SET-I

KENDRIYA VIDYALAYA SANGATHAN---MUMBAI REGION

SECOND PRE BOARD EXAMINATION - 2024-25

SUBJECT: PHYSICS (042) (THEORY)

CLASS – XII **TIME ALLOWED: 3 Hours**

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 MCQs 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. $c = 3X10^{8}\ ms^{-1}$

II. $m_e = 9.1\ X10^{-31}\ kg$

III. $m_p = 1.7\ X10^{-27}\ kg$

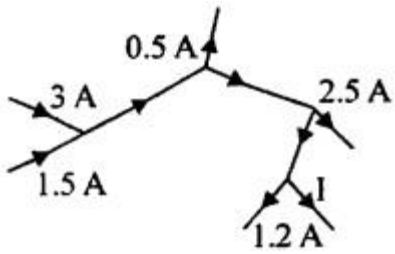
IV. $e\ = 1.6\ X10^{-19}\ C$

V. $\mu_o = 4\pi\ X10^{-7}\ TmA^{-1}$

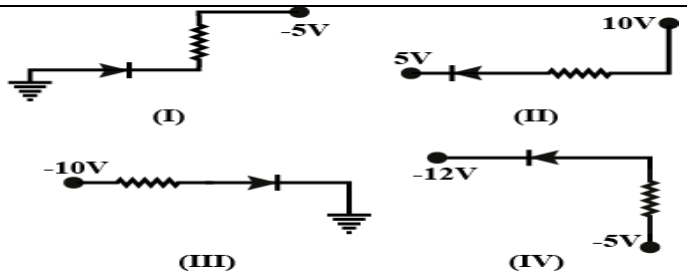
VI. $h\ = 6.63\ X10^{-34}\ Js$

VII. $\varepsilon_o = 8.854\ X10^{-12}\ C^2N^{-1}m^{-2}$

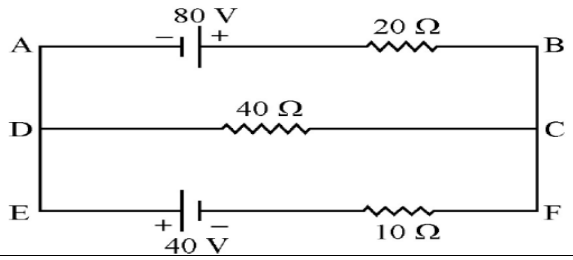
VIII. Avogadro's number $=\ 6.023\ X10^{23}$ per gram mole

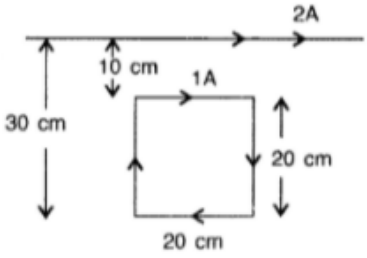
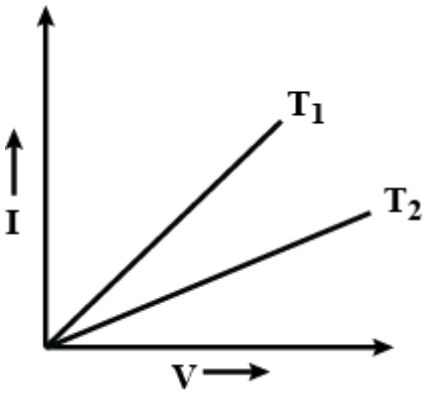
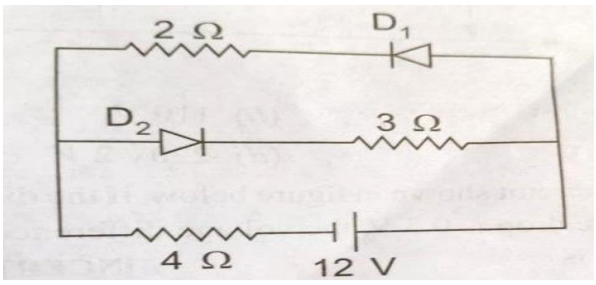
	Section A	
1	The following figure shows currents in a part of electrical circuit, then the value of I (in ampere) is given by:  (a) 0.3 A (b) 0.5 A (c) 1.3 A (d) 0.8A	**[1]**
2	Force between A and B is F. If 75% charge of A is transferred to B then force between A and B is :  (a) $\frac{F}{4}$ (b) 4F (c) F (d) 10F	**[1]**
3	Two horizontal thin long parallel wires, separated by a distance r carry current I each in the same directions. The net magnetic field at a point midway between them, will be (a) Zero (b)$\left(\frac{\mu_0 I}{2\pi r}\right)$ vertically downward (c) $\left(\frac{\mu_0 I}{\pi r}\right)$ vertically downward (d) $\left(\frac{2\mu_0 \mathrm{I}}{\mathrm{r}}\right)$ vertically upward	**[1]**
4	A short bar magnet placed with its axis at 30°with a uniform external magnetic field of 0.25 T experiences a torque of magnitude equal to 4.5 x 10^{-2} J. What is the magnitude of magnetic moment of the magnet?	**[1]**

	(a)0.26 J/T (b) 0.36 J/T (c) 0.43 J/T (d) 0.30 J/T	
5	In a coil of self - induction 10 H, the rate of change of current is 2 A s^{-1} . Then, e.m.f. induced in the coil is (a) 10V (b) - 20 V (c) - 5 V (d) 5 V	**[1]**
6	If the amplitude of the magnetic field is 3 × $10^{-6} tesla$, then the amplitude of the electric field for a electromagnetic waves is (a) 900 V/m (b) 300 V/m (c) 600 V/m (d) 200 V/m	**[1]**
7	A convex lens of focal length 10 cm is placed in contact with a concave lens of focal length 20cm. What is the nature and focal length of the combination? (a) Concave,10cm (b) Convex, 10cm (c) Concave, 20cm (d) Convex, 20cm	**[1]**
8	An object is placed at the focus of a concave mirror. If the focal length of the mirror is 20cm, then the distance of image from the pole is (a) 10cm (b) 20cm (c) Infinity (d) 40cm	**[1]**
9	In Young's double slit experiment the distance between the slit and the screen is doubled and the separation between the slit is reduced to half. The fringe width: (a) is doubled (b) become four time (c) is halved (d) remain unchanged	**[1]**
10	The energy of hydrogen atom in its ground state is -13.6eV. The energy of level corresponding to n=5 is (a)-0.54eV (b)-5.40eV (c)-0.85eV (d)-2.75eV	**[1]**
11	What will be the de-Broglie wavelength of an electron accelerated from rest through a potential difference of 100 volts? (a) 12.3 Å (b) 1.23 Å (c) 0.123 Å (d) 123 Å	**[1]**
12	Which of the following diode is reverse biased	**[1]**

	 (a) I (b) II (c) III (d) IV	
13	**Assertion**: Electromagnetic waves are transverse in nature. **Reason**: The electric and magnetic fields are perpendicular to each other and perpendicular to the direction of propagation (a) Assertion and reason both are correct statements and reason is correct explanation for assertion. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion. (c) Assertion is correct statement but reason is wrong statement. (d) Assertion is wrong statement but reason is correct statement.	**[1]**
14	**Assertion:** In a simple microscope, the image formed is virtual, erect and magnified. **Reason:** The object to be seen is held between the optical centre and focus of the convex lens. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion. (c) Assertion is correct statement but reason is wrong statement. (d) Assertion is wrong statement but reason is correct statement.	**[1]**
15	**Assertion (A):** Light from two coherent sources is reaching the screen. If the path difference at a point on the screen for yellow light is $\frac{3\lambda}{2}$, then the fringe at that point will be coloured.	**[1]**

