केंद्रीय विद्यालय संगठन, अहमदाबाद संभाग

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प्री-बोर्ड परीक्षा:**2024-25**

PRE-BOARD EXAMINATION: 2024-25

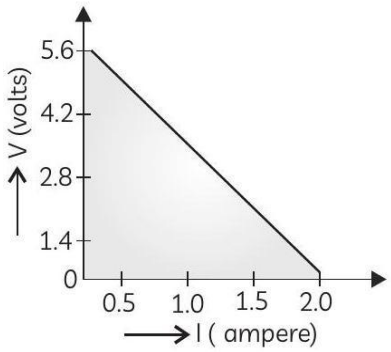
SUBJECT : PHYSICS THEORY (042) **TIME : 3 HOURS**

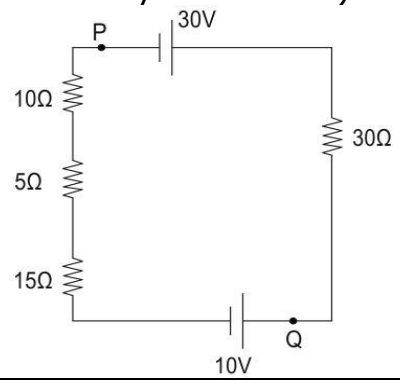
CLASS : XII **MM: 70**

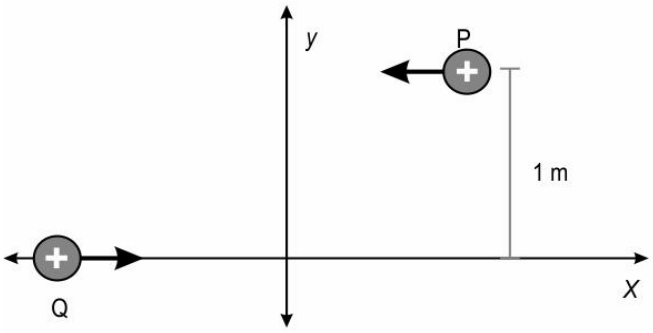
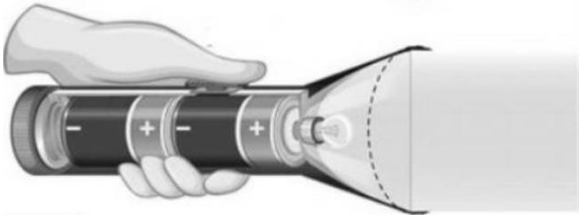
GENERAL INSTRUCTIONS:

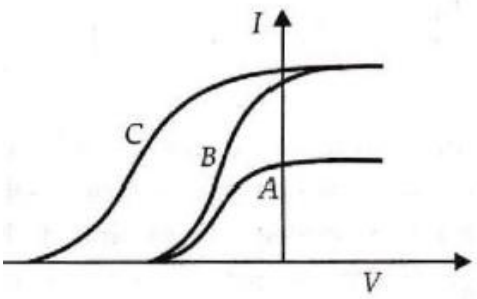
(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark 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.
(7) You may use the following values of physical constants where ever necessary
$c = 3 \times 10^8$ m/s, $m_e = 9.1 \times 10^{-31}$ kg , $e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4\pi \times 10^{-7}$ $Tm A^{-1}$, $\varepsilon_0 = 8.85 \times 10^{-12}$ $C^2 N^{-1} m^{-2}$, Avagadro Number $N_A = 6.02 \times 10^{23}$ per gram mole

