Unit - 5

Acoustics

detail :-

1) What are the factors that affect the speed of sound in gases?

The factors that affect the speed of sound in gases are :-

* Effect of Density
* Effect of temperature
* Effect of relative Humidity

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Effect of density :-

* The velocity of sound in a gas is inversely proportional to the square root of the density of the gas.

* Hence, the velocity decreases as the density of the gas increases.

$$V \propto \sqrt{\frac{1}{d}}$$

Effect of temperature :-

* The velocity of sound in a gas is directly proportional to the square root of its temperature.

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* The velocity of sound in a gas increases with the increase in temperature.

$$V \propto \sqrt{T}$$

* The velocity at temperature T is given by the following equation

$$V_T = (V_0 + 0.61\,T)\ ms^{-1}$$

* Here, V_0 is the velocity of sound in the gas at 0°c.

* For air $V_0 = 331\ ms^{-1}$.

* Hence the velocity of the sound changes by $0.61\ ms^{-1}$ when the temperature changes by one degree Clesius.

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Effect of relative humidity :-

* When humidity increases, the speed of sound increases.

* We can hear sound from long distance clearly during rainy seasons.

2) What is Meant by reflection of Sounds ?

reflection of sound :-

* When sound waves travel in a given medium and strike the surface of another medium, they can be bounced back into the first medium

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* This phenomenon is known as reflection of sounds.

a) Reflection at the boundary of a rarer medium :-

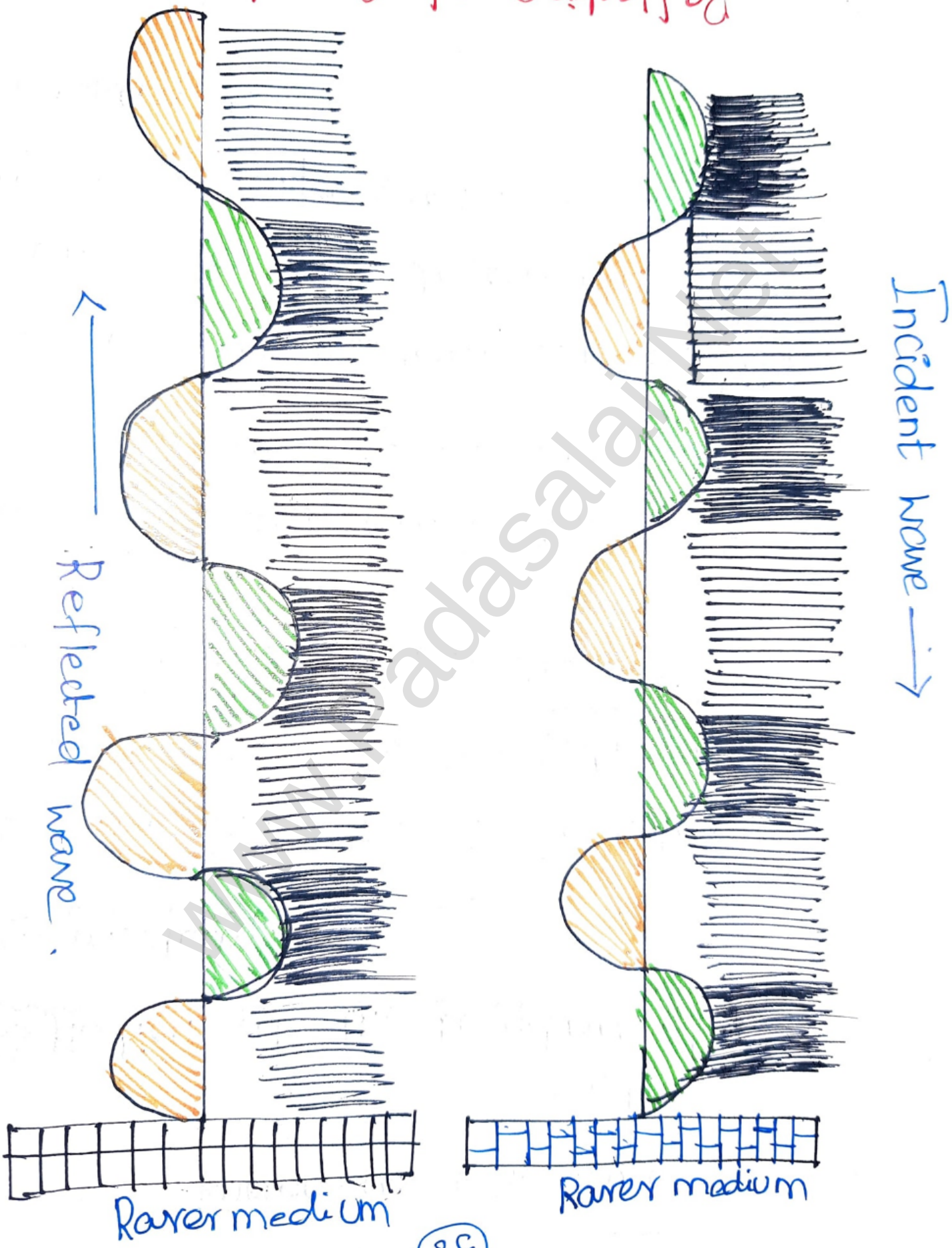
* A wave travelling in a solid medium strikes on the interface between the solid and the air

