केन्द्रीय विद्यालय संगठन, कोलकाता संभाग

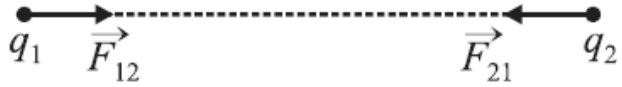
KENDRIYA VIDYALAYA SANGATHAN, KOLKATA REGION

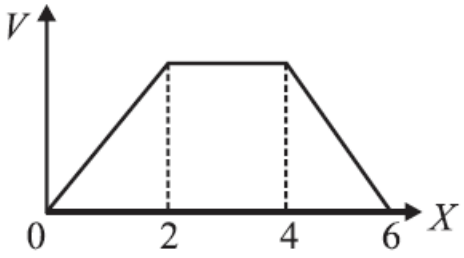
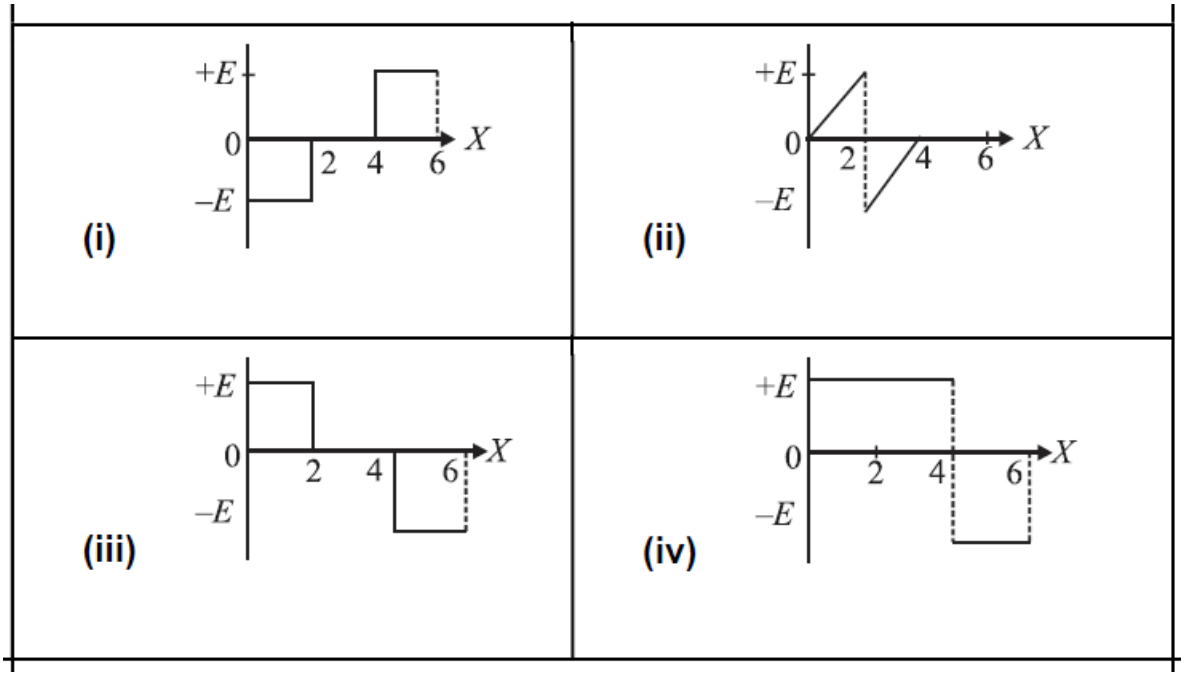
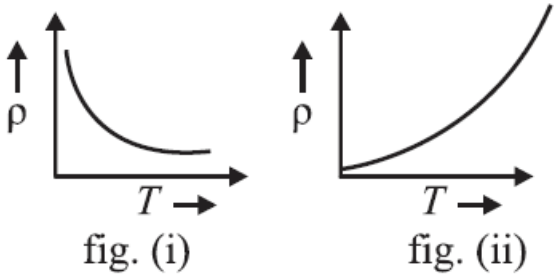
द्वितीय प्री-बोर्ड परीक्षा / SECOND PRE-BOARD EXAM. – 2025-26

