CLASS 12 SAMPLE PAPER – 2022-23

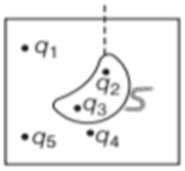
STANDARD: XII **Marks: 70**

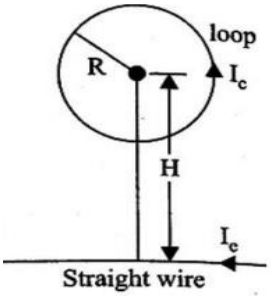
SUBJECT: PHYSICS **Duration: 3 hrs.**

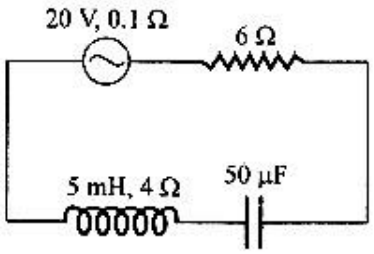
SUB Code: 042

General Instructions

1. All questions are compulsory.
2. There are 35 questions in total.
3. This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All sections are compulsory.
4. Section A contains eighteen MCQ's of one mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, Section D contains three long answer questions of five marks each and Section E contains two case study based questions of 4 marks each.
5. There is no overall choice. However, an internal choice has been provided in two questions of two marks, two questions of three marks and all three questions of five marks each and one each in case based questions. You have to attempt only one of the given choices in such questions.
6. Use of calculator is not permitted

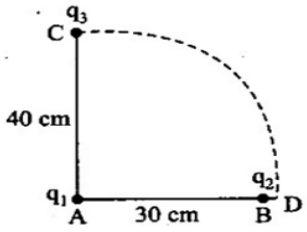
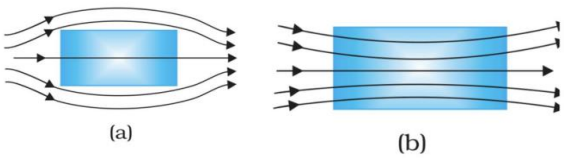
		Section A	
	1	Five charges q_1, q_2, q_3, q_4 and q_5 are fixed at their positions as shown in the figure. S is a Gaussian surface. The gauss law is given by $\oint \vec{E}.\overrightarrow{dS} = \frac{q}{\varepsilon_0}$. Which of the following statement is correct?  a) $\vec{E}$ on LHS of the above equation will have a contribution from q_1, q_4 and q_5 while q on the RHS will have a contribution from q_2 and q_3 only. b) $\vec{E}$ on LHS of the above equation will have a contribution from all charges while q on the RHS will have a contribution from q_2 and q_3 only. c) $\vec{E}$ on LHS of the above equation will have contribution from all charges while q on the RHS will have contribution from q_1, q_3 and q_5 only. d) Both $\vec{E}$ on the LHS and q on the RHS will have contributions from q_2 and q_3 only.	1
	2	A thin spherical conducting shell of radius R has a charge q. Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P at distance $\frac{R}{2}$ from the centre of the shell is	1