* The compression exerts a force F on the surface of the rarer medium.

* As a rarer medium has smaller resistance for any deformation, the surface of separation is pushed backwards.

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Reflection of sound at a rarer medium.



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* As the particles of the rarer medium are free to move, a rarefaction is produced at the interface.

* Thus a compression is reflected as a rarefaction and a rarefaction travels from right to left.

b) Reflection at the boundary of a denser medium :-

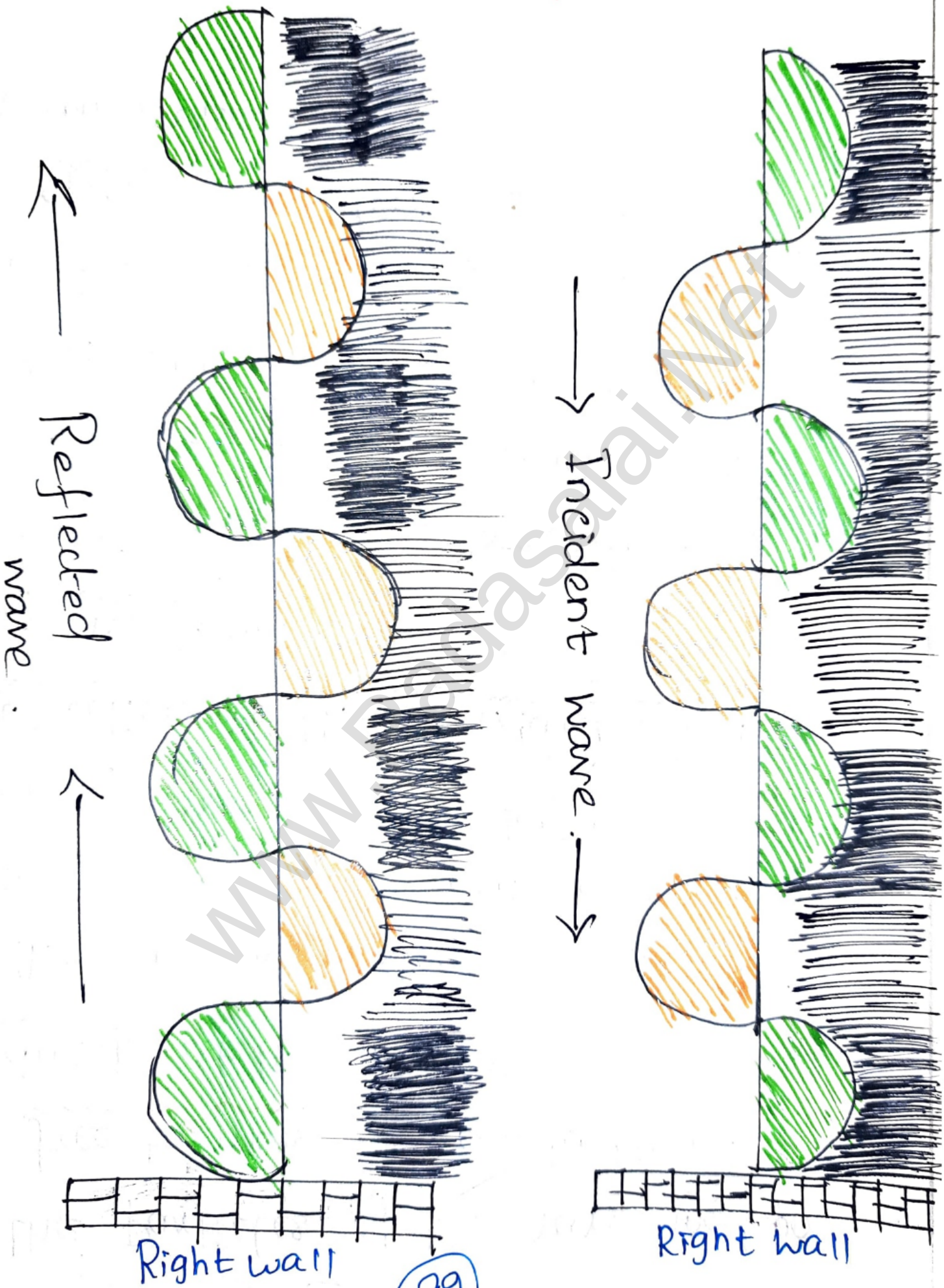
* Suppose compression travelling in air from left to right reaches a rigid wall it exerts a force F.

