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Class 12 Physics Chapterwise PYQs

2026 – 2003 | All CBSE Board Papers

Chapter-wise previous year questions, sorted by marks and year

Chapter 8: Electromagnetic Waves

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1-Mark Questions (79 questions · Section A · MCQ)

Q1. An electromagnetic wave passes from vacuum into a dielectric medium with relative electrical permittivity $(3/2)$ and relative magnetic permeability $(8/3)$. Then, its:

(A) wavelength is doubled and frequency remains unchanged.
(B) wavelength is doubled and frequency is halved.
(C) wavelength is halved and frequency remains unchanged.
(D) wavelength and frequency both will remain unchanged.

[2026 • Set 55-1-1]

Q2. Electromagnetic waves used in a diagnostic tool in medicine have a wavelength range:

(A) 1 nm to 10^{-3} nm
(B) 400 nm to 1 nm
(C) 1 mm to 700 nm
(D) 0.1 m to 1 mm

[2026 • Set 55-1-1]

Q3. Electromagnetic waves used for purification of water are:

(A) X-rays
(B) Ultraviolet rays
(C) Infrared rays
(D) Ultrasonic rays

[2026 • Set 55-1-2]

Q4. Welders wear special glass goggles or face masks with glass windows to protect their eyes from:

(A) Infrared rays
(B) Ultraviolet rays
(C) X-rays
(D) Microwaves

[2026 • Set 55-1-3]

Q5. An electromagnetic wave is propagating along x-axis. At any instant, the phase difference (in radian) between the electric field $(\vec{E})$ and the magnetic field $(\vec{B})$ associated with the wave is:

(A) zero
(B) $\frac{\pi}{4}$
(C) $\frac{\pi}{2}$
(D) π

[2026 • Set 55-2-1]

Q6. The expressions of magnetic fields associated with four electromagnetic waves are given below: I. $B_1 = (4 \times 10^{-7}\ \text{T}) \sin[0{\cdot}7 \times 10^3 x + 1{\cdot}4 \times 10^{11} t]$ II. $B_2 = (2 \times 10^{-7}\ \text{T}) \sin[0{\cdot}6 \times 10^3 x + 1{\cdot}5 \times 10^{11} t]$ III. $B_3 = (3 \times 10^{-6}\ \text{T}) \sin[0{\cdot}5 \times 10^3 x + 1{\cdot}5 \times 10^{11} t]$ IV. $B_4 = (5 \times 10^{-7}\ \text{T}) \sin[0{\cdot}2 \times 10^4 x + 4{\cdot}8 \times 10^{11} t]$ Which wave is travelling in free space?

(A) I
(B) II
(C) III
(D) IV

[2026 • Set 55-2-2]

Q7. The electric field and the magnetic field components of an electromagnetic wave travelling in vacuum are represented as $E = m\ \sin(\alpha z - \beta t)$ and $B = n\ \sin(\alpha z - \beta t)$, where m, n, α and β are constants characterising the wave. Then:

(A) $\frac{m}{n} = \frac{\alpha}{\beta}$
(B) $\frac{m}{n} = \frac{\beta}{\alpha}$
(C) $\frac{n}{m} = \frac{\beta}{\alpha}$
(D) $\frac{n}{m} = \alpha\beta$

[2026 • Set 55-2-3]

Q8. A plane electromagnetic wave travels through a medium and the magnetic field associated

with it is given by $B = 5 \times 10^{-8} \sin(3 \times 10^{10}\, t - 150\, x)$ T, where x is in metres and t is in seconds. The velocity of the wave is:

(A) $2{\cdot}0 \times 10^{8}$ m s^{-1}

(B) $4{\cdot}5 \times 10^{7}$ m s^{-1}

(C) $3{\cdot}5 \times 10^{7}$ m s^{-1}

(D) $2{\cdot}5 \times 10^{8}$ m s^{-1}

[2026 • Set 55-3-1]

Q9. The ratio of amplitude of electric field to the amplitude of the magnetic field associated with an electromagnetic wave propagating in glass $(n = 1 \cdot 5)$ is:

(A) 3×10^{8} m s^{-1}

(B) 2×10^{8} m s^{-1}

(C) $3 \cdot 3 \times 10^{-9}$ m s^{-1}

(D) 5×10^{-9} m s^{-1}

[2026 • Set 55-4-1]

Q10. The magnetic field in a plane electromagnetic wave travelling in glass $(n = 1.5)$ is given by $B_y = (2 \times 10^{-7}\,\text{T}) \sin(\alpha x + 1.5 \times 10^{11}\, t)$ where x is in metres and t is in seconds. The value of α is:

