PRE-BOARD EXAMINATION (2023-24)
CLASS : XII
SUBJECT: PHYSICS (042)

Neha 09

(M)

समय : 3 घंटे

Time Allowed : 3 hours

अधिकतम अंक - 70

Maximum Marks : 70

सामान्य निर्देश:

1. इस प्रश्न पत्र में कुल 33 प्रश्न हैं। सभी प्रश्न अनिवार्य हैं।
2. प्रश्न प्रश्न पत्र में पांच खंड हैं। खंड-क, खंड-ख, खंड-ग, खंड-घ एवं खंड ङ।
3. खंड क में प्रश्न संख्या 1 से 16 तक बहुविकल्पीय प्रकार के एक-एक अंक के प्रश्न हैं।
4. खंड ख में प्रश्न संख्या 17 से 22 तक अतिलघु उत्तरीय प्रकार के दो-दो अंकों के प्रश्न हैं।
5. खंड ग में प्रश्न संख्या 23 से 28 तक अतिलघु उत्तरीय प्रकार के तीन-तीन अंकों के प्रश्न हैं।
6. खंड घ में प्रश्न संख्या 29 तथा 30 तक केस आधारित चार-चार अंकों के प्रश्न हैं।
7. खंड ङ में प्रश्न संख्या 31 तथा 33 तक दीर्घउत्तरीय प्रकार के पाँच-पाँच अंकों के प्रश्न हैं।
8. प्रश्न पत्र में कोई समग्र विकल्प नहीं है। यद्यपि खंड ख के एक प्रश्न में खंड ग में दो प्रश्नों में, खंड घ के दो प्रश्नों में और खंड ङ के तीनों प्रश्नों में आंतरिक विकल्प का प्रावधान दिया गया है।
9. कैलकूलेटर का प्रयोग वर्जित है।

GENERAL INSTRUCTIONS:

1. This question paper contains 33 questions in all. All questions are compulsory.
2. This question paper is divided into five sections - Section A, Section B, Section C, Section D and Section E.
3. In Section A question number 1 to 16 are MCQ type questions carrying 1 mark each.
4. In Section B question number 17 to 21 are SA-1 type questions carrying 2 marks each.
5. In Section C question number 22 to 28 are SA-2 type questions carrying 3 marks each.
6. In Section D question number 29 to 30 are case based questions carrying 4 marks each.
7. In Section E question number 31 to 33 are long answer type questions carrying 5 marks each.
8. There is no over all choice. However an internal choice has been given in one question in Section B, two questions in Section C, one question in each CBQ in Section D and all three questions in Section E.
9. Use of calculator is NOT permitted.

$c = 3 \times 10^8$ m/s

$e = 1.6 \times 10^{-19}$ C

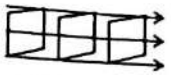
$\mu_0 = 4\pi \times 10^{-7}$ Tm A^{-1}

$\epsilon_0 = 8.85 \times 10^{-12}$ C^2 N^{-1} m^{-2}

SECTION-A

1. Which of the following diagram represents equipotential surfaces due to an electric dipole? (1)

(A) 

(B) 

(C) 

(D) 

2. A charge 'Q' is kept at the centre of a hollow sphere of radius 'R'. The electric flux associated with the sphere is 'ϕ'. If the magnitude of the charge and the radius of sphere both are doubled, then the electric flux associated with the sphere will be: (1)

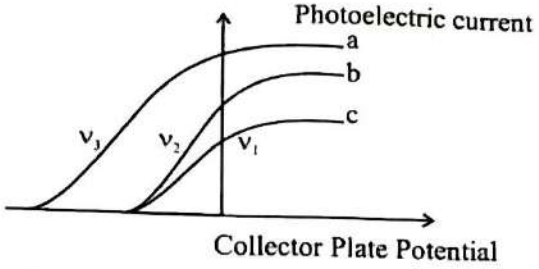
(A) ϕ

(B) 2ϕ

(C) $\phi/2$

(D) 4ϕ

3. Figure shows a plot of three curves a, b and c showing the variation of photoelectric current with collector plate potential for different frequencies, ν_1, ν_2, and ν_3, respectively incident on a photo-sensitive surface. (1)



Which of the following is correct?

