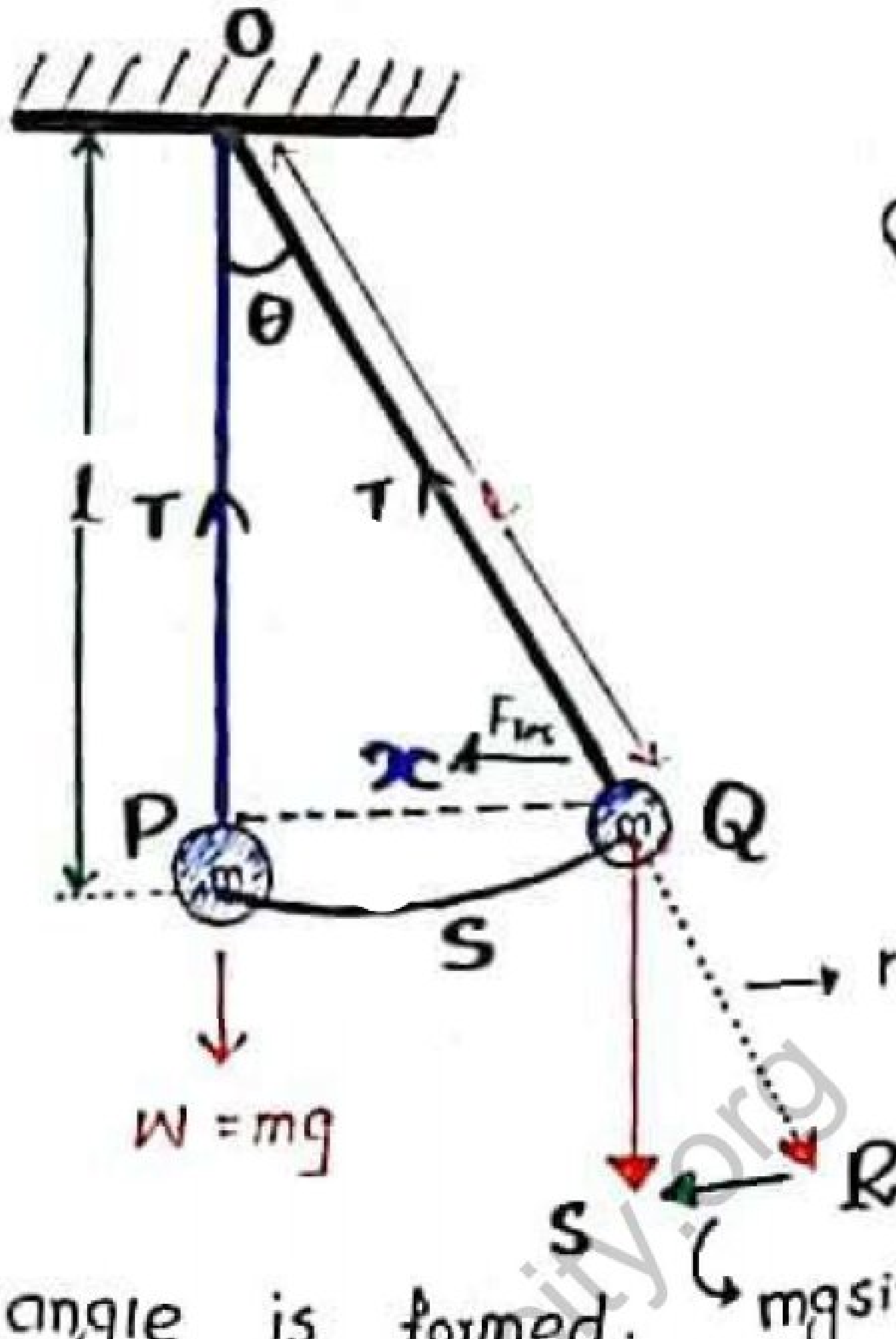
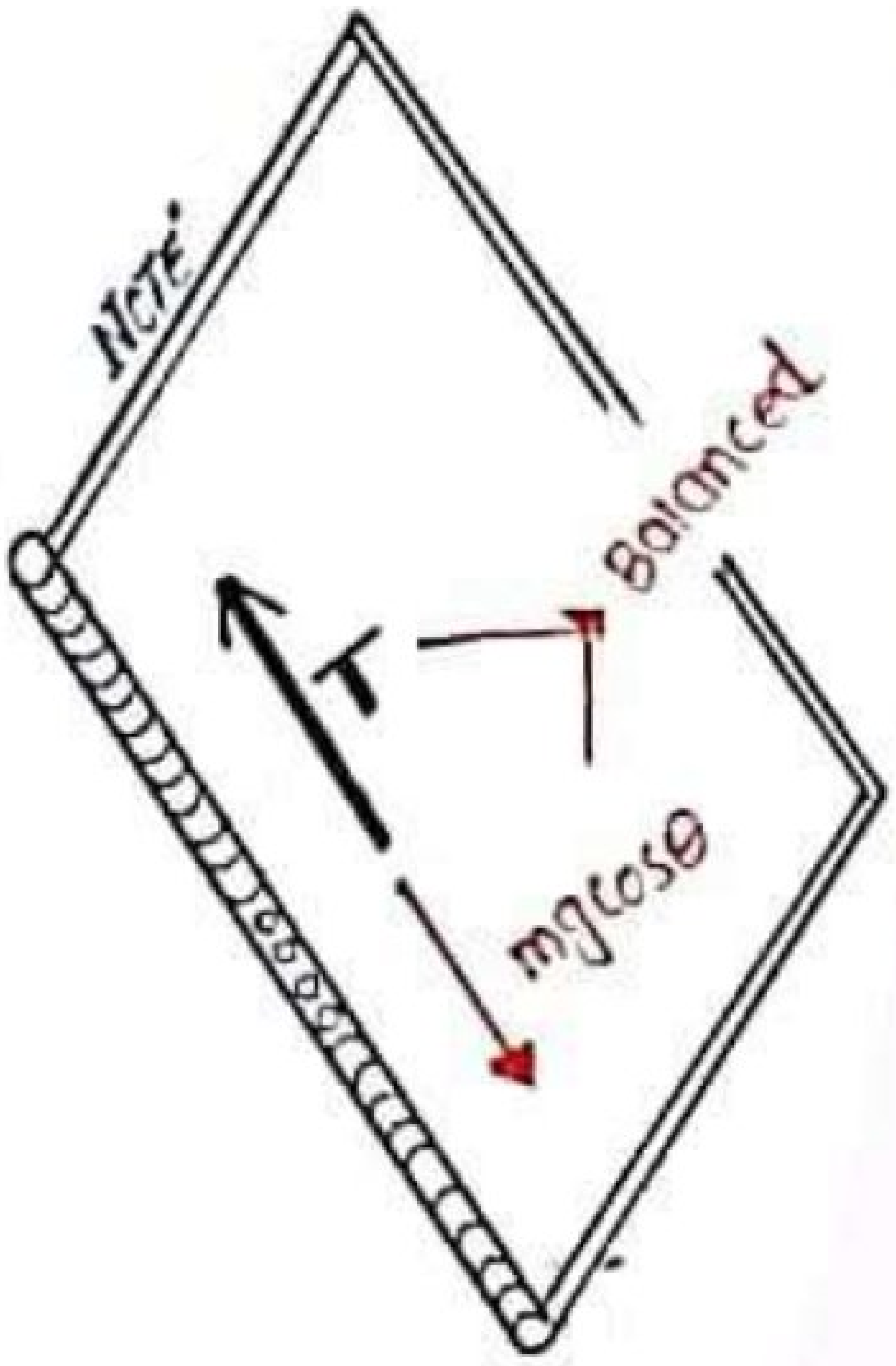
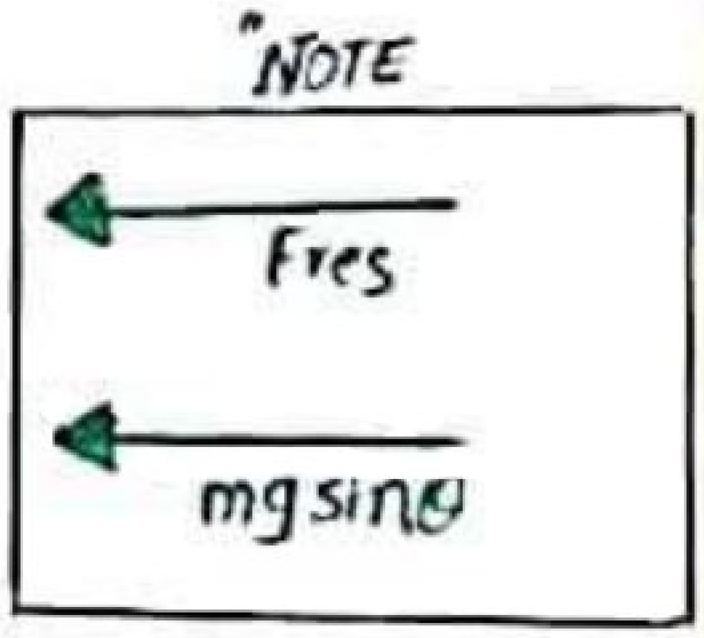
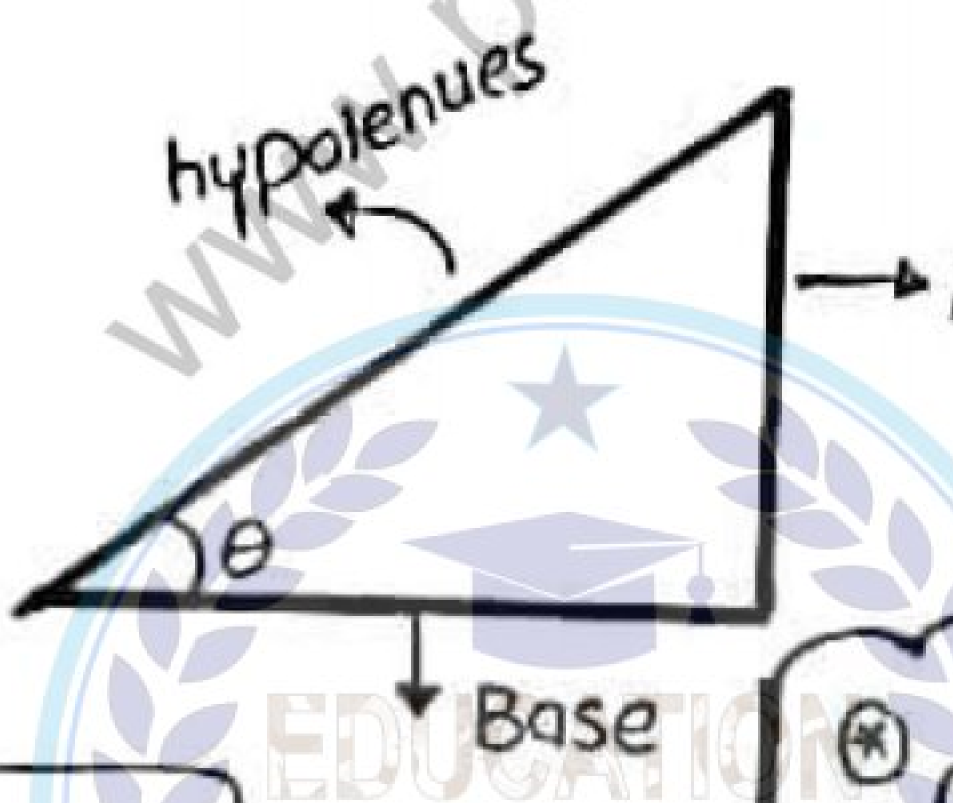
DIAGRAM:





Here a triangle is formed.





$$\boxed{\sin\theta = \frac{perp}{hyp} = \frac{x}{l}}$$

Note

- Some people Have
  $\sin\theta = \frac{perp}{hyp}$
- Curly Brow Hair
  $\cos\theta = \frac{Base}{hyp}$
- Through Proper Brushing
  $\tan\theta = \frac{perp}{Base}$

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EXPLANATION: " Pull the pendulum From Mean position To extream position By using external Force (**Fext**). When you leave the pendulum it will move toward mean position and due to inertia at will not stop at Equilibrium position and will start oscillatory motion.

→ the motion occure in a vertical plane and it driven By Gravitational Force. For ΔQRS We resolve The weight(w) into **TWO Components**.

① mg cosθ
② mg sinθ

in Figure above we note that the Component **mgCosθ** Balanced By The **Tension (T)** in the string.

↳ He the **Restoring Force** is only provided By the second Component **mgsinθ**. Therefore we Can Write as

$$\boxed{F_{res} = -mg\sin\theta} \longrightarrow ①$$

↦ Also note that in The Figure The only For Small angles The arc length "**S**" is nearly equal to Displacement "**x**"

$$\boxed{S \approx x}$$

Therefore From ΔOPQ

$$\boxed{\sin\theta = \frac{x}{l}} \longrightarrow ②$$

Putting Equation ① in equation ② we get

$$F_{res} = -mg\left(\frac{x}{l}\right) \longrightarrow ③$$

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Here

F_{res} = Restoring Force
m = Mass of a bob
g = accelaration due to gravity
x = Displacement
l = length of string.

Here m, g and "l" are Constant for simple pendulum oscillating with small angle. Therefore

$$F_{res} = -\frac{mg}{l}x \qquad \because \boxed{\text{Constants} = \frac{mg}{l}}$$

$$F_{res} = -\text{Constants}(x)$$

Constant Change To proportionality

$$\boxed{F_{res} \propto -x} \rightarrow ③$$

This is 1st Condition of Simple Harmonic motion which is satisfied.

A/C TO NEWTON'S SECOND LAW OF MOTION.

$$F = ma$$

$$\boxed{F_{res} = ma} \rightarrow ④$$

Comparing equation ③ and ④

$$F_{res} = F_{res}$$

$$-\cancel{m}g\frac{x}{l} = \cancel{m}a$$

$$-g\frac{x}{l} = a$$

$$a = -\frac{g}{l}x$$

Here again "g, l" are Constants.

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$$a = -\text{Constant}(x) \qquad \because \boxed{\text{Constant} = \frac{g}{l}}$$

$$\boxed{a \propto -x} \to (**)$$

This is the 2nd Condition for S.H.M.

So, This proves that the motion of Simple pendulum is S.H.M.

* * *

Time periode "T" and Frequency "f" of Simple pendulum.

① Time periode (T):- " The Time taken BY a body to Complete one cycle.

"it Can be shown that the accelaration and displacement of a simple pendulum are related by Time periode(T).

$$a \propto -x$$

$$a = -\text{Constant}(x) \to \circledast \qquad \boxed{\text{Constant} = \frac{4\pi^2}{T^2}}$$

put the Constant value in eq ⊛

$$\boxed{a = -\frac{4\pi^2}{T^2}x} \to ①$$

in previous Topic We See That

$$\boxed{a = -\frac{g}{l}x} \to ②$$

Comparing eq ① and eq ② we get

$$a = a$$

$$\cancel{-}\frac{4\pi^2}{T^2}\cancel{x} = \cancel{-}\frac{g}{l}\cancel{x}$$

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$$\frac{4\pi^2}{T^2} = \frac{g}{l}$$

By Cross Multiplication

$= \quad T^2 \times g = 4\pi^2 \times l$

$= \quad T^2 g = 4\pi^2 l$

= Divide Both side By "g"

$= \quad \frac{T^2 \cancel{g}}{\cancel{g}} = \frac{4\pi^2 l}{g}$

$= \quad T^2 = 4\pi^2 \frac{l}{g}$

= Taking Square ROOT on Both side (√)

$= \quad \sqrt{T^{\cancel{2}}} = \sqrt{4\pi^2 \frac{l}{g}}$

$= \quad T = \sqrt{4\pi^2}\sqrt{\frac{l}{g}}$

$= \quad T = \sqrt{(2)^2\pi^2}\sqrt{\frac{l}{g}}$

$= \quad T = \sqrt{(2\pi)^{\cancel{2}}}\sqrt{\frac{l}{g}}$

$= \quad T = 2\pi\sqrt{\frac{l}{g}}$

$$\boxed{T = 2\pi\sqrt{\frac{l}{g}}}$$

↳ Time periode Directly depend upon Length (l) of pendulum and inversely on the gravitational acceloration. (g)

↳ Time periode does not Depends upon moss (m) & amplitude (x_0/A) of a pendulum.

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(B) Frequency of simple pendum:-

Since we know that Frequency is Reciprocal of Time periode.

$$\boxed{f = \frac{1}{T}} \rightarrow (*)$$

put $T = 2\pi\sqrt{\frac{l}{g}}$ in equation (*)

$$f = \frac{1}{2\pi\sqrt{l/g}}$$

$$f = \frac{1}{2\pi} \times \sqrt{g/l}$$

$$\boxed{f = \frac{1}{2\pi}\sqrt{l/g}}$$

DAMPING:-

DEFINITION: " Any EFFECT That Tends (کوشش کرنا) to reduced The **amplitude** of vibration is called damping.

Damping Force: " A Particular Type of Force used To slow down or stop a motion, is Called damping Force.

(OR)

- A Force that restricts vibration that Can be mechanical, or electrical in nature.

Explanation:

ideal System" "if" we Consider oscillatory motion for an ideal System that is, System that oscillate indefinitely under the

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action of a Linear restoring Force.