(A) $0.5 \times 10^{3}\,\text{m}^{-1}$

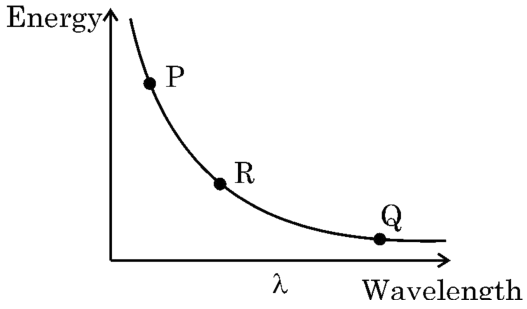
(B) $6.0 \times 10^{2}\,\text{m}^{-1}$

(C) $7.5 \times 10^{2}\,\text{m}^{-1}$

(D) $1.5 \times 10^{3}\,\text{m}^{-1}$

[2026 • Set 55-5-1]

Q11. The given diagram exhibits the relationship between the wavelength of the electromagnetic waves and the energy of photon associated with them. The three points P, Q and R marked on the diagram may correspond respectively to:



(A) X-rays, microwaves, UV radiation

(B) X-rays, UV radiation, microwaves

(C) UV radiation, microwaves, X-rays

(D) Microwaves, UV radiation, X-rays

[2025 • Set 55-1-1]

Q12. Which one of the following correctly represents the change in wave characteristics (all in vacuum) from microwaves to X-rays in electromagnetic spectrum?

(A) Speed: Remains same; Wavelength: Decreases; Frequency: Remains same
(B) Speed: Remains same; Wavelength: Decreases; Frequency: Increases
(C) Speed: Increases; Wavelength: Increases; Frequency: Decreases
(D) Speed: Remains same; Wavelength: Increases; Frequency: Remains same

[2025 • Set 55-1-2]

Q13. X-rays are more harmful to human beings than ultraviolet radiations because X-rays:

(A) have frequency lower than that of ultraviolet radiations.
(B) have wavelength smaller than that of ultraviolet radiations.
(C) move faster than ultraviolet radiations in air.
(D) are mechanical waves but ultraviolet radiations are electromagnetic waves.

[2025 • Set 55-1-3]

Q14. Assertion (A): Out of Infrared and radio waves, the radio waves show more diffraction effect. Reason (R): Radio waves have greater frequency than infrared waves.

(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) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-2-1]

Q15. The amplitude of electric field in an electromagnetic wave in free space is $1000\,\text{V m}^{-1}$. The amplitude of the magnetic field in this electromagnetic wave is :

(A) $3.0 \times 10^{-6}\,\text{T}$
(B) $3.33 \times 10^{-6}\,\text{T}$
(C) $3.0 \times 10^{-11}\,\text{T}$
(D) $3.33 \times 10^{-11}\,\text{T}$

[2025 • Set 55-4-1]

Q16. The electric field in space between the plates of a parallel plate capacitor (each of area $2.5 \times 10^{-3}\,\text{m}^2$) is changing at the rate of $4 \times 10^{6}\,\text{V m}^{-1}\text{s}^{-1}$. The displacement current between the plates of the capacitor is :

(A) $1.8 \times 10^{-5}\,\text{A}$
(B) $3.47 \times 10^{-8}\,\text{A}$
(C) $8.85 \times 10^{-8}\,\text{A}$
(D) $6.32 \times 10^{-4}\,\text{A}$

[2025 • Set 55-4-2]

Q17. In an electromagnetic wave travelling in free space, the amplitude of magnetic field is 6.0×10^{-4} T. The amplitude of its electric field is :

(A) 2×10^{-4} V m^{-1}

(B) 1.5×10^{12} V m^{-1}

(C) 1.8×10^{5} V m^{-1}

(D) 0.3×10^{4} V m^{-1}

[2025 • Set 55-4-3]

Q18. Which of the following rays coming from the Sun plays an important role in maintaining the Earth's warmth?

(A) Infrared rays

(B) γ rays

(C) UV rays

(D) Visible light rays

[2025 • Set 55-5-1]

Q19. The dimensions of $(\mu\varepsilon)$, where ε is permittivity and μ is permeability of a medium, are:

(A) $[M^0L^{-1}T]$

(B) $[M^0L^{-2}T^2]$

(C) $[M^{-1}L^{-2}T^{-1}]$

(D) $[M^1L^1T^{-1}]$

[2025 • Set 55-5-1]

Q20. Assertion (A): EM waves do not require a medium for their propagation. Reason (R): EM waves are transverse waves. Select the correct answer:

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Both Assertion (A) and Reason (R) are false.

[2025 • Set 55-7-1]

Q21. In the four regions, I, II, III and IV, the electric fields are described as: Region I: $E_y = E_0 \sin(kz - \omega t)$ Region II: $E_y = E_0$ Region III: $E_y = E_0 \sin kz$ Region IV: $E_y = E_0 \cos kz$ The displacement current will exist in the region:

(A) I

(B) IV

(C) II

(D) III

[2024 • Set 55-1-1]

Q22. The electric and magnetic fields of electromagnetic waves are:

(A) In the same phase and perpendicular to each other.
(B) In the same phase and not perpendicular to each other.
(C) Not in the same phase but are perpendicular to each other.
(D) Neither in the same phase nor perpendicular to each other.

