PRINCE ACADEMY
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BOARD SAMPLE PAPER- III (2025-26)

Time : 03 : 00 Hours | **CLASS :– XII-PHYSICS (042)** | **M.M. : 70**

General Instructions:

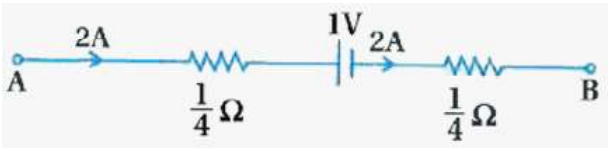
(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.
(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.

SECTION - A

1. Two capacitor of capacitances $3\mu F$ and $6\mu F$ are charged to a potential of 12 V each. They are now connected to each other, with the positive plate of each joined to the negative plate of the other. The potential difference across $3\mu F$ will be

(a) 12 V (b) Zero (c) 6 V (d) 4 V

2. Figure represents a part of a closed circuit. The potential difference between points A and B (V_A-V_B) is



(a) +2 V (b) -2 V (c) +3 V (d) 0 V

3. A magnet of magnetic moment m is cut into two equal parts. The two parts are placed perpendicular to each other so that their north poles touch each other. The resultant magnetic moment is :

(a) $\sqrt{2}m$ (b) $\frac{m}{\sqrt{2}}$ (c) $\sqrt{3}m$ (d) $\frac{m}{\sqrt{3}}$

4. When the current in a coil changes from 8A to 2A in 3×10^{-2} second, the emf induced in the coil is 2 volt. The self-inducatance of the coil, in millihenry, is

(a) 1 (b) 5 (c) 20 (d) 10

5. Yellow light is used in a single slit diffraction experiment with slit width of 0.6 mm. If yellow light is replaced by X-rays, then the observed pattern will reveal

(a) That the central maximum in narrower (b) More number of fringes

(c) Less number of fringes (d) No diffraction pattern

6. If an electron in a hydrogen atom jumps from the 3rd orbit to the 2nd orbit, it emits a photon of wavelength λ. When it jumps from the 4th orbit to the 3rd orbit, the corresponding wavelength of the photon will be

(a) $\frac{16}{25}\lambda$ (b) $\frac{9}{16}\lambda$ (c) $\frac{20}{7}\lambda$ (d) $\frac{20}{13}\lambda$

7. For plane electromagnetic waves propagating in the Z-direction, which one of the following combinations gives the correct possible direction for $\vec{E}$ and $\vec{B}$ fields respectively ?

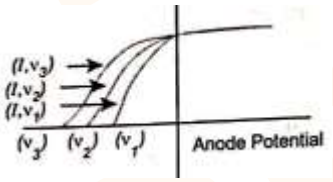
(a) $\left(2\hat{i}+3\hat{j}\right)$ and $\left(\hat{i}+2\hat{j}\right)$ (b) $\left(-2\hat{i}-3\hat{j}\right)$ and $\left(3\hat{i}-2\hat{j}\right)$

(c) $\left(3\hat{i}+4\hat{j}\right)$ and $\left(4\hat{i}-3\hat{j}\right)$ (d) $\left(\hat{i}+2\hat{j}\right)$ and $\left(2\hat{i}-\hat{j}\right)$

8. Two point charges placed in a medium of dielectric constant 5 are at a distance r between them, experience an electrostatic force 'F'. The electrostatic force between them in vacuum at the same distance r will be

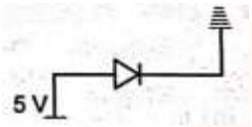
(a) 5 F (b) F (c) F/2 (d) F/5

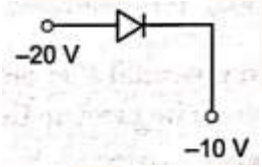
9. Identify the correct relation for the given diagram for frequency

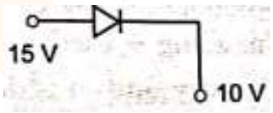


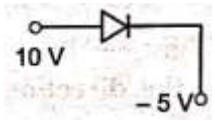
(a) $\nu_1 - \nu_2 = \nu_3$ (b) $\nu_1 = \nu_2 = \nu_3$ (c) $\nu_1 < \nu_2 < \nu_3$ (d) $\nu_1 = 2\nu_2 = 3\nu_3$

10. Which is reverse biased diode ?

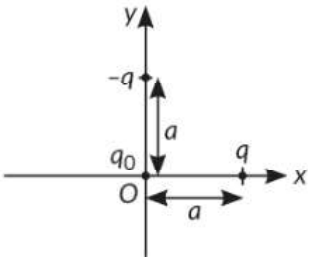
(a) 