	Reason (R): Two coherent source always have constant phase relationship. (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 but R is true.	
16	**Assertion:** Photoelectric saturation current increases with the increase in frequency of incident light. **Reason :** Energy of incident photons increases with increase in frequency and as a result photoelectric current increases (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) Both A and R are false	**[1]**
	Section B	
17	Electromagnetic waves with wavelength (i) λ_1 is suitable for radar systems used in aircraft navigation. (ii) λ_2 is used to kill germs in water purifiers. (iii) λ_3 is used to improve visibility in runways during fog and mist conditions. Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude	**[2]**
18	What is a wave front? Using Huygens' principle, explain reflection of a plane wave front from a surface and verify the laws of reflection	**[2]**
19	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	**[2]**
20	A concave lens made of material of refractive index 'n_2'is held in a reference medium of refractive index 'n_1'. Trace the path of parallel beam of light passing through the lens when: (i) $n_1 = n_2$ (ii) $n_1 > n_2$	**[2]**
21	Obtain an expression for the self-inductance of a long solenoid. Hence define one henry.	**[2]**

	OR Define mutual inductance. Write its SI unit. Give two factors on which the coefficient of mutual inductance between a pair of coils depends.	
	Section C	
22	(i) Two electric field lines cannot cross each other. Also, they cannot form closed loops. Give reasons. (ii) A particle of charge 2μ C and mass 1.6 g is moving with a velocity 4 $\hat{\imath}$ ms $^{-1}$. At t = 0 the particle enters in a region having an electric field $\vec{E}$ (in NC $^{-1}$) = 80 $\hat{\imath}$ + 60 $\hat{\jmath}$. Find the velocity of the particle at t = 5 s.	**[3]**
23	Using Kirchhoff's rules, calculate the current through the 40Ω and 20Ω resistors in the following circuit 	**[3]**
24	Plot suitable graphs to show the variation of photoelectric current with the collector plate potential for the incident radiation of (i) the same intensity but different frequenciesν_1 , ν_2 and ν_3 ($\nu_1<\nu_2<\nu_3$) (ii) the same frequency but different intensities I_1 , I_2 and I_3($I_1< I_2< I_3$) (iii) Monochromatic light of frequency 6.0 × 10^{14} Hz is produced by a laser. The power emitted is 2.0 × 10^{-3}W .Calculatethe number of photons emitted on an average by the source.	**[3]**
25	(i) Define current sensitivity of a galvanometer. Write its expression.	**[3]**

	(ii) A square loop of side 20 cm carrying current of 1 A is kept near an infinite long straight wire carrying current of 2A in the same plane as shown in the figure. Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor. 	
26	(i)V – I graph for a metallic wire at two different temperatures T1 and T2 is as shown in the figure. Which of the two temperatures is higher and why?  (ii) Two wires, one of copper and the other of manganin, have same resistance and length. Which wire is thicker? Justify your answer.	**[3]**
27	(i)Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams (ii) The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit? 	**[3]**

	OR Draw V-I characteristics of a p-n junction diode. 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?	
28	Draw the circuit diagram of a full-wave rectifier using p-n junction diode. Explain its working and show the output and input waveforms	**[3]**
	Section D	
29	**Question No. 29 and 30 are based on the given text.** **Read the text carefully and answer the questions:** A charged particle moving in a magnetic field experiences a force that is proportional to the strength of the magnetic field, the component of the velocity that is perpendicular to the magnetic field and the charge of the particle. This force is given by $\vec{F} = q(\vec{v} \times \vec{B})$ where **q**is the electric charge of the particle, **v**is the instantaneous velocity of the particle, and Bis the magnetic field (in tesla). The direction of force is determined by the rules of cross product of two vectors. Force is perpendicular to both velocity and magnetic field. Its direction is given as $\vec{v} \times \vec{B}$ if qis positive and opposite of $\vec{v} \times \vec{B}$ if qis negative. The force is always perpendicular to both the velocity of the particle and the magnetic field that created it. Because the magnetic force is always perpendicular to the motion, the magnetic field can do no work on an isolated charge. It can only do work indirectly, via the electric field generated by a changing magnetic field.	**[4]**
	(i) When a magnetic field is applied on a stationary electron, it a) moves in the direction of the field b) remains stationary c) moves perpendicular to the direction of the field d) spins about its own axis	

	(ii) A proton is projected with a uniform velocity **v**along the axis of a current - carrying solenoid, then a) the proton will be accelerated along the axis b) the proton will continue to move with velocity **v**along the axis c) the proton moves along helical path d) the proton path will be circular about the axis	
	(iii) A charged particle experiences magnetic force in the presence of magnetic field. Which of the following statement is correct? a) The particle is moving and magnetic field is parallel to velocity. b) The particle is stationary and magnetic field is perpendicular. c) The particle is moving and magnetic field is perpendicular to the velocity. d) The particle is stationary and magnetic field is parallel.	
	(iv) A charge **q**moves with a velocity 2 ms^{-1} along x - axis in a uniform magnetic field $\vec{B} = (\hat{\imath} + 2\hat{\jmath} + 3\hat{k})$T , then charge will experience a force a) along - z axis b) in z - y plane c) along +z axis d) along - y axis OR An electron is moving along positive x- axis in a magnetic field which is parallel to the positive y- axis. In what direction will the magnetic force be acting on the electron? a) along -x axis b) along -z axis c) along +z axis d) along -y axis	
30	**Read the text carefully and answer the questions** Basic postulates of Bohr's atomic model: (i) Every atom consists of a central core called nucleus in which entire positive charge and mass of the atom are concentrated. A suitable number of electrons revolve around the nucleus in circular orbit. The centripetal force required for revolution is provided by the electrostatic force of attraction between the electron and the nucleus. (ii) Electron can resolve only in certain discrete non-radiating orbits, called	**[4]**

stationary orbit. Total angular momentum of the revolving electron in an integral multiple of h/2π.
where [h is plank constant]

$$mvr = \frac{nh}{2\pi}$$

(iii) The radiation of energy occurs only when an electron jumps from one permitted orbit to another. The difference in the total energy of electron in the two permitted orbit is absorbed when the electron jumps from inner to the outer orbit and emitted when electron jumps from outer to inner orbit.

(i) The first postulate of Bohr atom model

(a) Explains stability of atoms
(b) Line spectrum emitted by hydrogen atom
(c) Relative variation in intensity of spectral lines
(d) None of the above

(ii)The angular momentum of electron in the second orbit of hydrogen atom is

(a) 2π/h (b) h/π (c) 3h/2π (d) h/2π

(iii) A set of atoms in an excited state jumps

(a) in general to any of the states of lower energy

(b) into a lower state, only when excited by an external electric field

(c) all together simultaneously into a lower state

(d) to emit photons only when they collide

(iv).Bohr model explains the spectrum emitted by

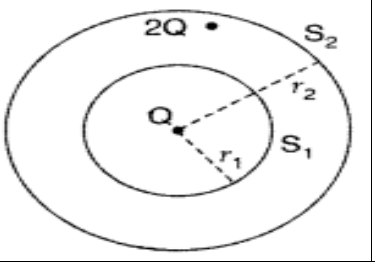
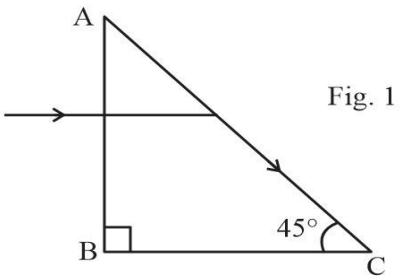
(a) All atoms (b) Hydrogen and hydrogen like atoms

