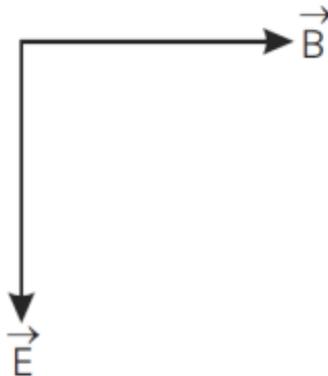


## ELECTROMAGNETIC WAVES

### SECTION – A

Questions 1 to 10 carry 1 mark each.

- Which of the following statement is NOT true about the properties of electromagnetic waves?  
(a) These waves do not require any material medium for their propagation  
(b) Both electric and magnetic field vectors attain the maxima and minima at the same time  
(c) The energy in electromagnetic wave is divided equally between electric and magnetic fields  
(d) Both electric and magnetic field vectors are parallel to each other
- The ratio of the magnitudes of the electric field and magnetic field of a plane electromagnetic wave is:  
(a) 1                                      (b)  $1/c$                                       (c)  $c$                                       (d)  $1/c^2$
- The diagram below shows the electric field (E) and magnetic field (B) components of an electromagnetic wave at a certain time and location.



- What is the direction of propagation of the EM wave?
- Perpendicular to E and B and out of the plane of the paper
  - Perpendicular to E and B and into the plane of the paper
  - Parallel and in the same direction as E
  - Parallel and in the same directions as B
- Electromagnetic waves used as a diagnostic tool in medicine are  
(a) X-rays                      (b) ultraviolet rays                      (c) infrared radiation                      (d) ultrasonic waves
  - A welder wears special glasses to protect his eyes mostly from the harmful effect of  
(a) very intense visible light                      (b) infrared radiation  
(c) ultraviolet rays                      (d) microwaves
  - Displacement current exists only when  
(a) electric field is changing.                      (b) magnetic field is changing.  
(c) electric field is not changing.                      (d) magnetic field is not changing.

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7. The electromagnetic waves used in radar systems are  
(a) Infrared waves      (b) Ultraviolet rays      (c) Microwaves      (d) X-rays
8. In the process of charging of a capacitor, the current produced between the plates of the capacitor is (where symbols have their usual meanings)  
(a)  $\mu_0 \frac{d\phi_E}{dt}$       (b)  $\frac{1}{\mu_0} \frac{d\phi_E}{dt}$       (c)  $\epsilon_0 \frac{d\phi_E}{dt}$       (d)  $\frac{1}{\epsilon_0} \frac{d\phi_E}{dt}$

In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).  
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).  
(c) Assertion (A) is true but reason (R) is false.  
(d) Assertion (A) is false but reason (R) is true.

9. **Assertion (A):** When a charged particle moves in a circular path, it produces electromagnetic wave.

**Reason (R):** Charged particle has acceleration.

10. **Assertion (A):** In an electromagnetic wave, electric field vector and magnetic field vector are mutually perpendicular.

**Reason (R):** Electromagnetic waves are transverse.

## SECTION – B

Questions 11 to 14 carry 2 marks each.

11. Consider an induced magnetic field due to changing electric field and an induced electric field due to changing magnetic field. Which one is more easily observed? Justify your answer.
12. (a) Explain briefly the fact that electromagnetic waves carry energy.  
(b) Why do we not, feel the pressure due to sunshine?
13. (i) How are infrared waves produced? Write their one important use.  
(ii) The thin ozone layer on top of the stratosphere is crucial for human survival. Why?
- OR**
- How are X-rays produced? Give any two uses of these.
14. (i) Which segment of electromagnetic waves has highest frequency? How are these waves produced? Give one use of these waves.  
(ii) Which EM waves lie near the high frequency end of visible part of EM spectrum? Give its one use. In what way this component of light has harmful effects on humans?

## SECTION – C

Questions 15 to 17 carry 3 marks each.

15. (a) Write the following radiations in a descending order of frequencies: red light, X-rays, microwaves, radio waves  
(b) What is the nature of waves used in radar?  
(c) What is the role of ozone layer in the atmosphere?
16. (a) How are electromagnetic waves produced by oscillating charges?  
(b) State clearly how a microwave oven works to heat up a food item containing water molecules.  
(c) Why are microwaves found useful for the radar systems in aircraft navigation?

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17. Electromagnetic waves of wavelengths  $\lambda_1$ ,  $\lambda_2$  and  $\lambda_3$  are used in radar systems, in water purifiers and in remote switches of TV, respectively.
- Identify the electromagnetic waves, and
  - Sketch a schematic diagram depicting oscillating electric and magnetic fields of an em wave propagating along + z-direction.

