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Introduction

This is a learning as well as an exam preparation video.

At the end of the video are practice assignments for you to attempt.

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Chapter 8: Electromagnetic Waves

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Displacement Current:

The current which comes into play m the region in which the electric field and the electric flux is changing with time. It is given by

$$I_D = \varepsilon_0 \frac{d\phi_E}{dt}$$

Ampere-Maxwell Law:

$$\oint B\,0 =. dl = \mu_0 (I + I_D)$$

Where, μ_0 = Permeability

$$= 4\pi \times 10^{-7} V/Am$$

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Maxwell's Equations:

Maxwell's equations relate electric field E and magnetic field B and their sources which are electric charges and current. In free space Maxwell's equations are as follows.

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Maxwell's Equations:

1. $\oint \vec{E} . \overrightarrow{ds} = \frac{q}{\varepsilon_0}$

   This equation represents Gauss's law in electrostatics.

2. $\oint \vec{B} . \overrightarrow{ds} = 0$

   This equation is considered as Gauss's law in magnetism. It states that net magnetic flux passing through a closed surface is zero.

3. $\oint \vec{E} . \overrightarrow{dl} = \frac{d\phi}{dt}$

   This equation is Faraday's law of electromagnetic induction. This law relates electric field with changing magnetic flux.

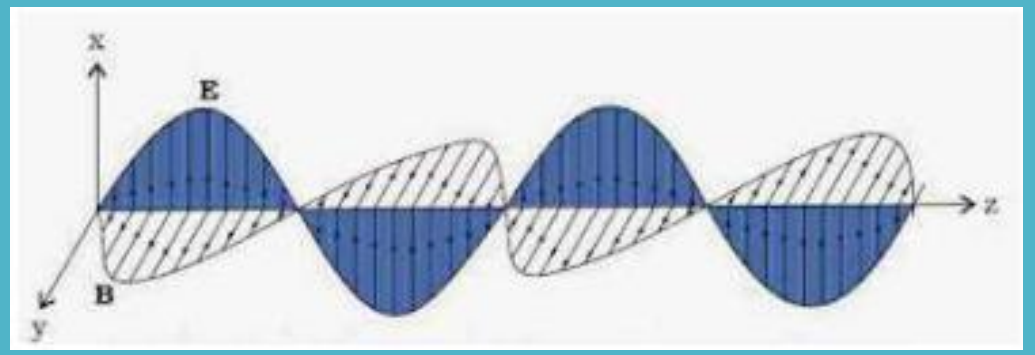
4. $\oint \vec{B} . \overrightarrow{dl} = \mu_0 (I_c + I_d)$

   This equation represents Ampere-Maxwell's law or generalized from of Ampere's law.

Chapter 8: Electromagnetic Waves

Definition

An electromagnetic wave is a wave radiated by an accelerated or oscillatory charge in which varying magnetic field is the source of electric field and varying electric field is the source of magnetic field. Thus, two fields become source of each other, and the wave propagates in a direction perpendicular to both the fields.



Chapter 8: Electromagnetic Waves

Definition

Electromagnetic waves are transverse in nature, i.e., electric and magnetic fields are perpendicular to each other and to the direction of wave propagation. Electromagne-tic waves are not. deflected by electric and magnetic fields.

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Sources of electromagnetic waves:

1. An electric charge at rest produces only electrostatic field around it.
2. A charge moving with uniform velocity produces both electric and magnetic field, here magnetic field does not change with time hence it does not produce time varying electric field.
3. An accelerating charge produces both electric field and magnetic field which varies with space and time which forms electromagnetic wave.

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Sources of electromagnetic waves:

4. An accelerating charge emits electromagnetic wave of same frequency as frequency of accelerating charge.

5. An electron orbiting around its nucleus in a stationary orbit does not emit electromagnetic wave. It will emit only during transition from higher energy orbit to lower energy orbit.

6. Electromagnetic wave (X-ray) is produced when high speed electron enters into target of high atomic weight.

7. Electromagnetic wave (γ-rays) is produced during de-excitation of nucleus in radioactivity.

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Electromagnetic Spectrum:

The orderly distribution of electromagnetic radiations according to their frequency (or wavelength) is called electromagnetic spectrum. Maxwell predicted the existence of electromagnetic wave. Electromagnetic wave experimentally discovered by Hertz.