(c)Only hydrogen atom (d) All the above

OR

The radius of the innermost orbit of hydrogen atom is 0.53Å.The radius of the second orbit is

(a)1.06 Å (b) 2.12 Å (c) 21.2 Å (d) 10.6 Å

	Section E	
31	(i)Define the capacitance of a capacitor. Give its S I unit. (ii) Derive the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if a dielectric slab of thickness t (t<d) is introduced between the plates of capacitor. **OR** (i)State Gauss' law in electrostatics. Using this law derive an expression for the electric field due to a uniformly changed infinite plane sheet. (ii) A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius r_2 (r_2 > r,) enclosing charge 2Q, find the ratio of the electric flux through S_1 and S_2 	**[5]**
32	(i) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (μ) in terms of angle of prism (A) and angle of minimum deviation (δ_m). (ii)A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1. Find the refractive index of Prism.  Fig. 1 **OR**	**[5]**

	(i) Draw a ray diagram for the formation of the image of a point object by a thin double convex lens having radii of curvatures R_1 and R_2 and hence, derive lens maker's formula. (ii)For a plano-concave lens of radius of curvature 10 cm, the focal length in air is 25 cm. Find the refractive index of the material of the lens.	
33	(i)Differentiate between the term inductive reactance and capacitive reactance of an ac circuit. (ii)If the frequency of alternating current is tripled, how will it affect resistance R, inductive reactance X_L and capacitive reactance X_C? (iii) An alternating source of 220 V is connected to a circuit having a device "A", a current of 0.5 A flows, which lag behind the applied voltage in phase by π/2. If the same voltage is applied to another device "B", same current flows but now it is in phase with the applied voltage. (a) Name the devices A and B (b) Draw the phasor diagram for device A **OR** (a) What is impedance? (b) A series LCR circuit is connected to an ac source having voltage V = V_0 sin ωt . Derive expression for the impedance, instantaneous current and its phase relationship to the applied voltage. Find the expression for resonant frequency	**[5]**

SET-2

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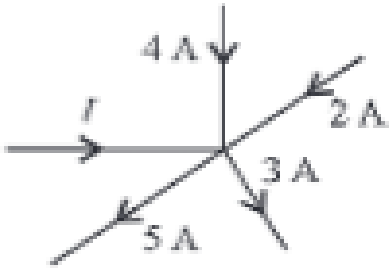
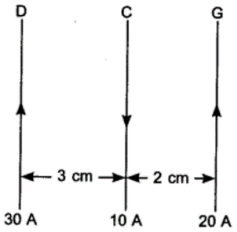
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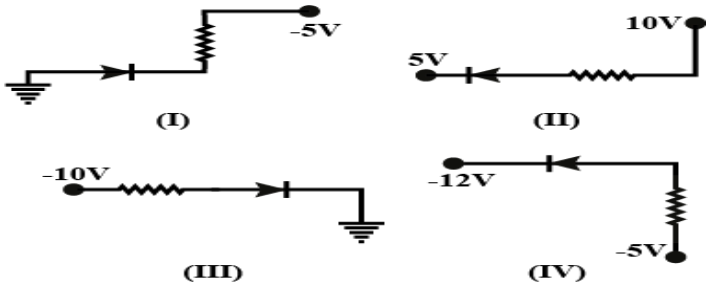
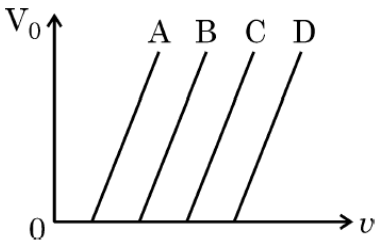
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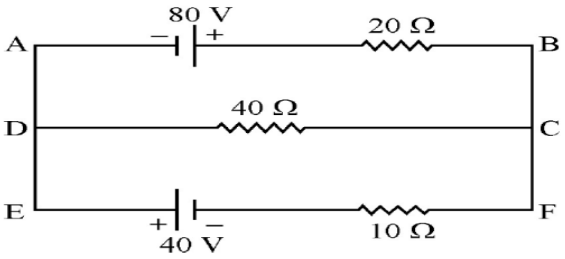
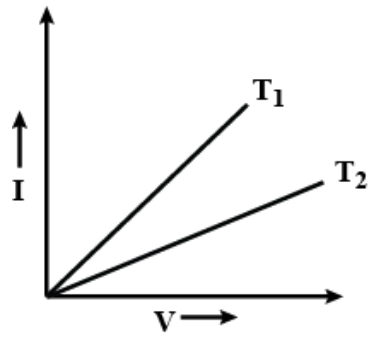
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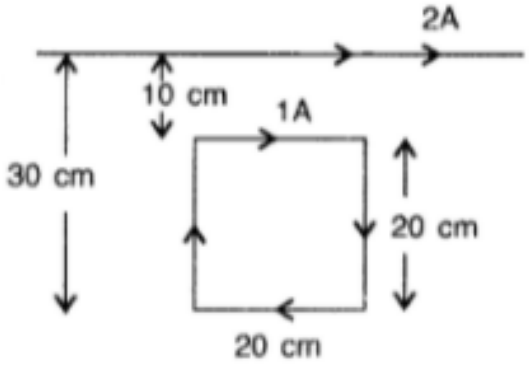
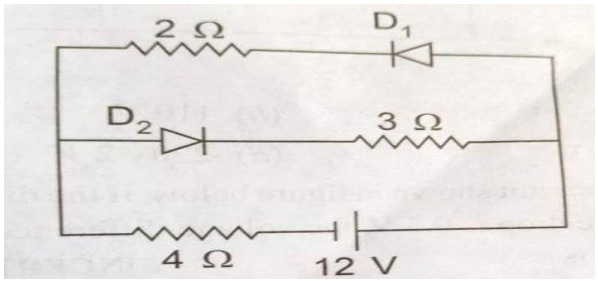
Section A

1	The value of current I in the given circuit Is (a) 4.5 A (b) 3.7 A (c) 2.0 A (d) 2.5 A 	[1]
2	Force between A and B is F. If 50% charge of A is transferred to B then force between A and B is  (a) $\frac{F}{4}$ (b) F (c) $\frac{3F}{2}$ (d) 12F	[1]
3	Three long, straight parallel wires, carrying current are arranged as shown in the figure. The force experienced by a 25 cm length of wire C is (a) $10^{-3}N$ (b) $2.5X10^{-3}N$ (c) zero (d) $1.5\ X10^{-3}N$ 	[1]
4	The magnetic fluxØ (in Wb) through a closed loop of resistance 3·0 Ω varies with time t (s) as $\emptyset = 6t^2 + 3.0t + 5$. The value of the induced current in the loop at t = 1·0 s is : (A) 15·0 A (B) 3·0 A (C) 4·0 A (D) 5·0 A	[1]
5	The magnetic susceptibility for a diamagnetic material is (A) small and negative (B) small and positive (C) large and negative (D) large and positive	[1]
6	A compound microscope consists of an objective of 10X and an eyepiece of 20X. The magnification due to the microscope would be - (a) 2X (b) 10X (c) 30X (d) 200X	[1]
7	The ratio of contributions made by the electric field and magnetic field components to the intensity of an EM wave is (a) c:1 (b) c^2:1 (c) 1:1 (d)) $\sqrt{c}$: 1	[1]
8	In Young's experiment, the distance between the slits is reduced to half and the distance between the slit and screen is doubled, then the fringe width (a) Will become four times (b) Will be doubled (c) Will become half (d) Will not change	[1]

