Series P/PB2/1

SET 1

CLASS XII PRE-BOARD EXAMINATION – 2024-25

Q.P. Code: 042/2/1

Roll No. | | | | | | | | |

Candidate must write the Q.P. Code on the title page of the answer-book.

- Please check that this question paper contains **9** printed pages.
- Please check that this question paper contains **33** questions.
- Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
- **Please write down the serial number of the question in the answer-book before attempting it.**
- 15 minute time has been allotted to read this question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.

PHYSICS

Time allowed : 3 hours *Maximum Marks : 70*

General Instructions:

Read the following instructions very carefully and strictly follow them :

(i) *This question paper contains **33** questions. **All** questions are **compulsory**.*
(ii) *This question paper is divided into **five** sections **Sections A, B, C, D** and **E**.*
(iii) *In **Section A** Questions no. **1 to 16** are Multiple Choice type questions. Each question carries **1** mark.*
(iv) *In **Section B** Questions no. **17 to 21** are Very Short Answer type questions. Each question carries **2** marks.*
(v) *In **Section C** Questions no. **22 to 28** are Short Answer type questions. Each question carries **3** marks.*
(vi) *In **Section D** Questions no. **29 and 30** are case study-based questions. Each question carries **4** marks.*
(vii) *In **Section E** Questions no. **31 to 33** are Long Answer type questions. Each question carries **5** marks.*
(viii) *There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except Section A.*
(ix) *Use of calculators is **not** allowed.*

You may use the following values of physical constants wherever necessary:

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

$h = 6{\cdot}63 \times 10^{-34}$ Js

$e = 1{\cdot}6 \times 10^{-19}$ C

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

$\varepsilon_0 = 8{\cdot}854 \times 10^{-12}$ C^2 N^{-1} m^{-2}

$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^{9}$ N m^2 C^{-2}

Mass of electron (m_e) = $9{\cdot}1 \times 10^{-31}$ kg

Mass of neutron = $1{\cdot}675 \times 10^{-27}$ kg

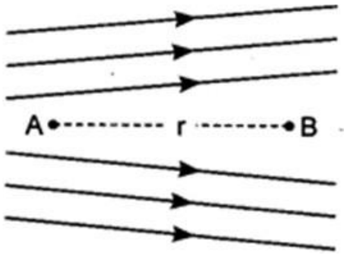
Mass of proton = $1{\cdot}673 \times 10^{-27}$ kg

Avogadro's number = $6{\cdot}023 \times 10^{23}$ per gram mole

Boltzmann constant = $1{\cdot}38 \times 10^{-23}$ JK^{-1}

[SECTION – A] (16x1=16 marks)

Q1. Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement between A and B is r then



(a) $E_A > E_B$ (b) $E_A < E_B$ (c) $E_A = E_B / r$ (d) $E_A = E_B /r^2$

Q2. The electric field at a point on the perpendicular bisector of a dipole is directed

(a) Along the dipole moment (b) Perpendicular to the dipole moment

(c) Opposite to the dipole moment (d)45° to the dipole moment

Q3. A potential difference. V is applied across a conductor of length L and diameter D. How are electric field E and resistance R affected if the potential difference V is halved?

a) E and R become double b) E doubles and R is halved

c) E and R become half d) E is halved and R remains same

Q4. Two α-particles have the ratio of their velocities as 3: 2 on entering the field. If they move in different circular paths, then the ratio of the radii of their paths is

a) 2 : 3 b) 3 : 2 c) 9 : 4 d) 4 : 9

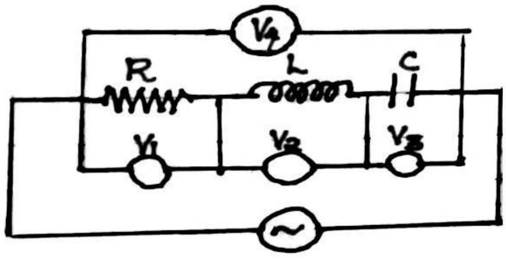
Q5. An ideal resistance R, ideal inductance L, ideal capacitance C and A.C volt meters, V1, V2, V3 and V4 are connected to an A. C source as shown. At resonance

(A) Reading in V3 = Reading in V1

(B) Reading in V1 = Reading in V2

(C) Reading in V2 = Reading in V4

(D) Reading in V2 = Reading in V3



Q6. Two waves of intensities I and 4I superpose. Then, the maximum and minimum intensities are

a) 9 I and I b) 5 I and I c) 9 I and 3 I d) 5 I and 3 I

Q7. Refractive index of water and glass are 4/3 and 5/3. A light ray is going to water from glass. Then, its critical angle will be:

(a) $\sin^{-1}$ (4/5) (b) $\sin^{-1}$(5/6) (c) $\sin^{-1}$ (½) (d) $\sin^{-1}$ (2/1)

Q8. A microscope is focused on a mark. Then a glass slab of refractive index 1.5 and thickness 6 cm is placed on the mark. To get the mark again in focus the microscope should be moved

a) 9 cm upward b) 2 cm downward c) 4 cm upward d) 2 cm upward

Q9. A thin convex lens of glass (n=1.5) has focal length+10 cm is immersed in water (n=1.33). The focal length of lens in water is –.