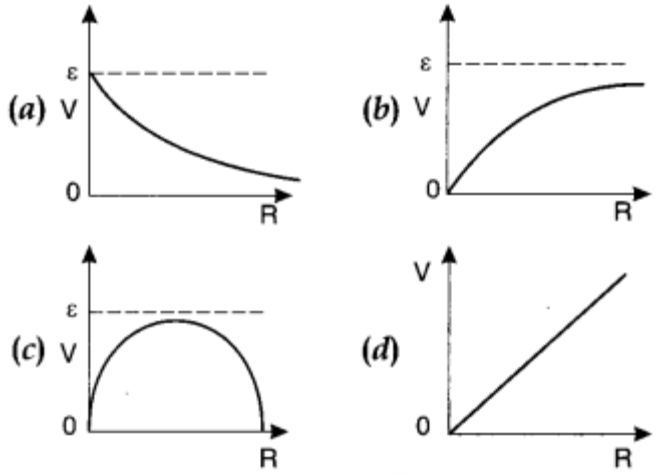
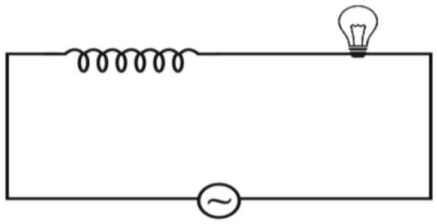
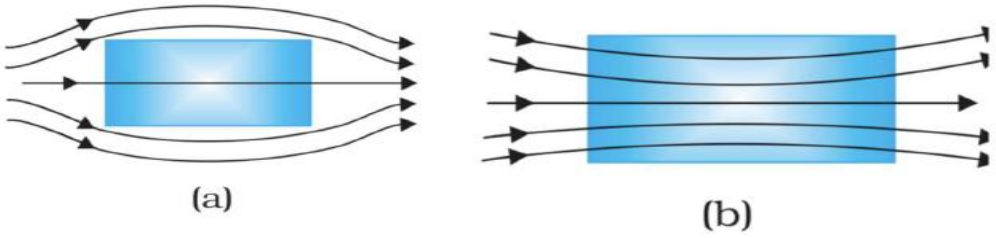
कक्षा / CLASS – XII **अविकतम अकं /MAX. MARKS –70**

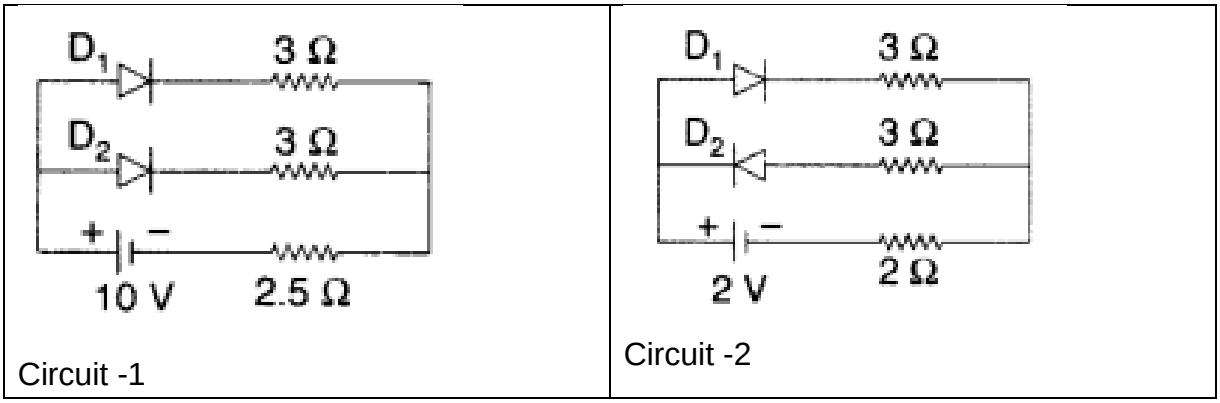
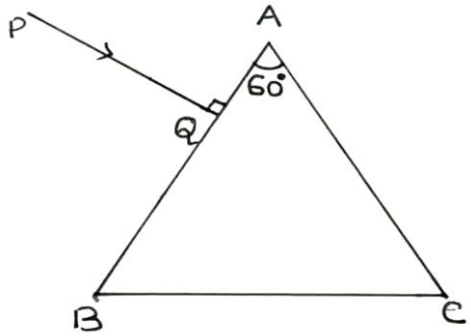
विषय/SUB. – भौतिकी/ PHYSICS (042) **समय/TIME – 03 घंटे/Hours**