[2024 • Set 55-1-2]

Q23. The first scientist who produced and observed electromagnetic waves of wavelengths in the range $25\,\text{mm} - 5\,\text{mm}$ was:

(A) J.C. Maxwell
(B) H.R. Hertz
(C) J.C. Bose
(D) G. Marconi

[2024 • Set 55-1-3]

Q24. Electromagnetic waves with wavelength 10 nm are called:

(A) Infrared waves
(B) Ultraviolet rays
(C) Gamma rays
(D) X-rays

[2024 • Set 55-2-1]

Q25. Welders wear special glass goggles or face masks with glass windows to protect their eyes from radiations produced by welding arcs. These radiations are:

(A) X-rays
(B) Ultraviolet rays
(C) Infrared waves
(D) Gamma rays

[2024 • Set 55-2-2]

Q26. In four regions I, II, III and IV, the magnetic field is given by: I. $B_y = B_0 \sin kz$ II. $B_y = B_0 \cos kz$ III. $B_y = B_0 \sin(kz - \omega t)$ IV. $B_y = B_0 \sin kz + B_0 \cos kz$ The electromagnetic wave will exist in the region:

(A) IV
(B) I
(C) III
(D) II

[2024 • Set 55-2-3]

Q27. Which one of the following has the highest frequency?

(A) Infrared rays
(B) Gamma rays
(C) Radio waves
(D) Microwaves

[2024 • Set 55-3-1]

Q28. Electromagnetic waves with frequency 1.0×10^{18} Hz are known as:

(A) Infrared rays
(B) Ultraviolet rays
(C) X-rays
(D) Gamma rays

[2024 • Set 55-3-2]

Q29. A plane electromagnetic wave is travelling in air in $+x$ direction. At a particular moment, its electric field $\vec{E}$ is along $+y$ direction. At that moment, the magnetic field $\vec{B}$ is along:

(A) $+z$ direction and in phase with $\vec{E}$
(B) $-z$ direction and in phase with $\vec{E}$
(C) $+z$ direction and out of phase with $\vec{E}$
(D) $-z$ direction and out of phase with $\vec{E}$

[2024 • Set 55-3-3]

Q30. The phase difference between electric field $\vec{E}$ and magnetic field $\vec{B}$ in an electromagnetic wave propagating along z-axis is

(A) zero
(B) π
(C) $\frac{\pi}{2}$
(D) $\frac{\pi}{4}$

[2024 • Set 55-4-1]

Q31. The electromagnetic waves used to purify water are:

(A) Infrared rays
(B) Ultraviolet rays
(C) X-rays
(D) Gamma rays

[2024 • Set 55-5-1]

Q32. 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) $\varepsilon_0 \frac{d\phi_E}{dt}$

(D) $\frac{1}{\varepsilon_0} \frac{d\phi_E}{dt}$

[2023 • Set 55-1-1]

Q33. $\vec{E}$ and $\vec{B}$ represent the electric and the magnetic field of an electromagnetic wave respectively. The direction of propagation of the wave is along

(A) $\vec{B}$

(B) $\vec{E}$

(C) $\vec{E} \times \vec{B}$

(D) $\vec{B} \times \vec{E}$

[2023 • Set 55-2-1]

Q34. The ratio of the magnitudes of the electric field and magnetic field of a plane electromagnetic wave is

(A) 1

(B) $\frac{1}{c}$

(C) c

(D) c^2

[2023 • Set 55-2-2]

Q35. An electromagnetic wave is produced by a charge

(A) moving with a constant velocity

(B) moving with a constant speed parallel to a magnetic field

(C) moving with an acceleration

(D) at rest

[2023 • Set 55-2-3]

Q36. The electromagnetic radiations used to kill germs in water purifiers are called:

(A) Infrared waves

(B) X-rays

(C) Gamma rays

(D) Ultraviolet rays

[2023 • Set 55-3-1]

Q37. Electromagnetic waves of wavelength of the order of a few meters were first produced

and detected in the laboratory by:

(A) J.C. Maxwell

(B) J.C. Bose

(C) H.R. Hertz

(D) G. Marconi

[2023 • Set 55-3-2]

Q38. A capacitor is charged by a battery. Between the plates, during process of charging:

(A) only displacement current exists.

(B) only conduction current exists.

(C) both displacement current and conduction current exist.

(D) no current exists.

[2023 • Set 55-3-3]

Q39. The electromagnetic waves used in radar systems are:

(A) Infrared waves

(B) Ultraviolet rays

(C) Microwaves

(D) X-rays

[2023 • Set 55-4-1]

Q40. Name the electromagnetic waves also known as 'heat waves'.

(A) Radio waves

(B) Microwaves

(C) X-rays

(D) Infrared waves

[2023 • Set 55-4-3]

Q41. Which one of the following electromagnetic radiation has the least wavelength?

(A) Gamma rays

(B) Microwaves

(C) Visible light

(D) X-rays

[2023 • Set 55-5-1]

Q42. Choose the correct option related to wavelengths (λ) of different parts of electromagnetic spectrum.