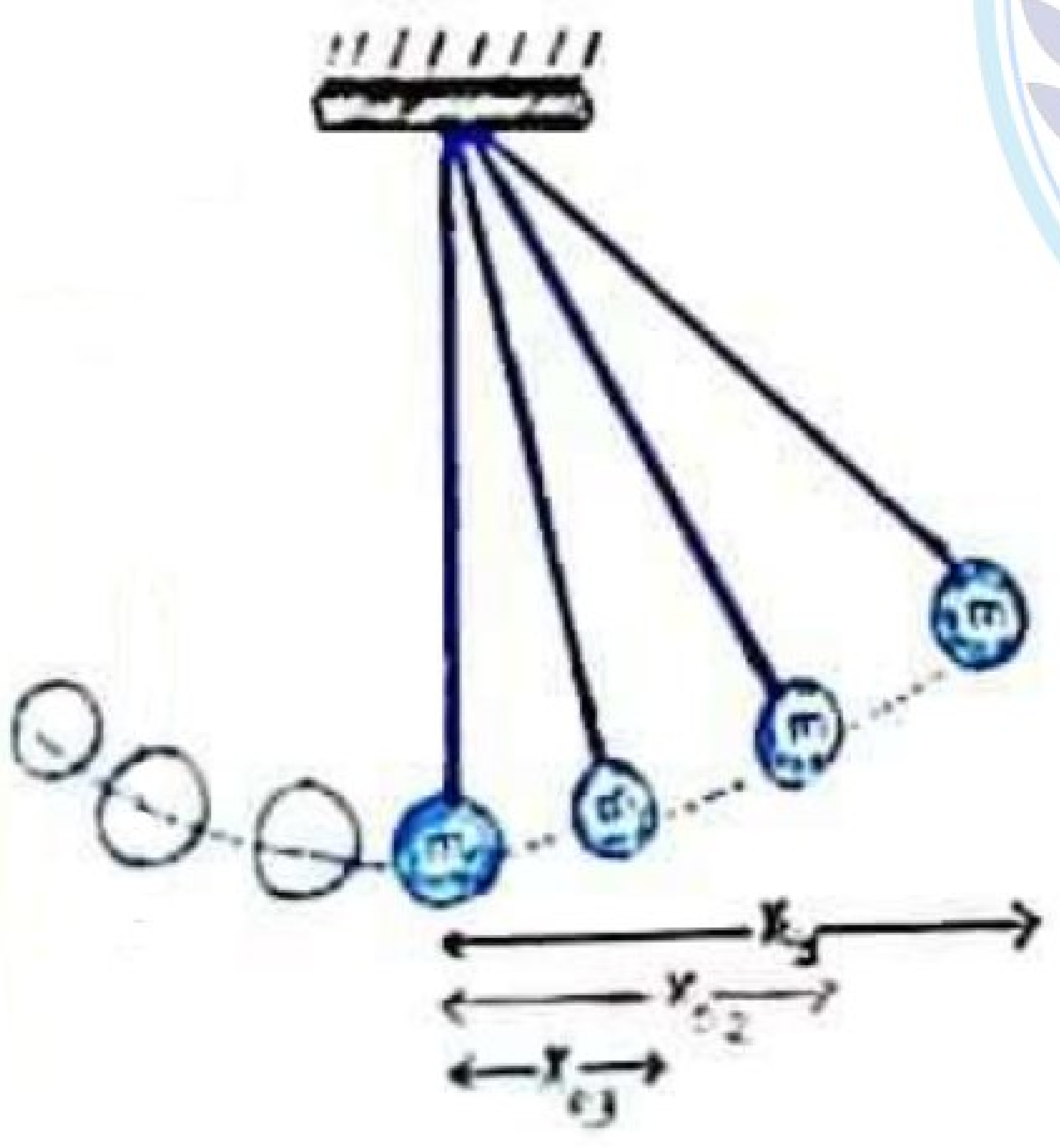
Real System: " However in many real System Resistive Forces such as Friction reduce the motion.

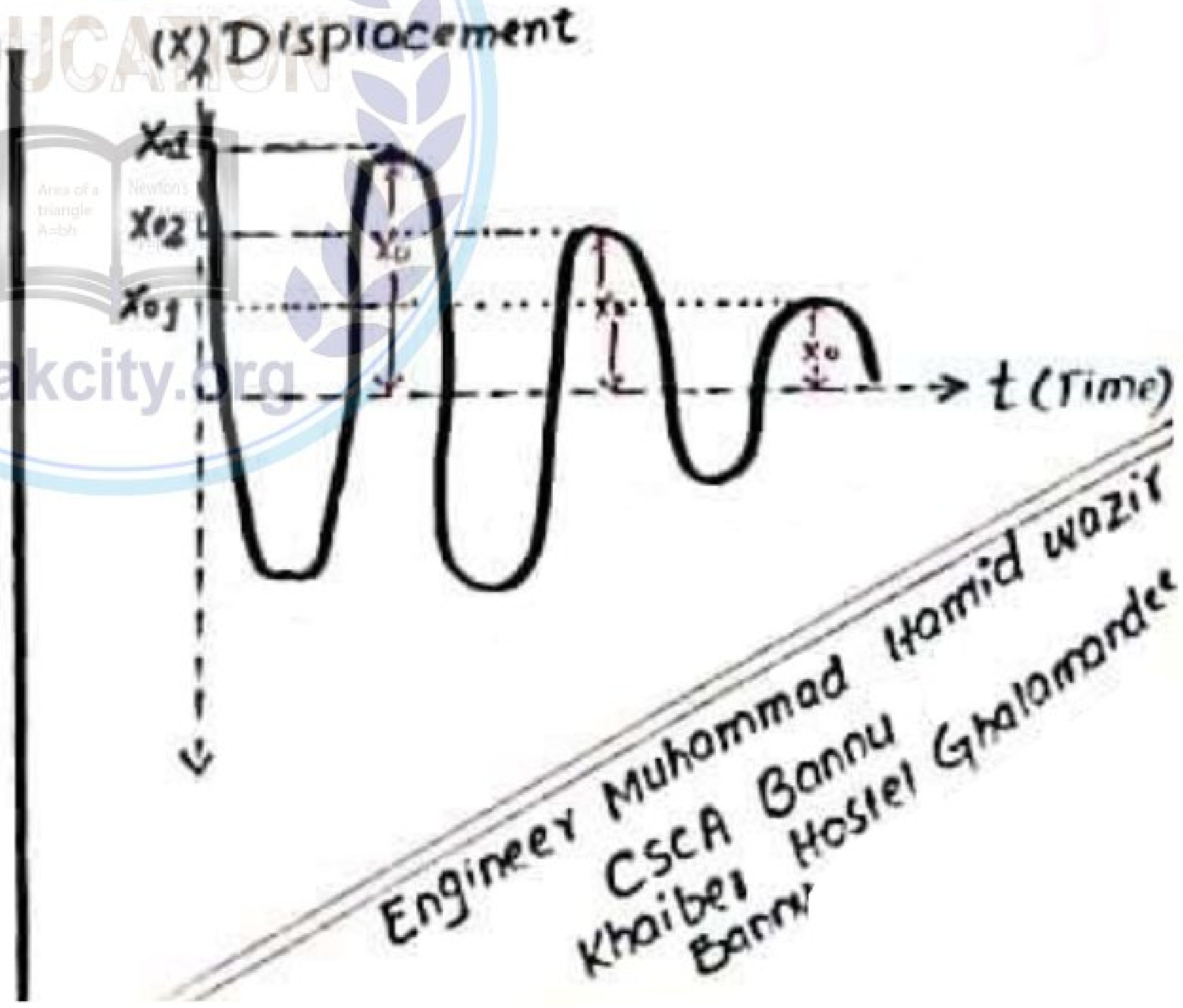
Result: As a result that resistive Force reduce the amplitude of System progressively with Time, and the motion is said to be damped.

Aim OF DAMPING FORCE: The aim of any damping force in an oscillatory system is to decrease the **amplitude** of its oscillation or prevent the oscillation From happening.

in pendulum:- " The motion of pendulum eventually Stop if it is left untouched B/c the pendulum **Loses Energy** By doing work on the Surrounding Forces, Such air resistance and Friction. The energy of The System decreases with Time and eventually Fall to zero and pendulum Comes to rest.

DIAGRAM:-





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Nature OF Waves and their Types:

WAVE: " a disturbance that moves from its point of Origin Tranferring energy by means of vibration.

--(OR)--

A wave is a disturbance in a medium that Carries energy without a net movement oo particles.

Common Feature to all waves:

There are Two Common feature to all Waves.

1: "A wave is a traveLing Disturbance.

2: A wave Carries energy From place to place.

Explanation: " A wave is disturbance that transfers Energy through a medium.

↳ wave Can't transfor matter. each particle in the medium vibrate about Some mean (or rest) position as the wave passes.

Water Waves As Means OF Energy Transfer.

Take a tub full of water moves a pencil up and down at one edge of the tub. waves are produced on the water Surface which move away from point of impact of the pencil place a Cork in middle of the tub. When waves moves/passes through through the Cork it will move up and down.

Notice that during This process the Cork does not move with waves. It moves up and down Which shows that the particles of mater (Water) does not move forward with waves and only oscillates about mean position.