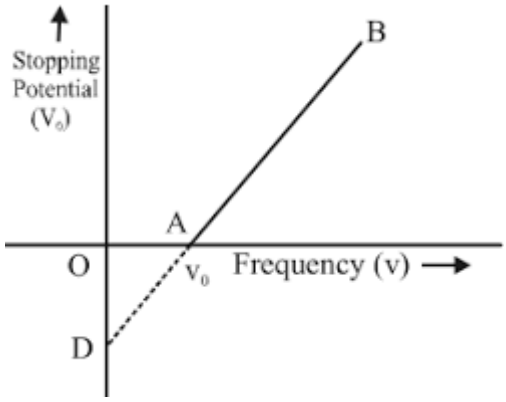
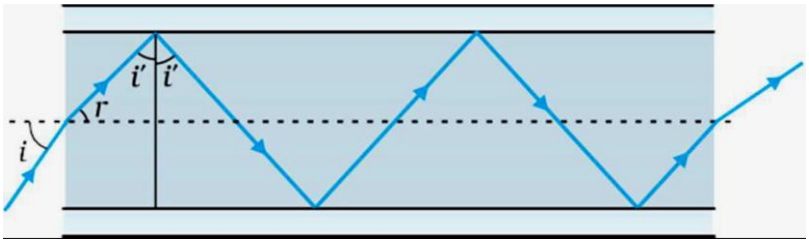
General Instructions:
(1) There are 33 questions in all. All questions are compulsory.
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.
(3) All the sections are compulsory.
(4) Section A contains sixteen questions, twelve MCQ (Qn No. 1-12) and four assertion reasoning(Qn No. 13-16) based of 1 mark each, ***Section B contains five questions(Qn No. 17-21) of two marks each,*** ***Section C contains seven (Qn No. 22-28) questions of three marks each,*** ***Section D contains two (Qn No. 29-30) case study-based questions of four marks each and*** ***Section E contains three (Qn No. 31-33) long answer questions of five marks each.***
(5) There is no overall choice. However, an internal choice has been provided in two question in Section B, one question in Section C and all three questions in Section E. You have to attempt only one of the choices in such questions.
(6) Use of calculators is not allowed.
(7) You may use the following values of physical constants where ever necessary
i. c = 3 x 108 m/s
ii. m_e = 9.1 x10^{-31} kg
iii. m_p = 1.7 x10^{-27} kg
iv. e = 1.6 x 10^{-19} C
v. μ_0 = 4π x 10^{-7} T m A^{-1}
vi. h = 6.63 x10^{-34} J s
vii. ε_0 = 8.854 x10^{-12} $C^2N^{-1}m^{-2}$
viii. Avogadro's number = 6.023 X 10^{23} per gram mole

	SECTION A	
Q.1	According to Coulomb's law, which is the correct relation for the following figure?  (i) q1 q2> 0 (ii) q1 q2<0 (iii) q1 q2 =0 (iv) 1> q1/ q2 > 0	1

Q.2	The electric potential V as a function of distance X is shown in the figure.  The graph of the magnitude of electric field intensity E as a function of X is  	1
Q.3	The temperature (T) dependence of resistivity of materials A and material B is represented by fig (i) and fig (ii) respectively. Identify material A and material B.  fig. (i) fig. (ii) (i) material A is copper and material B is germanium (ii) material A is germanium and material B is copper (iii) material A is nichrome and material B is germanium (iv) material A is copper and material B is nichrome	1