* In turn, the wall exerts an equal and opposite reaction which result in compression.

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Reflection of sound at a denser medium.



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R = - F on the air molecules

* Thus a compression travelling towards the rigid wall is reflected back as a compression

* That is the direction of compression is reversed

c) Reflection at curved Surfaces :-

* When sound waves are reflected from the curved surfaces, the intensity is changed.

* When reflected from a convex surface, the reflected waves are

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diverged out and the intensity is decreased.

* When sound is reflected from a concave surface, the reflected waves are converged and focused at a point

* Parabolic surfaces are used when it is required to focus the sound at a particular point.

* In elliptical surfaces sound from one focus will always be reflected to the other focus No

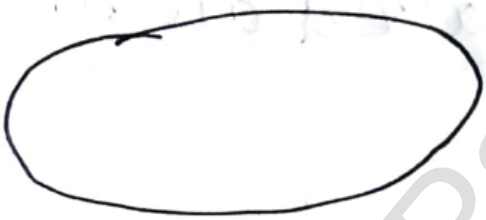
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matter where it strikes the wall.

Parabolic shape



Elliptical shape



3) a) What do you understand by the term 'ultrasonic vibration'?

Ultrasonic vibrations are vibrations with frequency greater than 20KHz.

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b) State three uses of ultrasonic Vibrations

(i) Tracking a satellite :-

* The frequency of radio waves emitted by a satellite decreases as the satellite moved away from the Earth

* By measuring the change in the frequency of the radio waves, the location of the satellite is studied.

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(ii) RADAR (Radio Detection and Ranging)

* In RADAR radio waves are sent and the reflected waves are detected by the receiver of the RADAR station

* From the frequency change the speed and location of the aeroplanes and aircrafts are tracked.

(iii) SONAR :-

In SONAR by measuring the change in the frequency between the sent signal and received signals the speed of Marine animals and submarine can be determined.

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c) Name three animals which can hear ultrasonic vibrations

- ✓ Mosquito
- ✓ dogs
- ✓ bats.

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4) What is an echo?

An echo is the sound reproduced due to the reflection of the original sound from various rigid surfaces.

Eg:-
- ✓ walls
- ✓ ceilings
- ✓ surfaces of mountains,

etc.....

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a) State two conditions Necessary for hearing an echo

* The Persistance of hearing for human ears is 0.1 second.