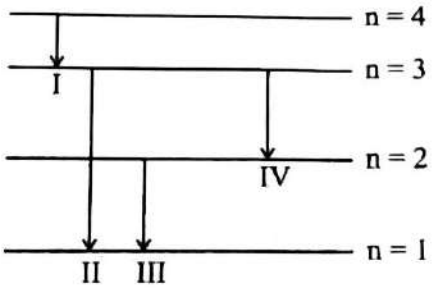
(A) $\nu_1 > \nu_2 > \nu_3$

(B) $\nu_1 < \nu_2 < \nu_3$

(C) $\nu_1 = \nu_2 < \nu_3$

(D) $\nu_1 = \nu_2 > \nu_3$

4. The diagram shows four energy levels of an electron in Bohr model of hydrogen atom. Identify the transition in which emitted photon will have longest wavelength : (1)



(A) I

(B) II

(C) III

(D) IV

5. The resistance of an ammeter, a micrometer and a milliammeter are R_1, R_2 and R_3 respectively. Which of the following represents correct sequence of their resistance? (1)

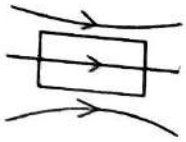
(A) $R_1 < R_3 < R_2$

(B) $R_1 < R_2 < R_3$

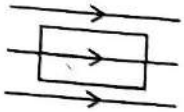
(C) $R_3 < R1 < R_2$

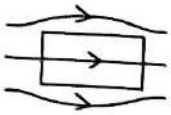
(D) $R_3 < R_2 < R_1$

6. A diamagnetic substance is placed in a uniform magnetic field. Which of the following diagram shows modification in field lines correctly? (1)

(A) 

(B) 

(C) 

(D) 

7. A charge of $-2\mu c$ moving along positive X-axis, enters into a uniform magnetic of 1T along positive, Y-axis with a speed of 2×10^4 m/s. The magnetic force experienced by the charge is : (1)

(A) $0.04N(\hat{k})$

(B) $0.4N(-\hat{k})$

(C) $0.04N(\hat{k})$

(D) $0.04N(-\hat{k})$

8. An inductor, a capacitor and a resistor are connected in series across an a.c. source. If $X_L > X_C$, then the current flowing in the circuit will : (1)

(A) lead the voltage by the phase $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$

(B) lead the voltage by phase $\phi = \frac{\pi}{2}$

(C) lags behind voltage by phase $\phi = \tan^{-1}\left(\frac{X_L - X_C}{R}\right)$

(D) lags behind voltage by phase $\phi = \frac{\pi}{2}$

9. The S.I. Unit of pole-strnegth of a bar magnet is : (1)

(A) Ampere × (metre)$^{-1}$

(B) Ampere × metre

(C) Ampere × (metre)$^{-2}$

(D) Ampere × (metre)^2

10. In an electro-magnetic wave : (1)

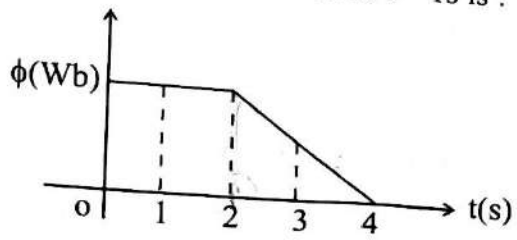
(A) electric field and magnetic field always oscillate in the same phase

(B) electric field and magnetic field always oscillate perpendicular to each other

(C) Both (A) and (B) are correct

(D) Neither (A) nor (B) are correct

11. The variation in the magnetic flux, 'ϕ' associated with a coil with time 't' is shown in the graph given below. The induced emf in the coil at t = 1s is : (1)