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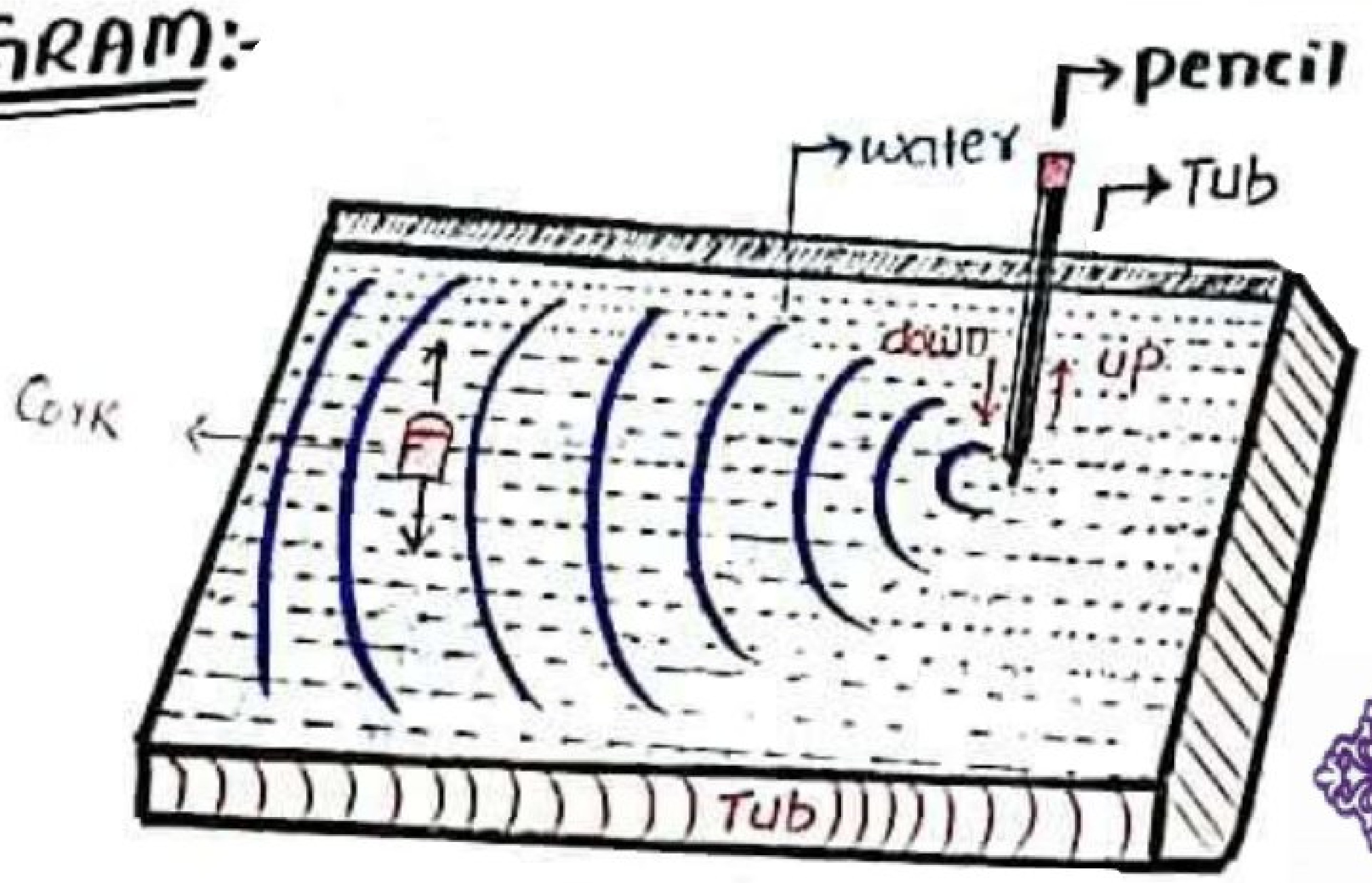
DiaGRAM:-



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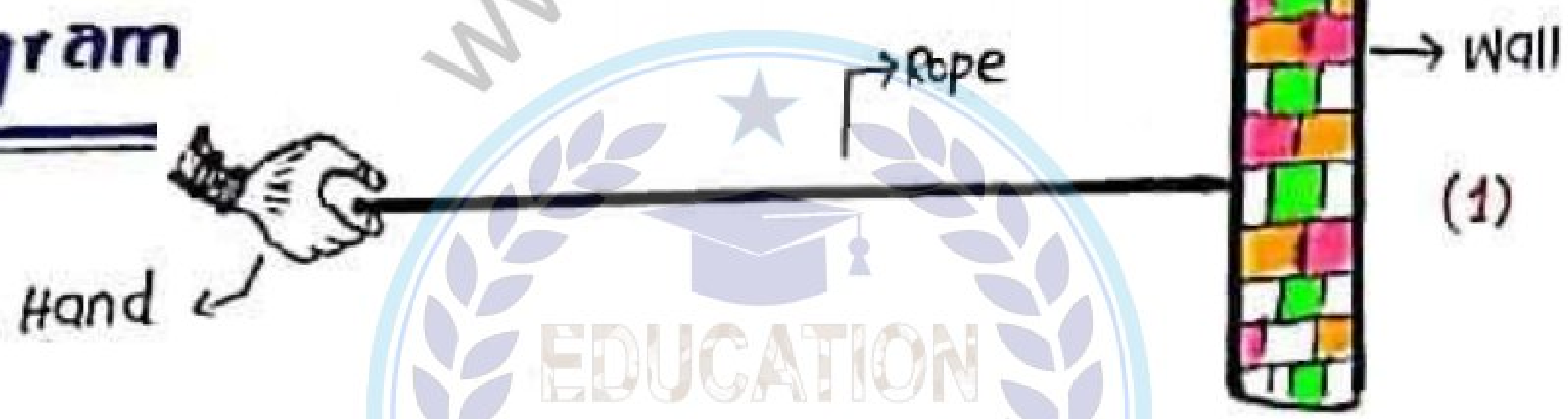
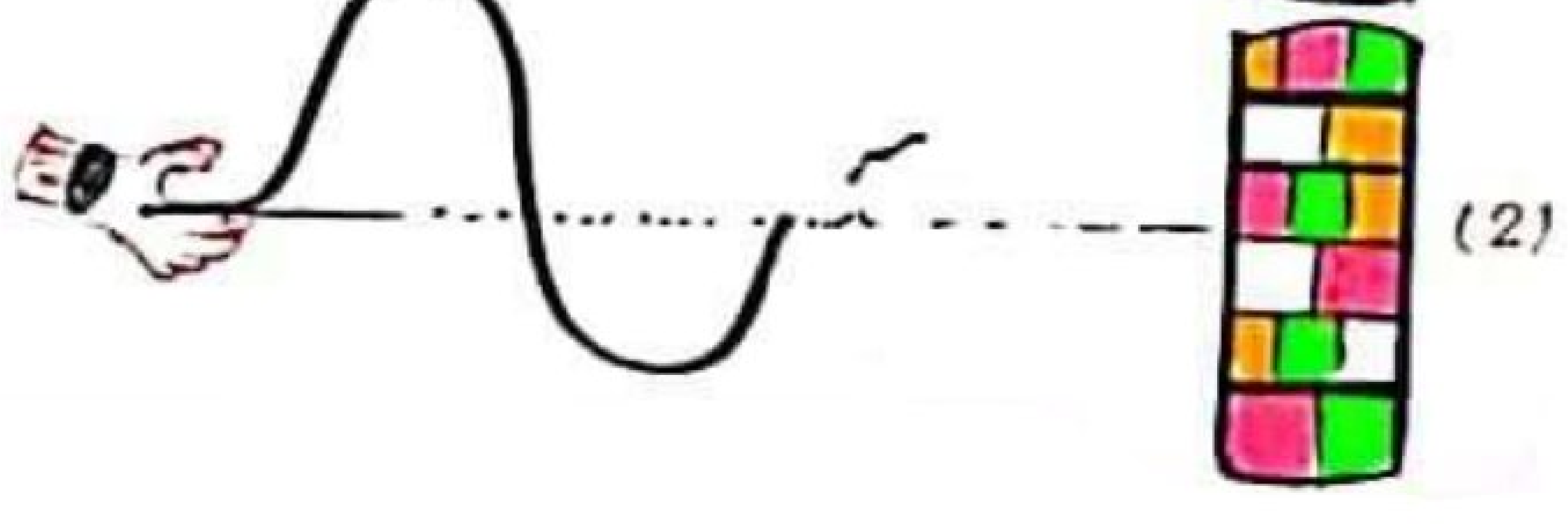
Example No2: (Rope Example):. " Take a rope and Colour a part of it. attached one end of the rope to the wall and give motion up and down to the rope, regurlary and Continuosly. a number of waves will be produced forming a wave train. observe The Color marking. it will. execute forming a wave trains. observe the Color marking. it will execute oscillation about mean position.

