

PHYSICS

SAMPLE PAPER – III

Time : 3 hours

Max. Marks : 70

General Instructions

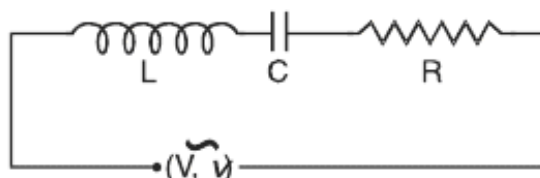
All questions are compulsory.

1. Draw the equipotential surfaces for two point charges each of magnitude $q > 0$ placed at some finite distance? 1
2. A bar magnet of dipole moment M is cut into two equal parts along its axis. What is the new pole strength of each part. 1
3. A rod of length L , along East-West direction is dropped from a height H . if B be the magnetic field due to earth at that place and angle of dip is δ , then what is the magnitude of induced emf across two ends of the rod when the rod reaches the earth? 1
4. Which characteristic of the following electromagnetic waves (i) increases (ii) remains same as we move along γ -radiation, ultraviolet rays, microwaves and radio waves? 1
5. Two polaroids are placed with their optic axis perpendicular to each other. One of them is rotated through 45° what is the intensity of light emerging from the second polaroid if I_0 is the intensity of unpolarised light? 1
6. Sketch the graph showing the variation of applied voltage and photo electric current for (i) same frequency and two different intensities, and (ii) same intensity and two different frequencies. 1
7. A heavy nucleus splits into two lighter nuclei. Which one of the two – parent nucleus or the daughter nuclei have more binding energy per nucleon? 1

8. What happens to the width of depletion layer of a p - n junction diode when it is (i) forward biased (ii) reverse biased. 1
9. Four equal charges $+q$, $-q$ and $+q$ are placed at the vertices P , Q and R of an equilateral triangle of side ' a '. What is the electric potential at the centre of the triangle? How will your answer change if position of charges at P and Q are interchanged? 2
10. What are ohmic and non-ohmic conductors? Give one example of each. Why one can not measure the potential barrier of a p - n junction by using a voltmeter? 2
11. A charged particle enters a magnetic field perpendicular to it. The particle follows a zigzag path and comes out of it. What happens to its velocity and kinetic energy of the particle? Justify your answer. 2
12. Two solenoids each of length L are wound over each other. A_1 and A_2 are the areas of the outer and inner solenoids and N_1 and N_2 are the no. of turns per unit length of the two solenoids. Write the expressions for the self inductances of the two solenoids and their mutual inductance. Hence show that square of the mutual inductance of the two solenoids is less than the product of the self inductances of the two solenoids. 2
13. Why two equipotential surfaces do not intersect each other? A charge q_0 is placed at the centre of a conducting sphere of radius R , what is the work done in moving a charge q from one point to other diametrically opposite along the surface of the sphere? 2
14. In an LCR circuit if frequency of the supply is made 4 times, how should the values of C and L be changed so that there is no change in the current in the circuit. 2

OR

The series LCR circuit shown in figure is in resonance state. What is the voltage across the inductor?