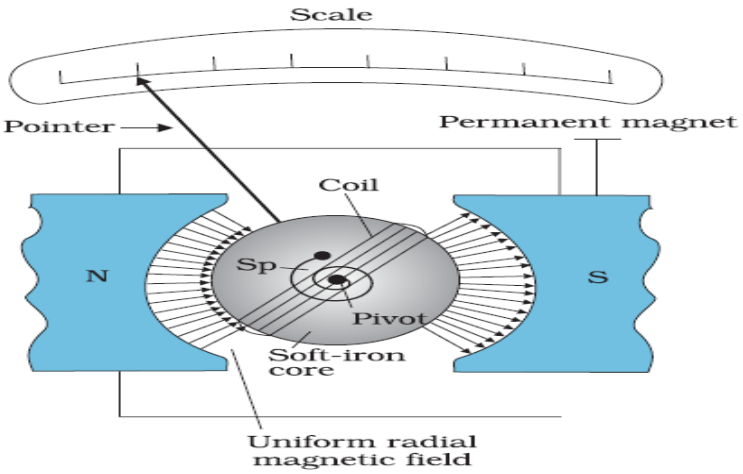
Q. No	**Section A**	MM
1	Correct match of column I with column II is **C-I (waves)** / **C-II (Production)** (1) Infra-red — P . Rapid vibration of electrons in aerials (2) Radio — Q . Electrons in atoms emit light when they move from higher to lower energy level. (3) Light — R . Klystron valve (4) Microwaves — S . Vibration of atoms and molecules (A) 1-P, 2-R, 3-S, 4-Q (B) 1-S, 2-P, 3-Q, 4-R (C) 1-Q, 2-P, 3-S, 4-R (D) 1-S. 2-R, 3-P, 4-Q	1
2	In a given region, electric potential varies with position as $V(x) = 3 + 2x^2$. Identify which of the following statements is correct. (A) Potential difference between the two points x = 2 and x = -2 is 2 V. (B) A charge of 1 C placed at x = 2 experiences a force of 6 N. (C) The force experienced by the above charge is along +x - axis. (D) The electric field in the given region is non-uniform along x - axis.	1
3	In a given region of an electric field, there is no charge present. A closed container is placed in this region of the electric field. What is the requirement for the total flux through the closed container to be zero? (A) The field must be uniform. (B) The container must be symmetric. (C) The container must be oriented in a particular direction. (D) There is no such requirement. The total flux through the container is zero no matter what.	1

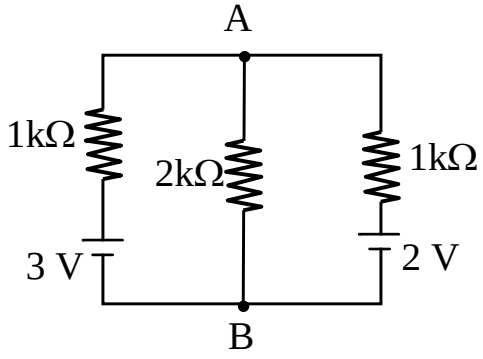
4	A straight line plot showing the terminal potential difference (V) of a cell as a function of current I drawn from it, is shown in the figure. The internal resistance of the cell would be:  (A) 2.8 Ω (B) 1.4 Ω (C) 1.2 Ω (D) Zero	1
5	A 5-ohm resistor, a 5 mH inductor and a 5 μF capacitor, joined in series resonate with an ac source of frequency ω_o. If only the resistance is changed to 10 ohm, the circuit resonates at a frequency ω_1. If only the inductor is changed to 20 mH, the circuit resonates at a frequency ω_2. Find the ratio ω_1/ω_2. (A) 0.5 (B) 1 (C) 2 (D) 4	1
6	Which of the following wave has a maximum frequency? (A) Radio wave (B) Infra-red wave (C) Microwaves (D) X Ray	1
7	A convex lens of focal length 40 cm is in contact with a concave lens of focal length 25 cm. The power of combination is (A) -1.5 D (B) - 6.5 D (C) 6.5 D (D) 6.67 D	1
8	Two waves $Y_1 = a \sin \omega t$ and $Y_2 = a \sin (\omega t + \delta)$ are producing interference, then resultant intensity is…. (where, δ is phase difference between both waves) (A) $a^2\cos^2 \delta/2$ (B) $2a^2\cos^2 \delta/2$ (C) $3a^2\cos^2 \delta/2$ (D) $4a^2\cos^2 \delta/2$	1
9	Soap bubble appears coloured due to the phenomenon of (a) Interference (b) Diffraction (c) Dispersion (d) Reflection	1
10	The potential energy of an electron in an excited state of the hydrogen atom is about −3 eV. How many emission spectral lines are possible for this excited electron? (A) 1 (B) 2 (C) 3 (D) 6	1
11	In an unbiased p-n junction at equilibrium, which of the following statements is true about diffusion current and drift current? (A) Diffusion current is equal to drift current (B) Drift current exists while diffusion current is zero (C) Diffusion current exists while drift current is zero (D) Neither drift current nor diffusion current exists	1
12	A long straight wire of circular cross section of radius 'a' carries a steady current I. The current is uniformly distributed across its cross section. The ratio of magnitudes of the magnetic field at a point a/2 above the surface of wire to that of a point a/2 below its surface is (A) 4:1 (B) 1:1 (C) 4: 3 (D) 3 :4	1