(A) 25V

(B) 50V

(C) Zero

(D) 12.5V

12. In the Rutherfords scattering experiment, an α-particle of kinetic energy 'K' is bombarded on a thin foil of gold. The distance of the closest approach is 'r'. If α-particle are replaced by a protons of same kinetic energy, the distance of the closest approach will be: (1)

(A) r/2

(B) r

(C) 2r

(D) 4r

Note: In question number 13 to 16, two statements are given, one-labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the code (A), (B), (C) and (D) as given below:

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

(B) Both Assertion (A) and Reason (R) are true and Reason (R) is not the correct explanation of Assertion (A).

(C) Assertion (A) is true and Reason (R) is false.

(D) Assertion (A) is false and Reason (R) is also false.

13. Assertion (A) : In a photon-electron collision, the total energy and the total momentum are conserved and number of photons may not be conserved. (1)

Reason (R) : In the photon-picture of radiation, all the photons of a light of particular frequency have same energy and momentum.

14. Assertion (A) : In an n-type semiconductor, electrons are majority carriers. (1)

Reason (R) : In an n-type semiconductor, penta valent atoms are dopants which contribute conduction electrons.

15. Assertion (A) : In an open circuit, the terminal voltage across a cell is equal to its emf. (1)

Reason (R) : The terminal voltage across a cell is the potential difference between its two terminals in open circuit.

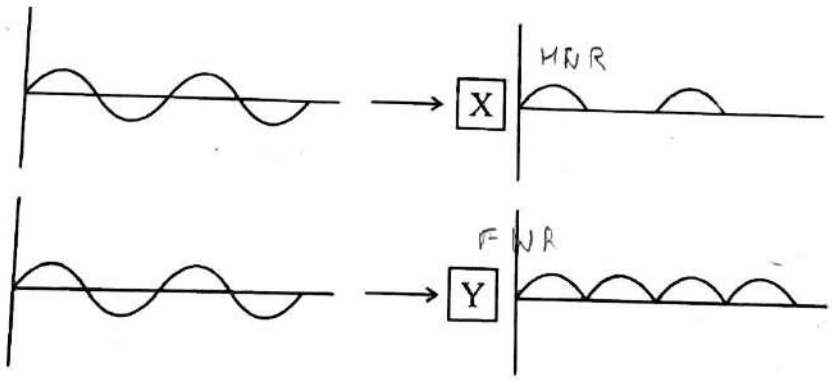
16. Assertion (A) : A prism is placed in air, when air is replaced by water, the angle of minimuim deviation remains same for a particular wavelength. (1)

Reason (R) : The angle of minimum deviation is independent of surrounding medium.

SECTION-B

17. A proton and an alpha particle are accelerated by potential differences V_1 and V_2 respectively. If their de-Broglie wavelength are same, find the ratio V_1/V_2. (2)

18. An a.c. signal is fed into two circuits X and Y, and the corresponding outputs in the two cases are shown : (2)

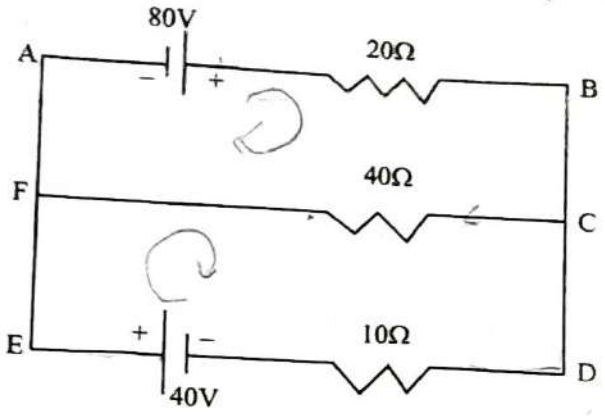


(a) Identify the circuit X and Y.

(b) Write working principle for both are circuits.