Diagram





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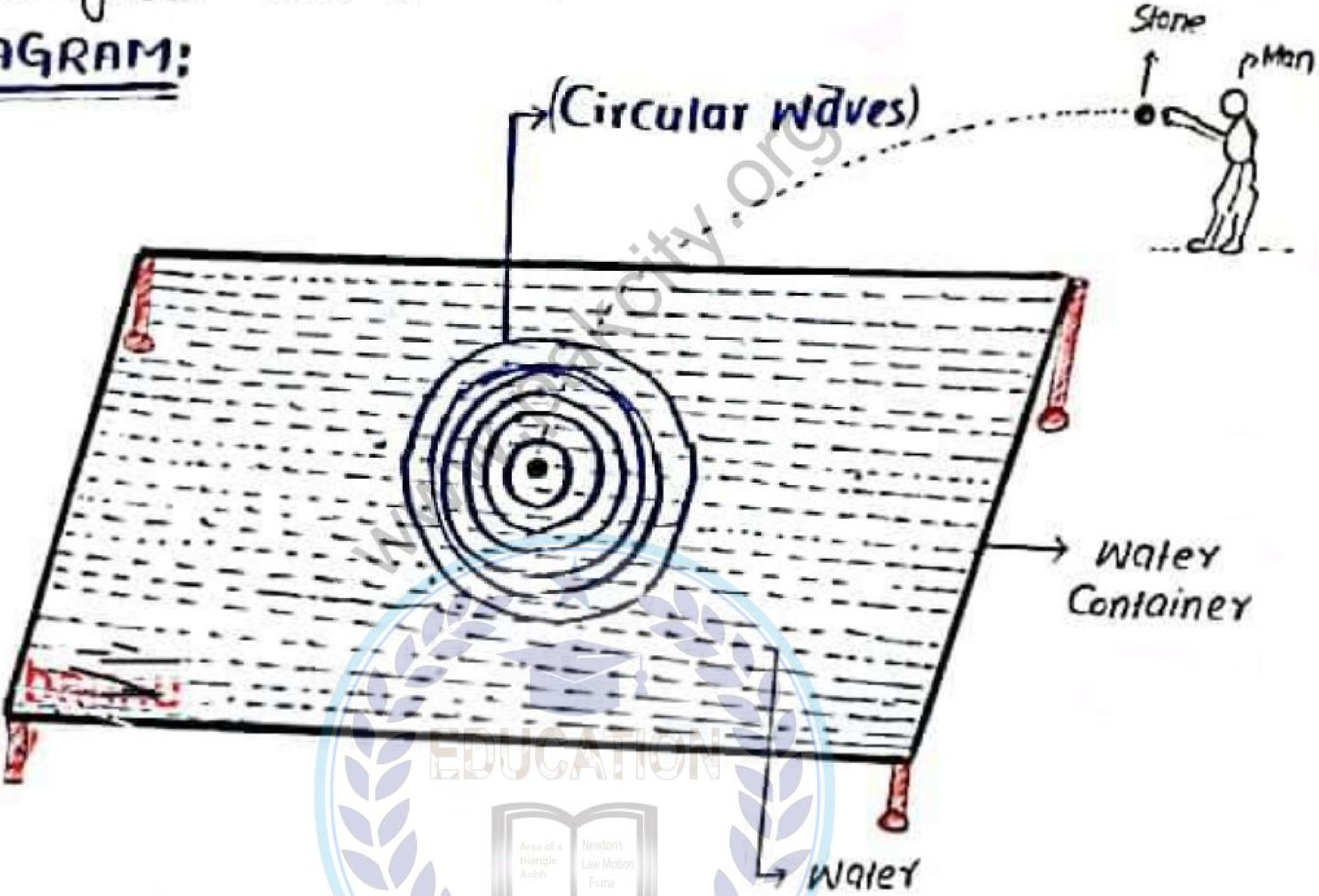
Example NO 03: (water waves)

" When a stone is dropped in a pond water, ripple (waves). are produced in the pond and You will see on the surface of water. the particles of water. will absorbed energy and start oscillating. these particles will Transfer some of its energy to the neighboring particles which also start vibrating and all pasticles will start oscillating and energy is spread out throughout the water pond.

DIAGRAM:



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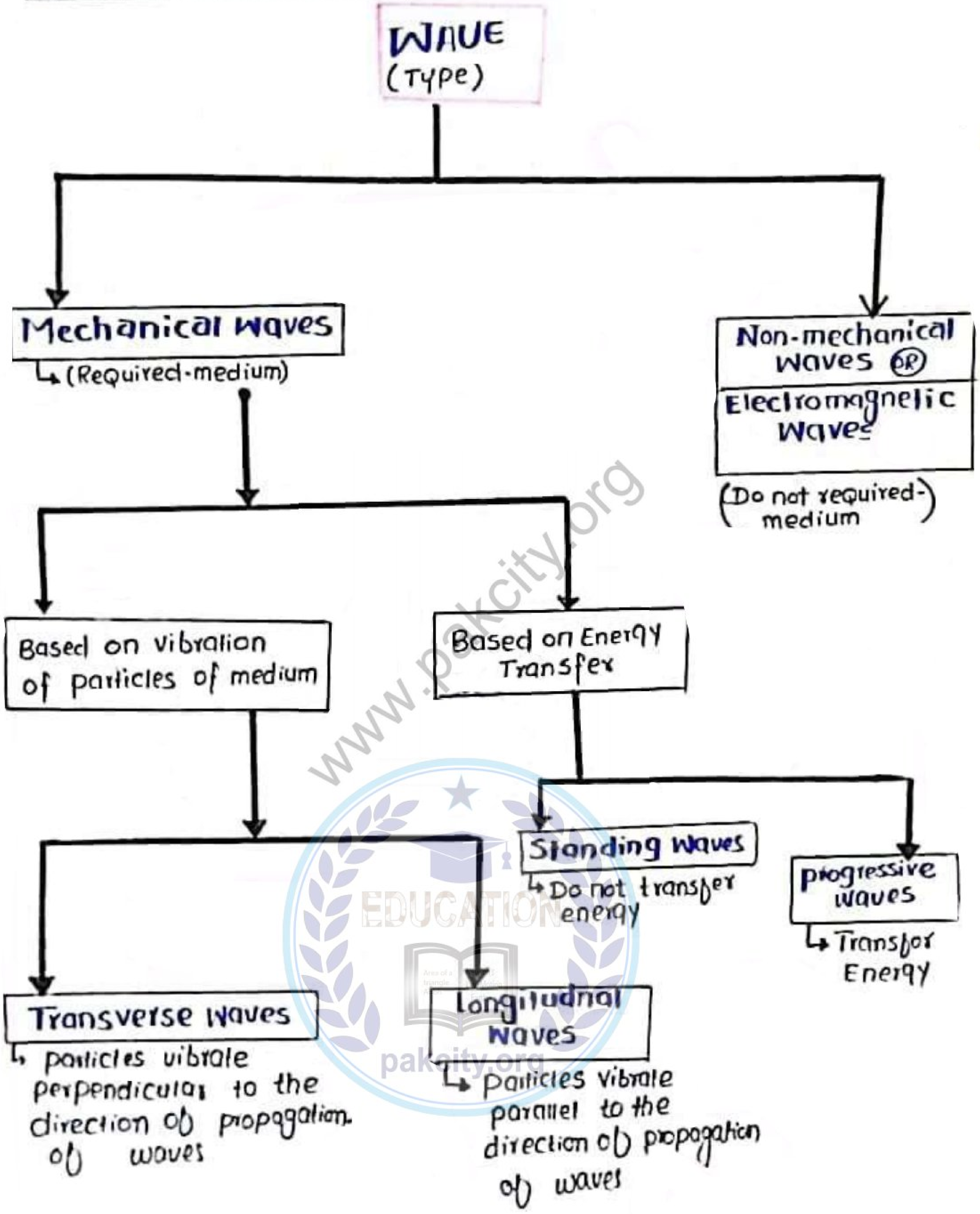
Types Of Waves:



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There are two Categories of waves

1) **Mechanical Waves**
2) **Electromagnetic waves**

1) Mechanical Waves:

" waves which required medium For their propagation are Called mechanical waves.

(OR)

" The waves produced by oscillation of material particles are Called mechanical waves.

Examples:

"

① Sound waves
② water waves
③ Air waves
④ seismic waves
⑤ Tsumami waves
⑥ Waves produced on the strings and Springs.

Note: These waves Can exist only within a material medium

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2) Electromagnetic Waves:

" Waves which do not reQuire any medium For their propagation are Called electromagnetic waves.

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(OR)

" The waves that propagate by oscillation of **Electric** and **magnetic** Fields are Called electromagnetic waves.

$$\boxed{\text{E-M Waves} = \text{Electric field} + \text{magnetic Field}}$$

4. The electric and Magnetic Fields are Right Angle(90°) to each other.

Examples:

1. Radio waves
2. Television waves
3. X- Rays
4. Heat and Light waves
5. Ultraviolet Light
6. Micro waves

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Types OF Mechanical waves:

Depending upon the direction of displacement of medium with respect to the direction of propagation of waves itself, mechanical waves may be Classified as **Longitudnal** or **transverse**.

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A). TRANUERSE WAVES:- * A Longitudinal waves is one in which the disturbance occures parallel to the Line of travel of the waves.

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Characteristic wave Parameter:

there are many ways to describe or measure a wave. Some Characteristic depend on how the. wave is produced, Whereas others depends on the medium through which the wave travels. Certain Characteristic wave parameter and their definition are given as under

(1) **Wavelength** (2) **Amplitude**

(3) **Wave Cycle** (4) **FreQuency**

(5) **Time Periode.** (6) **Wave Speed**

(1) Wavelength (λ) : " The Shortest **distance**. between points where the wave pattern repeats itself is Called the Wavelength.

(OR)

" The distance Between two Successive **Crest** or **Trough** is Called Wavelength. i.e Transverse wave

(OR)

" The distance Between two Successive **Compression** or **Rarefaction** is Called Wavelength.

i.e Longitudnal wave

Representation:- " It is represented By a Greek letter **Lambda (λ).**

Unit: " The unit of Wavelength is meter(m). B/c it is a distance.