(b) 

(c) 

(d) 

11. Three charges q, -q and q_0 are placed as shown in figure. The magnitude of the net force on the charge q_0 at point O is $\left[k=\frac{1}{(4\pi\varepsilon_0)}\right]$



(a) 0 (b) $\frac{2kqq_0}{a^2}$ (c) $\frac{\sqrt{2}kqq_0}{a^2}$ (d) $\frac{1}{\sqrt{2}}\frac{kqq_0}{a^2}$

12. When an electron in an atom goes from a lower to a higher orbit, its
    (a) Kinetic energy (KE) increases, potential energy (PE) decreases
    (b) KE increases, PE increases
    (c) KE decreases, PE increases
    (d) KE decreases, PE decreases

Direction (Q: 13 to 16) Two statements are given-one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true and R is NOT the correct explanation of A.

(c) A is true but R is false

(d) A is false and R is also false

13. Assertion (A) : Coloured spectrum is seen when we look through a muslin cloth.
    Reason (R) : Coloured spectrum is due to diffraction of white light passing through fine slits made by fine threads in the muslin cloth.
14. Assertion (A) : On increasing the frequency of light, the photocurrent remains unchanged.
    Reason (R) : Photocurrect is independent of frequency but depends only on intensity of incident light.
15. Assertion (A) : When the apparatus of Young's double-slit experiment is brought in a liquid from air, the fringe width decrease.
    Reason (R) : The wavelength of light decreases in the liquid.
16. Assertion (A) : For identical coherent waves, the maximum intensity is four times the intensity due to each wave.
    Reason (R) : Intensity is proportional to the square of amplitude.

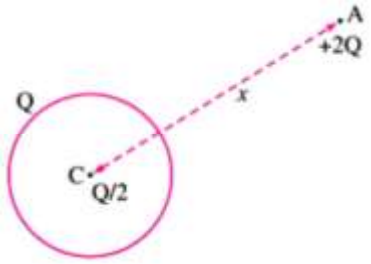
SECTION - B

17. Which of the following electromagnetic waves has (i) minimum wavelength, and (ii) minimum frequency ? Write one use of each of these two waves.
    Infrared waves, Microwaves, $\gamma - rays$ and X-rays.
18. The focal length of an equiconcave lens is $\frac{3}{4}$ times of radius of curvature of its surfaces. Find the refractive index of the material of the lens. Under what condition will this lens behave as a converging lens ?

    OR

    Write any four properties of Nuclear force.

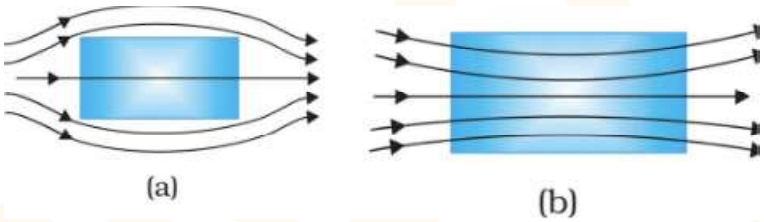
19. A thin metallic spherical shell of radius R carries a charge Q on its surface. A point charge $\frac{Q}{2}$ is placed at the centre C and another charge +2Q is placed outside the shell at A at a distance x from the centre as shown in the figure.



(i) Find the electric flux through the shell.

(ii) Find the force on the charges at the centre C of the shell and at the point A.

20. A uniform magnetic field gets modified as shown in figure when two specimens A and B are placed in it.



(i) Identify the specimen A and B.

(ii) How the magnetic susceptibility of specimen A different from that of specimen B ?

21. A difference of 2.3 eV separates two energy levels in an atom. What is the frequency of radiation emitted when the atom makes transition from the upper level to the lower level ?

OR

The nuclear radius of $^{27}_{13}$Al is 3.6 fermi. Find the nuclear radius of $^{64}_{29}$Cu.

SECTION - C

22. An a.c. source generating a voltage $\varepsilon = \varepsilon_0 \sin \omega t$ is connected to a capacitor of capacitance C. find the expression for the current I flowing through it. Plot a graph of ε and I versus ωt to show that the current is ahead of the voltage by $\frac{\pi}{2}$.

OR

An ac voltage $V = V_0 \sin \omega t$ is aplied across a pure inductor of inductance L. Find an expression for the current i, flowing in the circuit and show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\frac{\pi}{2}$. Also drawn graphs of V and i versus ωt for the circuit.

23. Two long straight parallel conductors carrying currents I_1 and I_2 are separated by a distance d. If the currents are flowing in the same direction, show how the magnetic field produced by one exerts an attractive force on the other. Obtain the expression for the force and hence define 1 ampere.