* If the time interval between the two sounds is at least 0.1s

* Thus, the minimum time gap between the ~~orgi~~ original sounds and an echo must be 0.1.s

* When the distance between the Source of sound and the reflecting surface would satisfy the following equation.

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Velocity = $\frac{\text{distance travelled by sound}}{\text{time taken}}$.

$$V = \frac{2d}{t}$$

$$d = \frac{Vt}{2}$$

Since, $t = 0.1$

Second then $d_1 = \frac{V \times 0.1}{2} = \frac{V}{20}$

If the velocity of sound as $344\ ms^{-1}$ the minimum distance required to hear an echo is 17.2m

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b) What are the medical applications of echo?

* The Principle of echo is used in obstetric ultrasonography, which is used to create real-time visual images of the developing embryo or fetus in the mother's uterus.

* This is a safe testing tools as it does Not use any harmful radiations.

c) How can you calculate the speed of sound using echo?

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The speed of sound wave using an echo is given by

$$\text{Speed of Sound} = \frac{\text{distance travelled}}{\text{time taken}} = \frac{2d}{t}$$

Unit - 6

Nuclear Physics

1) Explain the Process of Controlled and Uncontrolled chain reactions

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Controlled chain reaction :-

* In the controlled chain reaction the Number of Neutrons released is maintained to be one

* This is achieved by absorbing the extra Neutrons with a Neutron absorber leaving only one Neutron to Produce further fission.

* Thus, the reaction is sustained in a controlled manner

* This energy is utilized for constructive Purpose.

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* It is used in a Nuclear reactor to Produce energy in a sustained and controlled manner.