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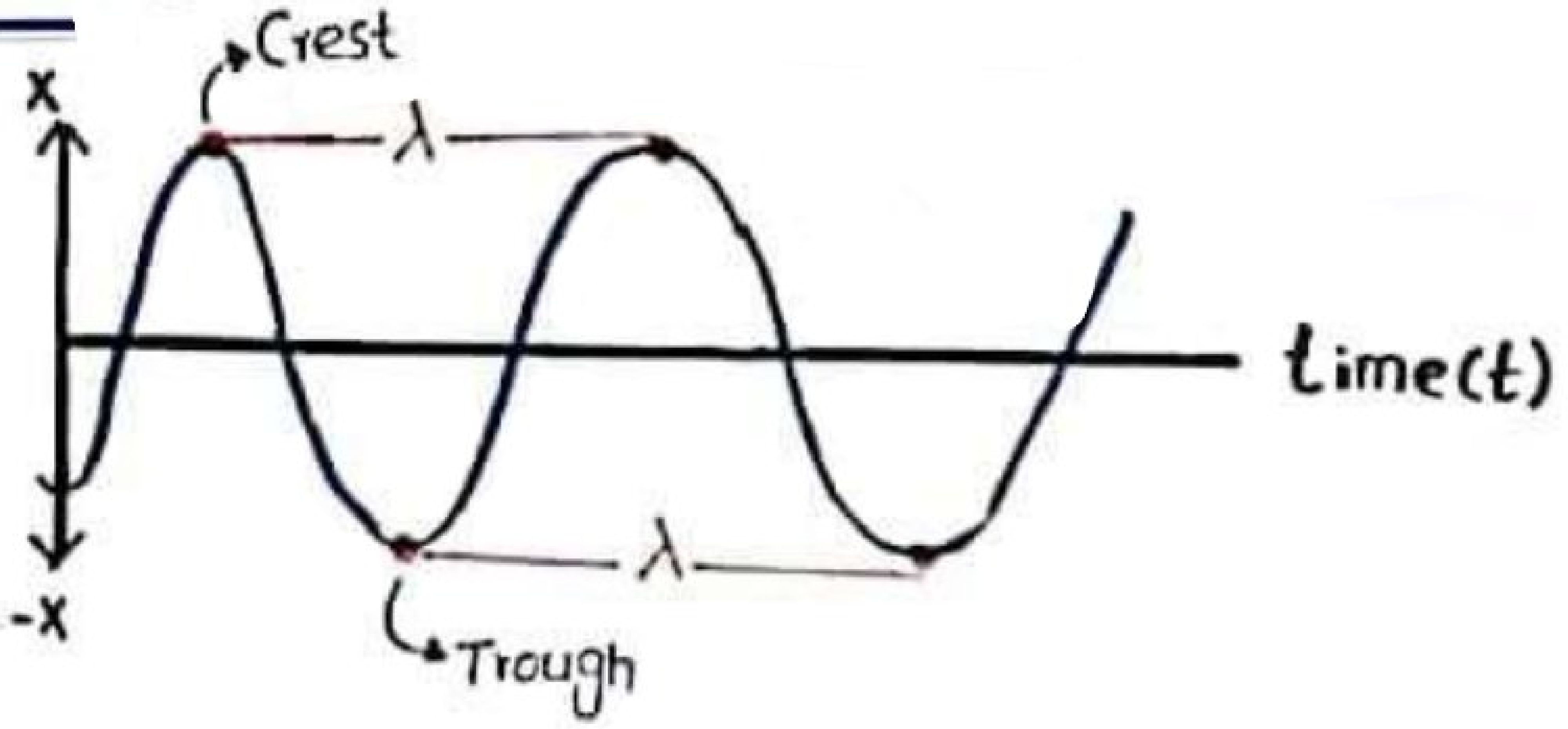
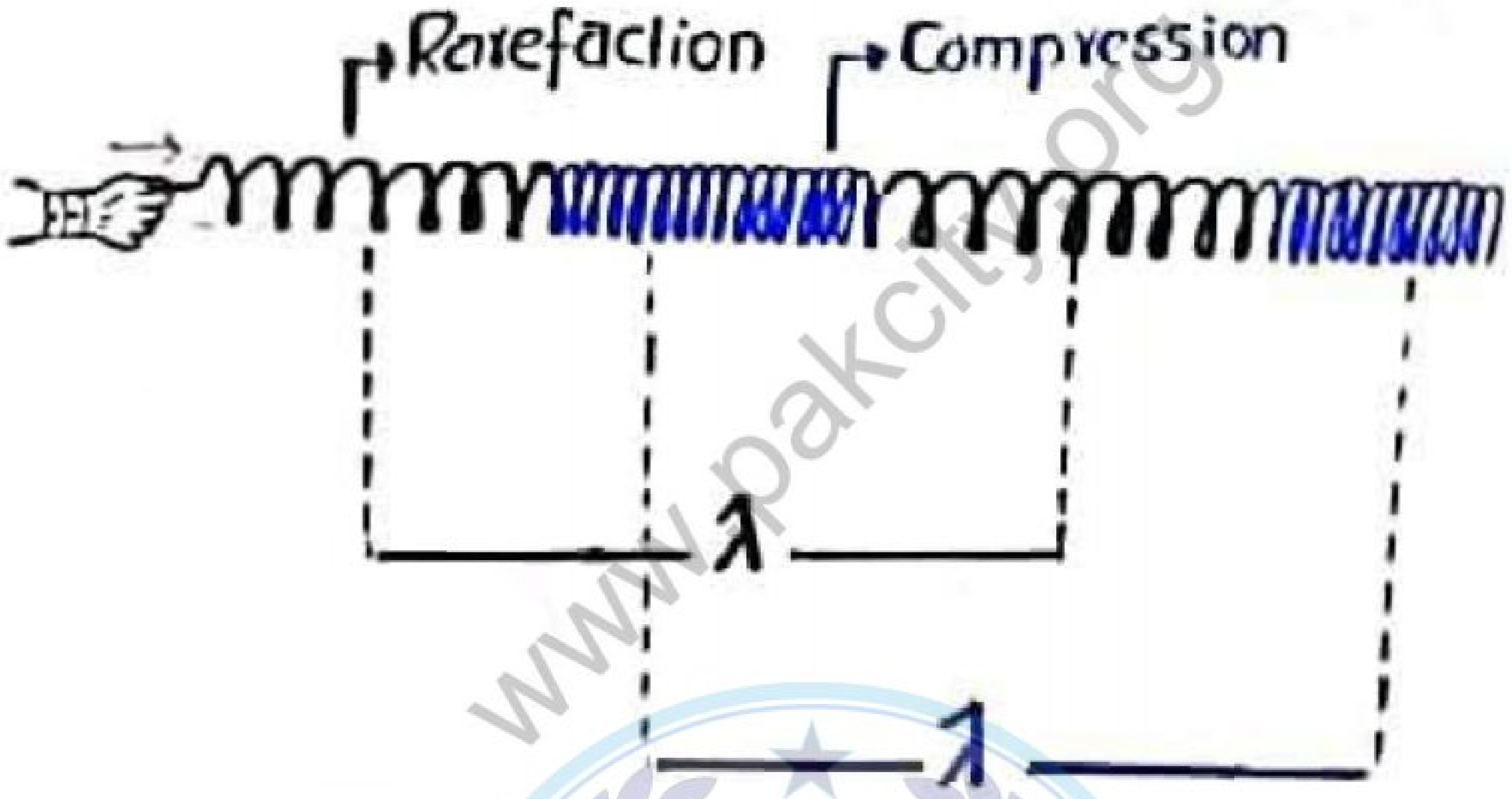
Diagram: (1)



(wavelength of transverse wave)

Diagram No 02:



(wavelength of longitudnal waves)

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⊛ **CREST:** " in Case of transverse wave the portion of the displacement **above** the EQuilibrium position is Called Crest.

⊛ **TROUGH:** " in Case of transverse wave. The Portion of the displacement **below** the EQuilibrium position is Called Trough.

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Amplitude (X_0/A)

" Megnitude of maximum Displacement of the elements of wave from their Equillibrium position is Called amplitude.

(OR)

" The amplitude (A/X_0) of a wave is the distance from the Centre Line (Equilibrium position) to the top of a Crest or to the bottom of a trough.

(OR)

The loudness or the amount of amount of maximum Displacement of vibrating particles of the medium from their mean position is Called Amplitude.

Note: ↳ loudness is Direcly propotional to amplitude of the sound. if amplitude of a is Small then the Sound will be feeble.

↳ the amplitude have no negative value.