(A) $\lambda_{X\text{-rays}} < \lambda_{micro\,waves} < \lambda_{visible}$

(B) $\lambda_{visible} > \lambda_{X\text{-rays}} > \lambda_{radio\,waves}$

(C) $\lambda_{radio\,waves} > \lambda_{visible} > \lambda_{X\text{-rays}}$

(D) $\lambda_{visible} < \lambda_{microwaves} < \lambda_{radio\,waves} < \lambda_{X\text{-rays}}$

[2023 • Set 55-5-2]

Q43. What oscillates in an electromagnetic wave of frequency $10\,\text{MHz}$?

[2021]

Q44. Name the electromagnetic radiation used for killing germs in water purifiers.

[2021]

Q45. Write the mathematical form of Ampere-Maxwell circuital law.

[2020 • Set 55-1-1]

Q46. How is displacement current produced between the plates of a parallel plate capacitor during charging?

[2020 • Set 55-1-2]

Q47. Differentiate between conduction current and displacement current.

[2020 • Set 55-1-3]

Q48. 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.

[2020 • Set 55-2-1]

Q49. Electromagnetic waves used as a diagnostic tool in medicine are

(A) X-rays.
(B) ultraviolet rays.
(C) infrared radiation.
(D) ultrasonic waves.

[2020 • Set 55-2-1]

Q50. 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.

[2020 • Set 55-2-2]

Q51. In a travelling plane electromagnetic wave, which of the following have zero average

value?

(A) Magnetic energy and electric energy
(B) Magnetic field and electric field
(C) Magnetic energy and magnetic field
(D) Electric energy and electric field

[2020 • Set 55-2-3]

Q52. Mention the contribution of Indian physicist J.C. Bose in the production of electromagnetic waves.

[2020 • Set 55-3-1]

Q53. Write one use of the electromagnetic waves of frequency range from 10^{16} Hz to 10^{20} Hz.

[2020 • Set 55-3-1]

Q54. Which physical quantity associated with an electromagnetic wave does not change when it propagates from one medium into another medium?

[2020 • Set 55-3-2]

Q55. Name the electromagnetic radiations which may cause sunburn. Write their wavelength range.

[2020 • Set 55-3-3]

Q56. An A.C. source with variable frequency is connected to a parallel plate capacitor. How will the displacement current be affected with the decrease in frequency of the source?

[2020 • Set 55-4-1]

Q57. Depict the fields diagram of an electromagnetic wave propagating along positive X-axis with its electric field along Y-axis.

[2020 • Set 55-5-1]

Q58. Which part of the electromagnetic spectrum is used in RADAR? Give its frequency range.

OR

How are electromagnetic waves produced by accelerating charges?

[2019 • Set 55-2-1]

Q59. The small ozone layer on top of the stratosphere is crucial for human survival. Why?

OR

Illustrate by giving suitable examples, how you can show that electromagnetic waves carry both energy and momentum.

[2019 • Set 55-4-1]

Q60. Name the electromagnetic radiations used for (a) water purification, and (b) eye surgery.

[2018]

Q61. How is the speed of em-waves in vacuum determined by the electric and magnetic fields?

[2017]

Q62. Write the expression for speed of electromagnetic waves in a medium of electrical permittivity ε and magnetic permeability μ.

[2017]

Q63. Do electromagnetic waves carry energy and momentum?

[2017]

Q64. Write the relation for the speed of electromagnetic waves in terms of the amplitudes of electric and magnetic fields.

[2017]

Q65. In which directions do the electric and magnetic field vectors oscillate in an electromagnetic wave propagating along the x-axis?

[2017]

Q66. In which situation is there a displacement current but no conduction current?

[2016]

Q67. To which part of the electromagnetic spectrum does a wave of frequency 5×10^{19} Hz belong ?

[2014]

Q68. A capacitor has been charged by a dc source. What are the magnitudes of conduction and displacement currents, when it is fully charged?

[2013]

Q69. Name the part of electromagnetic spectrum whose wavelength lies in the range of 10^{-10} m. Give its one use.

[2012]

Q70. What are the directions of electric and magnetic field vectors relative to each other and relative to the direction of propagation of electromagnetic waves?

[2012]

Q71. Name the physical quantity which remains same for microwaves of wavelength 1 mm and

UV radiations of $1600\,\mathring{A}$ in vacuum.

[2012]

Q72. Name the electromagnetic waves, which (i) maintain the Earth's warmth and (ii) are used in aircraft navigation.

[2012]

Q73. A plane electromagnetic wave travels in vacuum along z-direction. What can you say about the direction of electric and magnetic field vectors?

[2011 • Set 55-1-1]

Q74. Which part of electromagnetic spectrum has largest penetrating power?

[2010]

Q75. Write the following radiations in ascending order in respect of their frequencies: X-rays, microwaves, UV rays and radio waves.

[2009]

Q76. Name the EM waves used for studying crystal structure of solids. What is its frequency range?

[2009]

Q77. Name the part of the electromagnetic spectrum of wavelength 10^{-2} m and mention its one application.

[2008]

Q78. Identify the part of the electromagnetic spectrum to which the following wavelengths belong: (i) $1\ mm$ (ii) $10^{-11}\ m$.