19. You are given two lances L_1 : of focal length 15 m and of large aperture, L_2 : of focal length 1 cm and of small aperture. Select objective and eyepiece to construct an astronomical telescope. Calculate magnifying power of this telescope in the normal adjustment. (2)

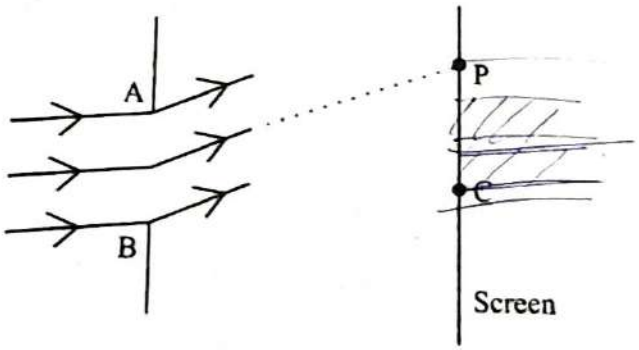
20. Using Kirchioff's laws, calculate potential difference across 40Ω resistor in the given circuit diagram. (2)



OR

The resistance of a wire is measured as 2Ω and 4Ω at temperatures 5°C and 60°C respectively. Find the temperature coefficient of resistance of the material of wire.

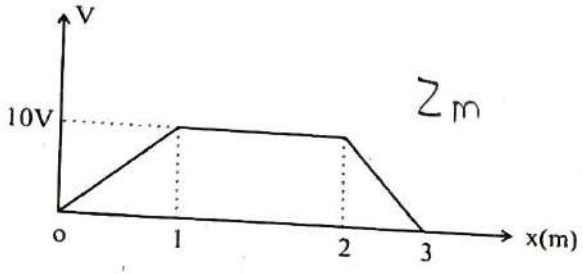
21. Figure shows a parallel beam of monochromatic light incident on a narrow slit AB. If the light waves reaching to any point 'P' on the screen from points A & B have a phase difference of 7π, explain whether a bright or a dark fringe will be obtained at point P. (2)



SECTION-C

22. Define the term 'Binding Energy'. Write an expression for it. Draw a graph of Binding Energy perm nucleon as a function of mass number. (3)

23. The electric potential 'V' as a function of distance x is shown. Calculate electric field for – (i) $x < 1$ (ii) $3 > x > 2$ and (iii) $1 < x < 2$. Hence draw a graph of electric field as a function of 'x'.



OR

Two point charges '+Q' and '–2Q' are placed 'r' distance apart. A third charge 'q' is brought from infinity at point P, x distance away from +2 somewhere between +Q and –2Q, such that work done to place q at P is zero. Find the value of x. (2)

24. Using Bohr's postulate of atomic model, drive an expression for radius of n^{th} orbit. Hence show that orbits are not evenly spaced. (3)

25. Estimate the drift speed of electrons in a conductor of length 1m, cross sectional area 2.5×10^{-7} m^2 carrying a current of 2.7 A. The number density of free electrons of conductor is 5×10^{28} m^{-3}. How the drift velocity will change if conductor is replaced by another conductor of length 2m? (3)

26. Two circular coils X and Y having radii R/2 and R are placed co-axially with their centres separated by a distance 'R'. The coil X-carrys a current of 1A. Calculate current flowing in coil 'Y' such that magnetic field at the centre of coil X is zero. (3)

27. Answer the following questions : (3)

(a) Name the electro-magnetic waves which are :

(i) produced during a radioactive decay of nucleic. Write their one use.

(ii) used to take photographs of boxes. Write their wavelength range.

(b) The speed of an electromagnetic wave depends on the nature of the medium of propagation. Explain.

28. (a) Name a physical quantity which is defined as magnetic flux linked with a coil per unit current flowing through it. Write its SI unit.

(b) State Faraday, laws of electromagnetic induction. (3)

SECTION-D

Question number 29 and 30 are case based questions. Read the passage and write the question answer.

