GOVIND VIDYALAYA TAMULIA
XII – PHYSICS

Time : 3 Hours **Max. Marks : 70**

General Instructions

(a) All questions are compulsory.

(b) There are 30 questions in total. Questions 1 to 8 carry one mark each, questions 9 to 18 carry two marks each, questions 19 to 27 carry three marks each and questions 28 to 30 carry five marks each.

(c) 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 three questions of five marks each. You have to attempt only one of the given choices in such questions.

(d) Use of calculators is not permitted.

(e) You may use the following physical constants wherever necessary :

c = 3 × 10^8 m/s
h = 6.63 × 10^{-31} Js
e = 1.6 × 10^{-19} C
μ_0 = 4 π × 10^{-7}T mA^{-1}
$\frac{1}{4\pi\varepsilon_0}$ = 9 × 10^9 N m^2C^{-2}
Mass of electron = 9.1 × 10^{-31} kg
Mass of Neutron= 1.675 × 10^{-27} kg
Mass of proton = 1.673 × 10^{-27}kg

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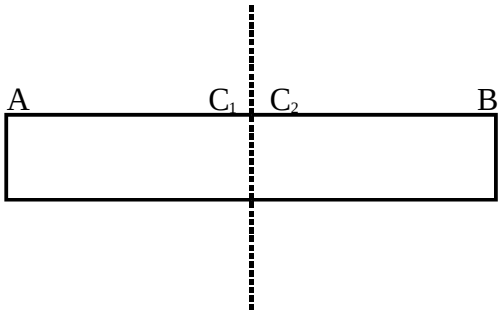
1 .An electrical element X, when connected to an alternating voltage source, has the current through it leading the voltage by $\frac{\pi}{2}$ radii. Identify X and write an expression for its reactance. 1

2 .A (hypothetical) bar magnet (AB) is cut into two equal parts. One part is now kept over the other, so that pole C_2 is above C_1. If M is the magnetic moment of the original magnet, what would be the magnetic moment of the combination so formed? 1



3. Write the electromagnetic wave, having the (i) Maximum (ii) Minimum frequency.1

4. Why does a metallic piece become very hot when it is surrounded by a coil carrying high frequency alternating current? 1

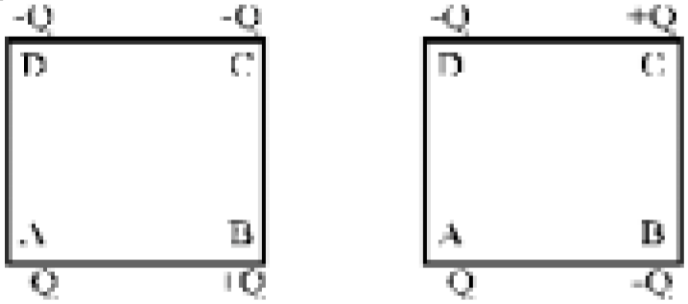
5. A partially plane polarised beam of light is passed through a polaroid. Show graphically the variation of the transmitted light intensity with angle of rotation of the polaroid. 1

6. Give expression for the average value of the a c voltage V = V0 Sin ωt over the time interval t = 0 and t = $\frac{\pi}{\omega}$ 1

7. Four nuclei of an element fuse together to form a heavier nucleus. If the process is accompanied by release of energy, which of the two - the parent or the daughter nucleus would have a higher binding energy/nucleon? 1

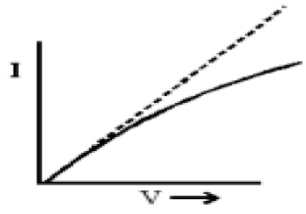
8. Zener diodes have higher dopant densities as compared to ordinary p-n junction diodes. How does it affect the
   (i) Width of the depletion layer? (ii) Junction field? 1

9. Four point charges are placed at the four corners of a square in the two ways (i) and (ii) as shown below. Will the a)Electric field (b) Electric potential, at the center of the square, be the same or different in the two configurations and why? 2



(i) (ii)

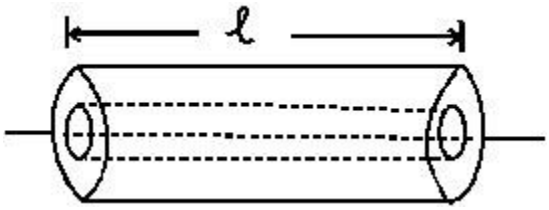
10. The I-V characteristics of a resistor are observed to deviate from a straight line for higher values of current as shown below. Why? 2



11. A charged particle moving with a uniform velocity $\vec{v}$ enters a region where uniform electric and magnetic fields E *and* B are present. It passes through the region without any change in its velocity. What can we conclude about the

a. Relative directions of E, V and B?
b. Magnitudes of E and B? 2

12. Figure shows two long coaxial solenoids, each of length 'L'. The outer solenoid has an area of cross-section A and number of turns/ length n_1. The corresponding values for the inner solenoid are A_2 and n_2. Write the expression for self-inductance L_1, L_2 of the two coils and their mutual inductance M. Hence show that $M < \sqrt{L_1 L_2}$.