(a) 12cm (b) 20 cm (c) 40 cm (d) 48 cm

Q10. In young's double slit experiment the separation between the slits is halved and the distance between the slits and screen is doubled. The fringe width –

(a)Unchanged (b) halved (c) doubled (d) quadrupled

Q11.The distance of closest approach of an alpha particle is *d* when it moves with kinetic energy 'K' towards a nucleus. Another alpha particle is projected with higher energy such that the new distance of the closest approach is *d*/2. What is the kinetic energy of projection of the alpha particle in this case?

(a) K /2 (B) $\sqrt{2}$ K (c) 2 K (d) 4K

Q12. The p-n junction diode is connected to a battery of e.m.f. 5.5 V and external resistance 5.1 kΩ. The barrier potential in the diode is 0.4 V. The current in the circuit is

(a) 1A (b) 1 mA (c) 2 mA (d) 0.08 mA

For Questions 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 options as given below.

a) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
c) If Assertion is true but Reason is false.
d) If both Assertion and Reason are false.

Q13. Assertion (A): If an electron and proton enter a magnetic field with equal momentum, then the paths of both of them will be equally curved.

Reason (R): The magnitude of charge on an electron is the same as that of a proton

Q14. Assertion: The force of repulsion between atomic nucleus and alpha particle varies with distance according to inverse square law.

Reason: Rutherford did alpha particle scattering experiment.

Q15. Assertion (A): The binding energy per nucleon for nuclei with atomic mass A>120 decreases with A.

Reason (R): The nuclear force are weak for heavier nuclei.

Q16. Assertion (A): The de Broglie wave length of an electron is greater than proton, when both are moving with same speed.

Reason (R): de Broglie's wavelength of a particle is directly proportional to its linear momentum. .

[SECTION – B] (5x2=10 marks)

Q17. A proton and an alpha particle are accelerated through the same potential. Which one of the two has (i) greater value of de Broglie wavelength associated with it and (ii) less kinetic energy? Give reasons to justify your answer.

Q18. A convex lens made of a material of refractive index n_1 is kept in a medium of refractive index n_2 . Parallel rays of light are incident on the lens. Complete the path of rays of light emerging from the convex lens if (i) $n_1 > n_2$ (ii) $n_1<n_2$ (iii) $n_1=n_2$

OR

Light from a point source in air falls on a spherical glass surface (n = 1.5 and radius of curvature = 10 cm). The distance of the light source from the glass surface is 100 cm. At what position the image is formed?

Q19. A galvanometer coil has a resistance of 15 Ω and the metre shows full scale deflection for a current of 4 mA. How will you convert the metre into an ammeter of range 0 to 6A?

Q20. A beam of high energy photons, each of energy of E is incident on a metal surface and electrons are ejected from the surface. Assuming that the work function of the metal, is negligible, find the relation between the de Broglie wavelength associated with photoelectrons and the energy of photons E. Show in a figure, the variation of as a function of E

Q21 A cell of emf E and internal resistance r is connected across an external resistance R. Plot a graph showing the variation of potential difference across R, verses R.

[SECTION – C] **(07x3=21 marks)**

Q22. (i) Briefly describe the classification of solids into metals, insulators and semi-conductors on the basis of energy level diagrams.

(ii) In a silicon diode, the current increases from 10 mA to 20 mA when the voltage changes from 0 6 V to 0 7 V. Calculate the dynamic resistance of the diode.

Q23. Draw V I characteristics of a p-n junction diode. Answer the following giving reasons :

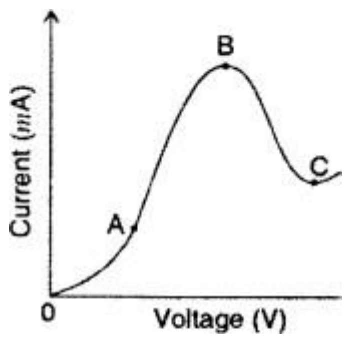
(a) Why is the reverse bias current almost independent of applied voltage up to breakdown voltage?

(b) Why does the reverse current show a sudden increase at breakdown voltage ?