When a beam of light encounters a transparent medium, a part of light gets reflected back into first medium while rest enters the other. The direction of propagation of obliquely incident ray of light that enters the other medium changes at the interface of two media. The refracted ray may bends towards or away from the normal depending upon the optical density of the two media. When angle of incidence 'i' is equal to critical angle 'i_c', the refracted ray grazes the surface of interface between two media in a one particular case of refraction. (4)

(i) For total internal reflection to occur, the light must travel from :

(A) raser medium to denser medium and $i > i_c$

(B) denser medium to raser medium and $i < i_c$

(C) denser medium to raser medium and $i > i_c$

(D) raser medium to denser medium and $i < i_c$

(ii) In an optical fibre, the refractive index light pipe of glass fibre is n_2 and that of outer covering in n_1. Which of the following is correct?

(A) $n_1 = n_2$ (B) $n_1 < n_2$

(C) $n_1 \geq n_2$ (D) $n_1 >> n_2$

(iii) The critical angle for a pair of two media A and B of refractive indices $\sqrt{2.0}$ and 1.0 respectively is :

(A) 0° (B) 30°

(C) 60° (D) 45°

(iv) The critical angle of pair of a medium is 45°. The speed of light in the medium is:

(A) $\frac{3}{\sqrt{2}} \times 10^8 \text{ m/s}$

(B) $\sqrt{2} \times 10^8 \text{ m/s}$

(C) $1.5 \times 10^8 \text{ m/s}$

(D) $3 \times 10^8 \text{ m/s}$

OR

A point source of light is placed at the bottom of a tank containing water to a depth 'd'. What is the area of surface of water through which the light from the source can emerge-out? Refractive index of water is 'n'.

(A) $\frac{\pi d^2}{n^2 - 1}$

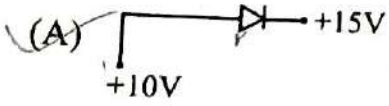
(B) $\frac{\pi d^2}{2(n^2 - 1)}$

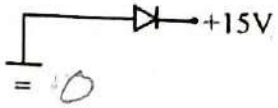
(C) $\frac{2\pi d^2}{n^2 - 1}$

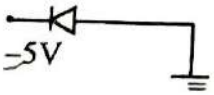
(D) $\frac{\pi d^2}{\sqrt{n^2 - 1}}$

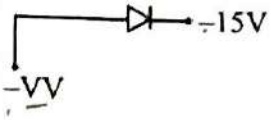
30. A p–n function is the building block of many semiconductor devices. During the formation of a p–n junction, movement of majority carriers as well as minority carriers taken place across the junction that leads to two processes – diffusion and drift. Applying suitable voltage across the diode is called biasing. It is of two types – forward biasing and reverse biasing. The semi-conductor diode behaves differently in these two biasing. (4)

(i) Which of the following diode is forward biased?

(A) 

(B) 

(C) 

(D) 

(ii) When a forward bias is applied to a p–n function, it :

(A) increases the barriers potential (B) decreases the barriers potential

(C) decrease the diffusion current (D) increases the depletion region

(iii) In an unbiased p–n function :

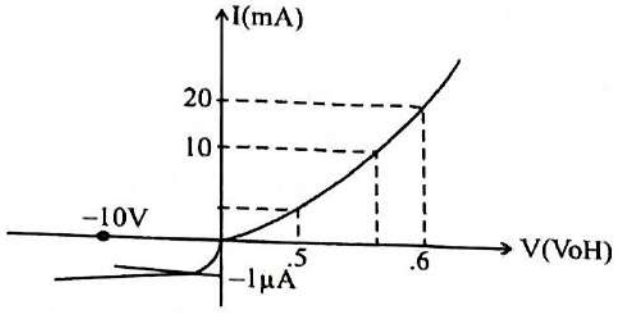
(A) electrons diffuses from p–region to n–region

(B) holes diffuses from p–region to n–region

(C) holes diffuses from n–region to p–region

(D) No diffusion takes placed when diode is unbiased.