24. The currents flowing in the two coils of self-inductance L_1=16 mH and L_2=12 mH are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of (i) induced voltages, (ii) the currents and (iii) the energies stored in the two coils at a given instant.

25. State the working of ac generator with the help of a labelled diagram.

    The coil of an ac generator having N turns, each of area A, is rotated with a constant angular velocity ω. Deduce the expression for the alternating emf generated in the coil. What is the source of energy generation in this device?

    OR

    (i) Draw a labelled diagram of a step-up transformer. Obtain the ratio of secondary to primary voltage in terms of number of turns and currents in the two coils.

    (ii) A power transmission line feeds input power at 2200 V to a step-down transformer with its primary windings having 3000 turns. Find the number of turns in the secondary to get the power output at 220 V.

26. A parallel beam of light of wavelength 600 nm is incident normally on a slit of width 'a'. If the distance between the slit and the screen is 0.8 m and the distance of 2nd order maximum from the centre of the screen is 1.5 mm, calculate the width of the slit.

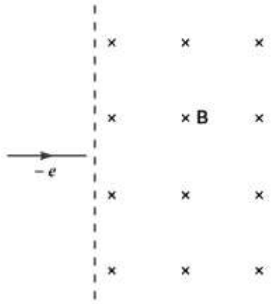
27. Explain with a proper diagram how an ac signal can be converted in dc (pulsating) signal with output frequency as double than the input frequency using p-n junction diode. Give its input and output waveforms.

28. A proton, a deuteron and an alpha particle, are accelerated through the same potential difference and then subjected to a uniform magnetic field $\vec{B}$ perpendicular to the direction of their motions. Compare (i) their kinetic energies, and (ii) if the radius of the circular path described by proton is 5 cm, determine the radii of the paths described by deuteron and alpha particle.

    OR

    (i) An electron moving horizontally with a velocity of $4\times10^4 m/s$ enters a region of uniform magnetic field of $10^{-5}T$ acting vertically upward as shown in the figure. Draw its trajectory and find out the time it takes to come out of the region of magnetic field.

    (ii) A straight wire of mass 200 g and length 1.5 m carries a current of 2A. It is suspended in mid air by a uniform magnetic field B. What is the magnitude of the magnetic field?



SECTION - D

29. **Read the following paragraph and answer the questions that follow.**

In 1887, German physicist Heinrich Hertz noticed that shining a beam of ultraviolet light onto a metal plate could cause it to shoot sparks. It is due to the emission of negatively charged particles called electrons from the metal surface into the surrounding space.

Hallwachs and Lenard also observed that when ultraviolet light fell on the emitter plate, no electrons were emitted at all when the frequency of the incident light was smaller than a certain minimum frequency.

Experimental study shows that different metals required different minimum frequencies of light for the emission of electron. When brightness of the incident light increases, more electrons were produced, without increasing their energy, and increasing the frequency of the light produced electrons with higher energies, but without increasing the number produced. This is known as the photoelectric effect, and it would be understood in 1905 by a young scientist named Albert Einstein.

(i) If the wavelength of em radiation is doubled, what will happen to the energy of photons?

(a) Halved (b) Doubled (c) One-fourth (d) Four times

(ii) Why are alkali metals most suited as photosensitive metals?

(a) Due to high frequency (b) Due to zero rest mass

(c) Due to high work function (d) Due to low work function

(iii) Which of the following is unit of work function?

(a) Electron volt (b) Hertz (c) Watt (d) Ohm

(iv) If in a photoelectric experiment, the wavelength of incident radiation is reduced from 6000 Å to 4000 Å then,

(a) the stopping potential will decrease.

(b) the stopping potential will increase.

(c) the kinetic energy of emitted electrons will decrease.

(d) the value of work function will decrease.

OR

(iv) The stopping potential for photoelectrons

(a) does not depend on the frequency of the incident light.

(b) does not depend upon the nature of the cathode material.

(c) depends on both the frequency of the incident light and the nature of the cathode material.

(d) depends upon the intensity of the incident light.

30. Case Study

Read the following paragraph and answer the questions that follow.

A semiconductor has same electron and hole concentraion equals to $6 \times 10^8 / m^3$. On doping the semiconductor with certain impurity, the electron concentraion becomes $9 \times 10^{12} / m^3$.

(i) Which of the following atoms are used as impurity material ?

(a) Aluminium (b) Phosphorus (c) Carbon (d) Sodium

(ii) Identify the new semiconductor after doping.

