CLASS XII – PHYSICS (042)
PRACTICE PAPER – CHAPTER 8: ELECTROMAGNETIC WAVES

Academic Session 2026–27

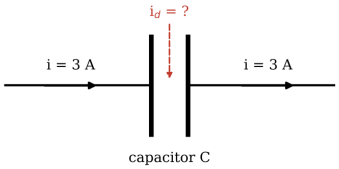
Maximum Marks : 35 **Time Allowed : 1 hour 15 minutes**

General Instructions

(1) There are 18 questions in all. All questions are compulsory.
(2) The question paper has five sections: Section A, B, C, D and E.
(3) Section A (Q.1–9) has seven MCQs and two Assertion–Reasoning questions of 1 mark each. Section B (Q.10–13) has four questions of 2 marks each. Section C (Q.14–16) has three questions of 3 marks each. Section D (Q.17) is one case study based question of 4 marks. Section E (Q.18) is one long answer question of 5 marks.
(4) There is no overall choice. An internal choice is provided in Q.12 (Section B), Q.15 (Section C), Q.17 part (iv) (Section D) and Q.18 (Section E). Attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.
(6) You may use the following values wherever necessary: $c = 3 \times 10^{8}$ m s^{-1}, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2}, $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}, $h = 6.6 \times 10^{-34}$ J s, $e = 1.6 \times 10^{-19}$ C, $\pi = 3.14$, $\sqrt{2} = 1.41$.

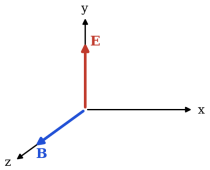
SECTION A (9 × 1 = 9)

1. A capacitor is being charged, and the current in the connecting wires is 3 A, as shown. The displacement current between the plates of the capacitor is **1**



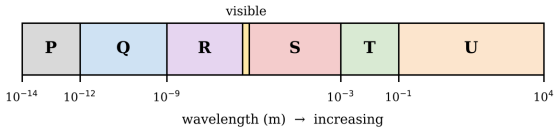
(a) zero
(b) 1.5 A
(c) 3 A
(d) 6 A

2. At a point in space the electric field E and the magnetic field B of an electromagnetic wave point along +y and +z respectively, as shown. The wave is travelling along **1**



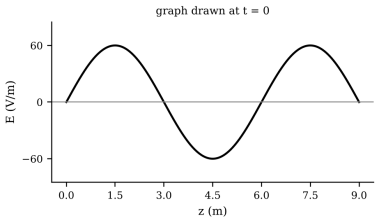
(a) −x direction
(b) +x direction
(c) +z direction
(d) −y direction

3. The figure shows the electromagnetic spectrum on a scale of wavelength, the regions being marked P, Q, R, S, T and U. Region V is the visible region. The radiation in region S, which is next to the red end of the visible region and is often called ‘heat waves’, is **1**



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

4. The graph shows the electric field of a plane electromagnetic wave in vacuum as a function of position z at t = 0. The amplitude of its magnetic field and its frequency are respectively **1**



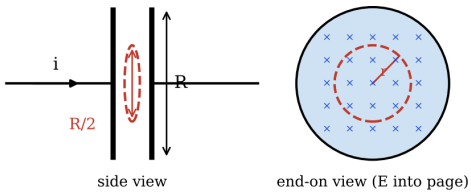
(a) 2×10^{-7} T, 25 MHz
(b) 2×10^{-7} T, 50 MHz
(c) 2×10^{-6} T, 50 MHz
(d) 2×10^{-8} T, 100 MHz

5. Match the waves in Column I with their method of production in Column II. The correct matching is **1**

Column I (wave)	Column II (production)
P. Microwaves	1. Radioactive decay of the nucleus
Q. Gamma rays	2. Klystron or magnetron valve
R. X-rays	3. Vibration of atoms and molecules
S. Infrared	4. X-ray tube / inner shell electrons

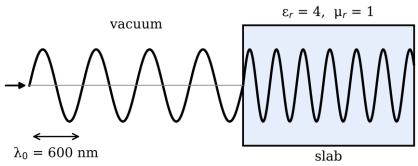
(a) P–1, Q–2, R–3, S–4
(b) P–2, Q–4, R–1, S–3
(c) P–3, Q–1, R–2, S–4
(d) P–2, Q–1, R–4, S–3