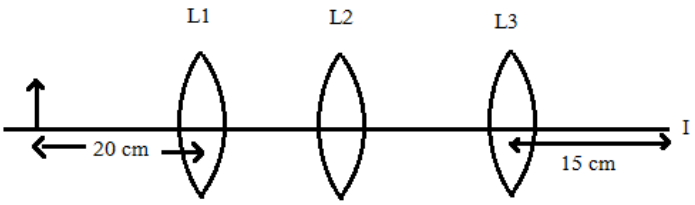
	For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below. **A.** If both Assertion and Reason are true and Reason is the correct explanation of Assertion. **B.** If both Assertion 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.	
13	**Assertion :** de Broglie's wavelength of a freely falling body keeps decreasing with time. **Reason :** The momentum of the freely falling body increases with time.	1
14	**Assertion:** The atom with a filled valence shell does not react with other elements. **Reason:** If an atom has a filled valence shell, the atomic nucleus is stable.	1
15	**Assertion**: Most of the mass of the atom is concentrated in its nucleus. **Reason:** All alpha particles striking a gold sheet are scattered in different directions.	1
16	**Assertion:** The kinetic energy of a charged particle describing a circular path in a uniform magnetic field does **NOT** remain constant with time. **Reason :** The velocity of a charged particle moving in a circular path in a uniform magnetic field does not change with time.	1
	SECTION - B	
17	A beam of light consisting of two wavelengths, 4000 Å and 6000 Å, is used to obtain interference fringes in a Young's double-slit experiment. What is the least distance from the central maximum where the dark fringe is obtained? **OR** In Young's double-slit experiment using monochromatic light of wavelength λ, the intensities of two sources are I. What is the intensity of light at a point where path difference between wavefronts is λ/4?	2 2
18	In the circuit containing two cells of emfs 30 V and 10 V, determine (with necessary calculation) which of the two points, P or Q is at higher potential?  	2
19	P and Q are two identical charged particles of mass 4×10^{-26} kg and charge 4.8×10^{-19} C, each moving with the same speed of 2.4×10^{5} m/s as shown in the figure. The two particles are equidistant from the vertical y-axis. At some instant, a magnetic field B is switched on so that the two particles undergo head-on collision.	2

	 Find (a) the direction of the magnetic field and (b) the magnitude of the magnetic field applied in the region.	
20	Write Einstein's photoelectric equation and explain how does this equation provide an explanation for the concept of the threshold frequency in the context of the photoelectric effect?	2
21	The fission properties of $^{239}_{94}Pu$ are similar to those of $^{235}_{92}U$. How much energy in (MeV) is released if all the atoms in 1 g of pure $^{239}_{94}Pu$ undergo fission ? The average energy released per fission is 180 MeV.	2
	SECTION C	
22	A flashlight uses two batteries, each of emf 2 V and internal resistance 0.1 ohm, in series. The flashlight bulb has a resistance of 10 ohm.  (a) What is the current drawn by the flashlight bulb? (b) How much power is dissipated through the flashlight bulb? (c) If the two batteries have zero internal resistances, will the power dissipated through the flashlight bulb be more or less? Calculate the difference.	3
23	State Gauss's theorem in electrostatics. Using this theorem, derive an expression for the electric field due to an infinitely long straight wire of linear charge density λ. **OR** (a) Define electric flux and write its SI unit. (b) Use Gauss's law to obtain the expression for the electric field due to a uniformly charged infinite plane sheet of charge.	3 3
24	Differentiate between the Diamagnetic, Paramagnetic and ferromagnetic materials on the basis of following properties- (a) Behaviour in external magnetic field. (b) Magnetic permeability, and (c) Dependence of Magnetic susceptibility on the temperature.	3
25	A thin convex lens of focal length 10 cm and refractive index $n_2 = 1.5$ is immersed in a medium of refractive index n_1. In each of the following instances, determine whether the lens behaves as a converging lens, plane glass or a diverging lens? Also find the focal length of the lens in each case. (a) $n_1 = 1.2$ (b) $n_1 = 1.5$ (c) $n_1 = 2$	3

26	(i) Draw a labeled ray diagram to show the formation of image in an astronomical reflecting telescope(Cassegrain) for a distant object. (ii) Write any four advantages of a reflecting type telescope over a refracting type telescope.	3
27	Draw circuit diagram to study V-I characteristics of a p-n junction diode in forward and reverse bias. Answer the following questions, giving reasons: (i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage? (ii) Why does the reverse current show a sudden increase at the critical voltage?	3
28	The hole and electron concentration in the intrinsic semiconductor of germanium at room temperature is 2×10^{18} m^{-3}. After doping with an element Q, the concentration of electrons in the doped semiconductor becomes 6×10^{22} m^{-3}. The concentration of germanium atoms is $6 \times 10^{30} m^{-3}$. (a)Is Q trivalent or pentavalent element? Give reason. (b)What is the ratio of atoms of element Q and germanium in the doped semiconductor? (c) Draw energy band diagram of doped semiconductor so obtained at T>0K.	3
	SECTION D **Case Study Based Questions**	
29	**Read the following paragraph and answers the questions:** **Case Study Based Question: Photoelectric effect** 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 plate 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	4