9	Which of the following diode is **Forward biased**?  (a) I & III (b) I, II & IV (c) III (d) III & IV	**[1]**
10	The variation of the stopping potential (V_o) with the frequency (v) of the incident radiation for four metals A, B, C and D is shown in the figure. For the same frequency of incident radiation producing photo-electrons in all metals, the kinetic energy of photo-electrons will be maximum for metal  (a) A (b) B (c) C (d) D	**[1]**
11	The energy of an electron in the ground state of hydrogen atom is -13.6 eV. The kinetic and potential energy of the electron in the first excited state will be (A) --13.6 eV, 27.2 eV (B) -6.8 eV, 13.6 eV (C) 3.4 eV, - 6.8eV (D) 6.8eV, -3.4eV	**[1]**
12	An object is placed at the centre of curvature of a concave mirror. If the focal length of the mirror is 20cm, then the distance of image from the pole is (a) 10cm (b) 20cm (c) Infinity (d) 40cm	**[1]**
Questions number 13 to 16 are Assertion (A) and Reason (R) type questions. Two statements are given one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.		
13	Assertion (A): In a Young's double-slit experiment, interference pattern is not observed when two coherent sources are infinitely close to each other. Reason (R) : The fringe width is proportional to the separation between the two coherent sources. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Both Assertion (A) and Reason (R) are false.	**[1]**

14	**Assertion (A)** : In photoelectric effect, the kinetic energy of the emitted photoelectrons increases with increase in the intensity of the incident light. **Reason (R)** : Photoelectric current depends on the wavelength of the incident light. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Both Assertion (A) and Reason (R) are false.	**[1]**
15	**Assertion (A)** : Electromagnetic waves carry energy and momentum. **Reason (R)** : Electromagnetic waves can be polarised. (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Both Assertion (A) and Reason (R) are false.	**[1]**
16	**Assertion (A):** For a simple microscope, the angular size of the object equals the angular size of the image. **Reason (R):** Magnification is achieved as the small object can be kept much closer to the eye than 25 cm and hence it subtends a large angle. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion. (c) Assertion is correct statement but reason is wrong statement. (d) Assertion is wrong statement but reason is correct statement	**[1]**
	Section B	
17	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	**[2]**
18	Obtain an expression for the self-inductance of a long solenoid. Hence define one henry. OR Define mutual inductance. Write its SI unit. Give two factors on which the coefficient of mutual inductance between a pair of coils depends.	**[2]**
19	Electromagnetic waves with wavelength (i) λ_1 is suitable for radar systems used in aircraft navigation. (ii) λ_2 is used to kill germs in water purifiers. (iii) λ_3 is used to improve visibility in runways during fog and mist conditions. Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude.	**[2]**

20	What is a wave front? Using Huygens' principle, explain reflection of a plane wave front from a surface and verify the laws of reflection	**[2]**
21	A concave lens made of material of refractive index 'n_2'is held in a reference medium of refractive index 'n_1'. Trace the path of parallel beam of light passing through the lens when: (i) $n_1 = n_2$ (ii) $n_1 > n_2$	**[2]**
	Section C	
22	Using Kirchhoff's rules, calculate the current through the 40Ω and 20Ω resistors in the following circuit 	**[3]**
23	Plot suitable graphs to show the variation of photoelectric current with the collector plate potential for the incident radiation of (i) the same intensity but different frequencies ν_1 , ν_2 and ν_3 ($\nu_1<\nu_2<\nu_3$) (ii) the same frequency but different intensities I_1 , I_2 and I_3 ($I_1< I_2< I_3$) (iii) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3}W .Calculate the number of photons emitted on an average by the source.	**[3]**
24	(i) V – I graph for a metallic wire at two different temperatures T1 and T2 is as shown in the figure. Which of the two temperatures is higher and why?  (ii) Two wires, one of copper and the other of manganin, have same resistance and equal length. Which wire is thicker? Justify your answer.	**[3]**
25	(i) Two electric field lines cannot cross each other. Also, they cannot form closed loops. Give reasons. A particle of charge 2μ C and mass 1.6 g is moving with a velocity 4 $\hat{\imath}$ms $^{-1}$. At t = 0 the particle enters in a region having an electric field $\vec{E}$ (in NC $^{-1}$) = 80 $\hat{\imath}$ + 60 $\hat{\jmath}$. Find the velocity of the particle at t = 5 s	**[3]**

26	Draw the circuit diagram of a full-wave rectifier using p-n junction diode. Explain its working and show the output and input waveforms.	**[3]**
27	(i) Define current sensitivity of a galvanometer. Write its expression. (ii) A square loop of side 20 cm carrying current of 1 A is kept near an infinite long straight wire carrying current of 2A in the same plane as shown in the figure. Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor. 	**[3]**
28	(i)Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams (ii) The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?  OR Draw V-I characteristics of a p-n junction diode. 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]**
	Section D	
	Question No. 29 and 30 are based on the given text.	

29	**Read the text carefully and answer the questions:** A charged particle moving in a magnetic field experiences a force that is proportional to the strength of the magnetic field, the component of the velocity that is perpendicular to the magnetic field and the charge of the particle. This force is given by $\vec{F} = q(\vec{v} \times \vec{B})$ where **q**is the electric charge of the particle, **v**is the instantaneous velocity of the particle, and Bis the magnetic field (in tesla). The direction of force is determined by the rules of cross product of two vectors. Force is perpendicular to both velocity and magnetic field. Its direction is givenas$\vec{v} \times \vec{B}$ if qis positive and opposite of $\vec{v} \times \vec{B}$ if qis negative. The force is always perpendicular to both the velocity of the particle and the magnetic field that created it. Because the magnetic force is always perpendicular to the motion, the magnetic field can do no work on an isolated charge. It can only do work indirectly, via the electric field generated by a changing magnetic field.	**[4]**
	(i) When a magnetic field is applied on a stationary electron, it a) moves in the direction of the field b) remains stationary c) moves perpendicular to the direction of the field d) spins about its own axis	
	(ii) A proton is projected with a uniform velocity **v**along the axis of a current - carrying solenoid, then a) the proton will be accelerated along the axis b) the proton will continue to move with velocity **v**along the axis c) the proton moves along helical path d) the proton path will be circular about the axis	
	(iii) A charged particle experiences magnetic force in the presence of magnetic field. Which of the following statement is correct? a) The particle is moving and magnetic field is parallel to velocity. b) The particle is stationary and magnetic field is perpendicular. c) The particle is moving and magnetic field is perpendicular to the velocity. d) The particle is stationary and magnetic field is parallel.	
	(iv) A charge **q** moves with a velocity 2 ms^{-1} along x - axis in a uniform magnetic field $\vec{B} = (\hat{\imath} + 2\hat{\jmath} + 3\hat{k})$T , then charge will experience a force a) along - z axis b) in z - y plane c) along +z axis d) along - y axis OR (v) An electron is moving along positive x- axis in a magnetic field which is parallel to the positive y- axis. In what direction will the magnetic force be acting on the electron? (a) along -x axis (b) along -z axis (c) along +z axis (d) along -y axis	