[2008]

Q79. What is the name given to that part of electromagnetic spectrum which is used for taking photographs of earth under foggy conditions from great heights?

[2004]

2-Mark Questions (39 questions · Section B · VSA)

Q1. 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.

[2023 • Set 55-1-1]

Q2. A plane electromagnetic wave propagates in vacuum along x-axis.

(a) Give the direction of electric field and magnetic field vectors.

(b) E_0 and B_0 are the magnitudes of electric and magnetic fields respectively in a plane electromagnetic wave. Find the ratio of energy densities of electric field and magnetic field.

[2023 • Set 55-1-2]

Q3. Identify the part of electromagnetic spectrum which is:

(a) next to the lowest frequency end of the visible part of electromagnetic spectrum, and

(b) produced by bombarding a metal target by high energy electrons. Give one use of each of them.

[2023 • Set 55-1-3]

Q4. How are infrared waves produced? Why are these waves referred to as heat waves? Give any two uses of infrared waves.

[2023 • Set 55-2-1]

Q5. How are X-rays produced? Give any two uses of these.

[2023 • Set 55-2-1]

Q6. What is meant by the term 'displacement current'? Briefly explain how this current is different from a conduction current.

[2023 • Set 55-3-1]

Q7. (a) What is a displacement current? How is it different from a conduction current?

OR

(b) Write any two characteristics of an electromagnetic wave. Why are microwaves used in radar systems?

[2023 • Set 55-4-1]

Q8. Identify the electromagnetic wave whose wavelengths range is from about

(a) 10^{-12} m to about 10^{-8} m.

(b) 10^{-3} m to about 10^{-1} m. Write one use of each.

[2023 • Set 55-5-1]

Q9. Identify the electromagnetic radiation and write its wavelength range, which is used to kill germs in water purifier. Name the two sources of these radiations.

[2023 • Set 55-5-2]

Q10. How are electromagnetic waves produced? Write their two characteristics.

[2023 • Set 55-5-3]

Q11. (a) The electric field of an electromagnetic wave is represented as $E_x = E_0 \sin(\omega t + kz)$. (i) In which direction is the wave propagating? (ii) In which direction does the magnetic field oscillate?

(b) Write two characteristics of electromagnetic waves.

[2021]

Q12. Which of the following electromagnetic waves has (a) minimum wavelength, and (b) minimum frequency? Write one use of each of these two waves. Infrared waves, Microwaves, γ-rays and X-rays

[2020 • Set 55-2-1]

Q13. How does an oscillating charge radiate an electromagnetic wave? Give the relation between the frequency of radiated wave and the frequency of oscillating charge.

OR

(a) Explain briefly the fact that electromagnetic waves carry energy.

(b) Why do we not feel the pressure due to sunshine?

[2020 • Set 55-3-1]

Q14. Gamma rays and radio waves travel with the same velocity in free space. Distinguish between them in terms of their origin and the main application.

[2020 • Set 55-5-1]

Q15. A capacitor made of two parallel plates, each of area 'A' and separation 'd' is charged by an external dc source. Show that during charging, the displacement current inside the capacitor is the same as the current charging the capacitor.

[2019 • Set 55-2-1]

Q16. How is the equation for Ampere's circuital law modified in the presence of displacement current? Explain.

[2019 • Set 55-2-2]

Q17. How are electromagnetic waves produced by oscillating charges? What is the source of the energy associated with the em waves?

[2019 • Set 55-2-3]

Q18. A parallel plate capacitor of plate area A each and separation d, is being charged by an ac source. Show that the displacement current inside the capacitor is the same as the

current charging the capacitor.

[2019 • Set 55-4-1]

Q19. (a) Why are infra-red waves often called heat waves ? Explain.

(b) What do you understand by the statement, "Electromagnetic waves transport momentum" ?

[2018]

Q20. 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.

[2017]

Q21. Identify the electromagnetic waves whose wavelengths vary as

(a) 10^{-12} m $< \lambda < 10^{-8}$ m

(b) 10^{-3} m $< \lambda < 10^{-1}$ m Write one use for each.

[2017]

Q22. (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?

[2016]

Q23. State two properties of electromagnetic waves. How can we show that em waves carry momentum?

[2016]

Q24. Considering the case of a parallel plate capacitor being charged, show how one is required to generalize Ampere's circuital law to include the term due to displacement current.

[2014]

Q25. (a) An em wave is travelling in a medium with a velocity $\vec{v} = v\,\hat{i}$. Draw a sketch showing the propagation of the em wave, indicating the direction of the oscillating electric and magnetic fields.

(b) How are the magnitudes of the electric and magnetic fields related to the velocity of the em wave?

[2013]

Q26. Draw a sketch of a plane electromagnetic wave propagating along the z-direction. Depict clearly the directions of electric and magnetic fields varying sinusoidally with z.

[2012]

Q27. A capacitor of capacitance 'C' is being charged by connecting it across a dc source along with an ammeter. Will the ammeter show a momentary deflection during the process of charging? If so, how would you explain this momentary deflection and the resulting continuity of current in the circuit? Write the expression for the current inside the capacitor.