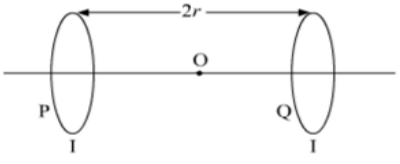
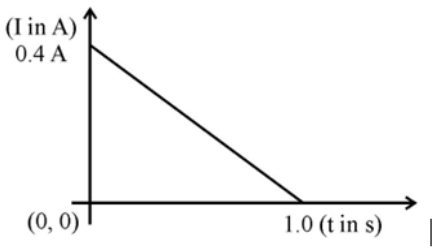
		a) $\frac{2Q}{4\pi\varepsilon_o R}+\frac{q}{4\pi\varepsilon_o R}$ b) $\frac{2Q}{4\pi\varepsilon_o R}-\frac{2q}{4\pi\varepsilon_o R}$ c) $\frac{2(Q+q)}{4\pi\varepsilon_o R}$ d) $\frac{2Q}{4\pi\varepsilon_o R}$	
	3	A metal rod of length 10 cm and a rectangular cross-section of 1cm $\times \frac{1}{2}$ cm is connected to a battery across opposite faces. The resistance will be a) maximum when the battery is connected across1cm $\times \frac{1}{2}$ cm faces. b) maximum when the battery is connected across 10 cm ×1cm faces. c) maximum when the battery is connected across10 cm $\times \frac{1}{2}$ cm faces. d) same irrespective of the three faces.	1
	4	Circular loop of a wire and a long straight wire carry current c I and e I respectively as shown in figure. Assuming that these are placed in the same plane, the magnetic fields will be zero at the center of the loop when separation H is  a) $\frac{I_e R}{I_c \pi}$ b) $\frac{I_c R}{I_e \pi}$ c) $\frac{I_c \pi}{I_e R}$ d) $\frac{I_e \pi}{I_c R}$	1
	5	The magnetic field due to a current carrying circular loop of radius 3cm at a point on the axis at a distance 4cm from the centre is 54μT . What will be its value at the centre of the loop? a) Zero b) 250 μT c) 150 μT d) 75 μT	1
	6	The magnetic susceptibility is negative for a) diamagnetic material only. b) paramagnetic material only. c) ferromagnetic material only. d) paramagnetic and ferromagnetic materials.	1
	7	In the circuit of figure, the ac source has voltage $20\cos\omega T$ volt with $\omega = 2000$ rad/s . The amplitude of the current will be nearest to	1

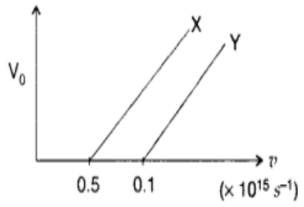
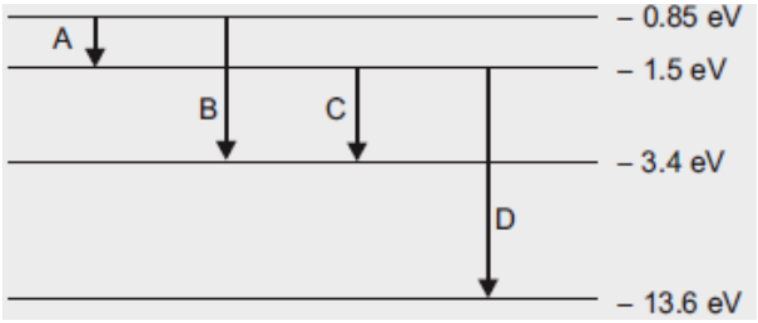


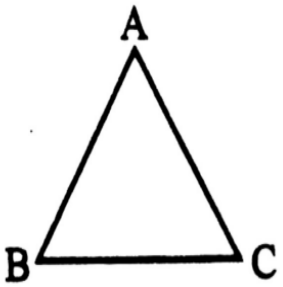
a) 2A b) 3.3A c) $\frac{2}{\sqrt{5}}$A d) $\sqrt{5}$A