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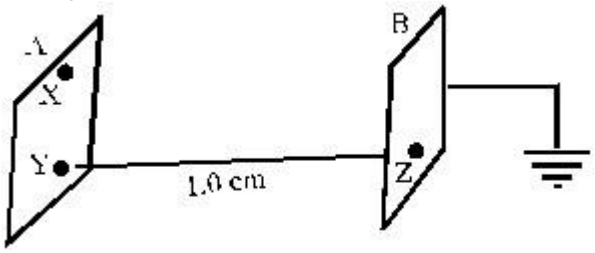
13. Two identical plane metallic surfaces A and B are kept parallel to each other in air separated by a distance of 1.0 cm as shown in the figure.



Surface A is given a positive potential of 10V and the outer surface of B is earthed. (i) What is the magnitude and direction of the uniform electric field between points Y and Z? (ii) What is the work done in moving a charge of 20 μC from point X and point Y. 2

14. Experimental observations have shown that X-rays

(i) travel in vacuum with a speed of 3×10^8 ms^{-1},
(ii) Exhibit the phenomenon of diffraction and can the polarized.

What conclusion can be drawn about the nature of X-rays from each of these observations? 2

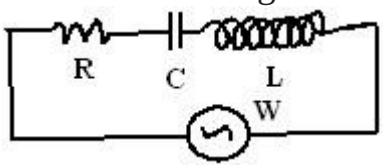
15. Write the relation between the angle of incidence (i), the angle of emergence (e), the angle of prism (A) and the angle of deviation (δ) for rays undergoing refraction through a prism. What is the relation between angle i and angle e for rays undergoing

minimum deviation? Using this relation, write the expression for the refractive index (μ) of the material of prism in terms of angle A and the angle of minimum deviation (δm) 2

16.A radioactive material is reduced to of its original amount in 4 days. How much material should one begin with so that 4×10^{-3} kg of the material is left after 6 days?2

17.Distinguish between 'point to point' and 'broadcast' communication modes. Give one example of each. 2

18. In the circuit shown below, R represents an electric bulb. If the frequency ν of the supply is doubled, how should the values of C and L be changed so that the glow in the bulb remains unchanged? 2



19.An electric dipole of dipole moment P is placed in a uniform electric field E . Write the expression for the torque τ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression. Show diagrammatically the orientation of the dipole in the field for which the torque is (i) Maximum (ii) Half the maximum value (iii) Zero.

OR

Two capacitors with capacity C_1 and C_2 are charged to potential V_1 and V_2 respectively and then connected in parallel. Calculate the common potential across the combination, the charge on each capacitor, the electrostatic energy stored in the system and the change in the electrostatic energy from its initial value. 3

20. Using a suitable combination from a NOR, an OR and a NOT gate, draw circuits to obtain the truth table given below:

A	B	Y
0	0	0
0	1	0
1	0	1
1	1	0

(i)

A	B	Y
0	0	1
0	1	1
1	0	0
1	1	1

(ii)

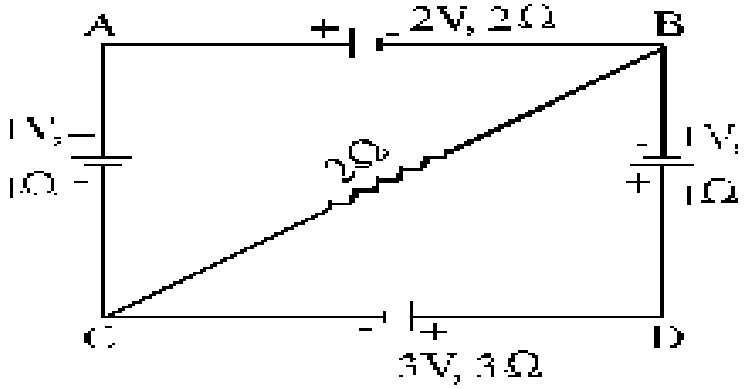
21. Which two main considerations are kept in mind while designing the 'objective' of an astronomical telescope? Obtain an expression for the angular magnifying power and the length of the tube of an astronomical telescope in its 'normal adjustment' position. 3

22. Calculate the de-Broglie wavelength of (i) an electron (in the hydrogen atom) moving with a speed of $\frac{1}{100}$ of the speed of light in vacuum and (ii) a ball of radius 5mm and mass 3 x 10^{-2} kg. moving with a speed of 100ms^{-1}. Hence show that the wave nature of matter is important at the atomic level but is not really relevant at the macroscopic level. 3