30	**Read the text carefully and answer the questions** Basic postulates of Bohr's atomic model: (i) Every atom consists of a central core called nucleus in which entire positive charge and mass of the atom are concentrated. A suitable number of electrons revolve around the nucleus in circular orbit. The centripetal force required for revolution is provided by the electrostatic force of attraction between the electron and the nucleus. (ii) Electron can resolve only in certain discrete non-radiating orbits, called stationary orbit. Total angular momentum of the revolving electron in an integral multiple of h/2π. where [h is plank constant] $mvr = \frac{nh}{2\pi}$ (iii) The radiation of energy occurs only when an electron jumps from one permitted orbit to another. The difference in the total energy of electron in the two permitted orbit is absorbed when the electron jumps from inner to the outer orbit and emitted when electron jumps from outer to inner orbit.	**[4]**
	(i) The first postulate of Bohr atom model (a) Explains stability of atoms (b) Line spectrum emitted by hydrogen atom (c) Relative variation in intensity of spectral lines **(d)** None of the above	
	(ii)The angular momentum of electron in the second orbit of hydrogen atom is (a) 2π/h (b) h/π (c) 3h/2π (d) h/2π	
	(iii)A set of atoms in an excited state jumps (a) in general to any of the states of lower energy (b) into a lower state, only when excited by an external electric field (c) all together simultaneously into a lower state (d) to emit photons only when they collide	
	(iv). Bohr model explains the spectrum emitted by (a) All atoms (b) Hydrogen and hydrogen like atoms (c)Only hydrogen atom (d) All the above **OR** (v) The radius of the innermost orbit of hydrogen atom is 0.53Å.The radius of the second orbit is (a)1.06 Å (b) 2.12 Å (c) 21.2 Å (d) 10.6 Å	

Section E

31 (i) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (μ) in terms of angle of prism (A) and angle of minimum deviation (δ_m). **[5]**

(ii)A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1. Find refractive index of the prism.

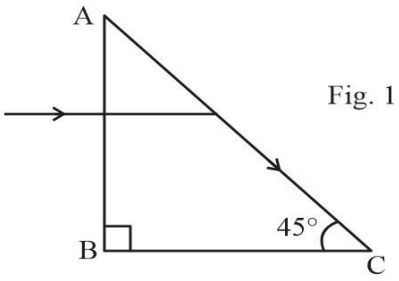


Fig. 1

OR

(i) Draw a ray diagram for the formation of the image of a point object by a thin double convex lens having radii of curvatures R_1 and R_2 and hence, derive lens maker's formula.

(ii)For a plano-concave lens of radius of curvature 10 cm, the focal length in air is 25 cm. Find the refractive index of the material of the lens.

32 (i)Differentiate between the term inductive reactance and capacitive reactance of an ac circuit. **[5]**

(ii)If the frequency of alternating current is tripled, how will it affect resistance R, inductive reactance X_L and capacitive reactance X_C?

(iii) An alternating source of 220 V is connected to a circuit having a device "A", a current of 0.5 A flows, which lag behind the applied voltage in phase by π/2. If the same voltage is applied to another device "B", same current flows but now it is in phase with the applied voltage.

(a) Name the devices A and B

(b) Draw the phasor diagram for device A

OR

(a) What is impedance?

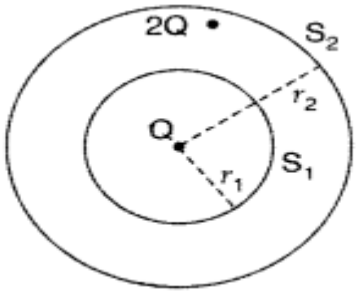
(b) A series LCR circuit is connected to an ac source having voltage $V = V_0 \sin \omega t$. Derive expression for the impedance, instantaneous current and its phase relationship to the applied voltage. Find the expression for resonant frequency

33 (i)Define the capacitance of a capacitor. Give its S I unit. **[5]**

(ii) Derive the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if a dielectric slab of thickness t (t<d) is introduced between the plates of capacitor using suitable labled diagram.

OR

(i)State Gauss' law in electrostatics. Using this law derive an expression for the electric field due to a uniformly changed infinite plane sheet.

	(ii) A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius r_2 (r_2 > r,) enclosing charge 2Q, find the ratio of the electric flux through S_1 and S_2 	

SET-3

KENDRIYA VIDYALAYA SANGATHAN---MUMBAI REGION

SECOND PRE BOARD EXAMINATION - 2024-25

SUBJECT: PHYSICS (042) (THEORY)

CLASS – XII **TIME ALLOWED: 3 Hours**

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 MCQs 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. $c = 3X10^{8}\ ms^{-1}$

II. $m_e = 9.1\ X10^{-31}\ kg$

III. $m_p = 1.7\ X10^{-27}\ kg$

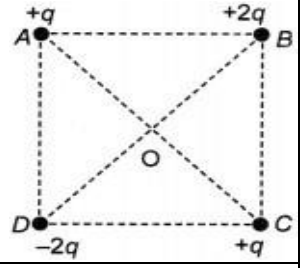
IV. $e\ = 1.6\ X10^{-19}\ C$

V. $\mu_o = 4\pi\ X10^{-7}\ TmA^{-1}$

VI. $h\ = 6.63\ X10^{-34}\ Js$

VII. $\varepsilon_o = 8.854\ X10^{-12}\ C^2N^{-1}m^{-2}$

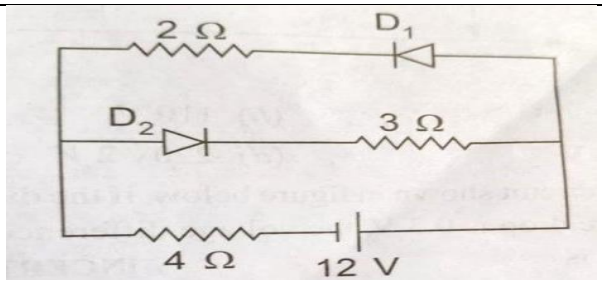
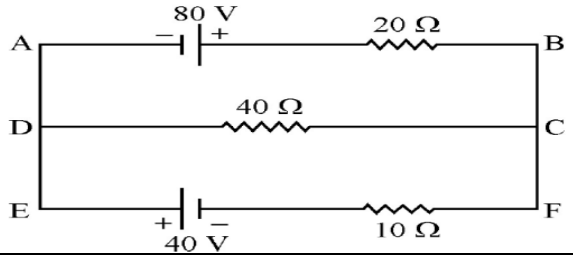
VIII. Avogadro's number $=\ 6.023\ X10^{23}$ per gram mole

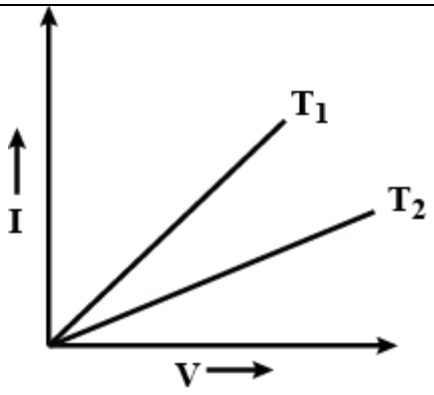
	Section A	
1	In an LCR circuit, capacitance is changed from C to 2C. For resonant frequency to remain unchanged, the inductance should be changed from L to (a) 4 L (b) 2 L (c) L/2 (d) L/4	**[1]**
2	Four charges are arranged at the comers of a square ABCD, as shown. The force on the charge kept at the center O is (a) Zero (b) along the diagonal AC (c) along the diagonal BD (d) perpendicular to side AB 	**[1]**
3	Two parallel conductors carrying currents of 4.0 A and 10.0 A are placed 2.5 cm apart in vacuum. The force per unit length between them is – (a) 6.4×10^{-5} N/m (b) 6.4×10^{-2} N/m (c) 4.6×10^{-4} N/m (d) 3.2×10^{-4} N/m	**[1]**
4	Masses of three wires of copper are in the ratio of 1:3:5 and their lengths are in the ratio of 5: 3: 1. The ratio of their electrical resistances are (a) 1: 3: 5 (b) 5 : 3 : 1 (c)1 : 15 : 125 (d)125 : 15 : 1	**[1]**
5	A glass convex lens (μ_g = 1.5) has a focal length of 8cm when placed in air. What would be the focal length of the lens when it is immersed in water (μ_w = 1.33) (a) 32 cm (b) 4 cm (c) 16 cm (d) 2 m	**[1]**

