

Time: 3hrs;

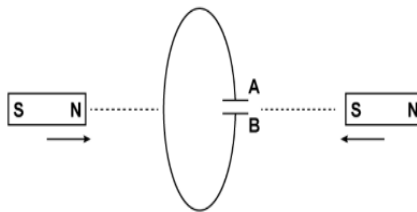
Total Marks: 70

**General Instructions:**

1. All questions are compulsory. There are 26 questions in all.
2. Section A contains of one mark each
3. Section B contains of two marks each
4. Section C contains of three marks each
5. Section D contains one value based question of four marks and
6. Section E contains of five marks each
7. There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.

**SECTION – A**

1. Nichrome and Copper wires of same length and same radius are connected in series. Current  $I$  am passed through them. Which wire gets heated up more? Justify your answer.
2. Do electromagnetic waves carry energy and momentum?
3. How does the angle of minimum deviation of a glass prism vary, if the incident violet light is replaced by red light? Give reason.
4. Name the phenomenon which shows the quantum nature of electromagnetic radiation.
5. Predict the polarity of the capacitor in the situation described below:



**SECTION – B**

6. Draw the intensity pattern for single slit diffraction and double slit interference. Hence, State two differences between interference and diffraction patterns.

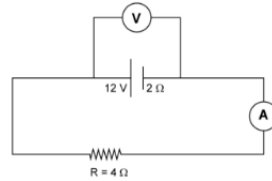
OR

Unpolarised light is passed through a Polaroid  $P_1$ . When this polarized beam passes through another Polaroid  $P_2$ , and if the pass axis of  $P_2$  makes angle  $\theta$  with the pass axis of  $P_1$ , then write the expression for the polarized beam passing through  $P_2$ . Draw a plot showing the variation of intensity when  $\theta$  varies from 0 to  $2\pi$ .

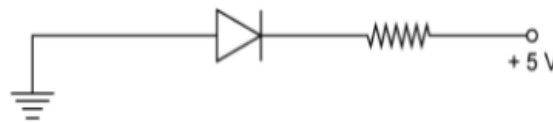
7. Identify the electromagnetic waves whose wavelength vary as  
 (a)  $10^{-12} \text{ m} < \lambda < 10^{-8} \mu$       (b)  $10^{-3} \text{ m} < \lambda < 10^{-1} \text{ m}$   
 Write one use for each.
8. Find the condition under which the charged particles moving with different speeds in the presence of electric and magnetic field vectors can be used to select charged particles of a particular speed.
9. A 12.5 eV electron beam is used to excite a gaseous hydrogen atom at room temperature. Determine the wavelength and the corresponding series of the lines emitted.
10. Write two properties of a material for making (a) a permanent magnet, and (b) an electromagnet.

SECTION – C

11. (a) The potential difference applied across a given resistor is altered so that the heat produced per second increases by a factor of 9. By what factor does the applied potential difference change?  
 (b) In the figure shown, an ammeter A and a resistor of  $4\ \Omega$  are connected to the terminals of the source. The emf of the source is 12 V having an internal resistance of  $2\ \Omega$ . Calculate the voltmeter and ammeter readings.



12. (a) How is amplitude modulation achieved?  
 (b) The frequencies of two side bands in an AM wave are 640 kHz and 660 kHz, respectively. Find the frequencies of carrier and modulating signal. What is the bandwidth required for amplitude modulation?
13. (a) In the following diagram, is the junction diode forward biased or reverse biased?

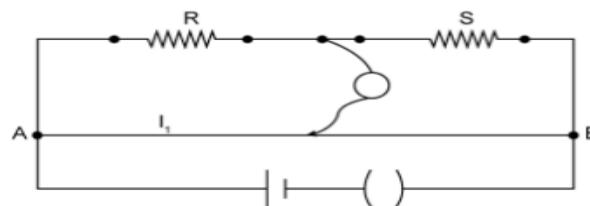


- (b) Draw the circuit diagram of a full wave rectifier and state how it works.
14. Using photon picture of light, show how Einstein's photoelectric equation can be established. Write two features of photoelectric effect which cannot be explained by wave theory.
15. (a) Monochromatic light of wavelength 589 nm is incident from air on a water surface. If  $\mu$  for water is 1.33, find the wavelength, frequency and speed of the refracted light.  
 (b) A double convex lens is made of a glass of refractive index 1.55, with both faces of the same radius of curvature. Find the radius of curvature required if the focal length is 20cm.
16. Define mutual inductance between a pair of coils. Derive an expression for the mutual inductance of two long coaxial solenoids of same length wound one over the other.

OR

Define self-inductance of a coil. Obtain the expression for the energy stored in an inductor L connected across a source of emf.

17. a) Write the principle of working of a metre bridge.  
 b) In a metre bridge, the balance point is found at a distance  $l_1$  with resistance R and S as shown in the figure.

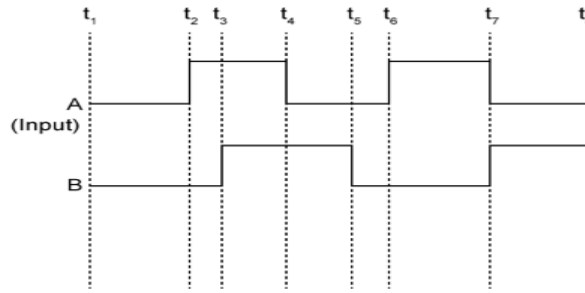


An unknown resistance X is now connected in parallel to the resistance S and the balance point is found at a distance  $l_2$ . Obtain a formula for X in terms of  $l_1$ ,  $l_2$  and S.