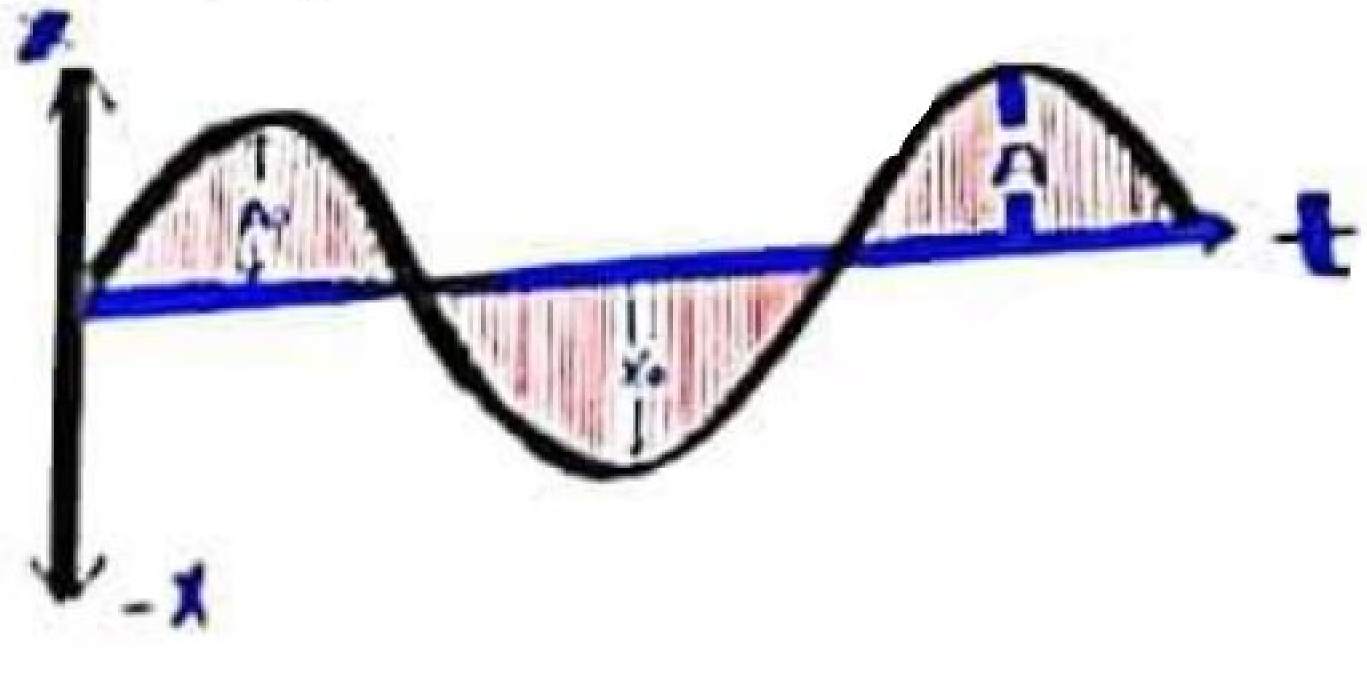
↳ The amplitude of a wave is the hight of a wave.

↳ A High amplitude wave Carries a large amount of energy.

Representation: " amplitude is represented BY A or X_0.

Unit: " the amplitude unit in S.I System is meter(m). B/C it is a distance.

Diagram:



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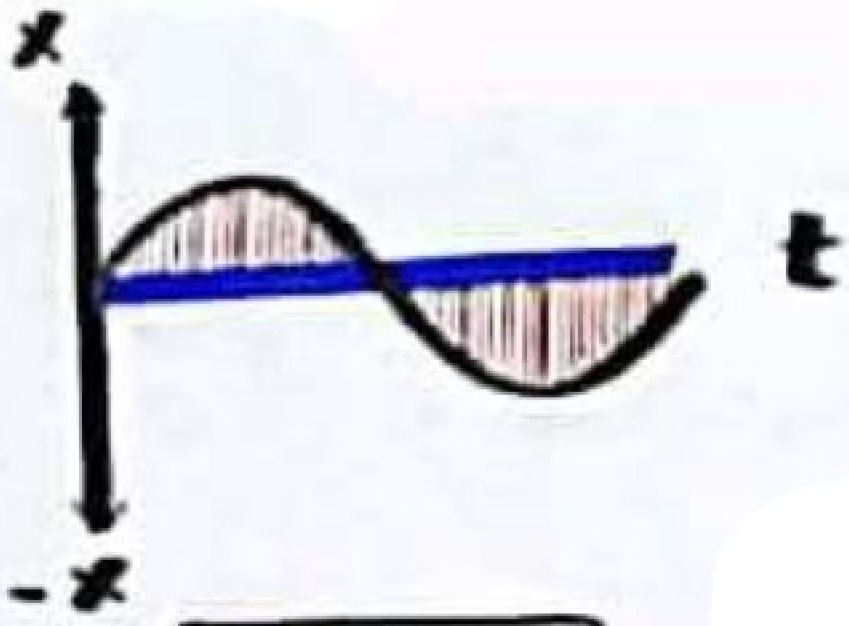
(i)



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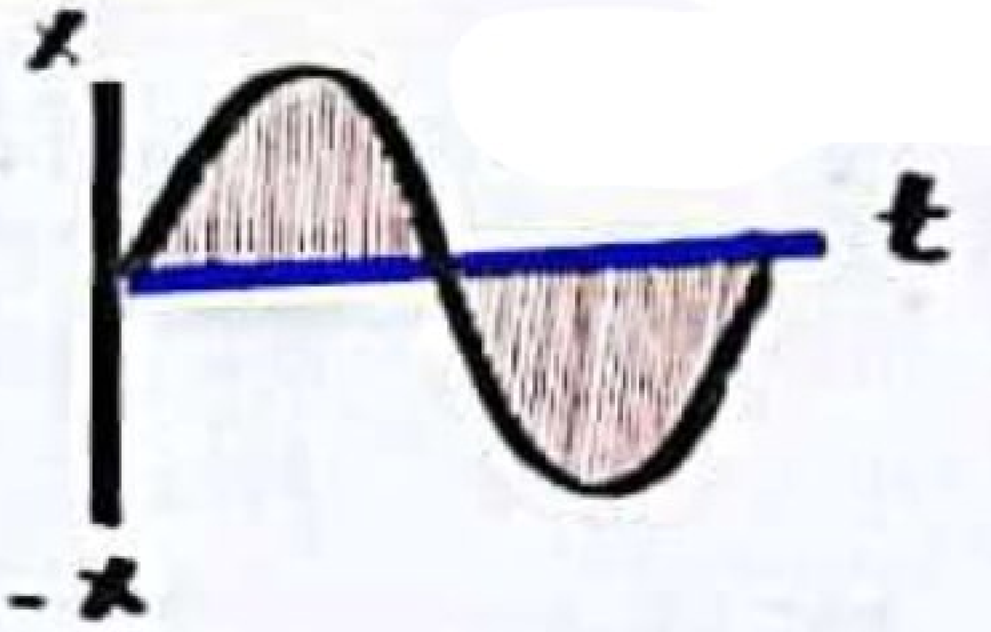
(ii)



Louder

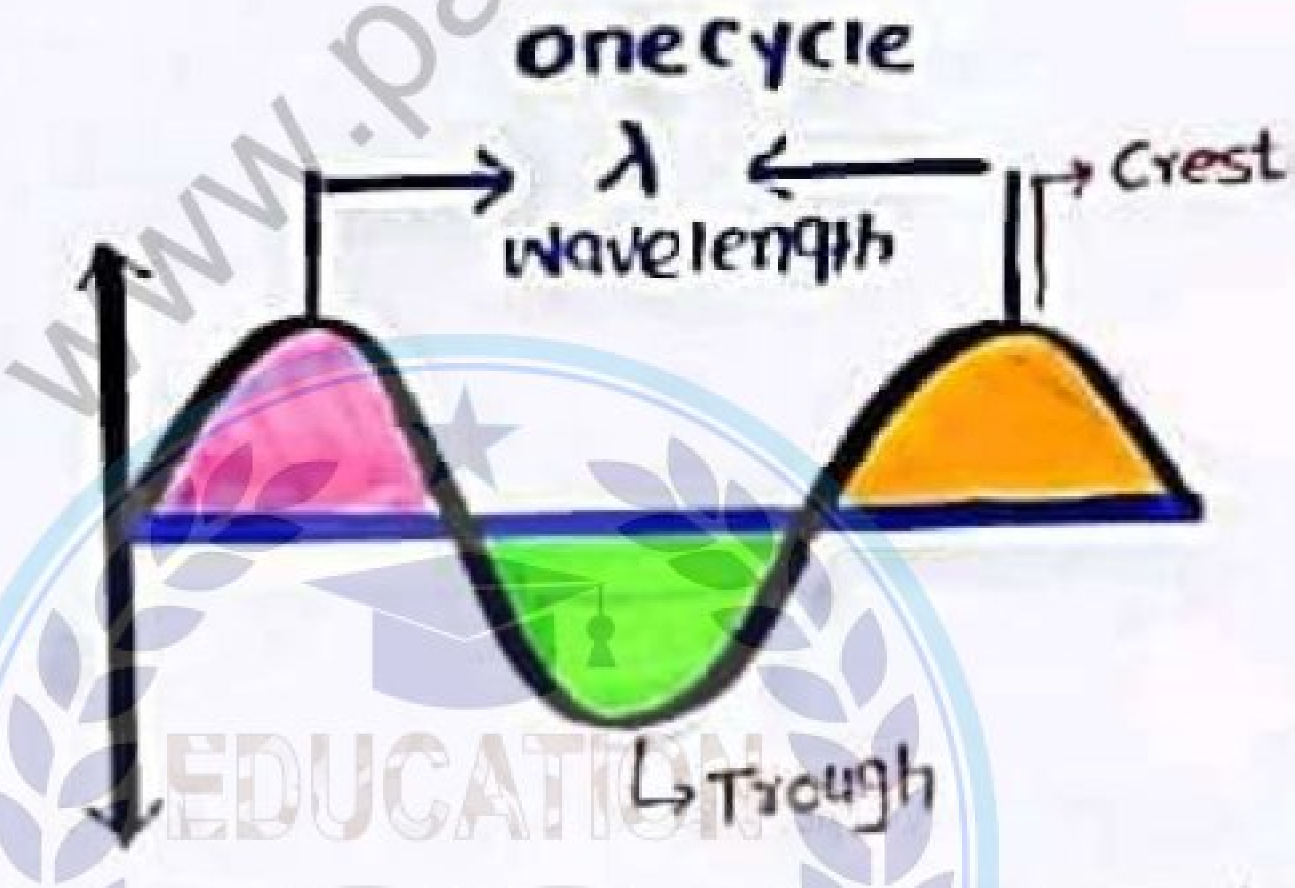
Wave Cycle:

" Wave's Peak to Peak or Trough to Trough.