6	A loop carrying a current I in clockwise direction is placed in x-y plane, in a uniform magnetic field directed along z-axis. The tendency of the loop will be to : (A) move along x-axis (B) move along y-axis (C) shrink (D) expand	**[1]**
7	In double slits experiment, for light of which color the fringe width will be minimum (a) Red (b) Violet (c)Green (d)Yellow	**[1]**
8	The most energetic electromagnetic radiations are: (a) microwaves (b) gamma rays (c) X-rays (d) ultraviolet waves	**[1]**
9	On doping germanium metal, with a little amount of indium, what does one get? (a) Intrinsic semiconductor (b) Insulator (c) p-type semiconductor (d) n-type semiconductor	**[1]**
10	The angular momentum of the electron in the nth permissible orbit is; (a) $nh/2\pi$ (b) $h/2\pi$ (c) $2h/\pi$ (d) $ph/2\pi$	**[1]**
11	Two beams, A and B whose photon energies are 3·3 eV and 11·3 eV respectively, illuminate a metallic surface (work function 2·3eV) successively. The ratio of maximum speed of electrons emitted due to beam A to that due to beam B is: (A) 3 (B) 9 (C) 1/3 (D) 1/9	**[1]**
12	An object is placed at the focus of a concave mirror. If the focal length of the mirror is 40 cm, then the distance of image from the pole is (a) 10cm (b) Infinity (c) 20cm (d) 40cm	**[1]**
13	**Assertion:** Plane and convex mirrors cannot produce real images under any circumstance. **Reason:** A virtual image cannot serve as an object to produce a real image. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion. (c) Assertion is correct statement but reason is wrong statement. (d) Assertion is wrong statement but reason is correct statement	**[1]**

14	**Assertion**: The basic difference between various types of electromagnetic waves lies in their wavelength or frequencies. **Reason**: Electromagnetic waves travel through vacuum with the same speed. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion. (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion. (c) Assertion is correct statement but reason is wrong statement. (d) Assertion is wrong statement but reason is correct statement	**[1]**
15	**Assertion:** In process of photoelectric emission, all emitted electrons do not have same kinetic energy. **Reason:** If radiation falling on photosensitive surface of a metal consists of different wavelength then energy acquired by electrons absorbing photons of different wavelengths shall be different (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) Both A and R are false	**[1]**
16	**Assertion (A):** The focal length of a convex mirror of radius R is equal to f = R/2. **Reason (R):** The focal length of the convex mirror will increase, if the mirror is placed in water. (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 but R is true	**[1]**
	Section B	
17	Obtain an expression for the self-inductance of a long solenoid. Hence define one henry. OR	**[2]**

	Define mutual inductance. Write its SI unit. Give two factors on which the coefficient of mutual inductance between a pair of coils depends.	
18	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.	**[2]**
19	A concave lens made of material of refractive index 'n_2' is held in a reference medium of refractive index 'n_1'. Trace the path of parallel beam of light passing through the lens when: (i) $n_1 = n_2$ (ii) $n_1 > n_2$	**[2]**
20	Electromagnetic waves with wavelength (i) λ_1 is suitable for radar systems used in aircraft navigation. (ii) λ_2 is used to kill germs in water purifiers. (iii) λ_3 is used to improve visibility in runways during fog and mist conditions. Identify and name the part of the electromagnetic spectrum to which these radiations belong. Also arrange these wavelengths in ascending order of their magnitude	**[2]**
21	What is a wave front? Using Huygens' principle, explain reflection of a plane wave front from a surface and verify the laws of reflection	**[2]**
	Section C	
22	Plot suitable graphs to show the variation of photoelectric current with the collector plate potential for the incident radiation of (i) the same intensity but different frequencies ν_1 , ν_2 and ν_3 ($\nu_1<\nu_2<\nu_3$) (ii) the same frequency but different intensities I_1 , I_2 and I_3 ($I_1 < I_2 < I_3$) (iii) Monochromatic light of frequency 6.0×10^{14} Hz is produced by a laser. The power emitted is 2.0×10^{-3} W. Calculate the number of photons emitted on an average by the source.	**[3]**
23	(i)Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams (ii) The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?	**[3]**

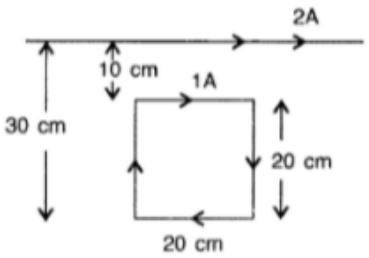
	 **OR** Draw V-I characteristics of a p-n junction diode. Answer the following questions, giving reasons: (i) Why is the current under reverse bias almost independent of the applied potential up to a critical voltage? (ii) Why does the reverse current show a sudden increase at the critical voltage?	
24	(a) Two electric field lines cannot cross each other. Also, they cannot form closed loops. Give reasons. (b)A particle of charge 2μ C and mass 1.6 g is moving with a velocity 4 $\hat{\imath}$ ms $^{-1}$. At t = 0 the particle enters in a region having an electric field $\vec{E}$ (in NC $^{-1}$) = 80 $\hat{\imath}$ + 60 $\hat{\jmath}$. Find the velocity of the particle at t = 5 s.	**[3]**
25	Draw the circuit diagram of a full-wave rectifier using p-n junction diode. Explain its working and show the output and input waveforms.	**[3]**
26	Using Kirchhoff's rules, calculate the current through the 40Ω and 20Ω resistors in the following circuit 	**[3]**
27	(i) V – I graph for a metallic wire at two different temperatures T1 and T2 is as shown in the figure. Which of the two temperatures is higher and why?	**[3]**



(ii) Two wires, one of copper and the other of manganin, have same resistance and equal length. Which wire is thicker? Justify your answer.

28 (i) Define current sensitivity of a galvanometer. Write its expression. **[3]**

(ii) A square loop of side 20 cm carrying current of 1 A is kept near an infinite long straight wire carrying current of 2A in the same plane as shown in the figure. Calculate the magnitude and direction of the net force exerted on the loop due to the current carrying conductor.



Section D

29 **Question No. 29 and 30 are based on the given text.** **[4]**

Read the text carefully and answer the questions:

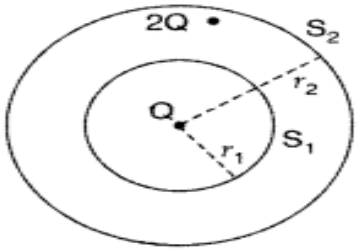
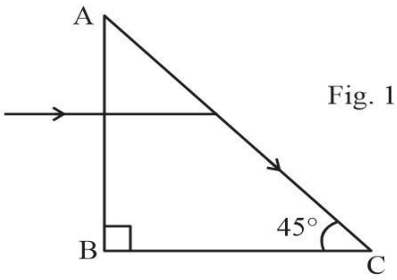
A charged particle moving in a magnetic field experiences a force that is proportional to the strength of the magnetic field, the component of the velocity that is perpendicular to the magnetic field and the charge of the particle.