OR

- Name the e.m. waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.
- If the Earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now? Explain.
- An e.m. wave exerts pressure on the surface on which it is incident. Justify.

## SECTION – D

Questions 18 carry 5 marks.

18. How does Ampere-Maxwell law explain the flow of current through a capacitor when it is being charged by a battery? Write the expression for the displacement current in terms of the rate of change of electric flux.

OR

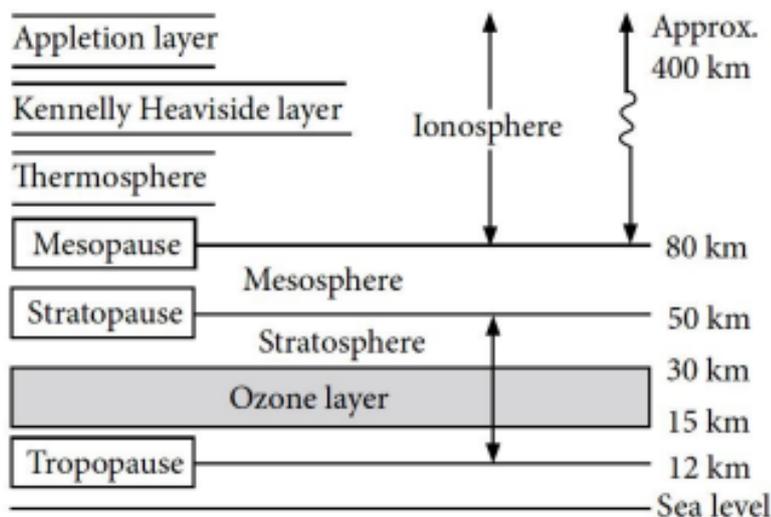
- Name the EM waves which are produced during radioactive decay of a nucleus. Write their frequency range.
- Welders wear special glass goggles while working. Why? Explain.
- Why are infrared waves often called as heat waves? Give their one application.
- Thin ozone layer on top of stratosphere is crucial for human survival. Why?
- Why is the amount of the momentum transferred by the em waves incident on the surface so small?

## SECTION – E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

### 19. Sources of Electromagnetic Waves

Radio waves are produced by the accelerated motion of charges in conducting wires. Microwaves are produced by special vacuum tubes. Infrared waves are produced by hot bodies and molecules also known as heat waves. UV rays are produced by special lamps and very hot bodies like Sun.



- Solar radiation is
  - transverse electromagnetic wave
  - longitudinal electromagnetic waves
  - both longitudinal and transverse electromagnetic waves

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(d) none of these.

(ii) What is the cause of greenhouse effect?

- (a) Infrared rays      (b) Ultraviolet rays      (c) X-rays      (d) Radiowaves

(iii) Biological importance of ozone layer is

- (a) it stops ultraviolet rays      (b) It layer reduces greenhouse effect  
(c) it reflects radiowaves      (d) none of these.

(iv) Ozone is found in

- (a) stratosphere      (b) ionosphere      (c) mesosphere      (d) troposphere

**OR**

(iv) Earth's atmosphere is richest in

- (a) ultraviolet      (b) infrared      (c) X-rays      (d) microwaves

## 20. Electromagnetic Spectrum

All the known radiations from a big family of electromagnetic waves which stretch over a large range of wavelengths. Electromagnetic wave include radio waves, microwaves, visible light waves, infrared rays, UV rays, X-rays and gamma rays. The orderly distribution of the electromagnetic waves in accordance with their wavelength or frequency into distinct groups having widely differing properties is electromagnetic spectrum.

(i) Which wavelength of the Sun is used finally as electric energy?

- (a) radio waves      (b) infrared waves      (c) visible light      (d) microwaves

(ii) Which of the following electromagnetic radiations have the longest wavelength?

- (a) X-rays      (b)  $\gamma$ -rays      (c) microwaves      (d) radiowaves

(iii) Which one of the following is not electromagnetic in nature?

- (a) X-rays      (b) gamma rays      (c) cathode rays      (d) infrared rays

(iv) Which of the following has minimum wavelength ?

- (a) X-rays      (b) ultraviolet rays      (c)  $\gamma$ -rays      (d) cosmic rays

**OR**

(iv) The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is

- (a) microwave, infrared, ultraviolet, gamma rays  
(b) gamma rays, ultraviolet, infrared, microwave  
(c) microwave, gamma rays, infrared, ultraviolet  
(d) infrared, microwave, ultraviolet, gamma rays.