At the end of nineteenth century, visible light, ultraviolet, infrared, X-rays and γ-rays had also been discovered.

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Electromagnetic Spectrum:

We now know that electromagnetic waves include:

- γ-rays
- X-ray
- Ultraviolet rays
- Visible light
- Infrared
- Microwaves
- Radio waves.

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Greenhouse Effect:

The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected to space and the rest is absorbed and re-radiated by greenhouse gases.
Greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide, ozone, and some artificial chemicals such as chlorofluorocarbons

(CFCs).

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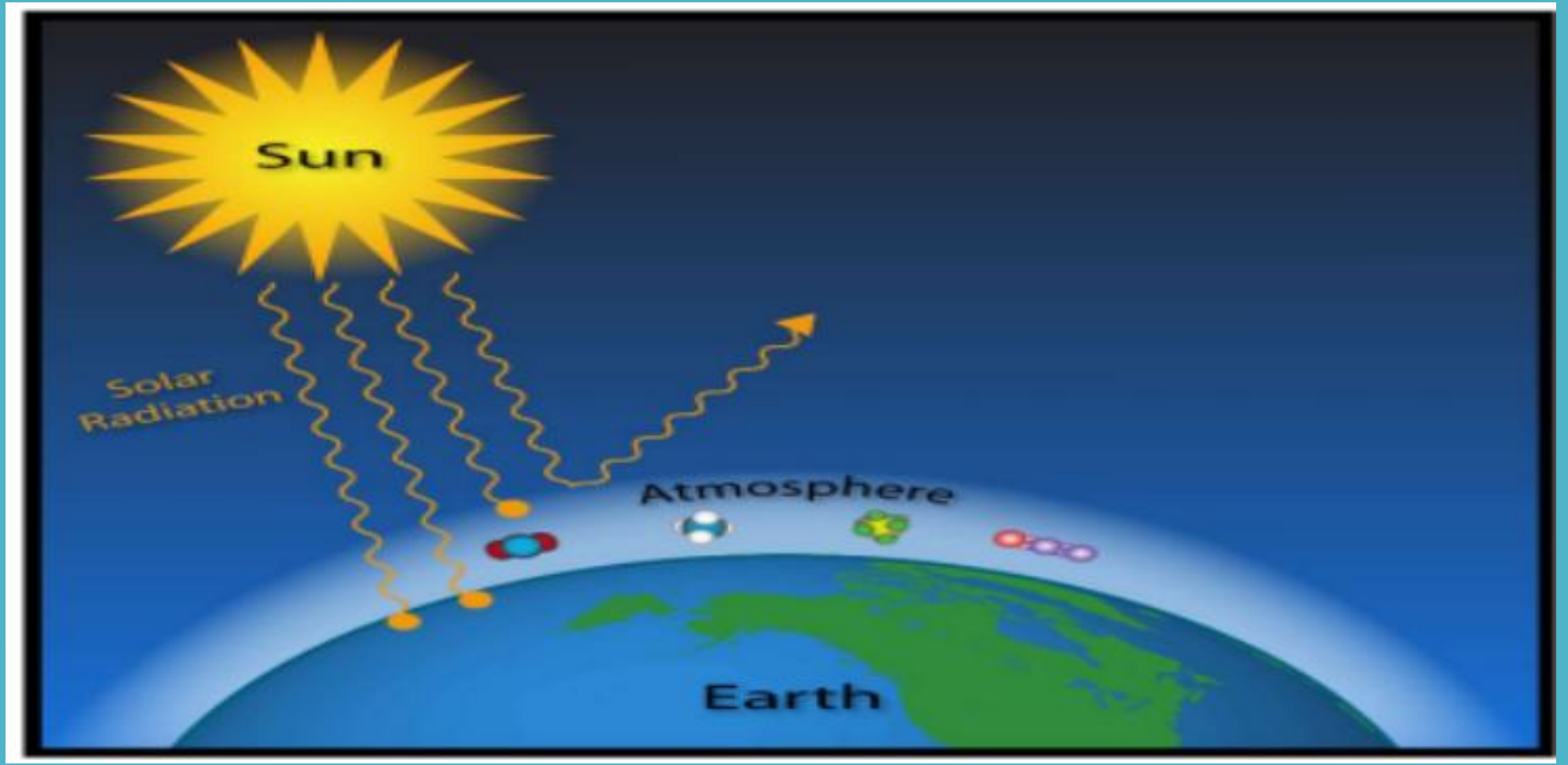
Greenhouse Effect:



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Maxwell's Experiments:

- Maxwell claimed that time-varying electric fields can generate magnetic fields.
- On the other hand, Faraday-Lenz law claims that a time varying magnetic field generates an electric field.
- According to Faraday-Lenz law, an EMF is induced in a circuit whenever the amount of magnetic flux linked with that circuit changes.