[2012]

Q28. When an ideal capacitor is charged by a dc battery, no current flows. However, when an ac source is used, the current flows continuously. How does one explain this, based on the concept of displacement current?

[2012]

Q29. Explain briefly how electromagnetic waves are produced by an oscillating charge. How is the frequency of the em waves produced related to that of the oscillating charge?

[2012]

Q30. What is sky wave communication? Why is this mode of propagation restricted to the frequencies only upto few MHz?

[2011]

Q31. A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized to incorporate the effect due to the displacement current.

[2011]

Q32. How are infrared waves produced? Why are these referred to as heat waves? Write their one important use.

[2011 • Set 55-1-1]

Q33. Show how the equation for Ampere's circuital law, viz. $\oint \vec{B} \cdot d\vec{l} = \mu_0 I$ is modified in the presence of displacement current.

[2011 • Set 55-2-1]

Q34. Arrange the following electromagnetic radiations in ascending order of their frequencies:

(i) Microwave

(ii) Radio wave

(iii) X-rays

(iv) Gamma rays Write two uses of any one of these.

[2010]

Q35. How does a charge q oscillating at certain frequency produce electromagnetic waves?

Sketch a schematic diagram depicting electric and magnetic fields for an electromagnetic wave propagating along the Z-direction.

[2009]

Q36. Answer the following questions:

(a) Optical and radio telescopes are built on the ground while X-ray astronomy is possible only from satellites orbiting the Earth. Why?

(b) The small ozone layer on top of the stratosphere is crucial for human survival. Why?

[2009]

Q37. Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and the other having negative susceptibility. What does negative susceptibility signify?

[2008]

Q38. What is meant by the transverse nature of electromagnetic waves? Draw a diagram showing the propagation of an electromagnetic wave along the x-direction, indicating clearly the directions of the oscillating electric and magnetic fields associated with it.

[2008]

Q39. Find the wavelength of electromagnetic waves of frequency $5 \times 10^{19}\,\text{Hz}$ in free space. Give its two applications.

[2004]

3-Mark Questions (53 questions · Section C · SA)

Q1. Name the electromagnetic waves which are used for:

(i) detection of fractures in bones

(ii) physiotherapy

(iii) radar systems Also write their wavelength range.

[2026 • Set 55-2-1]

Q2. Name the electromagnetic waves which are used:

(i) as a diagnostic tool in medicine

(ii) in remote switches for TV sets

(iii) in water purifiers Also write their wavelength range.

[2026 • Set 55-2-2]

Q3. Name the electromagnetic waves which are (i) also known as 'heat waves', (ii) used in LASIK eye surgery, (iii) used to destroy cancer cells. Also write their wavelength range.

[2026 • Set 55-2-3]

Q4. (a) Depict the variation of electric field $(\vec{E})$ and magnetic field $(\vec{B})$ with respect to the direction of propagation of an electromagnetic wave. Write their two important characteristics.

(b) Show that $\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ gives the velocity of an electromagnetic wave in free space.

[2026 • Set 55-3-1]

Q5. What are microwaves? How are they produced? Give any two uses of microwaves.

[2026 • Set 55-4-2]

Q6. What is displacement current (i_d)? Considering the case of charging of a capacitor, show that $i_d = \varepsilon_0 \frac{d\Phi_E}{dt}$. What is the value of i_d for a conductor across which a constant voltage is applied?

[2026 • Set 55-5-1]

Q7. Differentiate between conduction current and displacement current. A capacitor is connected across a source providing time-dependent current. Explain how the total current at an instant is the sum of conduction current and displacement current in the circuit at that instant.

[2026 • Set 55-5-2]

Q8. (a) A parallel plate capacitor is charged by an ac source. Show that the sum of conduction current (I_c) and the displacement current (I_d) has the same value at all points of the circuit.

(b) In case (a) above, is Kirchhoff's first rule (junction rule) valid at each plate of the capacitor? Explain.

[2025 • Set 55-1-1]

Q9. (a) The electric field $\vec{E}$ of an electromagnetic wave propagating in north direction is oscillating in up and down direction. Describe the direction of magnetic field $\vec{B}$ of the wave.

(b) Are the wave length of radio waves and microwaves longer or shorter than those detectable by human eyes?

(c) Write main use of each of the following in human life: (i) Infrared waves (ii) Gamma rays

[2025 • Set 55-2-1]

Q10. (a) How is an electromagnetic wave produced?

(b) An electromagnetic wave is travelling in vertically upward direction. At an instant, its electric field vector points in west direction. In which direction does the magnetic field vector point at that instant?

(c) Estimate the ratio of shortest wave length of radio waves to the longest wave length of gamma waves.

[2025 • Set 55-2-2]

Q11. (a) The amplitude of a light wave becomes n times. This results in intensity of the wave becoming m times. What is the relation between n and m?

(b) White light is incident on three identical surfaces - a black surface, a yellow surface and a white surface, one by one. For which surface, the pressure exerted on the surface by the incident light will be (i) maximum (ii) minimum? Justify your answer.