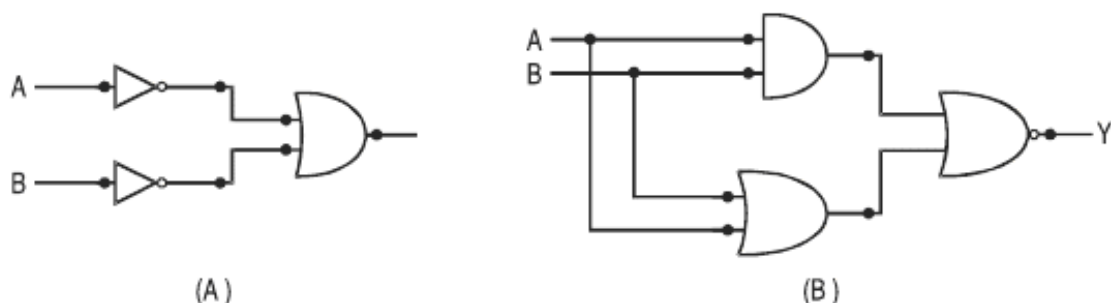


15. Arrange the following in ascending order of frequency X-rays, green light, red light, microwaves, γ -radiation. Which characteristic of the above waves is same for all in vacuum? 2
16. A ray of light travels through an equilateral triangular prism at an angle of incidence i and emerges out at an angle of emergence e write the expression for the angle of deviation relating i , e and A (angle of the prism). If the ray undergoes a minimum deviation of 30° then what is the refractive index of the material of the prism? 2
17. A radio active material after 10 days reduces to 6.25%. If 40 g sample is taken then in how many days only 5g of the material is left? 2
18. What is ground wave communication? Why it can not be used for long distance communication at high frequencies. 2
19. In young's double slit experiment the intensities of two interfering waves are I and $4I$. What are the maximum and minimum intensities in the interference pattern? 2
20. An electric dipole of moment $\mathbf{p}$ is placed in a uniform electric field $\mathbf{E}$. Derive the expression for the potential energy of the dipole and show diagrammatically the orientation of the dipole in the field for which the potential energy is (i) maximum (ii) minimum. 3

OR

Two capacitors C_1 and C_2 are charged to potential V_1 and V_2 respectively and then connected in parallel. Calculate (i) common potential, (ii) charge on each capacitor, (iii) electrostatic energy in the system after connection.

21. Produced the truth table for the combination of gates shown in the figure. 3



22. What are the characteristics of the objectives lens of an objective lens of and astronomical telescope? Derive the expression for the magnifying power of astronomical telescope in normal adjustment. 3
23. Calculate the de-Broglie wavelength of (i) an electron accelerated by a potential difference of 100V and (ii) a particle of mass 0.03 kg moving with a speed of 100 ms^{-1} . Hence show that wavelength of the particle is not relevant. 3
24. In a plane electromagnetic waves progressing towards $-x$ -axis, the electric field oscillates sinusoidally at a frequency of $2.0 \times 10^{10} \text{ Hz}$ and amplitude 48 Vm^{-1} along $-z$ -axis. Write the expression for the electric field and the magnetic field. 3
25. Name the series of hydrogen which does not lie in visible region?
The wavelength of first member of Lyman series is $1216 \text{ \AA}$. Calculate the wavelength of third member of Lyman series. 3
26. The height of a transmission antenna is 600 m find the area covered by the antenna in which the signal from the antenna can be received. 3
27. Draw the circuit diagram to draw the characteristics of common emitter npn transistor. Also draw the input and output characteristics of the transistor. 3
28. Derive the formula for the equivalent emf and internal resistance of the parallel combination of the cells of emf E_1 and E_2 and internal resistance r_1 and r_2 respectively. Two cells of emf 1 V and 2 V and internal resistance 2Ω and 1Ω respectively connected in (i) series (ii) parallel. What should be the value of external resistance in the circuit so that the current through the resistance be the same in the two cases? In which case more heat is generated in the cells?

OR

- Two cells of emf 1.5 V and 2.0 V and internal resistance 1Ω and 2Ω respectively are connected in parallel so as to send current in the same direction through an external resistance of 5Ω . (a) Draw the circuit diagram. (b) Using Kirchhoff's laws, calculate current through each branch of the circuit and potential across the 5Ω resistance.
29. Write the principle, working of moving coil galvanometer with the help of neat labelled diagram. What is the importance of radial field and phosphor bronze used in the construction of moving coil galvanometer?

OR

- (i) A beam of alpha particles and of protons, enter a uniform magnetic field at right angles to the field lines. The particles describe circular paths. Calculate the ratio of the radii two paths if they have same (a) velocity, (b) same momentum, (c) same kinetic energy.
 - (ii) A beam of α -particles and of protons of the same velocity u enters a uniform magnetic field at right angles to the field lines. The particles describe circular paths. What is the ratio of the radii of the two circles?
- 30.
- (i) Using the relation for the refraction at a single spherical refracting surface, derive lens maker's formula for a thin convex lens.
 - (ii) The radius of curvature of either face of a convex lens is equal to its focal length. What is the refractive index of its material?

OR

- (i) Deduce the relationship between the object distance, image distance and the focal length for a mirror. What is the corresponding formula for a thin lens?
- (ii) Two lenses of powers $+15D$ and $-5D$ are in contact with each other forming a combination lens. (a) What is the focal length of this combination? (b) An object of size $3cm$ is placed at $30cm$ from this combination of lenses. Calculate the position and size of the image formed.