(iv) The V–I characteristic of a silicon diode is shown. The resistance of diode at v = –10V is :



(A) 10 MΩ

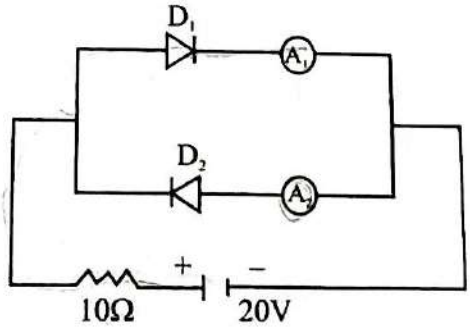
(B) 10 KΩ

(C) 16 KΩ

(D) 16 MΩ

OR

In the given circuit, D_1 and D_2 are ideal diodes and, A_1 and A_2 are ideal ammeters. The readings of ammeters A_1 and A_2 respectively are :



(A) 2A, 0A

(B) 0A, 0A

(C) 0A, 2A

(D) 2A, 2A

SECTION-E

31. (a) With the help of a ray diagram, show how a concave mirror is used to obtain an erect and magnified image of an object. Hence obtain the mirror formula. (5)

(b) Use mirror equation to deduce that a convex mirror always produces virtual image independent of location of the object.

OR

(a) Using Huygen's principle, verify Snell's law of refraction.

(b) In young's double slit experiment, two slits are separated by 3mm and illuminated by a light of wavelength 480 nm. The screen is placed 2m away from the place of slits. Calculate the separation between 8^{th} bright fringe and 3^{rd} dark fringe observed with respect to the central bright fringe.

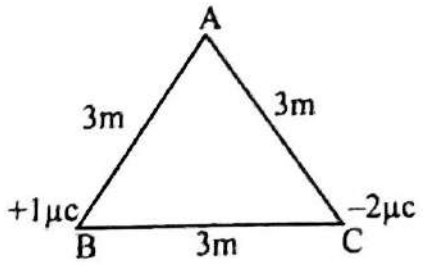
32. (a) Obtain expression for the capacitance of a parallel plate capacitor. (with air between the plates) (5)

(b) Two circular model plates each of radius 10 cm, are kept parallel to each other 3mm apart in air. Its capacitance is C_1. If the radius of each plate is increased to a factor of $\sqrt{2}$ and their distance of separation decreased to half of its initial value, its capacitance becomes C_2. Find C_2/C_1.

OR

(a) Derive an expression for the electric field at a point on the axis of an electric dipole of dipole moment $\vec{p} = q(2\vec{a})$. Write the expression for electric field at arial line when distance r from its centre is r>>a.

(b) Two point charges +1μc and–2μc are placed at the vertices 'B' and 'C' of an equilateral triangle ABC of side 3m as shown in the figure. Calculate magnitude of electric field at vertex 'A' of the triangle.



33. (a) An a.c. source of voltage $V = V_o \sin w\ell$ is applied across an inductor. Deduce an expression for the current flowing through the conductor. Discuss the phase relationship between current and voltage and draw phases diagram. (5)

(b) An ideal inductor is in turn, put across 230V, 60 Hz and 230V, 120Hz supplies. Will the current flowing through the inductor in the two cases be same? Explain with proper calculations.

OR

(a) Draw a labelled diagram for an a.c. generator. Write its working principle. Obtain an expression for the emf induced in the coil having 'N' turns each of area 'A', rotating with a constant angular speed 'w' in a magnetic field 'B' directed perpendicular to the axis of refraction.

(b) An a.c. generator consists of a coil of 100 turns and cross sectional area $3m^2$, rotating at a constant angular speed of 60 radian/sec in a uniform magnetic field of 0.04T. Calculate maximum emf induced in the coil.