	(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) 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 (iii) 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 (iv) 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 **OR** (iv) Photoelectrons are emitted when a zinc plate is (A) Heated (B) hammered (C) Irradiated by ultraviolet light (D) subjected to a high pressure	
30	**Read the following paragraph and answers the questions:** Moving coil galvanometers are of two types (i) Suspended coll (ii) Pivoted coil type or tangent galvanometer, Its working is based on the fact that when a current carrying coil is placed in a magnetic field, it experiences a torque. This torque tends to rotate the coil about its axis of suspension in such a way that the magnetic flux passing through the coil is maximum.  (i) To make the field radial in a moving coil galvanometer. (a) number of turns of coil is kept small (b) magnet is taken in the form of horse-shoe (c) poles are of very strong magnets (d) poles are cylindrically cut.	4

	(ii) To increase the current sensitivity of a moving coil galvanometer, we should decrease: (a) strength of magnet (b) torsional constant of spring (c) number of turns in coil (d) area of coil (iii) A moving coil galvanometer has a resistance of 50 ohm and gives full scale deflection for 10 mA. How could it be converted into an ammeter with a full scale deflection for 1A (a) 50/99 ohm in series (b) 50/99 ohm in in parallel (c) 0.01 ohm in series (d) 0.01 ohm in parallel (iv) In a moving coil galvanometer, having a coil of N-turns of area A and carrying current I is placed in a radial field of strength B. The torque acting on the coil is (a) NA^2B^2I (b) $NABI^2$ (c) N^2ABI (d) NABI **OR** (iv) The deflection in a moving coil galvanometer is (a) directly proportional to torsional constant of spring (b) directly proportional to the number of turns in the coil (c) inversely proportional to the area of the coil (d) inversely proportional to the current in the coil	
	SECTION E	
31	(a) Using Kirchhoff''s laws obtain the equation of the balanced state in Wheatstone bridge. (b) Two heating elements of resistances R_1 and R_2 when operated at a constant supply of voltage V , consumes power P_1 and P_2 respectively. Deduce the expression for the power of their combination when they are, in turn, connected in (i) series & (ii) parallel across the same voltage supply. **OR** (a)Two cells of emf E_1 and E_2 have their internal resistance r_1 and r_2 respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two cells are supporting each other. (b) Find potential difference between points A & B in the given diagram.  	5 5
32	(a) With the help of a diagram, explain the principle of a device which changes a low ac voltage into a high voltage . Deduce the expression for the ratio of secondary voltage to the primary voltage in terms of the ratio of the number of turns of primary and secondary winding. For an ideal transformer, obtain the ratio of primary and secondary currents in terms of the ratio of the voltages in the secondary and primary coils.	5

	(b) In an ideal transformer, number of turns in the primary and secondary are 200 and 1000 respectively. If the power input to the primary is 10 kW at 200 V, Calculate (i) output voltage and (ii) current in the primary. **OR** (a) Define self inductance. Write its SI unit. (b) Derive an expression for self inductance of a long solenoid of length l, cross section area A having N number of turns. (c) A coil having 2000 turns and area 70 cm^2 is placed in a magnetic field 0.3 Wb/m^2 which is perpendicular to its plane. Find the value of the induced emf if the coil takes 0.1 sec to rotate through 180°.	5
33	(a) Draw a ray diagram to show image formation when the concave mirror produces a real, inverted and magnified image of the object. Using the diagram Obtain the mirror formula. (b) You are given three lenses L_1, L_2 and L_3 each of focal length 15 cm. An object is kept at 20 cm in front of lens L_1 , as shown. The final real image is formed at the focus 'I' of the lens L_3. Find the separation between L_1, L_2 and L_3.  **OR** (a) Trace the rays of light showing the formation of an image due to a point object on the axis of a spherical surface separating the two media of refractive indices n_1 & n_2. Establish the relation between the distance of the object, the image and the radius of curvature from the central point of the spherical surface. (b) Monochromatic light of wavelength 589 nm is incident from air on a water surface. If 'n' for water is 1.33, find the wavelength, frequency and speed of the refracted light.	5 5