18. Draw a block diagram of a generalized communication system. Write the functions of each of the following.

- a) Transmitter                      b) Channel                      c) Receiver

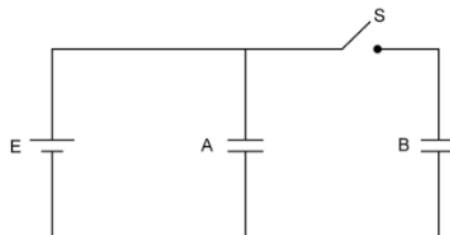
19. a) Write the functions of the three segments of a transistor.  
 b) The figure shows the input waveform A and B for 'AND' gate. Draw the output waveform and write the truth table for this logic gate.



20. a) Draw a ray diagram depicting the formation of the image by an astronomical telescope in normal adjustment.  
 b) You are given the following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope?  
 Give reason.

Lenses	Power (D)	Aperture (cm)
L <sub>1</sub>	3	8
L <sub>2</sub>	6	1
L <sub>3</sub>	10	1

21. a) State Biot – Savart law and express this law in the vector form,  
 b) Two identical circular coils, P and Q each of radius R, carrying currents 1 A and  $\sqrt{3}$  A respectively, are placed concentrically and perpendicular to each other lying in the XY and YZ planes. Find the magnitude and direction of the net magnetic field at the centre of the coils.  
 22. Two identical parallel plate capacitors A and B are connected to a battery of V volts with the switch S closed. The switch is now opened and the free space between the plates of the capacitors is filled with a dielectric constant k. Find the ratio of the total electrostatic energy stored in both capacitors before and after the introduction of the dielectric



**SECTION – D**

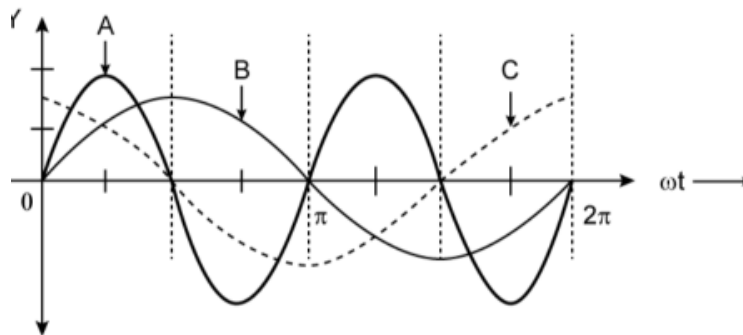
23. Asha's mother read an article in the newspaper about a disaster that took place at Chernobyl. She could not understand much from the article and asked a few questions from Asha regarding the article. Asha tried to answer her mother's question based on what she learnt in class XII Physics.  
 a) What was the installation at Chernobyl where the disaster took place? What, according to you, was the cause of this disaster?  
 b) Explain the process of release of energy in the installation at Chernobyl.  
 c) What, according to you, were the values displayed by Asha and her mother?

SECTION – E

24. a) Derive an expression for the electric field  $E$  due to a dipole of length “ $2a$ ” at a point distant  $r$  from the centre of the dipole on the axial line.  
 b) Draw a graph of  $E$  versus  $r$  for  $r \gg a$ .  
 c) If this dipole were kept in a uniform external electric field  $E_0$ , diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in both the cases.

OR

- a) Use Gauss’s theorem to find electric field due to a uniformly charged infinitely large plane thin sheet with surface charge density  $\sigma$ .  
 b) An infinitely large thin plane sheet has a uniform surface charge density  $+\sigma$ . Obtain the expression for the amount of work done in bringing a point charge  $q$  from infinity to a point, distant  $r$ , in front of the charged plane sheet.
25. A device ‘X’ is connected to an ac source  $V = V_0 \sin \omega t$ . The variation of voltage, Current and power in one cycle is shown in the following graph:



- a) Identify the device ‘X’  
 b) Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? Justify your answer.  
 c) How does its impedance vary with frequency of the ac source? Show graphically.  
 d) Obtain an expression for the current in the circuit and its phase relation with ac voltage.

OR

- a) Draw a labelled diagram of an ac generator. Obtain the expression for the emf induced in the rotating coil of  $N$  turns each of cross-sectional area  $A$ , in the presence of a magnetic field  $B$ .  
 b) A horizontal conducting rod 10 m long extending from east to west is falling with a speed  $5.0 \text{ ms}^{-1}$  at right angles to the horizontal component of the Earth’s magnetic field,  $0.3 \times 10^{-4} \text{ Wb m}^{-2}$ . Find the instantaneous value of the emf induced in the rod.
26. a) Define wave front. Use Huygens’ Principle to verify the laws of refraction.  
 b) How is linearly polarized light obtained by the process of scattering of light? Find the Brewster angle for air – glass interface, when the refractive index of glass = 1.5.

OR

- a) Draw a ray diagram to show the image formation by a combination of two thin convex lenses in contact. Obtain the expression for the power of this combination in terms of the lengths of the lenses.  
 b) A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is  $\frac{3}{4}$  of the angle of prism Calculate the speed of light in the prism.