(OR)

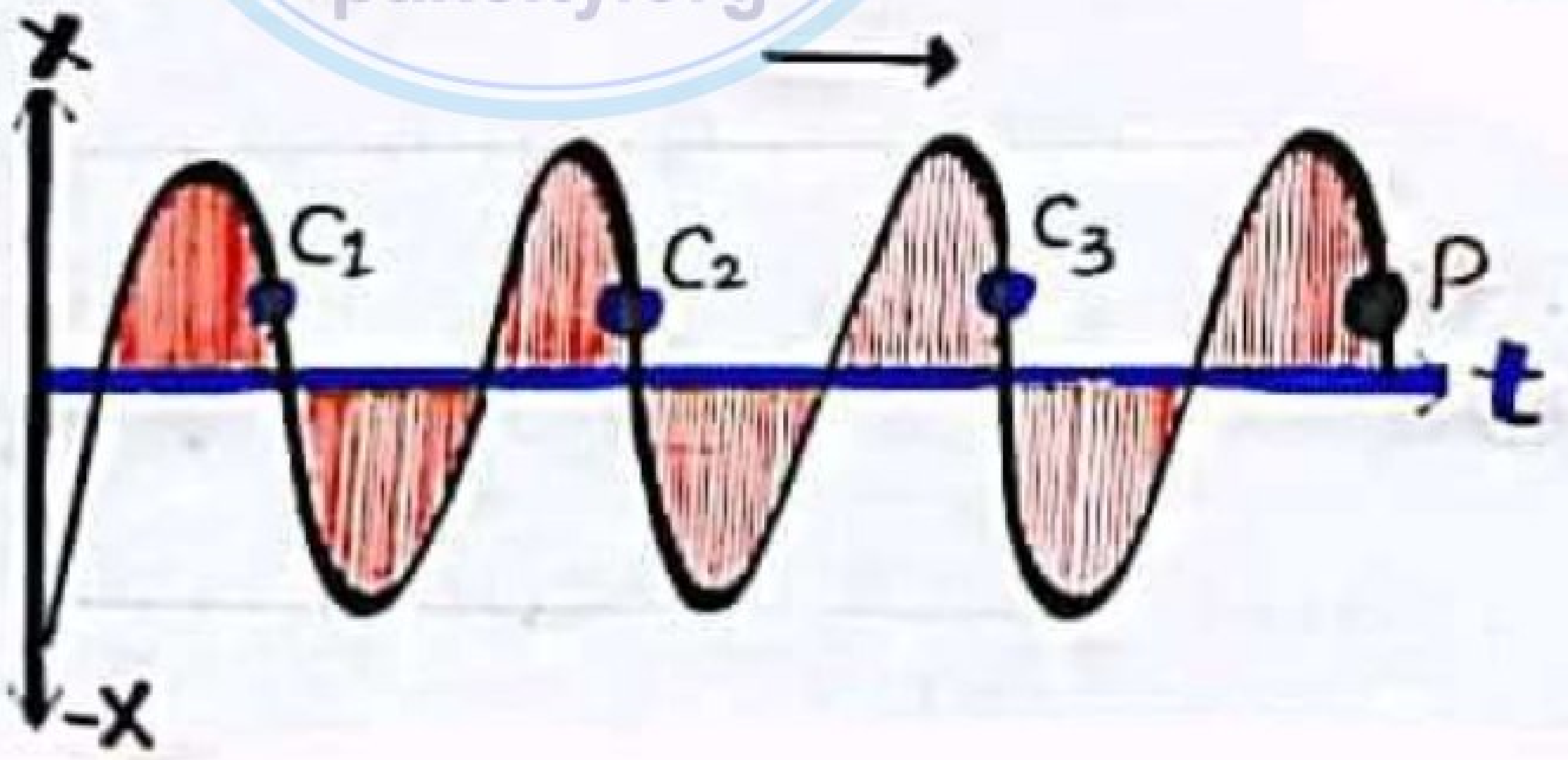
one Complete wave cycle is reffered to as a wavelength. (or) we can say " the wavelength of a wave is simply the length of one Complete wave cycle.

Diagram:



The Number of wave cycles is Represented By "**N**" which passes through any point let say point "**P**"

Diagram:-



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The wave show three wave Cycles C_1, C_2, C_3 Which are Passing through a point "P".

FREQUENCY "(f):- " The number of wave Cycles (N) passing through a Certain point (p) in unit time (t = 1 second) is Called Frequency.

(OR)

"The number of waves that pass a Fixed point in a given amount of time(t) is Called Frequency of a wave.

Representation: " Frequency is represented By a Sma "f".

↳ Also note that the frequency is also represented By a Greek letter **nu (v)** and **omega (ω)**

↳ Nu(v) is used more often when Specifying electromagnetic waves such as Light, x-rays, and Gamma rays.

↳ Omega(ω) is usually used to describe the angular frequency that is how much an object rotates or Revolve in radian per unit time.

Unit: The S·I unit of Frequency is hertz (Hz) or Cycle per second $(\frac{1}{s}, s^{-1})$.

Formula:

$$\boxed{f = \frac{N}{t}}$$

∴ f = Frequency
∴ N = No of cycle
∴ t = time

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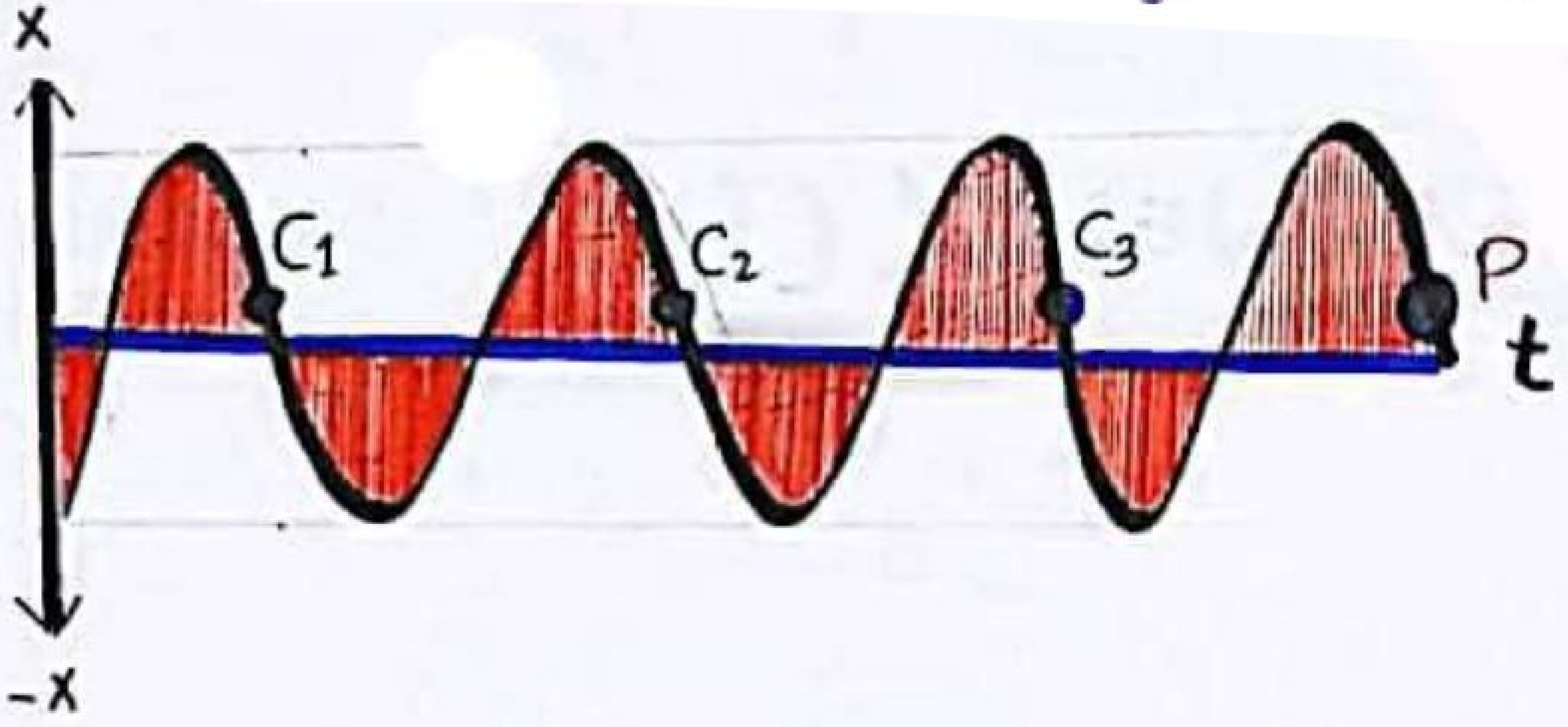
DiaGRAM:



in the above wave the number of wave cyle are three (c1, c2, c3) and if its passes through a point "p" in one second than frequency will be 3Hz. i.e

$N = 3$
$t = 1S$
$f = ?$

$$f = \frac{N}{t} = \frac{3}{1S} = 3S^{-1}$$

$$\boxed{f = 3S^{-1} \text{ or } 3Hz}$$

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(Low Frequency wave)

(High Frequency Sound wave)

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