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Maxwell's Experiments:

- As a result, electric current gets generated in the circuit which has an electric field associated with it.

- Now, when Maxwell came across this, he claimed that the vice-versa must also be true, i.e., a time varying electric field must also be able to generate a magnetic field.

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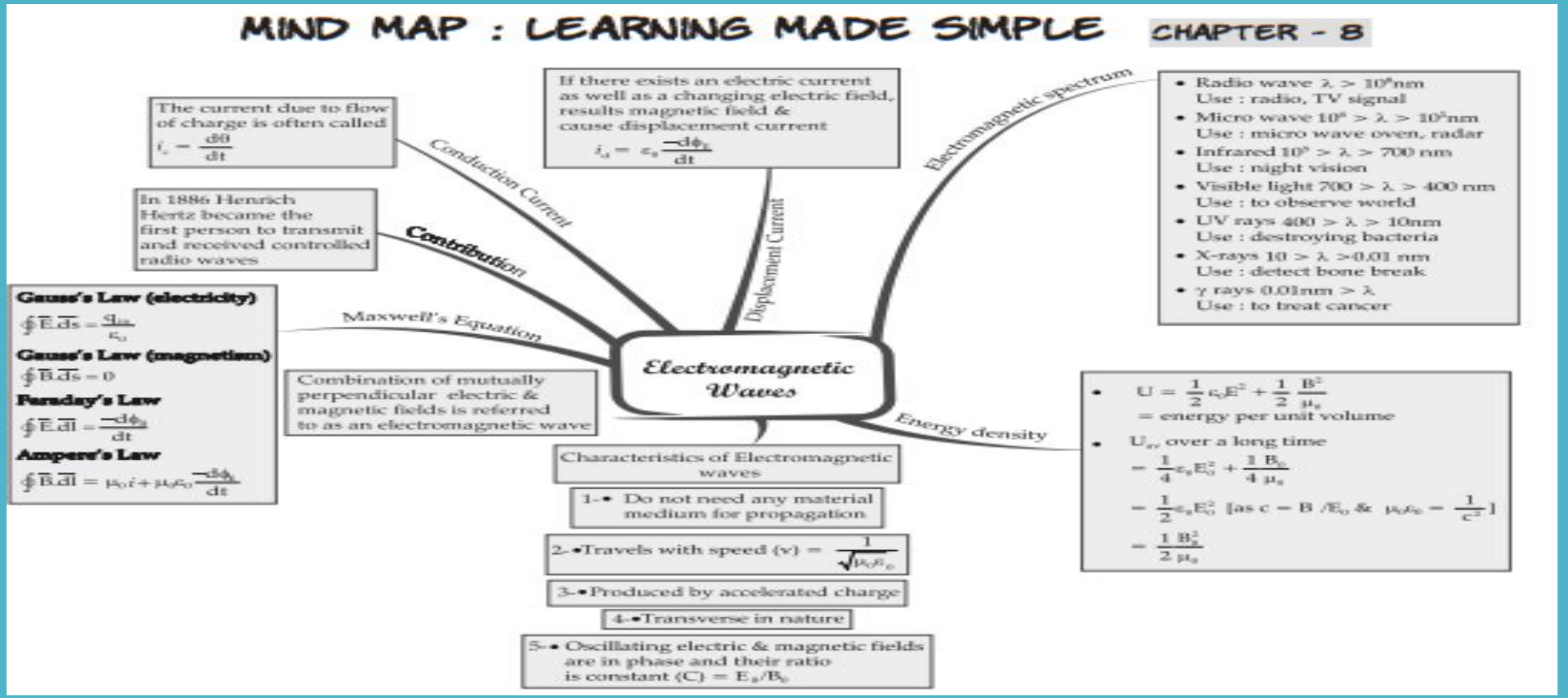

Practice Assignments, Exam Prep Assignments for The CBSE Business Studies

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