This force is given by $\vec{F} = q(\vec{v} \times \vec{B})$ where **q** is the electric charge of the particle, **v** is the instantaneous velocity of the particle, and B is the magnetic field (in tesla). The direction of force is determined by the rules of cross product of two vectors. Force is perpendicular to both velocity and magnetic field. Its direction is given as $\vec{v} \times \vec{B}$ if q is positive and opposite of $\vec{v} \times \vec{B}$ if q is negative.

	The force is always perpendicular to both the velocity of the particle and the magnetic field that created it. Because the magnetic force is always perpendicular to the motion, the magnetic field can do no work on an isolated charge. It can only do work indirectly, via the electric field generated by a changing magnetic field.	
	(i) When a magnetic field is applied on a stationary electron, it a) moves in the direction of the field b) remains stationary c) moves perpendicular to the direction of the field d) spins about its own axis	
	(ii) A proton is projected with a uniform velocity **v** along the axis of a current - carrying solenoid, then a) the proton will be accelerated along the axis b) the proton will continue to move with velocity **v** along the axis c) the proton moves along helical path d) the proton path will be circular about the axis	
	(iii) A charged particle experiences magnetic force in the presence of magnetic field. Which of the following statement is correct? a) The particle is moving and magnetic field is parallel to velocity. b) The particle is stationary and magnetic field is perpendicular. c) The particle is moving and magnetic field is perpendicular to the velocity. d) The particle is stationary and magnetic field is parallel.	
	(iv) A charge **q** moves with a velocity 2 ms^{-1} along x - axis in a uniform magnetic field $\vec{B} = (\hat{\imath} + 2\hat{\jmath} + 3\hat{k})\mathrm{T}$, then charge will experience a force a) along - z axis b) in z - y plane c) along +z axis d) along - y axis OR An electron is moving along positive x- axis in a magnetic field which is parallel to the positive y- axis. In what direction will the magnetic force be acting on the electron? a) along -x axis	

	b) along -z axis c) along +z axis d) along -y axis	
30	**Read the text carefully and answer the questions** Basic postulates of Bohr's atomic model: (i) Every atom consists of a central core called nucleus in which entire positive charge and mass of the atom are concentrated. A suitable number of electrons revolve around the nucleus in circular orbit. The centripetal force required for revolution is provided by the electrostatic force of attraction between the electron and the nucleus. (ii) Electron can resolve only in certain discrete non-radiating orbits, called stationary orbit. Total angular momentum of the revolving electron is an integral multiple of h/2π. where [h is plank constant] $mvr = \frac{nh}{2\pi}$ (iii) The radiation of energy occurs only when an electron jumps from one permitted orbit to another. The difference in the total energy of electron in the two permitted orbit is absorbed when the electron jumps from inner to the outer orbit and emitted when electron jumps from outer to inner orbit.	**[4]**
	(i) The first postulate of Bohr atomic model (a) Explains stability of atoms (b) Line spectrum emitted by hydrogen atom (c) Relative variation in intensity of spectral lines (d) None of the above	
	(ii)The angular momentum of electron in the second orbit of hydrogen atom is (a) 2π/h (b) h/π (c) 3h/2π (d) h/2π	
	(iii)A set of atoms in an excited state jumps (a) in general to any of the states of lower energy (b) into a lower state, only when excited by an external electric field (c) all together simultaneously into a lower state (d) to emit photons only when they collide	
	(iv) Bohr model explains the spectrum emitted by	

	(a) All atoms (b) Hydrogen and hydrogen like atoms (c) Only hydrogen atom (d) All the above **OR** (v) The radius of the innermost orbit of hydrogen atom is 0.53 Å. The radius of the second orbit is (a)1.06 Å (b) 2.12 Å (c) 21.2 Å (d) 10.6 Å	
	Section E	
31	(i) Differentiate between the term inductive reactance and capacitive reactance of an ac circuit. (ii) If the frequency of alternating current is tripled, how will it affect resistance R, inductive reactance X_L and capacitive reactance X_C? (iii) An alternating source of 220 V is connected to a circuit having a device "A", a current of 0.5 A flows, which lag behind the applied voltage in phase by π/2. If the same voltage is applied to another device "B", same current flows but now it is in phase with the applied voltage. (a) Name the devices A and B (b) Draw the phasor diagram for device A **OR** (a) What is impedance? (b) A series LCR circuit is connected to an ac source having voltage $V = V_0$ sin ωt. Derive expression for the impedance, instantaneous current and its phase relationship to the applied voltage. Find the expression for resonant frequency.	**[5]**
32	(i) Define the capacitance of a capacitor. Give its S I unit. (ii) Derive the expression for the capacitance of a parallel plate capacitor of area A and plate separation d if a dielectric slab of thickness t (t<d) is introduced between the plates of capacitor. OR (i)State Gauss' law in electrostatics. Using this law derive an expression for the electric field due to a uniformly changed infinite plane sheet.	**[5]**

	(ii) A sphere S_1 of radius r_1 encloses a net charge Q. If there is another concentric sphere S_2 of radius r_2 (r_2 > r,) enclosing charge 2Q, find the ratio of the electric flux through S_1 and S_2 	
33	(a) Draw a ray diagram showing refraction of a ray of light through a triangular glass prism. Hence, obtain the relation for the refractive index (μ) in terms of angle of prism (A) and angle of minimum deviation (δ_m) . (b) A light ray entering a right-angled prism undergoes refraction at the face AC as shown in Fig. 1. Find the refractive index of prism.  Fig. 1 **OR** (a) Draw a ray diagram for the formation of the image of a point object by a thin double convex lens having radii of curvatures R_1 and R_2 and hence, derive lens maker's formula. (b) For a Plano-concave lens of radius of curvature 10 cm, the focal length in air is 25 cm. Find the refractive index of the material of the lens	**[5]**

KENDRIYA VIDYALAYA SANGTHAN, MUMBAI REGION

SEPTEMBER MONTHLY TEST

CLASS – XII **MM – 35 MARKS**

SUBJECT – PHYSICS (042) **SET – A** **DURATION – 90 MIN**

General Instructions:

Read the following instructions carefully and follow them:

(i) This question paper contains 18 questions. All questions are compulsory.

(ii) This question paper is divided into five sections A, B, C, D and E.

(iii) In Section A Questions no. 1 to 9 are Multiple Choice type questions.

Each question carries 1 mark.

(iv) In Section B Questions no. 10 to 13 are Very Short Answer type questions.

Each question carries 2 marks.

(v) In Section C Questions no. 14 to 16 are Short Answer type questions. Each

question carries 3 marks.

(vi) In Section D Questions no. 17 is a case study-based question and carries 4 marks.

(vii) In Section E Questions no. 18 is a Long Answer type questions and carries 5 marks.

(viii) There is no overall choice given in the question paper. However, an internal

choice has been provided in few questions.

(ix) Use of calculators is not allowed.