6. A parallel plate capacitor with circular plates of radius R is charged by a constant current i, as shown. The displacement current through the dashed circular loop of radius R/2 drawn in the gap, coaxial with the plates, is **1**



(a) i/4
(b) i/2
(c) i
(d) 2i

7. A light wave of wavelength 600 nm in vacuum enters a non-magnetic slab of relative permittivity 4 and relative permeability 1, as shown. The wavelength of the wave inside the slab is **1**



(a) 150 nm
(b) 600 nm
(c) 300 nm
(d) 1200 nm

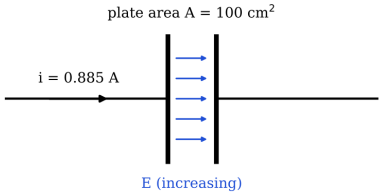
For Questions 8 and 9, a statement of Assertion (A) is followed by a statement of Reason (R). Select the correct answer from the options below.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

8. **Assertion (A):** A magnetic field exists between the plates of a charging capacitor although no conduction current flows across the gap. **1**
Reason (R): A time-varying electric field gives rise to a displacement current, which acts as a source of magnetic field just like a conduction current.

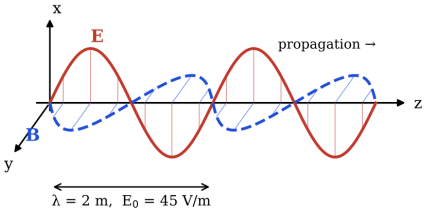
9. **Assertion (A):** A charge moving with a uniform velocity radiates electromagnetic waves. **1**
Reason (R): Electromagnetic waves are produced by accelerated charges.

SECTION B (4 × 2 = 8)

10. The plates of a parallel plate capacitor, each of area 100 cm^2, are being charged by a constant current of 0.885 A, as shown. Find (a) the displacement current between the plates, and (b) the rate at which the electric field between the plates changes. **2**



11. A plane electromagnetic wave travels along +z in vacuum with its electric field along the x-axis and magnetic field along the y-axis. From the figure, its wavelength is 2 m and the amplitude of the electric field is 45 V/m. Write the expressions for the electric field E_x and magnetic field B_y of the wave as functions of z and t. **2**



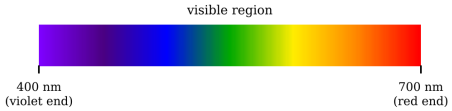
12. **(A)** The table gives the wavelength and method of production of three radiations P, Q and R of the electromagnetic spectrum. Identify each radiation and state one use of each. **2**

Radiation	Wavelength	Method of production
P	3 cm	special vacuum tube (magnetron)
Q	0.05 nm	high energy electrons striking a metal target
R	10 μm	vibration of atoms and molecules of hot bodies

OR

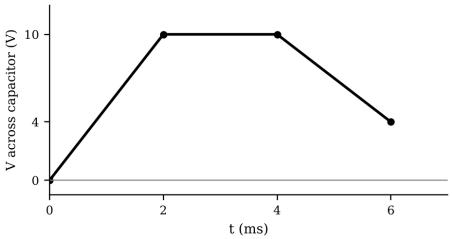
(B) Give reasons: (i) One cannot get tanned through a glass window although the sun is a source of ultraviolet radiation. (ii) Infrared waves are often called heat waves.

13. The figure shows the visible region of the electromagnetic spectrum between 400 nm and 700 nm. Using E = hν, find the energy in eV of a photon at (a) the violet end, and (b) the red end. Which end has photons of higher energy? **2**

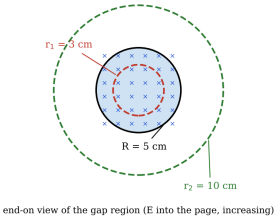


SECTION C (3 × 3 = 9)

14. A capacitor of capacitance 2 μF is charged by a source such that the potential difference across it varies with time as shown in the graph. (a) Find the displacement current between the plates in each of the time intervals 0–2 ms, 2–4 ms and 4–6 ms. (b) How is the displacement current in the interval 4–6 ms directed relative to that in the interval 0–2 ms? What does this tell you about the current in the connecting wires in the interval 4–6 ms? **3**