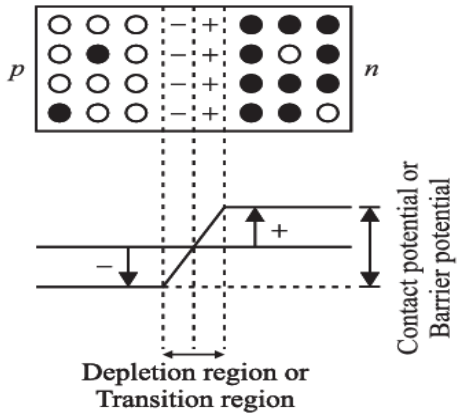
	8	The strong radiation emitted in an electrical arc is: a) Infrared radiation b) Ultraviolet radiation c) γ-rays d) X-rays	1
	9	A square of side L meters lies in the xy-plane in a region, where the magnetic field is given by $\vec{B} = B_0(2\hat{\imath} + 3\hat{\jmath} + 4\hat{k})$T, where B_0 is a constant. The magnitude of the flux passing through the square is a) $2\,B_0\mathrm{L}^2$ Wb b) $3\,B_0\mathrm{L}^2$ Wb c) $4\,B_0\mathrm{L}^2$ Wb d) $\sqrt{29}\,B_0\mathrm{L}^2$ Wb	1
	10	In Young's double-slit experiment, the distance between the two slits is 2.0 mm and the screen is at a distance of 120 cm from the slits. The smallest distance from the central maximum where the bright fringes due to light of wavelengths 6500 ^{0}A and 5200 ^{0}A would coincide is: a) O.117 cm. b) 0.156 cm c) 0.234 cm d) 0.20 cm	1
	11	In photoelectric emission process from a metal of work function 1.8 eV, the kinetic energy of most energetic electrons is 0.5 eV. The corresponding stopping potential is a) 2.3 V b) 1.8 V c) 1.3 V d) 0.5 V	1
	12	The longest wave length in Balmer series of hydrogen spectrum will be a) 6557 ^{0}A b) 1216 ^{0}A c) 4800 ^{0}A d) 5600 ^{0}A	1
	13	The ground state energy of Hydrogen atom is -13.6 eV. What is the potential energy of electron in this state? a) 0 eV b) -13.6 eV c) 2 eV d) -27.2 eV	1
	14	The self-inductance L of a solenoid of length l and area of cross-section A, with a fixed number of turns N increases as a) l and A increase b) l decreases and A increases	1

		c) l increases and A decreases d) both l and A decreases	
	15	Two charges q_1 and q_2 and are placed 30 cm apart, as shown in the figure. A third charge q_3 is moved along the arc of circle of radius 40 cm from C to D. The change in the potential energy of the system is $\frac{q_3}{4\pi\varepsilon_0}k$, where k is  a) 8 q_2 b) 8 q_1 c) 6 q_2 d) 6 q_1	1
		For question numbers 16, 17 and 18, two statements are given-one labelled Assertion (A) and the 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, but 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	
	16	**Assertion:** The diffusion current in a p-n junction is from the p-side to the n-side. **Reason:** The diffusion current in a p-n junction is greater than the drift current when the junction is in forward biased.	1
	17	**Assertion:** In Young's double slit experiment if wavelength of incident monochromatic light is just doubled, number of bright fringe on the screen will increase. **Reason:** Maximum number of bright fringe on the screen is inversely proportional to the wavelength of light used.	1
	18	**Assertion:** Photoelectric effect will not be observed if energy of incident radiation is less than work function of metals. **Reason:** If the energy of incident radiation is equal to work function of metal then kinetic energy of photo electrons is zero.	1
		<u>Section B</u>	
	19	Welders wear special goggles or face masks with glass windows to protect their eyes from electromagnetic radiations. Name the radiations and write the range of their frequency.	2
	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 is the magnetic susceptibility of specimen A different from that of specimen B?	2
	21	(i) What characteristic property of nuclear force explains the constancy of binding energy per nucleon in the range of mass number lying $30 < A < 170$? (ii) Show that the density of nucleus over a wide range of the nuclei is constant and independent of mass number A.	2

