Pre Board- Exam
Class XII
Physics

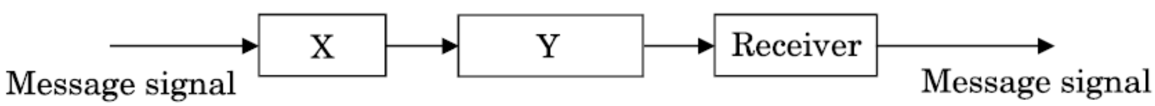
Time: 3hrs **mm: 70**

General Instructions:

1. All questions are compulsory. There are 27 questions in all.
2. This question paper has four sections: Section A, Section B, Section C and Section D.
3. Section A contains five questions of one mark each, Section B contains seven questions of two marks each, Section C contains twelve questions of three marks each, and Section D contains three questions of five marks each.
4. There is no overall choice. However, internal choices have been provided in two questions of one mark, two questions of two marks, four questions of three marks and three questions of five marks weightage. You have to attempt only one of the choices in such questions.

Section-A

1. In an a.c. circuit, the instantaneous voltage and current are V = 200 sin 300 t volt and I = 8 cos 300 t ampere respectively. Is the nature of the circuit capacitive or inductive? Give reason. 1
2. Name the boxes X and Y shown in the block diagram of a generalized communication system : 1

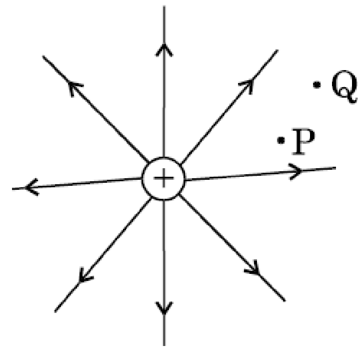


3. The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grinding, how will the focal length and power of the lens change? 1

OR

When light travels from an optically denser medium to a rarer medium, why does the critical angle of incidence depend on the colour of light?

4. Two wires, one of copper and the other of manganin, have same resistance and equal thickness. Which wire is longer ? Justify your answer. 1
5. The figure shows the field lines of a positive point charge. What will be the sign of the potential energy difference of a small negative charge between the points Q and P ? Justify your answer. 1



OR

Define dielectric constant of a medium. What is its S.I. unit? 1

SECTION B

6. Define the term 'power loss' in a conductor of resistance R carrying a current I. In what form does this power loss appear ? Show that to minimise the power loss in the transmission cables connecting the power stations to homes, it is necessary to have the connecting wires carrying current at enormous high values of voltage. 2
7. The wavelength of light from the spectral emission line of sodium is 589 nm. Find the kinetic energy of the electron for which it would have the same de Broglie wavelength. 2
8. A screen is placed 90 cm away from an object. The image of the object on the screen is formed by a convex lens at two different locations separated by 20 cm. Determine the focal length of the lens. 2

OR

Define a wavefront. Using Huygens' principle, draw the shape of a refracted wavefront, when a plane wave is incident on a convex lens. 2

9. (a) In the following nuclear reaction

$$n + {}_{95}U^{235} \rightarrow {}_{Z}Bi^{144} + {}_{36}X^{A} + 3n$$

assign the values of Z and A.

(b) If both the number of protons and the number of neutrons are conserved in each nuclear reaction, in what way is the mass converted into energy? Explain. 2

10. Which basic mode of communication is used in satellite communication? 2

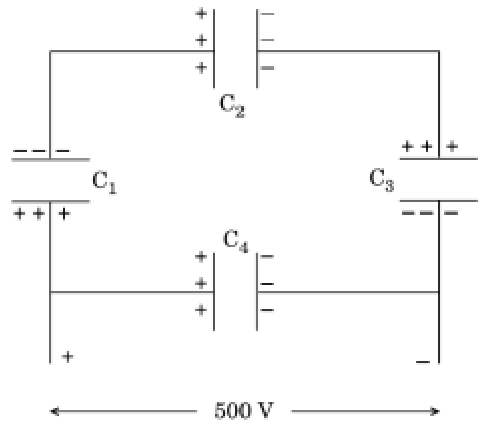
Which type of wave propagation is used in this mode? Write the expression for the maximum line of sight distance d between two antennas having heights h_1 and h_2.

