

KENDRIYA VIDYALAYA SANGATHAN TINSUKIA REGION

PRE-BOARD EXAMINATION 2025-26

Subject :- PHYSICS (042)

Class:-XII

Time Allowed: 3 Hours

Maximum Marks : 70

GENERAL INSTRUCTIONS:

Read the following instructions carefully and follow them:

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.
- 7) You may use the following values of physical constants where ever necessary.

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

ii. $m_e = 9.1 \times 10^{-31} \text{ kg}$

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

iv. $\mu_0 = 4\pi \times 10^{-7} \text{ TmA}^{-1}$

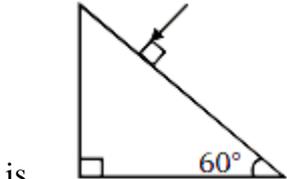
v. $h = 6.63 \times 10^{-34} \text{ J s}$

vi. $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$

vii. Avogadro's number = 6.023×10^{23} per gram mole

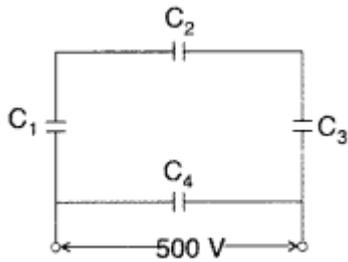
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	SECTION A	
Q1	A cube of side 'b' has a charge q at each of its vertices. The electric field due to charge distribution at the centre of cube will be (a) q/b^2 (b) $q/2b^2$ (c) $32q/b^2$ (d) zero	1
Q2	A cell having an emf E and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by	1

Q3	A charged particle is moving on circular path with velocity v in a uniform magnetic field B , if the velocity of the charged particle is doubled and strength of magnetic field is halved, then radius becomes (a) 8 times (b) 4 times (c) 2 times (d) 16 times	1
Q4	In the given figure current from A to B in the straight wire is decreasing. The direction of induced current in the loop is A (a) clockwise (b) anticlockwise (c) changing (d) nothing can be said	1
Q5	Lenz's law is a consequence of the law of conservation of (a) charge (b) energy (c) induced emf (d) induced current	1
Q6	Which of the following graphs represents the correct variation of inductive reactance X_L with frequency ω ? 	1
Q7	Which of the following is called heat radiation? (a) X-rays (b) γ -rays (c) Infrared radiation (d) Microwave	1
Q8	If the critical angle for total internal reflection from a medium to vacuum is 30° , the velocity of light in the medium is : (a) $3 \times 10^8 \text{ ms}^{-1}$ (b) $6 \times 10^8 \text{ ms}^{-1}$ (c) $1.5 \times 10^8 \text{ ms}^{-1}$ (d) $15 \times 10^8 \text{ ms}^{-1}$	1
Q9	Two waves of the same frequency and same intensity are super impose in the same phase. The intensity of the resultant wave at the Central point will be (a) equal to that of the individual wave. (b) 3 times that of individual wave. (c) 2 times that of individual wave. (d) 4 times that of individual wave.	1

Q10	The hydrogen atom can give spectral lines in the Lyman, Balmer and Paschen series. Which of the following statement is correct? a. Balmer series is in the visible region b. Paschen series is in the visible region c. Lyman series is in the infra-red region d. Balmer series is in the ultraviolet region	1
Q11	Find the value of the angle of emergence from the prism. The refractive index of the glass $\sqrt{3}$ is .  (a) 45° (b) 90° (c) 60° (d) 30°	1
Q12	Two nuclei have mass numbers in the ratio 27 : 125. What is the ratio of their nuclear radii? (a) 2:3 (b) 3:5 (c) 5:3 (d) 3:2	1
	Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses. (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion. (b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion. (c) If the Assertion is correct but Reason is incorrect. (d) If both the Assertion and Reason are incorrect.	
Q13	Assertion: A metallic shield in form of a hollow shell may be built to block an electric field. Reason: In a hollow spherical shield, the electric field inside it is zero at every point.	1
Q14	Assertion : The electric potential on the surface of a charged sphere is continuous. Reason : Electric field on the surface of a charged sphere is discontinuous.	1
Q15	Assertion : In Bohr's model of hydrogen atom, the angular momentum of the electron is quantized. Reason : Only those electron orbits are permitted in which the circumference of the orbit is an integral multiple of the de Broglie wavelength of the electron.	1
Q16	Assertion. For identical coherent waves, the maximum intensity is four times the intensity due to each wave. Reason. Intensity is proportional to the square of amplitude.	1
SECTION B		
Q17	Two charges of magnitudes $-3Q$ and $+2Q$ are located at points $(a, 0)$ and $(4a, 0)$ respectively. What is the electric flux due to these charges through a sphere of radius ' $5a$ ' with its centre at the origin?	2
Q18	Derive an expression for the resistivity of a good conductor, in terms of the relaxation time of electrons.	2
Q19	In what way is the behaviour of a diamagnetic material different from that of a paramagnetic, when kept in an external magnetic field? Distinguish between a diamagnetic material and a paramagnetic material based on their susceptibility.	2
Q20	In the ground state of hydrogen atom, its Bohr radius is given as $5.3 \times 10^{-11} \text{m}$. The atom is excited such that the radius becomes $21.2 \times 10^{-11} \text{m}$. Find (i) The value of the principal quantum number. (ii) Total energy of the atom in this excited state Or Calculate the wavelength of the photon emitted when an electron in a hydrogen atom makes a transition from the second orbit ($n = 2$) to the first orbit ($n = 1$).	2
Q21	The oscillating magnetic field in a plane electromagnetic wave is given by $B_y = (8 \times 10^{-6}) \sin [2 \times 10^{11} t + 300 \pi x] \text{ T}$ (i) Calculate the wavelength of the electro- magnetic wave. (ii) Write down the expression for the oscillating electric field.	2
SECTION C		
Q22	Use Kirchhoff's rules to determine the value of the current I_1 flowing in the circuit shown in the figure.	3