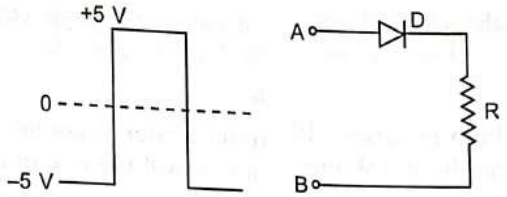
(a) p-type (b) n- type

(c) Half-wave rectifier (d) Full-wave rectifier

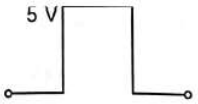
(iii) What is the new hole concentration ?

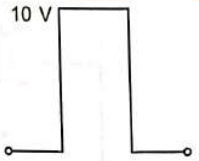
(a) $0.4 \times 10^4 / m^3$ (b) $14 \times 10^4 / m^3$ (c) $4 \times 10^4 / m^3$ (d) $40 \times 10^4 / m^3$

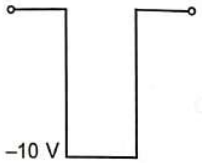
(iv) A square wave (-5 V to + 5 V) is applied to a p-n junction diode.

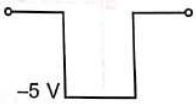


Which of the following is the output waveform across the resistor R ?

(a) 

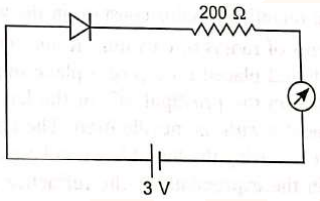
(b) 

(c) 

(d) 

OR

(iv) The reading of the ammeter of a silicon diode in the given circuit is



(a) zero (b) 15 mA (c) 11.5 mA (d) 13.5 mA

SECTION - E

31. (i) Define the term 'mobility' of charge carries in a current carrying conductor. Obtain the relation for mobility in terms of relaxation time.

(ii) A variable resistor R is connected across a cell of emf E and internal resistance r.

(a) Draw the circuit diagram.

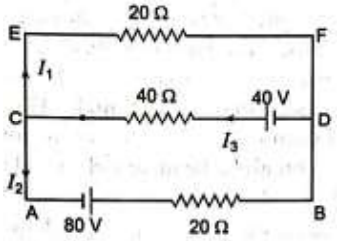
(b) Plot the graph showing variation of potential drop across R as function of R.

(c) At what value of R current in circuit will be maximum ?

OR

(i) Using concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms of number density and relaxation time. Hence obtain the relation between current density and the applied electric field E.

(ii) Use Kirchhoff's law to determine the value of current I_1 in the given electrical circuit.



32. (i) Draw equipotential surfaces for (i) an electric dipole and (ii) two identical positive charges placed near each other.

(ii) In a parallel plate capacitor with air between the plates, each plate has an area of $6 \times 10^{-3} m^2$ and the separation between the plates is 3 mm.

(a) Calculate the capacitance of the capacitor.

(b) If the capacitor is connected to 100 V supply, what would be the charge on each plate ?

(c) How would charge on the plate be affected if a 3 mm thick mica sheet of k = 6 is inserted between the plates while the voltage supply remains connected ?

OR

(i) Three charges -q, Q and -q are placed at equal distances on a straight line. If the potential energy of the system of these charges is zero, than what is the ratio Q : q ?

(ii) (a) Obtain the expression for the electric field intensity due to a uniformly charged spherical shell of radius R at a point distant r from the centre of the shell outside it.

(b) Draw a graph showing the variation of electric field intensity E with r, for r > R and r < R.

33. (i) Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvature R_1 and R_2. Hence, derive lens maker's formula for a double convex lens. State the assumptions made and sign convention used.

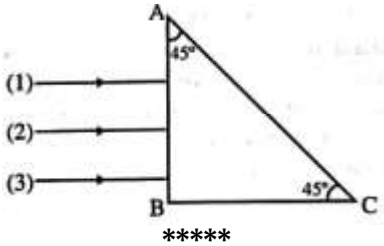
(ii) A converging lens has a focal length of 20 cm in air. It is made of a material of refractive index 1.6. If it inmmersed in a liquid of refractive index 1.3, find its new focal length.

OR

(i) Consider a point at the focal point of a convergent lengs. Another convergent lens of short focal length is placed on the other side. What is the nature of the wavefronts emerging from the final image ?

(ii) Why are coherent source necessary to produce a sustained interference pattern ?

(iii) Three rays (1, 2, 3) of different colours fall normally on one of the sides of an isosceles right angled prism as shown. The refractive index of prism for these rays is 1.39, 1.47 and 1.52 respectively. Find which of these rays get internally reflected and which get only refracted from AC. Trace the paths of rays. Justify your anser with the help of necessary calculations.



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