11. Determine the distance of closest approach when an alpha particle of kinetic energy 4·5 MeV strikes a nucleus of Z = 80, stops and reverses its direction. 2

12. When the electron orbiting in hydrogen atom in its ground state moves to the third excited state, show how the de Broglie wavelength associated with it would be affected. 2

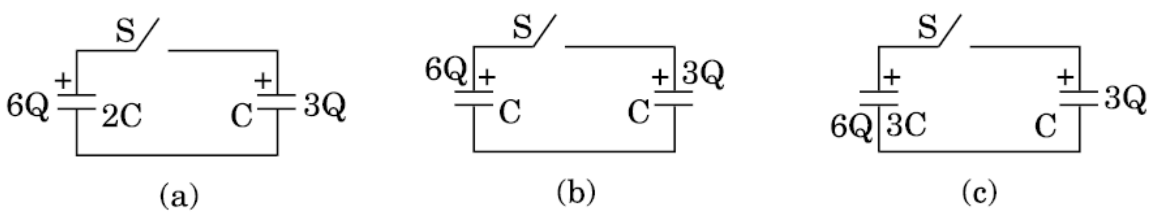
SECTION C

13. A network of four 10 μF capacitors is connected to a 500 V supply as shown in the figure. Determine the
    (a) equivalent capacitance of the network and
    (b) charge on each capacitor. 3

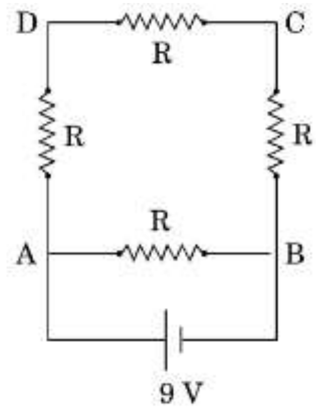


OR

Three circuits, each consisting of a switch 'S' and two capacitors, are initially charged, as shown in the figure. After the switch has been closed, in which circuit will the charge on the left-hand capacitor (i) increase, (ii) decrease and (iii) remain same ? Give reasons. 3



14. A 16 Ω resistance wire is bent to form a square. A source of emf 9 V is connected across one of its sides as shown. Calculate the current drawn from the source. Find the potential difference between the ends C and D. If now the wire is stretched uniformly to double the length and once again the same cell is connected in the same way, across one side of the square formed, what will now be the potential difference across one of its diagonals?



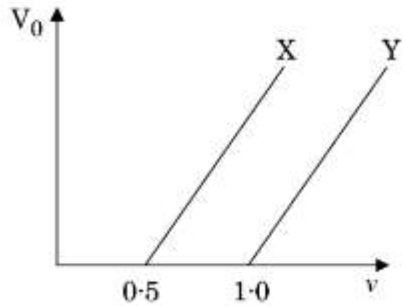
15. A uniform magnetic field of $6{\cdot}5 \times 10^{-4}$ T is maintained in a chamber. An electron enters into the field with a speed of $4{\cdot}8 \times 10^{6}$ m/s normal to the field. Explain why the path of the electron is a circle. Determine its frequency of revolution in the circular orbit. Does the frequency depend on the speed of the electron? Explain.
16. Describe briefly using the necessary circuit diagram, the three basic processes which take place to generate the emf in a solar cell when light falls on it. Draw the I – V characteristics of a solar cell. Write two important criteria required for the selection of a material for solar cell fabrication. 3

OR

Describe briefly how light emitting diode is fabricated and explain its working. Write three important advantages of LEDs over conventional incandescent lamps.
17. Compare and explain three distinguishing features observed in Young's double slit interference pattern with those seen for a coherently illuminated single slit producing diffraction pattern. 3
18. Use Bohr's postulates of hydrogen atom to deduce the expression for the kinetic energy (K.E.) of the electron revolving in the nth orbit and show that K.E.= $\frac{e^2}{8\pi\epsilon_0 r_n}$, where r_n is the radius of the nth orbit. How is the potential energy in the nth orbit related to the orbital radius r_n ? . 3
19. How are electromagnetic waves produced? What is the source of the energy carried by a propagating electromagnetic wave?
Identify the electromagnetic radiations used
(i) in remote switches of household electronic devices; and
(ii) as diagnostic tool in medicine. 3

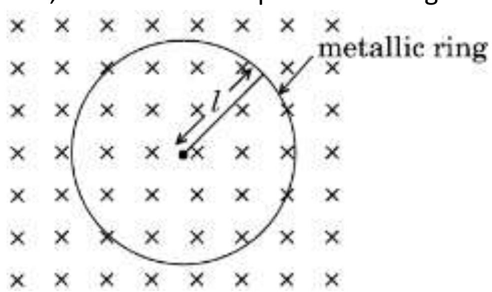
OR

Write the expression for the generalized Ampere's circuital law. Through a suitable example, explain the significance of time-dependent term. 3
20. (a) Monochromatic light of frequency 6×10^{14} Hz is produced by a laser. The power emitted is $2{\cdot}0\times10^{-3}$ W. How many photons per second on an average are emitted by the source?
(b) Figure shows variation of stopping potential (V0) vs. frequency (v) of incident radiation for two metals X and Y. Which metal will emit electrons of larger kinetic energy for same wavelength of incident radiation? Explain.