Q23	A steady current (I_1) flows through a long straight wire. Another wire carrying steady current (I_2) in the same direction is kept close and parallel to the first wire. Show with the help of a diagram how the magnetic field due to the current I_1 exerts a magnetic force on the second wire. Derive the expression for this force	3
Q24	Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.	3
Q25	Draw a ray diagram showing the image formation by a compound microscope. Hence obtain the expression for total magnification when the image is formed at least distance of distinct vision Or Draw a ray diagram to show the formation of the image of an object placed on the axis of a convex refracting surface, of radius of curvature 'R', separating the two media of refractive indices " n_1 and ' n_2 ' ($n_2 > n_1$). Use this diagram to deduce the relation $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$, where u and v represent respectively the distance of the object and the image formed.	3
Q26	State Huygen's principle. Using this principle draw a diagram to show how a plane wave front incident at the interface of the two media gets refracted when it propagates from a rarer to a denser medium. Hence verify Snell's law of refraction.	3
Q27	Draw a plot of the binding energy per nucleon as a function of mass number for a large number of nuclei, Using the curve for the binding energy per nucleon as a function of mass number A , state clearly how the release of energy in the processes of nuclear fission and nuclear fusion can be explained.	3
Q28	With the help of a labelled circuit diagram, explain how a junction diode is used as a full wave rectifier. Draw its input, output wave-forms.	3
	SECTION D	
Q29	<p>According to wave theory of light, light of any frequency can emit electrons from a metallic surface provided the intensity of light is sufficient to provide necessary energy for emission of electrons. However, according to experimental observations, light of frequency less than threshold frequency cannot emit electrons, whatever be the intensity of incident light. Einstein proposed that electromagnetic radiation is quantized.</p> <p>If photoelectrons are ejected from a surface when light of wavelength $\lambda_1 = 550$ nm is incident on it, the stopping potential for such electrons is $V_s = 0.19$ V. Suppose radiation of wavelength $\lambda_2 = 190$ nm is incident on the surface.</p> <p>(i) Photoelectric effect supports quantum nature of light because:</p> <p>(A) there is a minimum frequency of light below which no photoelectrons are emitted (B) the maximum K.E. of photoelectrons depends only on the frequency of light and not on its intensity (C) even when the metal surface is faintly illuminated, the photoelectrons leave the surface immediately (D) electric charge of the photoelectrons is quantized</p> <p>(a) A, B, C (b) B, C (c) C, D (d) A, D, C</p> <p>(ii) In photoelectric effect, electrons are ejected from metals if the incident light has a certain minimum:</p> <p>(a) wavelength (b) frequency (c) amplitude (d) angle of incidence</p>	