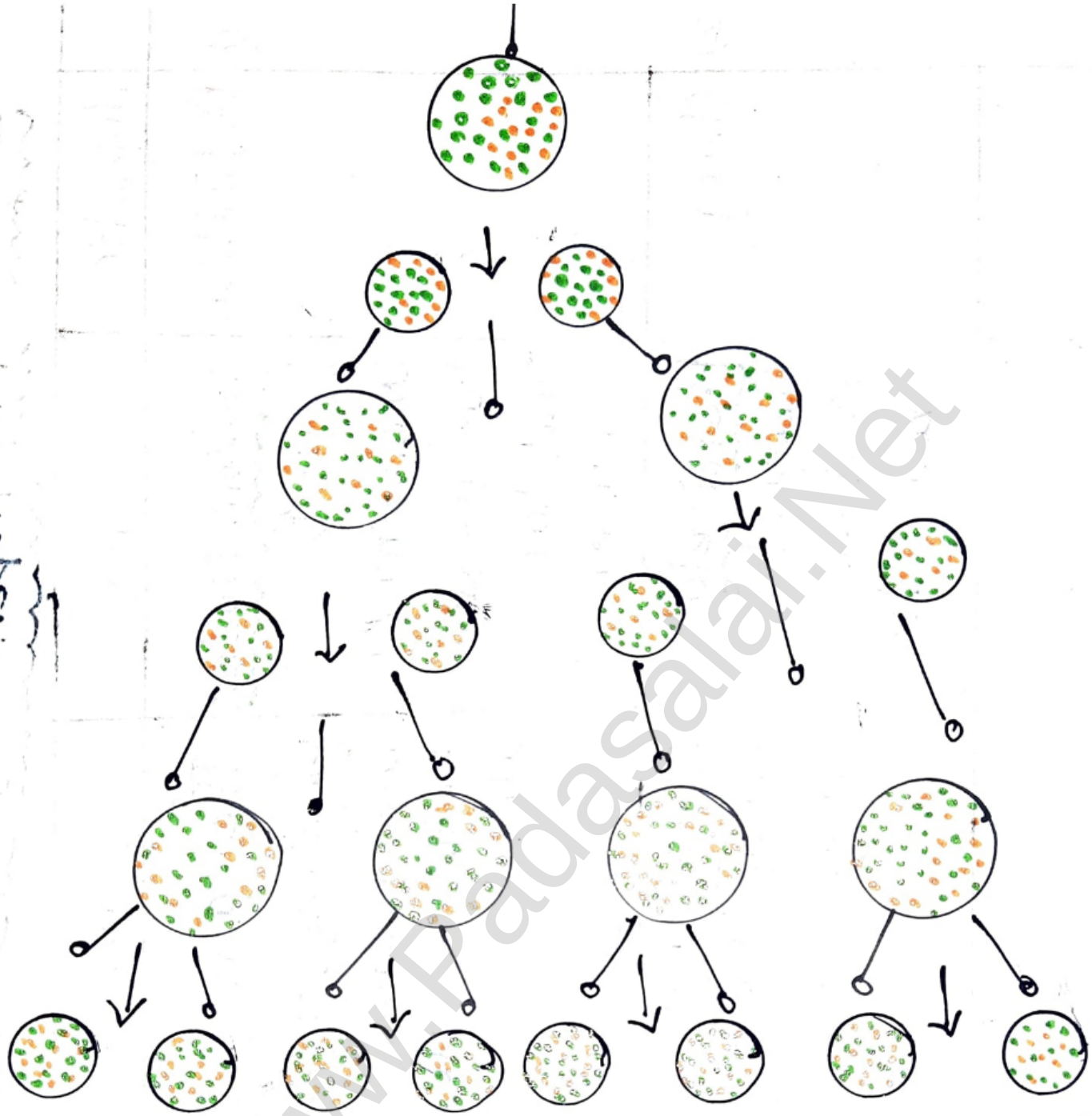
Uncontrolled chain reaction :-

* In the uncontrolled chain reaction the Number of Neutrons multiplies Indefinitely and causes fission in a large amount of the fissile materials.

* This results in the release of a huge amount of energy within a fraction of a second.

* This Kind of chain reaction is used in the atom bomb to Produce an explosion.

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Uncontrolled Chain reaction.

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2) compare the Properties of alpha, beta and gamma reaction.

	Properties	α rays	β rays	γ rays
1)	Definition	Helium Nucleus ($_2He^4$) Consisting of two Protons and two Neutrons	They are electrons ($_{-1}e^0$) basic elementary Particle in all atoms	They are electro magnetic waves Consisting of Photons.
2)	Charge	Positively charged Particles Charge = +2e	Negatively charged Particles charge = -e	Neutral Particle Charge = zero

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3) Ionizing	100 times greater than β rays and 10,000 times greater than γ rays.	Comparatively low	Very less Ionization Power.	
4) Penetrating Power	Low Penetrating Power (even stopped by a thick Paper)	* Penetrating Power is greater than that of α rays. * They can Penetrate through a thin metal foil	* They have a very high ~~Pre~~ Penetrating Power greater than that of β rays. * They can Penetrate through thick metal blocks.	

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5)	Effect of electric and magnetic field	Deflected by both the fields (in accordance with Fleming left hand rule)	Deflected by both the fields; but the direction of deflection is opposite to that for alpha rays (in accordance with Fleming's left hand rule)	They are Not deflected by both the fields.
6)	Speed	Their speed ranges from $\frac{1}{10}$ to $\frac{1}{20}$ times the speed of light	Their speed can go up to $\frac{9}{10}$ times the speed of light	They travel with the speed of light

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3) What is a Nuclear reactor? Explain its essential Parts with their functions

Nuclear reactor :-

A Nuclear reactor is a device in which the Nuclear fission reaction takes Place in a self-sustained and controlled manner to Produce electricity.