		Or Calculate the energy released in MeV in the deuterium-tritium fusion reaction. $${}_1^2H + {}_1^3H \longrightarrow {}_2^4He + n + \Delta$$ Using the data $$m\left({}_1^2H\right) = 2.014102\text{u}$$ $$m\left({}_1^3H\right) = 3.016049\text{u}$$ $$m\left({}_2^4He\right) = 4.002603\text{u}$$ $$m_n = 1.008665\text{u}$$ $$\text{u} = 931.5\text{MeV}$$.	
	22	A jar of height *h* is filled with a transparent liquid of refractive index μ. There is a dot at the centre of the bottom of the jar. Find the minimum diameter of a disc, such that when it is placed on the top surface symmetrically about the centre, the dot is invisible. Or Compare the interference pattern observed in YDSE with single slit diffraction patterns, pointing out two distinguishing features.	2
	23	What will be the effect on focal length and nature of a lens when immersed in a liquid whose refractive index is less than that of the material of the lens.	
	24	A parallel beam of light of wavelength 600 nm falls normally on a narrow slit of width 0.3 mm. Calculate the angular separation between (a) the first minimum and the central maximum, (b) the first secondary maxima on the two sides of central maximum.	2
	25	Net capacitance of three identical capacitors in series is 1μF. What will be their net capacitance if connected in parallel? Find the ratio of energy stored in these two configurations if both are connected to the same source.	2
		<u>Section C</u>	
	26	Two parallel coaxial circular coils of equal radius 'r' and equal number of turns 'N', carry equal current 'I' in the same direction and are separated by a distance '2r'. Find the magnitude and direction of the net magnetic field produced at the mid-point of the line joining their centers.  	3
	27	When a conducting loop of resistance 10 Ω and area 10cm^2 is removed from an external magnetic field acting normally, the variation of induced current in the loop with time is shown in the figure.  Find the (i) total charge passed through the loop. (ii) change in magnetic flux through the loop.	3

		(iii) magnitude of the magnetic field applied.	
	28	A wheel with 8 metallic spokes each 50 cm long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of the Earth's magnetic field. The Earth's magnetic field at the plane is 0.4 G and the angle of dip is 60°. Calculate the *emf* induced between the axle and the rim of the wheel. How will the value of *emf* be affected if the number of spokes were increased? OR An inductor 200 mH, capacitor 500 μF, resistor 10 Ω are connected in series with a 100 V, variable frequency ac source. Calculate the (*i*) frequency at which the power factor of the circuit is unity. (*ii*) current amplitude at this frequency. (*iii*) *Q*-factor	3
	29	The following graph shows the variation of stopping potential V_0 with the frequency v of the incident radiation for two photosensitive metals X and Y :  (i) Which of the metals has larger threshold wavelength? Give reason. (ii) Explain, giving reason, which metal gives out electrons, having larger kinetic energy, for the same wavelength of the incident radiation. (iii) If the distance between the light source and metal X is halved, how will the kinetic energy of electrons emitted from it change? Give reason.	3
	30	The energy level diagram of an element is given below. Identify, by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7 nm.  	3
		Section D	
	31	a) A dielectric slab of dielectric constant '*K'* and thickness 'd/3' is introduced, between the plates of a parallel plate capacitor having a plate separation 'd*'* and area 'A'. Derive an expression for the capacitance of the capacitor. How will the capacitance change, if the dielectric is replaced by a metal slab of same thickness? b) Calculate the electric field and potential at the center of a square ABCD of side 'L' due to charges 2Q, -Q, 2Q and -Q at the four corners A,B,C and D respectively. Or	5