	<p>(iii) Calculate the stopping potential V for surface 2 for $\lambda_2 = 190 \text{ nm}$:</p> <p>(a) 4.47 V (b) 3.16 V (c) 2.76 V (d) 5. V</p> <p>(iv) Calculate the work function of the surface 1:</p> <p>(a) 3.75 eV (b) 2.07 eV (c) 4.20 eV (d) 3.60 eV</p> <p style="text-align: center;">Or</p> <p>(v) Calculate the threshold frequency for the surface 2</p> <p>(a) $500 \times 10^{12} \text{ Hz}$ (b) $4.98 \times 10^{14} \text{ Hz}$ (c) $520 \times 10^{11} \text{ Hz}$ (d) $460 \times 10^{13} \text{ Hz}$</p>	
Q30	<p>A p–n junction diode is formed when a p-type semiconductor is joined with an n-type semiconductor. At the junction, electrons from the n-side combine with holes from the p-side, forming a depletion region that acts as a barrier. The diode shows different behaviors under biasing:</p> <p>In forward bias, the external voltage reduces the potential barrier and allows current to flow easily.</p> <p>In reverse bias, the barrier potential increases, and only a small leakage current flows due to minority carriers.</p> <p>Beyond a certain reverse voltage, breakdown occurs, causing a large current to flow. p–n junction diodes are widely used as rectifiers, in clamping circuits, and in switching applications.</p> <p>(i) What is formed at the junction of a p–n diode due to diffusion of charge carriers? (a) Conduction band (b) Depletion region (c) Valence band (d) Potential well</p> <p>(ii) What happens to the width of the depletion layer in forward bias? (a) Increases (b) Decreases (c) Remains same (d) Becomes infinite</p> <p>(iii) In reverse bias, the current through a p–n junction diode is due to: (a) Majority carriers (b) Minority carriers (c) Both majority and minority carriers (d) None</p> <p>(iv) When used as a rectifier, the main function of a p–n junction diode is (a) Amplification (b) Switching (c) Converting AC to DC (d) Voltage regulation</p> <p style="text-align: center;">Or</p> <p>The typical forward voltage drop across a silicon diode is approximately: (a) 0.1 V (b) 0.3 V (c) 0.7 V (d) 1.5 V</p>	
SECTION E		
Q31	<p>(i) Derive expression for capacitance of a parallel plate capacitor with dielectric medium fully placed</p> <p>(ii) A network of four capacitors each of $12\mu\text{F}$ capacitance is connected to a 500 V supply as shown in the figure. Determine (a) equivalent capacitance of the network and (b) charge on each capacitor.</p>	



OR

(a) Write two properties of equipotential surfaces. Depict equipotential surfaces due to an isolated point charge. Why do the equipotential surfaces get closer as the distance between the equipotential surface and the source charge decreases?

(b) An electric dipole of dipole moment p , is placed in a uniform electric field E . Deduce the expression for the electric potential energy and write condition for stable and unstable equilibrium.

Q32

(a) Draw a schematic arrangement for winding of primary and secondary coil in a transformer when the two coils are wound on top of each other.

(b) State the underlying principle of a transformer and obtain the expression for the ratio of secondary to primary voltage in terms of the

- (i) number of secondary and primary windings and
- (ii) primary and secondary currents.

(c) Write the main assumption involved in deriving the above relations.

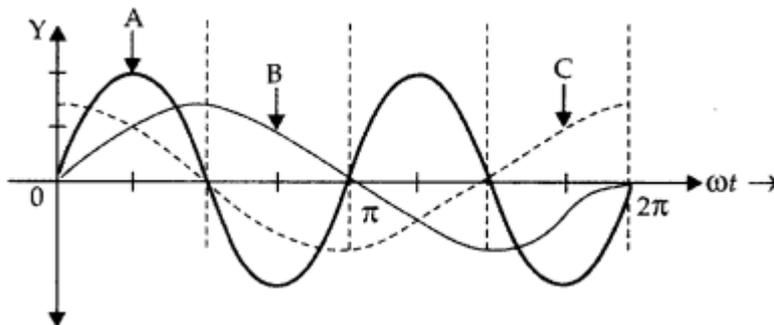
(d) Write any two reasons due to which energy losses may occur in actual transformers.

OR

A device 'X' is connected to an ac source $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the following graph:

(a) Identify the device 'X'.

(b) Which of the curves A, B and C represent the voltage, current and the power consumed in the circuit? Justify your



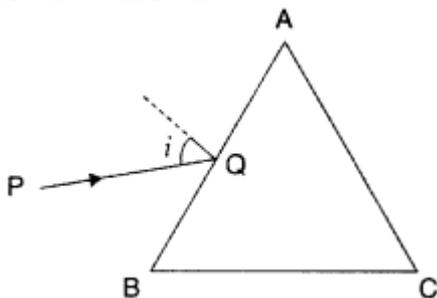
(c) How does its impedance vary with frequency of the ac source? Show graphically.

(d) Obtain an expression for the current in the circuit and its phase relation with ac voltage

Q33

(a) A ray 'PQ' of light is incident on the face AB of a glass prism ABC (as shown in the figure) and emerges out of the face AC. Trace the path of the ray. Show that

$$\angle i + \angle e = \angle A + \angle \delta$$



where δ and e denote the angle of deviation and angle of emergence respectively.

Plot a graph showing the variation of the angle of deviation as a function of angle of incidence. State the condition under which $\angle \delta$ is minimum.

(b) Find out the relation between the refractive index (μ) of the glass prism and $\angle A$ for the case when the angle of prism (A) is equal to the angle of minimum deviation (δ_m). Hence obtain the value of the

refractive index for angle of prism $A = 60^\circ$

OR

(a) A point object is placed in front of a double convex lens (of refractive index $n = \frac{n_2}{n_1}$ with respect to air) with its spherical faces of radii of curvature R_1 and R_2 . Show the path of rays due to refraction at first and subsequently at the second surface to obtain the formation of the real image of the object. Hence obtain the Lens-maker's formula for a thin lens.

(b) A double convex lens having both faces of the same radius of curvature has refractive index 1.55. Find out the radius of curvature of the lens required to get the focal length of 20 cm