[2025 • Set 55-2-3]

Q12. (a) State any three characteristics of electromagnetic waves.

(b) Briefly explain how and where the displacement current exists during the charging of a capacitor.

[2025 • Set 55-4-1]

Q13. Name the electromagnetic wave used (i) in radar, (ii) in eye surgery and (iii) as diagnostic tool in medicine. Write their wavelength range also.

[2025 • Set 55-6-1]

Q14. (a) Differentiate between 'conduction current' and 'displacement current', giving one similarity and one dissimilarity between them.

(b) Explain the existence of electromagnetic waves in free space, using the concept of displacement current.

[2025 • Set 55-7-1]

Q15. (a) How are electromagnetic waves produced?

(b) Write the wavelength range and one use of: (i) Microwaves, and (ii) Ultraviolet waves.

[2025 • Set 55-7-2]

Q16. Name the electromagnetic radiations and write their frequency range:

(a) Used to take the photograph of the bones

(b) Produced by hot bodies

(c) Used in television communication systems

[2025 • Set 55-7-3]

Q17. (a) "The wavelength of the electromagnetic wave is often correlated with the characteristic size of the system that radiates." Give two examples to justify this statement.

(b) (i) Long distance radio broadcasts use short-wave bands. Why? (ii) Optical and radio telescopes are built on the ground, but X-ray astronomy is possible only from satellites orbiting the Earth. Why?

[2024 • Set 55-1-1]

Q18. (a) On what factors does the speed of an electromagnetic wave in a medium depend?

(b) How is an electromagnetic wave produced?

(c) Sketch a schematic diagram depicting the electric and magnetic fields for an electromagnetic wave propagating along z-axis.

[2024 • Set 55-2-1]

Q19. The electric field in an electromagnetic wave in vacuum is given by: $\vec{E} = (6.3\,\text{N/C})[\cos((1.5\,\text{rad/m})y + (4.5 \times 10^8\,\text{rad/s})t)]\,\hat{i}$

(a) Find the wavelength and frequency of the wave.

(b) What is the amplitude of the magnetic field of the wave?

(c) Write an expression for the magnetic field of this wave.

[2024 • Set 55-3-1]

Q20. Name the electromagnetic waves with their wavelength range which are used for

(i) FM radio broadcast

(ii) detection of fracture in bones

(iii) treatment of muscular strain

[2024 • Set 55-4-1]

Q21. What is meant by displacement current? How is this current different from the conduction current? A capacitor is being charged by a source of emf. Justify the continuity of current in the circuit.

[2024 • Set 55-4-2]

Q22. Explain the following giving reasons:

(i) 'Electromagnetic waves differ considerably in their mode of interaction with matter'.

(ii) 'Food items to be heated in microwave oven must contain water'.

(iii) 'Welders wear face mask with glasses during welding'.

[2024 • Set 55-4-3]

Q23. (a) Name the parts of the electromagnetic spectrum which are (i) also known as 'heat waves' and (ii) absorbed by ozone layer in the atmosphere.

(b) Write briefly one method each, of the production and detection of these radiations.

[2024 • Set 55-5-1]

Q24. Name the part of the electromagnetic spectrum which are:

(i) stopped by face mask worn by welders.

(ii) used in detectors in Earth satellites.

(iii) used in 'short-wave band' in communication. Also write the order of wavelengths, in each case.

[2024 • Set 55-5-2]

Q25. (i) Depict a plane electromagnetic wave propagating along the x-axis. Write the expressions for its oscillating electric and magnetic fields.

(ii) Write three characteristics of electromagnetic waves.

[2022 • Set 55-2-1]

Q26. Name the electromagnetic waves which are produced by the following:

(i) Radioactive decays of nucleus

(ii) Welding arcs

(iii) Hot bodies Write one use each of these waves.

[2022 • Set 55-2-1]

Q27. Electromagnetic waves of wavelengths λ_1, λ_2 and λ_3 are used in radar systems, in water purifiers and in remote switches of TV, respectively.

(i) Identify the electromagnetic waves, and

(ii) Write one source of each of them.

[2022 • Set 55-3-1]

Q28. Identify electromagnetic waves which:

(i) are used in radar system.

(ii) affect a photographic plate.

(iii) are used in surgery. Write their frequency range.

[2022 • Set 55-4-1]

Q29. **(i)** Arrange the following electromagnetic radiation in the ascending order of their frequencies: X-rays, microwaves, gamma rays, radio waves

(ii) Write two uses of any two of these radiation.

[2022 • Set 55-5-1]

Q30. Write the expression for the speed of light in a material medium of relative permittivity ε_r and relative magnetic permeability μ_r.

[2020 • Set 55-1-1]

Q31. Write the wavelength range and name of the electromagnetic waves which are used in (i) radar systems for aircraft navigation, and (ii) Earth satellites to observe the growth of the crops.

[2020 • Set 55-1-1]

Q32. Name the electro-magnetic waves with their frequency range, produced in

(a) some radioactive decay

(b) sparks during electric welding

(c) TV remote

[2020 • Set 55-4-1]

Q33. **(a)** We feel the warmth of the sun light but not the pressure on our hands. Explain.