21. (a) Assume that the light of wavelength 6000 Å is coming from a star. Find the limit of resolution of a telescope whose objective has a diameter of 250 cm.
(b) Two slits are made 1 mm apart and the screen is placed 1 m away. What should be the width of each slit to obtain 10 maxima of the double slit pattern within the central maximum of the single slit pattern? 3

22. A metallic rod of length 'l' is rotated with a frequency 'ν', with one end hinged at the centre and the other end at the circumference of a circular metallic ring, about an axis passing through the centre and perpendicular to the plane of the ring. A constant and uniform magnetic field B parallel to the axis is present everywhere.
(a) Obtain the expression for the emf induced between the centre and the ring.
(b) Given that the rod has resistance 'R', then how much power will be generated? 3

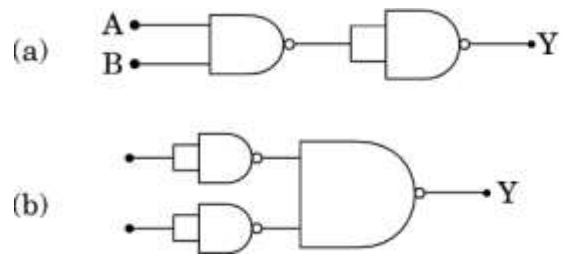


23. A cyclotron's oscillator frequency is 10 MHz. What should be the operating magnetic field for accelerating protons? If the radius of its 'dees' is 60 cm, calculate the kinetic energy (in MeV) of the proton beam produced by the accelerator. 3

24. The outputs of two NOT gates are fed to a NOR gate. Draw the logic circuit of the combination of gates. Write its truth table. Identify the gate equivalent to this circuit. 3

OR

You are given two circuits (a) and (b) as shown in the figures, which consist of NAND gates. Identify the logic operation carried out by the two. Write the truth tables for each. Identify the gates equivalent to the two circuits. 3



25. (a) Write the principle of working of a transformer. Show, with the help of suitable diagrams, how the windings of a step-up transformer are done.
(b) Assuming the transformer to be an ideal one, deduce the expression for the ratio of (i) output voltage to input voltage and (ii) output current to input current in terms of the number of turns in the primary and secondary coils.
(c) What are the main sources of energy loss in actual transformers and how are these reduced? 5

OR

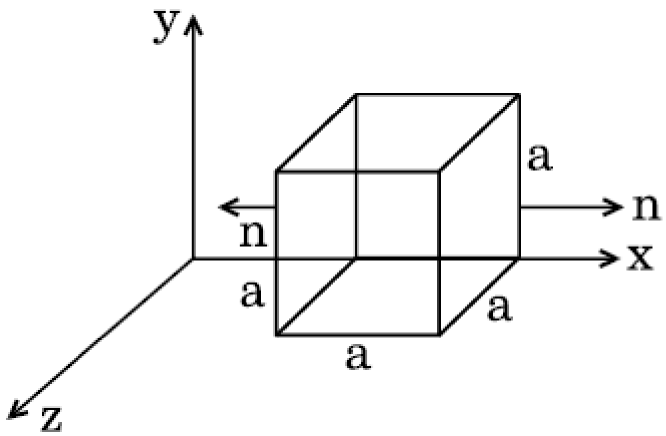
(a) Draw a labelled diagram of a moving coil galvanometer. State its working principle. What is the function of a cylindrical soft iron core used in it?
(b) Define the terms (i) current sensitivity and (ii) voltage sensitivity.
(c) Explain the underlying principle used in converting a galvanometer into a (i) voltmeter and (ii) ammeter.

26. (a) State the essential conditions for the phenomenon of total internal reflection to take place.
(b) Draw a ray diagram to show how a right isosceles prism made of crown glass can be used to obtain the inverted image.
(c) Explain briefly with the help of a necessary diagram, how the phenomenon of total internal reflection is used in optical fibers. Illustrate giving an example how optical fibers can be employed for transmission of optical signals.

OR

(a) Draw a suitable diagram to demonstrate that given the shape of a wave front at t = 0, its shape at a later time t_1 can be obtained using Huygens' geometrical construction.
(b) Consider the propagation of a plane wave front from a rarer to a denser medium and verify Snell's law of refraction. Show that when a wave gets refracted into a denser medium, the wavelength and speed of propagation decreases but the frequency remains the same. 5

27. (a) Define the term 'electric flux'. Write its S.I. unit.
(b) Given the components of an electric field as Ex = αx, Ey = 0 and Ez = 0, where α is a dimensional constant. Calculate the flux through each face of the cube of side 'a', as shown in the figure, and the effective charge inside the cube. 5



OR

(a) Define equipotential surface. Why the electric field at any point on the equipotential surface is directed normal to the surface?

(b) Draw the equipotential surfaces for an electric dipole. Why does the separation between successive equipotential surfaces get wider as the distance from the charges increases?

(c) For this dipole, draw a plot showing the variation of potential V versus x, where x (x >> 2a), is the distance from the point charge – q along the line joining the two charges. 5