Q24. Identify the part of electromagnetic spectrum which is

(i) produced in Welder's arc (ii) produced by bombarding fast moving electrons on metal target (iii) produced in nuclear reactions (iv) the cause for Green House effect. Arrange these waves in the increasing order of frequency

Q25. (a) The graph shown in the figure represents a plot of current versus voltage for a given semi-conductor. Identify the region, if any, over which the semi-conductor has a negative resistance.



(b) A battery is connected first across the series combination and then across the parallel combination, of three resistances R, 2R and 3R. Find ratio of power consumed in the two cases

Q26. How is the mutual inductance of a pair of coils affected when

(1) Separation between the coils is increased.

(2) The number of turns of each coil is increased.

(3) A thin iron sheet is placed between two coils, other factors remaining the same.

Explain answer in each case

Q27. A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1.

(i) What is the refractive index of the material of the prism in Fig. 1?

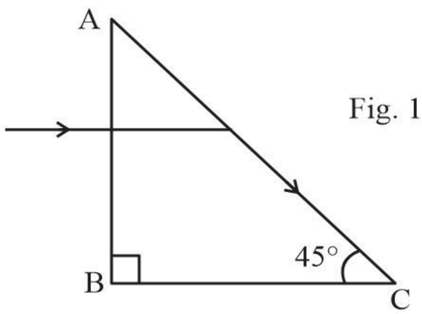


Fig. 1

(ii) (a) If the side AC of the above prism is now surrounded by a liquid of refractive index $2/\sqrt{3}$ shown in Fig. 2, determine if the light ray continues to graze along the interface AC or undergoes total internal reflection or undergoes refraction into the liquid.

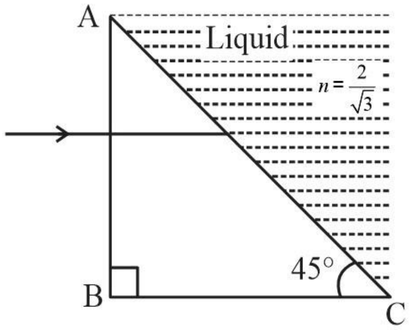


Fig. 2

(b) Draw the ray diagram to represent the path followed by the incident ray with the corresponding angle values.

(Given, $sin^{-1}(\frac{\sqrt{2}}{\sqrt{3}}) = 54.6^{\circ}$)

Q28. A parallel plate capacitor is charged to a potential difference V by a DC source. The capacitor is then disconnected from the source. If the distance between the plates is doubled, state with reason, how the following will change -

(i) Electric field between the plates?

(ii) Capacitance?

(iii) Energy stored in the capacitor?

OR

(1) If two similar large plates, each of area A having surface charge densities $+\sigma$ and $-\sigma$ are separated by a distance d in air, then find the expression for the field at points between the two plates and on the outer side of the plates. Specify the direction of the field in each case.

(i) the potential difference between the plates.

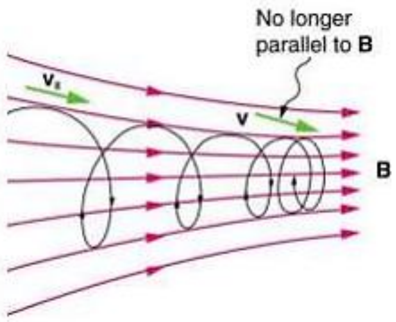
(ii) the capacitance of the capacitor so formed.

(2) Two metallic spheres of radii R and 2R are charged so that both of these have the same surface charge density σ . If they are connected to each other with a conducting wire, in which direction will the charge flow and why?

[SECTION D]

Case Study Based Question (2x4=08marks)

Q29.



A point charge q (moving with a velocity v and located at r at a given time t) in the presence of both the electric field E and magnetic field B. The force on an electric charge q due to both of them can be written as $F = q [E + (v \times B)] = F_{ef} + F_{mf}$ It is called Lorentz force.

(i). If the charge q is moving under a field, the force acting on the charge depends on the magnitude of field as well as the velocity of the charge particle, what kind of field is the charge moving in?

(a) Electric field (b) Magnetic field

(c) Both electric and magnetic field perpendicular to each other (d) None of these

(ii) The magnetic force acting on the charge 'q' placed in a magnetic field will vanish if

(a) if v is small (b) If v is perpendicular to B

(c) If v is parallel to B (d) None of these

(iii). If an electron of charge –e is moving along +X direction and magnetic field is along +Z direction then the magnetic force acting on the electron will be along

(a) + X axis (b) - X axis (c) –Y axis (d) +Y axis

(iv). The vectors which are perpendicular to each other in the relation for magnetic force acting on a charge particle are

a) F and v (b) F and B (c) v and B (d) Both (a) and (b)

OR

A particle moves in a region having a uniform magnetic field and a parallel, uniform electric field. At some instant, the velocity of the particle is perpendicular to the field direction. The path of the particle will be