23. **A teacher has given three lenses of power 0.5 D, 4 D, 10 D to a student. He is not sure as to which lenses would he use for constructing a good astronomical telescope. So he consults his seniors and the teacher also and constructs a telescope. Later he shows this telescope to the junior classes and explains about the choice of lenses.**
a) What values has he shown by doing these? b) Which lenses are used as objective and which one as Eyepiece? 3

24. Show that during the charging of a parallel plate capacitor, the rate of change of charge on each plate equals ϵ_o times the rate of change of electric flux (ϕ_E) linked with it. What is the name given to the term $\epsilon_o \frac{d\phi_E}{dt}$? 3

25. For the circuit shown here, calculate the potential difference between points B and D.



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26. What is space wave propagation? Which two communication methods make use of this mode of propagation? If the sum of the heights of transmitting and receiving antennae in line of sight of communication is fixed at h, show that the range is maximum when the two antennae have a height $\frac{h}{2}$ each. 3

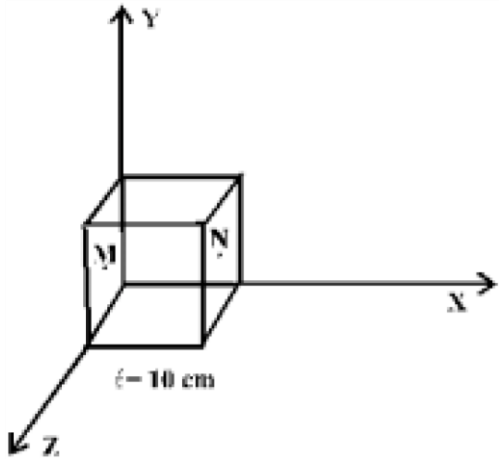
27. Draw the transfer characteristics of a base biased transistor in its common emitter configuration.Explain briefly the meaning of the term 'active region' in these characteristics. For what practical use, do we use the transistor in this 'active region' 3

28. (a) Define electric flux. Write its S.I. unit.

(b) Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it. (c) How is the field directed if (i) the sheet is positively charged,(ii) negatively charged

OR

Use Gauss's law to obtain an expression for the electric field due to an infinitely long straight uniformly charged wire.



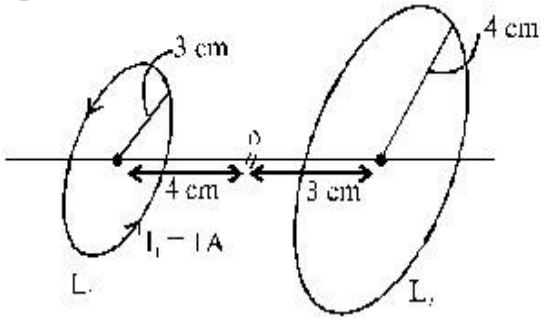
Electric field in the above figure is directed along + X direction and given by E_x = 5Ax + 2B, where E is in NC^{-1} and x is in metre, A and B are constants with dimensions Talking $A = 10NC^{-1}m^{-1}$ and B = $5NC^{-1}$ calculate.

(i) The electric flux through the cube.

(ii) Net charge enclosed within the cube. 5

29.(i) Describe an expression for the magnetic field at a point on the axis of a current carrying circular loop.

(ii) Two coaxial circular loops L_1 and L_2 of radii 3cm and 4cm are placed as shown. What should be the magnitude and direction of the current in the loop L_2 so that the net magnetic field at the point O be zero?



OR

(i) What is the relationship between the current and the magnetic moment of a current carrying circular loop? Use the expression to derive the relation between the magnetic moment of an electron moving in a circle and its related angular momentum?

(ii) A muon is a particle that has the same charge as an electron but is 200 times heavier than it. If we had an atom in which the muon revolves around a proton instead of an electron, what would be the magnetic moment of the muon in the ground state of such an atom? 5

30. What is interference of light? Write two essential conditions for sustained interference pattern to be produced on the screen.

Draw a graph showing the variation of intensity versus the position on the screen in Young's experiment when (a) both the slits are opened and

(b) one of the slit is closed. What is the effect on the interference pattern in Young's double slit experiment when:

(i) Screen is moved closer to the plane of slits?

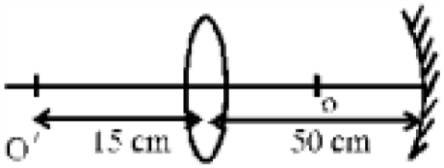
(ii)Separation between two slits is increased. Explain your answer in each case.

OR

(i) Using the relation for refraction at a single spherical refracting surface, derive the lens maker's formula.

(ii) In the accompanying diagram, the direct image formed by the lens

(f = 10cm) of an object placed of O and that formed after reflection from the spherical mirror are formed at the same point o'. What is the radius of curvature of the mirror?



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