(b) Which out of wavelength, frequency and speed of an electro-magnetic wave does not change on passing from one medium to another?

(c) A thin ozone layer in the upper atmosphere is crucial for human survival on earth, why?

[2020 • Set 55-4-2]

Q34. **(a)** How are electro-magnetic waves produced? Depict an electro-magnetic wave propagating in Z-direction with its magnetic field $\vec{B}$ oscillating along X-direction.

(b) Write two characteristics of electro-magnetic waves.

[2020 • Set 55-4-3]

Q35. Identify the part of the electromagnetic spectrum used in (i) radar and (ii) eye surgery. Write their frequency range.

[2019 • Set 55-1-1]

Q36. Prove that the average energy density of the oscillating electric field is equal to that of

the oscillating magnetic field.

[2019 • Set 55-1-1]

Q37. Name the radiation of the electromagnetic spectrum which is used for the following:

(a) Radar

(b) To photograph internal parts of human body

(c) For taking photographs of the sky during night and foggy conditions Give the frequency range in each case.

[2019 • Set 55-3-1]

Q38. When a parallel plate capacitor is being charged by a dc battery, why does a galvanometer show a momentary deflection? Obtain the expression for the displacement current and show how it is related to conduction current in a steady state.

[2019 • Set 55-3-2]

Q39. Write the range of the wavelength of the following electromagnetic radiations:

(a) Infrared rays

(b) Ultraviolet rays

(c) γ-rays Write one use of each of the above.

[2019 • Set 55-3-3]

Q40. Define displacement current. What role does it play while charging a capacitor by dc source. Is the value of displacement current same as that of the conduction current? Explain.

[2019 • Set 55-5-1]

Q41. (a) How are electromagnetic waves produced? Explain.

(b) A plane electromagnetic wave is travelling through a medium along the +ve z-direction. Depict the electromagnetic wave showing the directions of the oscillating electric and magnetic fields.

[2017]

Q42. (i) Identify the part of the electromagnetic spectrum which is:

(a) suitable for radar system used in aircraft navigation,

(b) produced by bombarding a metal target by high speed electrons. (ii) Why does a galvanometer show a momentary deflection at the time of charging or discharging a capacitor? Write the necessary expression to explain this observation.

[2016]

Q43. How are electromagnetic waves produced? What is the source of energy of these waves? Write mathematical expressions for electric and magnetic fields of an electromagnetic wave propagating along the z-axis. Write any two important properties of electromagnetic waves.

[2016]

Q44. How are electromagnetic waves produced? What is the source of energy of these waves? Draw a schematic sketch of the electromagnetic waves propagating along the $+x$-axis. Indicate the directions of the electric and magnetic fields. Write the relation between the velocity of propagation and the magnitudes of electric and magnetic fields.

[2015]

Q45. Name the parts of the electromagnetic spectrum which is

(a) suitable for radar systems used in aircraft navigation.

(b) used to treat muscular strain.

(c) used as a diagnostic tool in medicine. Write in brief, how these waves can be produced.

[2015]

Q46. Answer the following :

(a) Name the em waves which are suitable for radar systems used in aircraft navigation. Write the range of frequency of these waves.

(b) If the earth did not have atmosphere, would its average surface temperature be higher or lower than what it is now ? Explain.

(c) An em wave exerts pressure on the surface on which it is incident. Justify.

[2014]

Q47. Answer the following :

(a) Name the em waves which are used for the treatment of certain forms of cancer. Write their frequency range.

(b) Thin ozone layer on top of stratosphere is crucial for human survival. Why ?

(c) Why is the amount of the momentum transferred by the em waves incident on the surface so small ?

[2014]

Q48. Answer the following the questions :

(a) Name the em waves which are produced during radioactive decay of a nucleus. Write their frequency range.

(b) Welders wear special glass goggles while working. Why ? Explain.

(c) Why are infrared waves often called as heat waves ? Give their one application.

[2014]

Q49. Write briefly any two factors which demonstrate the need for modulating a signal. Draw a suitable diagram to show amplitude modulation using a sinusoidal signal as the modulating signal.

[2011]

Q50. Draw a schematic diagram showing the (i) ground wave (ii) sky wave and (iii) space wave propagation modes for em waves. Write the frequency range for each of the following:

(i) Standard AM broadcast

(ii) Television

(iii) Satellite communication

[2011 • Set 55-1-1]

Q51. Write four characteristics of electromagnetic waves. Give two uses each of (i) Radio-waves (ii) Micro-waves.

[2007]

Q52. Name the following constituent radiations of electromagnetic spectrum which

(i) produce intense heating effect.

(ii) is absorbed by the ozone layer in the atmosphere.

(iii) is used for studying crystal structure. Write one more application for each of these radiations.

[2007]

Q53. Draw a labelled diagram of Hertz's experimental set-up to produce electromagnetic waves. Explain the generation of electromagnetic waves using this set-up.

[2006]