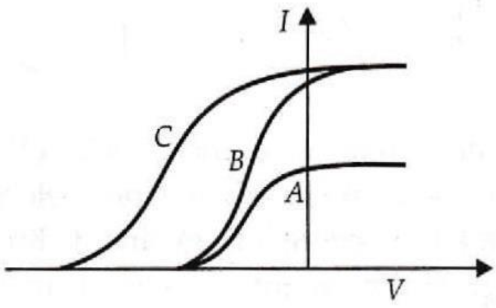
(a) A straight line (b) A circle

(c) A helix with uniform pitch. (d) A helix with non-uniform pitch

Q30. It is the phenomenon of emission of electrons from a metallic surface when light of a suitable frequency is incident on it. The emitted electrons are called photoelectrons.

Nearly all metals exhibit this effect with ultraviolet light but alkali metals like lithium, sodium, potassium, cesium etc. show this effect even with visible light. It is an instantaneous process i.e. photoelectrons are emitted as soon as the light is incident on the metal surface. The number of photoelectrons emitted per second is directly proportional to the intensity of the incident radiation. The maximum kinetic energy of the photoelectrons emitted from a given metal surface is independent of the intensity of the incident light and depends only on the frequency of the incident light. For a given metal surface there is a certain minimum value of the frequency of the incident light below which emission of photoelectrons does not occur.

(i) In a photoelectric experiment photo current is plotted against anode potential.



(a) A and B will have same intensities while B and C will have different frequencies
(b) B and C will have different intensities while A and B will have different frequencies
(c) A and B will have different intensities while B and C will have equal frequencies
(d) B and C will have equal intensities while A and B will have same frequencies.

(ii) Photoelectrons are emitted when a zinc plate is

(a)Heated (b) hammered

(c) Irradiated by ultraviolet light (d) subjected to a high pressure

(iii) The threshold frequency for photoelectric effect on sodium corresponds to a wavelength of 500 nm. Its work function is about

(a) $4x10^{-19}$J (b) 1 J (c) $2x10^{-19}$ J (d) $3x10^{-19}$J

(iv) The maximum kinetic energy of photoelectrons emitted from a surface when photons of energy 6 eV fall on it is 4 eV. The stopping potential is

(a) 2 V (b) 4 V (c) 6 V (d) 10 V
(b)

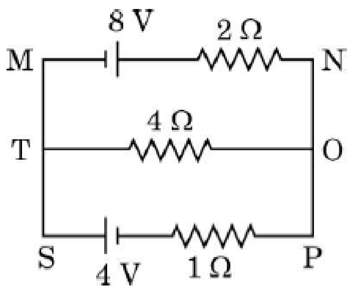
OR

The minimum energy required to remove an electron from a substance is called its
(a) work function (b) kinetic energy (c) stopping potential (d) potential energy

[SECTION E] (3X5=15)

Q31. (a) State Kirchhoff's rules used in the analysis of electric circuits and use them to obtain the condition of balance of Wheatstones bridge.

(b Use Kirchhoff rule to determine the current flowing through the branches MN, TO and SP in the circuit shown in the figure



OR

(a) Write two limitations of ohm's law. Plot their I-V characteristics.
(b) Show on a plot, variation of resistivity (i) a conductor, and of (ii) a typical semiconductor as a function of temperature

(c) Using the concept of free electrons is a conductor; derive the expression for the conductivity of a wire in term of current density and relaxation time. Hence obtain the relation between current density and the applied electric field E.

Q32. In an LR series circuit, a sinusoidal voltage V = V sin ωt is applied. It is given that L = 35 mH, R = 11Ω, V = 220V, and frequency = 50 Hz . Find inductive reactance,impedance , the amplitude of current in the steady state and obtain the phase difference between the current and the voltage. Also plot the variation of current for one cycle .

OR

In an LCR series combination, R = 400 Ω, L = 100 mH and C = μF. This combination is connected to a 25 sin 2000 t volt source. Find

i) the Impedance,
ii) peak value of current,
iii) phase difference of voltage and current
iv) power factor and dissipated power In the circuit.

Q33. (a)Explain two features to distinguish between the interference pattern in Young's double slit experiment with the diffraction pattern obtained due to a single slit.

(b) Explain diffraction of light due to a narrow single slit..
(c) If the width of the slit is made double the original width , how does it affect the size and intensity of the central band ?

OR

(a) State the conditions under which total internal reflection takes place? Define critical angle and establish its relationship with refractive index. (3)

(b) A beam of light converges at a point P. Now a convex lens is placed in the path of the convergent beam at 15 cm from P. At what point does a beam converge if the convex lens has a focal length 10cm (2)

****