Essential parts and functions :-

- Fuel
- moderator
- control rod
- Coolant
- Protection wall

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1) Fuel :-

* A fissile material is used as the fuel

* Uranium is commonly used as the fuel material

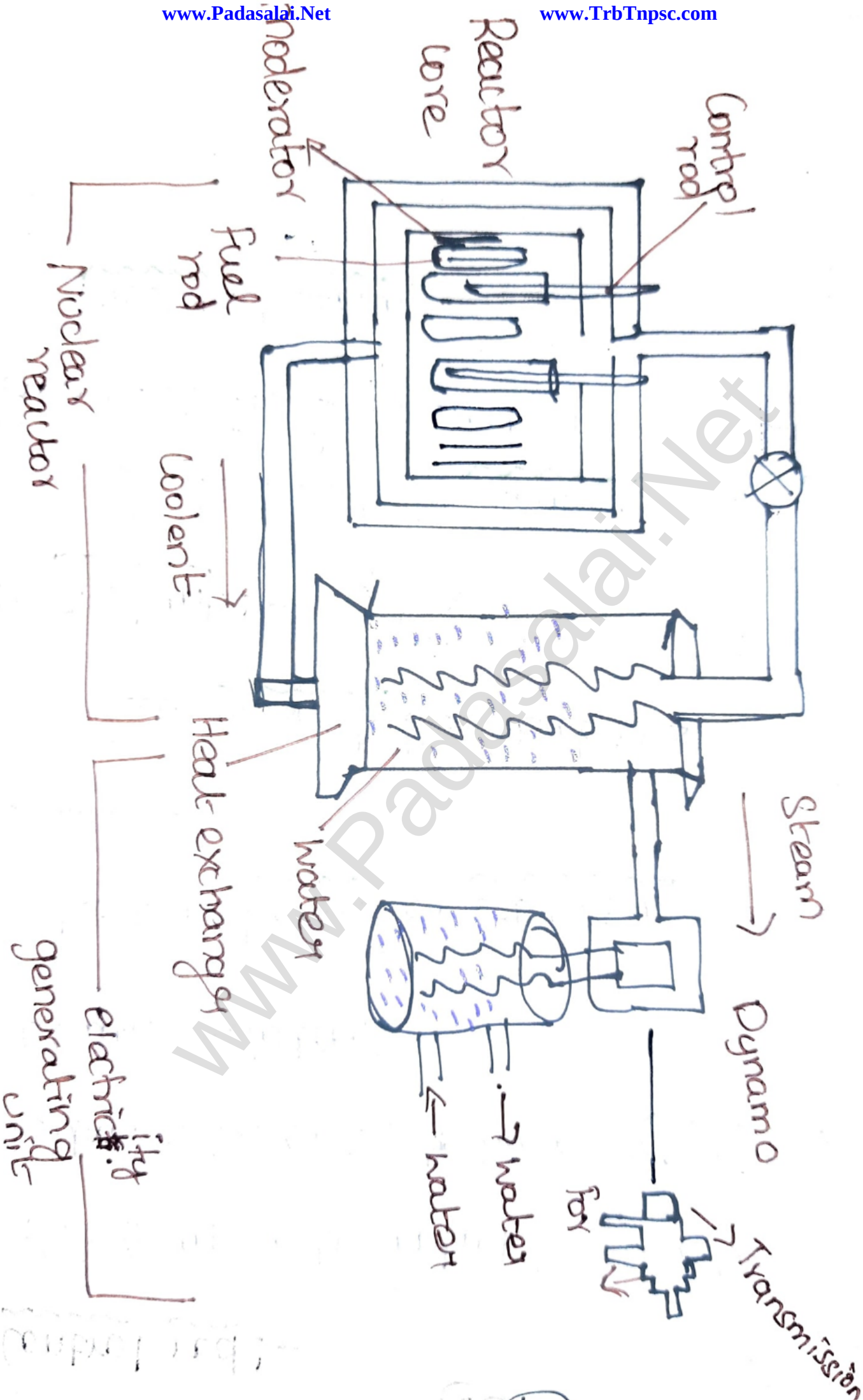
2) Moderator :-

* It is used to slow down the high energy Neutrons to Provide slow Neutrons.

* Graphite and heavy water are commonly used as moderators.

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3) Control rod :-

* It is used to control the Number of Neutrons in order to have sustained chain reaction

* Mostly boron or cadmium rods are used

* They absorb the Neutrons

4) Coolant :-

* It is used to remove the heat Produced in the reactor core, to Produce steam

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*This steam is used to ron a turbine in order to .Produce electricity

* water, air and helium are some of the coolants.

5) Protection wall :-

A thick concrete lead wall is built around the Nuclear reactor in order to Prevent the harmful radiations from escaping into the environment.

End.

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