Jai GuRudev INTERNATIONAL SCHOOL

PAPER CODE
PRE/1/SET B

FIRST PRE BOARD EXAMINATION 2017-18

Time allowed: 3 hours **PHYSICS (XII)** Maximum Marks: 70

General Instructions:

1. All questions are compulsory. There are 26 questions in all.
2. This question paper has five sections : Section A, Section B, Section C, Section D and Section E.
3. Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.
4. 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.
5. You may use the following values of physical constants wherever necessary :

$c = 3 \times 10^{8}$ m/s, $h = 6.63 \times 10^{-34}$ Js $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}

$\varepsilon_0 = 8.854 \times 10^{-12}$ C^2 N^{-1} m^{-2} $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ Nm^{2}C^{-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, Avogadro's number = 6.023×10^{23} per gram mole

Boltzmann constant = 1.38×10^{-23} JK^{-1}

SECTION – A

1. Draw a plot showing variation of electric field with distance from the centre of a solid conducting sphere of radius R, having a charge of +Q on its surface. (1)

2. State one factor which determines the intensity of light in the photon picture of light. (1)

3. An iron-cored solenoid has self-inductance 2.8 H. When the core is removed, the self-

inductance become 2 mH. What is the relative permeability of the core used? (1)

4. An object is kept in front of a concave lens. What is the nature of the image formed ?

5. When light travels from a rarer medium to denser medium, the speed of light decreases. Does the reduction in speed imply a reduction in the energy? (1)

SECTION – B

6. How is electromagnetic wave produced ? Draw a sketch of a plane e.m. wave propagating along X-axis depicting the directions of the oscillating electric and magnetic fields. (2)

7. A charge q of mass m is moving with a velocity of V, at right angles to a uniform magnetic field B. Deduce the expression for the radius of the circular path it describes.

8. Calculate the shortest wavelength of light emitted in the Paschen series of hydrogen spectrum. Which part of the electromagnetic spectrum, does it belong ? (Given : Rydberg constant, $R = 1.1 \times 10^{7}\ m^{-1}$). (2)

9. A small illuminated bulb is at the bottom of a tank, containing a liquid of refractive index μ upto a height H. Find the expression for the diameter of an opaque disc, floating symmetrically on the liquid surface in order to cut-off the light from the bulb. (2)

OR A ray of light is incident on a glass prism of refractive index μ and refracting angle A. If it just suffers total internal reflection at the other face, obtain an expression relating the angle of incidence, angle of prism and critical angle.

10. Depict the behaviour of magnetic field lines near (i) diamagnetic and (ii) paramagnetic substances. Justify, giving reasons. (2)

SECTION – C

11. Draw a graph showing the variation of de Broglie wavelength of a particle of charge q and mass m with the accelerating potential. Proton and deuteron have the same de Broglie wavelengths. Explain which has more kinetic energy. (3)

12. Explain the term, ‘amplitude modulation’ of a signal. For an amplitude modulated wave, the maximum amplitude is 10 V and the minimum amplitude is 2 V. Calculate the modulation index. (3)

13. State the Lorenz’s force and express it in vector form. Which pair of vectors are always perpendicular to each other? Derive the expression for the force acting on a current carrying conductor of length L in a uniform magnetic field ‘B’. (3)

14. An optical instrument uses eye-lens of power 16 D and objective lens of power 50 D and has a tube length of 16.25 cm. Name the optical instrument and calculate its magnifying power if it forms the final image at infinity.

15. Explain the two processes involved in the formation of a p-n junction diode. Hence define the term 'barrier potential'.

16. (a) Write two properties by which electric potential is related to the electric field.

(b) Two point charges q_1 and q_2, separated by a distance of r_{12} are kept in an external electric field. Derive an expression for potential energy of the system of two charges in field. OR State Gauss's law in electrostatics. Derive an expression for the electric field due to an infinitely long straight uniformly charged wire. (3)

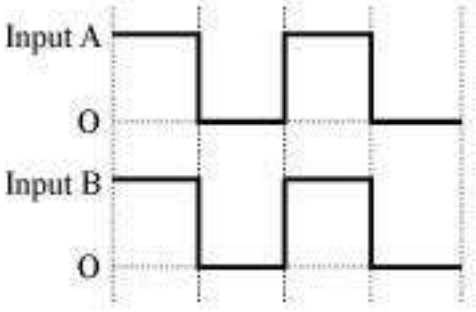
17. State Lenz's law. Explain, by giving examples that Lenz's law is a consequence of conservation of energy. (3)