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

c = 3 x10^8 m/s

h = 6.63x 10^{-34} Js

e = 1.6 x10^{-19} C

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

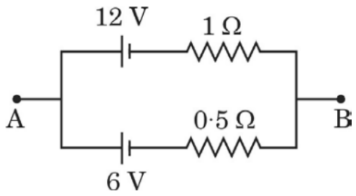
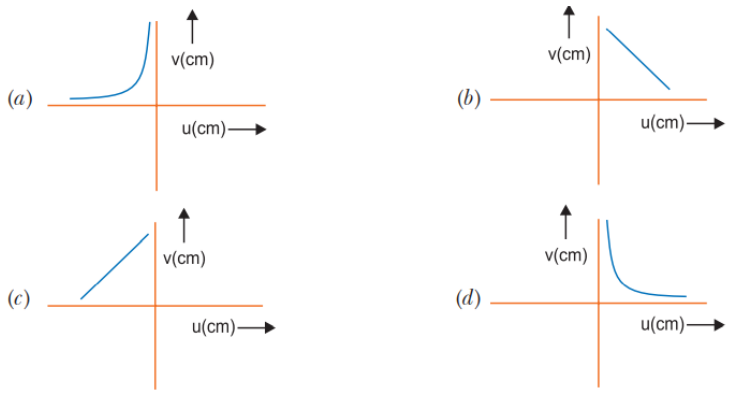
$\varepsilon_0 = 8.854 \times 10^{-12}\ C^2\ N^{-1}\ m^{-2}$

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

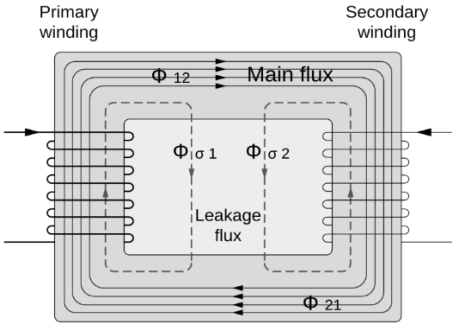
Mass of electron (m_e) = 9.1x 10^{-31} kg

Mass of neutron = 1.675 x10^{-27} kg

Mass of proton = 1.673x 10^{-27} kg

Q. No.	SECTION – A (Multiple Choice Questions)	MARKS
Q1	A thin plastic rod is bent into a circular ring of radius R. It is uniformly charged with charge density λ . The magnitude of the electric field at its centre is : (A) $\frac{\lambda}{2R\varepsilon 0}$ (B) Zero (C) $\frac{\lambda}{4\Pi R\varepsilon 0}$ (D) $\frac{\lambda}{4R\varepsilon 0}$	1
Q2	Consider the circuit shown in the figure. The potential difference between points A and B is :  (A) 6 V (B) 8 V (C) 9 V (D) 12 V	1
Q3	The reactance of a capacitor of capacitance C connected to an ac source of frequency w is X. If the capacitance of the capacitor is doubled and the frequency of the source is tripled, the reactance will become : (A) X/6 (B) 6X (C) (2X/3) (D)(3X/2)	1
Q4	In the four regions, I, II, III and IV, the electric fields are described as : Region I : $E_x = E_0 \sin(kz-wt)$ Region II : $E_x = E_0$ Region III : $E_x = E_0 \sin kz$ Region IV : $E_x = E_0 \cos kz$ The displacement current will exist in the region : (A) I (B) IV (C) II (D) III	1
Q5	A student measures the focal length of a convex lens by putting an object pin at a distance 'u' from the lens and measuring the distance 'v' of the image pin. The graph between 'u' and 'v' plotted by the student should look like:  	1
Q6	In a series LCR circuit, the voltage across the resistance, capacitance and inductance is 10 V each. If the capacitance is short circuited the voltage across the inductance will be : (A) 10 V (B) 10√2 V (C) 10/√2 V (D) 20 V	1

For Questions 7 to 9, 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 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.		
Q7	Assertion :Electromagnetic waves carry energy and momentum. Reason: Electromagnetic waves can be polarised.	1
Q8	Assertion (A) : Plane and convex mirrors cannot produce real images under any circumstance. Reason (R) : A virtual image cannot serve as an object to produce a real image.	1
Q9	Assertion (A): On increasing the current sensitivity of a galvanometer by increasing the number of turns may not necessarily increase its voltage sensitivity. Reason(R) : The resistance of the coil of the galvanometer increases on increasing the number of turns.	1
SECTION – B (Very Short Answer Type Questions)		
Q10	An electric field E is maintained in a metallic conductor. If n be the number of electrons (mass m, charge e) per unit volume in the conductor and its relaxation time, show that the current density j =α E , where $\alpha = \left(\frac{ne^2}{m}\right)\tau$.	2
Q11	A proton with kinetic energy 1·3384 X 10^{14} J moving horizontally from north to south, enters a uniform magnetic field B of 2·0 mT directed eastward. Calculate : (a) the radius of the path traced by the proton (b) the magnitude of acceleration of the proton	2
Q12	An electric dipole consists of point charges -1·0 pC and + 1·0 pC located at (0, 0) and (3 mm, 4 mm) respectively in x y plane. An electric field E = 1000 V/m **i** is switched on in the region. Find the torque acting on the dipole.	2
Q13	Derive motional emf by Faraday's Law.	2
SECTION – C (Short Answer Type Questions)		
Q14	a)"The wavelength of the electromagnetic wave is often correlated with the characteristic size of the system that radiates." Give two examples to justify this statement. (b) (i) Long distance radio broadcasts use short-wave bands. Why ? (ii) Optical and radio telescopes are built on the ground, but X-ray astronomy is possible only from satellites orbiting the Earth. Why ?	3
Q15	An inductor, a capacitor and a resistor are connected in series with an ac source $V = V_m \sin t$. Derive an expression for the average power dissipated in the circuit. Also obtain the expression for the resonant frequency of the circuit.	3
Q16	An equi-convex lens of radius of curvature R is cut into two equal parts by a vertical plane, so it becomes a Plano convex lens. If 20 cm is the focal length of the equi-convex lens, then what will be focal length of Plano convex lens?	3
SECTION – D (Case Study Based Question)		
Q17	A varying current in the transformer's primary winding creates a varying magnetic flux in the transformer core, which is also encircled by the secondary winding. According to Faraday's law, since the same magnetic flux passes through both the primary and secondary windings in an ideal transformer, a voltage is induced in each winding proportional to its number of turns. The transformer winding voltage ratio is equal to the winding turns ratio.	4



i) A power transformer is used to step up an alternating e.m.f. of 220 V to 11 kV to transmit 4.4 kW of power. If the primary coil has 1000 turns, what is the current rating of the secondary?

(a) 4 A (b) 0.4 A (c) 0.04 A (d) 0.2 A

ii)A transformer has 100 turns in the primary coil and carries 8 A current. If input power is one kilowatt, the number of turns required in the secondary coil to have 500V output will be

(a) 100 (b) 200 (c) 400 (d) 300

iii)What is a wattless current?

iv) A resistance of 20 Ω is connected to a source of an alternating potential, V=220 sin (100πt) The time taken by the current to change from its peak value to its rms value will be:

a.)	0.2 sec	b.)	0.25 sec
c.)	25×10^{-3} sec	d.)	2.5×10^{-3} sec

SECTION – E (Long Answer Type Questions)

Q18 i) A ray of light is incident normally on a refracting face of a prism of prism angle A and suffers a deviation of angle . Prove that the refractive index n of the material of the prism

$$n = \frac{\sin (A + \delta)}{\sin A}.$$

3

ii) The refractive index of the material of a prism is √2 . If the refracting angle of the prism is 60^0, find the

(a) Angle of minimum deviation, and

(b) Angle of incidence.

2

OR

i)Draw a ray diagram showing the formation of the image by a point object on the principal axis of a spherical concave surface separating two media of refractive indices n_1 and n_2, when a point source is kept in the rarer medium of refractive index n_1. Derive the relation between object and image distance in terms of refractive index of the medium and radius of curvature of the surface.

3

ii) A small telescope has an objective lens of focal length 140cm and an eyepiece of focal length 5.0cm. If this telescope is used to view a 100m tall tower 3km away, what is the height of the image of the tower formed by the objective lens?

2