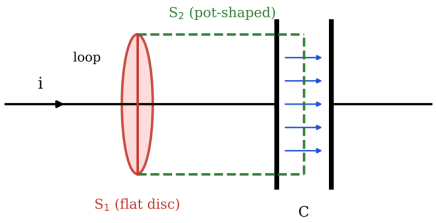
15. **(A)** A parallel plate capacitor with circular plates of radius R = 5 cm is charged by a constant current i = 2 A. The figure shows an end-on view of the gap region with two circular loops of radii r_1 = 3 cm (inside the plate radius) and r_2 = 10 cm, drawn coaxial with the plates in the plane of the gap. (a) State the Ampere–Maxwell law. (b) Find the magnetic field at the points of loop r_1. (c) Find the magnetic field at the points of loop r_2. **3**



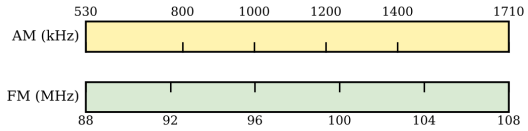
end-on view of the gap region (E into the page, increasing)

OR

(B) The figure shows a capacitor being charged by a current i. A flat disc S_1 and a pot-shaped surface S_2 have the same circular loop as their boundary; S_1 is cut by the wire while S_2 passes through the gap between the plates. Explain what contradiction arises when Ampere's circuital law is applied to the two surfaces, how Maxwell removed it, and write the generalised law.

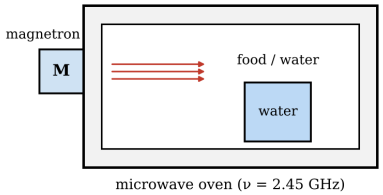


16. The figure shows the tuning dial of a radio with the AM band from 530 kHz to 1710 kHz and the FM band from 88 MHz to 108 MHz. (a) Find the range of wavelengths of the AM band. (b) Find the range of wavelengths of the FM band. (c) A transmitting or receiving antenna works best when its size is comparable to the wavelength. Which band needs a shorter antenna? Give a reason. **3**



SECTION D (1 × 4 = 4)

17. **Case Study.** In a microwave oven, a magnetron produces microwaves of frequency 2.45 GHz. These waves enter the cooking chamber and are absorbed by the water molecules in the food, which raises its temperature, as shown in the figure. Microwaves are short-wavelength radio waves and are also used in radar systems. Answer the following: **4**



(i) The wavelength of the microwaves used in the oven is nearly
(a) 1.2 cm (b) 12 cm (c) 1.2 m (d) 12 m

(ii) The frequency of the microwaves in the oven is chosen because it
(a) is the frequency of the mains supply (b) is the only frequency which can pass through glass (c) matches the resonant frequency of water molecules so that energy is transferred efficiently (d) is the same as the frequency of visible light

(iii) The microwaves in the oven are produced by
(a) a magnetron valve (b) radioactive nuclei (c) an X-ray tube (d) a thermopile

(iv) The energy of one photon of these microwaves is nearly
(a) 10^{-8} eV (b) 10^{-5} eV (c) 10^{-2} eV (d) 1 eV

OR

(iv) If the amplitude of the electric field of the microwaves in the chamber is 600 V/m, the amplitude of the magnetic field is
(a) 2×10^{-6} T (b) 2×10^{-9} T (c) 1.8×10^{11} T (d) 2×10^{-3} T

SECTION E (1 × 5 = 5)

18. **(A)** Explain how electromagnetic waves are produced. With a labelled diagram describe their nature, and write the expressions for E and B of a wave travelling along +z. State the relations $c = 1/\sqrt{(\mu_0 \varepsilon_0)}$ and $E_0/B_0 = c$. (3) **5**
The magnetic field of a plane electromagnetic wave travelling along +x in vacuum is $B_z = 2 \times 10^{-7} \sin(2.1\ x - 6.3 \times 10^{8}\ t)$ tesla. Find the wavelength and frequency of the wave. Write the expression for its electric field, stating its direction. (2)

OR

(B) State the four Maxwell's equations for vacuum, naming each, and mention the physical meaning of each. (3)
The circular plates of a capacitor have radius 4 cm and capacitance 80 pF. The capacitor is connected to a 150 V (rms) ac source of angular frequency 500 rad s^{-1}. Find the rms value of the conduction current, and the amplitude of the magnetic field between the plates at a distance of 2 cm from the axis. (2)

— End of Question Paper —