		a) State Gauss theorem in electrostatics. Apply Gauss's theorem to derive an expression for electric field intensity at a point near a thin infinite plane sheet of electric charge. b) Four charges +10nC, +10nC, -10nC, -10nC are placed at the four corners A,B,C and D respectively of a square ABCD of side 'L'. What is the force experienced by a +1μC charge placed at the center of the square?	
	32	(*a*) Show that in an ac circuit containing a pure inductor, the voltage is ahead of current by $\pi/2$ in phase. (*b*) A horizontal straight wire of length L extending from east to west is falling with speed *v* at right angles to the horizontal component of Earth's magnetic field B. (*i*) Write the expression for the instantaneous value of the *e.m.f.* induced in the wire. (*ii*) What is the direction of the *e.m.f.*? (*iii*) Which end of the wire is at the higher potential? OR 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 *e.m.f.* generated in the coil. What is the source of energy generation in this device?	5
	33	a) (i) Draw a labelled ray diagram to show the formation of image in an astronomical telescope for the normal adjustment. (ii) Deduce an expression for its magnifying power. b) A convex lens of focal length 10 cm is placed coaxially 5 cm away from a concave lens of focal length 10 cm. If an object is placed 30 cm in front of the convex lens, find the position of the final image formed by the combined system. Or a) Write two points of difference between an interference pattern and a diffraction pattern. b) (i) A ray of light incident on face AB of an equilateral glass prism, shows minimum deviation of 30°. Calculate the speed of light through the prism.  (ii) Find the angle of incidence at face AB so that the emergent ray grazes along the face AC.	5
		Section E	
	34	**CASE STUDY: <u>DOPING IN SEMICONDUCTOR</u>** p-n junction is a single crystal of Ge or Si doped in such a manner that one half portion of it acts as p-type semiconductor and other half functions as n-type semiconductor. As soon as a p-n junction is formed, the holes from the p-region diffuse into the n-region and electron from n region diffuse into p-region. This results in the development of V_B across the junction which opposes the further diffusion of electrons and holes through the junction.	



(i) In an unbiased p-n junction electrons diffuse from n-region to p-region because — 1

a) holes in p-region attract them
b) electrons travel across the junction due to potential difference
c) electron concentration in n-region is more as compared to that in p-region
d) only electrons move from n to p region and not the vice-versa

(ii) Electron hole recombination in p-n junction may lead to emission of — 1

(a) light
(b) ultraviolet rays
(c) sound
(d) radioactive rays

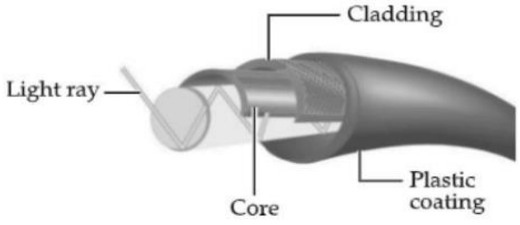
(iii) In an unbiased p-n junction — 1

(a) potential at p is equal to that at n
(b) potential at p is +ve and that at n is –ve
(c) potential at p is more than that at n
(d) potential at p is less than that at n.

(iv) The potential of depletion layer is due to — 1

(a) electrons
(b) holes
(c) ions
(d) forbidden band

35 Optical fiber works on the principle of total internal reflection. Light rays can be used to transmit a huge amount of data, but there is a problem here – the light rays travel in straight lines, so unless we have a long straight wire without any bends at all, harnessing this advantage will be very tedious. Instead, the optical cables are designed such that they bend all the light ray's inwards (using TIR). Light rays travel continuously, bouncing off the optical fiber walls and transmitting end to end data. It is usually made of plastic or glass.



Single-mode fiber is used for long distance transmission, while multimode fiber is used for shorter distances. The outer cladding of these fibers needs better protection than metal wires. Although light signals do degrade over progressing distances due to absorption and scattering, hence, Optical Regenerator System is necessary to boost the signals. The type of optical fibers depends on the refractive index, material used and the mode of propagation of light.

		(i) Optical fiber works on the principle of a) Scattering of light b) Diffraction of light c) Total internal reflection of light d) Dispersion of light.	1
		(ii) For long-distance transmission fiber used is a) Single mode b) Multi-mode c) Both single-mode and multi-mode d) Any one of single-mode or multimode.	1
		(iii) Optical fiber is made up of a) Copper b) Semiconductor c) Plastic or glass d) Superconductors	1
		(iv) Light signal through optical fiber may degrade due to: a) Refraction b) Refraction and reflection c) Diffraction and scattering d) Scattering and absorption	1