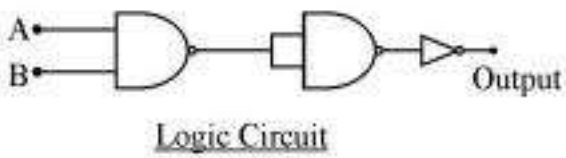
18. A capacitor of unknown capacitance is connected across a battery of V volt. A charge of 360 μC is stored in it. When the potential across the capacitor is reduced by 120 V, the charge stored in the capacitor becomes 120 μC. Calculate V and the unknown capacitance. What would have been the charge on capacitor if the voltage were increased by 120 V? (3)

19. A plane wavefront propagating from a rarer into a denser medium is incident at an angle of incidence i on a refracting surface. Draw a diagram showing incident wavefront and refracted wavefront. Hence verify Snell's laws of refraction. (3)

20. Distinguish between sky wave and space wave modes of communication. What is the main limitation of space wave mode ? Write the expression for the optimum separation between the transmitting and receiving antenna for effective reception of signals in this mode of communication. (3)

21. Using the wave forms of the input A and B, draw the output waveform of the given logic circuit. Identify the logic gate obtained. Write also the truth table. (3)





Logic Circuit

22. Derive the expression for the current density of a conductor in terms of the conductivity and applied electric field. Explain, with reason how the mobility of electrons in a conductor

changes when the potential difference applied is doubled, keeping the temperature of the conductor constant. (3)

SECTION – D

23. Ram was a daily wage worker in a factory. He was suffering from Cancer. On hearing this, most of his co-workers, started avoiding him under the impression that it was a contagious disease. When Prof. Srivatsava came to know about this case, he took him to a leading radiologist, who examined him and told that it was at the beginning stage. He advised that it could be easily cured and also certified that it was not a communicable disease. After this, Ram was given proper treatment by the doctor and got cured completely.

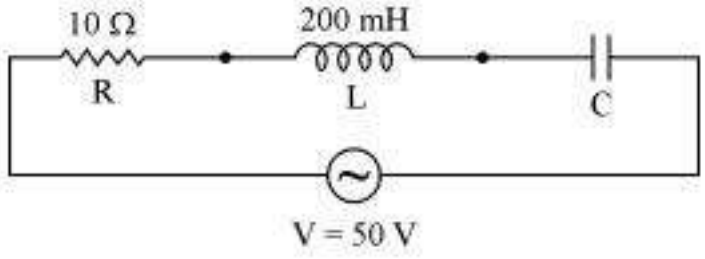
(1) What moral values did Prof. Srivatsava display ?

(2) How is mean life of a radioactive element related to its half life ? (4)

(3) A radioactive sample has activity of 10,000 disintegrations per second after 20 hours. After next 10 hours its activity reduces to 5,000 dps. Find out its halflife and initial activity.

SECTION – E

24. In the following circuit, calculate (a) the capacitance of the capacitor, if the power factor of the circuit is unity, (b) the Q-factor of this circuit. What is the significance of the Q-factor in a.c. circuit ? Given the angular frequency of the a.c. source to be 100/s. Calculate the average power dissipated in the circuit.



OR (a) Prove that the current flowing through an ideal inductor connected across a.c. source, lags the voltage in phase by 2.

(b) An inductor of self-inductance 100 mH, and a bulb are connected in series with a.c. source of rms voltage 10 V, 50 Hz. It is found that effective voltage of the circuit leads the current in phase by $\frac{\pi}{4}$. Calculate the inductance of the inductor used and average power dissipated in the circuit, if a current of 1 A flows in the circuit. (5)

25. Explain with diagram, how plane polarized light can be produced by scattering of sunlight. An incident beam of light of intensity Io is made to fall on a polaroid A. Another polaroid B is so oriented with respect to A that there is no light emerging out of B. A third polaroid C is now introduced mid-way between A and B and is so oriented that its axis bisects the angle between the axes of A and B. Calculate the intensity of light transmitted by A, B and C.

OR (a) In Young's double slit experiment, a monochromatic source of light S is kept equidistant from the slits S_1 and S_2. Explain the formation of dark and bright fringes on the screen.

(b) A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double-slit experiment.

(i) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

(ii) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide?

Given: the separation between the slits is 4 mm and the distance between the screen and plane of the slits is 1.2 m. (5)

26. (a) Draw a circuit diagram of a meter bridge used to determine the unknown resistance R of a given wire. Hence derive the expression for R in terms of the known resistance S.

(b) What does the term 'end error' in a metre bridge circuit mean and how is it corrected ? How will the balancing point be affected, if the positions of the battery and galvanometer are interchanged in a metre bridge experiment ? Give reason for your answer.

OR (a) State the working principle of a potentiometer with help of the circuit diagram, explain how the internal resistance of a cell is determined.

(b) How are the following affected in the potentiometer circuit when (i) the internal resistance of the driver cell increases and (ii) the series resistor connected to the driver cell is reduced ? Justify your answer. (5)