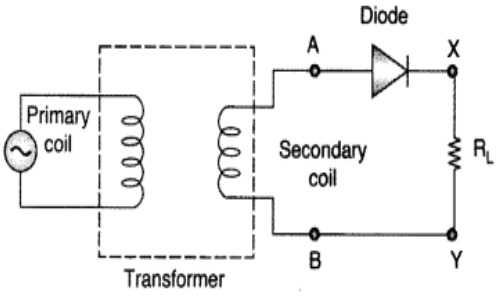
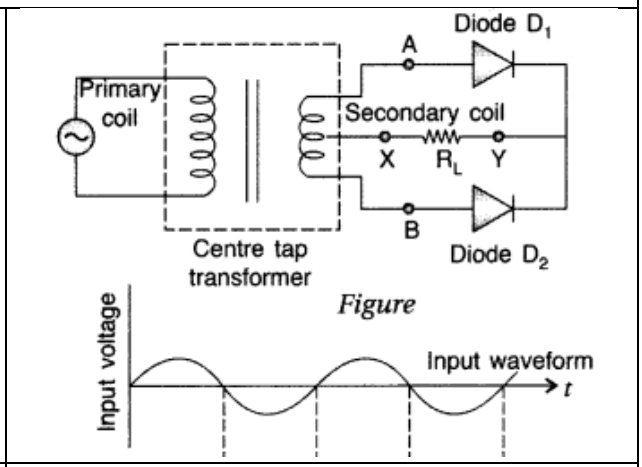
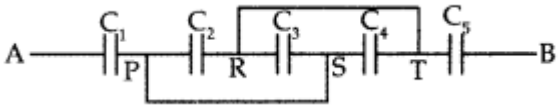
Q.4	A cell having an emf E and internal resistance r is connected across a variable external resistance R. As the resistance R is increased, the plot of potential difference V across R is given by  	1
Q.5	An iron cored coil is connected in series with an electric bulb with an AC source as shown in figure. When iron piece is taken out of the coil, the brightness of the bulb will  (i) decrease (ii) increase (iii) remain unaffected (iv) fluctuate	1
Q.6	A uniform magnetic field gets modified as shown in figure when two specimens A and B are placed in it.  (i)Identify the specimen B. (ii) How is the magnetic susceptibility of specimen A different from that of specimen B? a) (i) specimen B= Diamagnetic material (ii) magnetic susceptibility of specimen A is smaller than that of B b) (i) specimen B= Paramagnetic material (ii) magnetic susceptibility of specimen A is greater than that of B c) (i) specimen B= Ferromagnetic material (ii) magnetic susceptibility of specimen A is very high than that of B d) (i) specimen B. = Diamagnetic material (ii) magnetic susceptibility of specimen A is greater than that of B	1

Q.7	Assuming that the two diodes D_1 and D_2 used in the electric circuits shown in the figure are ideal, find out the value of the current flowing through 2.5 Ω resistor in Circuit -1and in 2 Ω resistor in Circuit -2.  a) Circuit -1: current flowing through 2.5 Ω resistor = 2.5 A Circuit -2: current flowing through 2Ω resistor = 0.4A (b) Circuit -1: current flowing through 2.5 Ω resistor = 0.4 A Circuit -2: current flowing through 2Ω resistor = 2.5 A (c) Circuit -1: current flowing through 2.5 Ω resistor = 1 A Circuit -2: current flowing through 2Ω resistor = 4 A (d) Circuit -1: current flowing through 2.5 Ω resistor = 4 A Circuit -2: current flowing through 2Ω resistor = 1 A	1
Q.8	The binding energies per nucleon for a deutron and an α- particle are x_1 and x_2 respectively. The energy Q released in reaction $1H^2 + 1H^2 \rightarrow 42He + Q$ is (a) 4 $(x_1 + x_2)$ (b) 4 $(x_1 - x_2)$ (c) 2 $(x_1 + x_2)$ (d) 2 $(X_1 - x_2)$	1
Q.9	A ray PQ is incident normally on the face AB of a triangular prism of refracting angle 60^0 as shown in figure. The prism is made of a transparent material of refractive index $2/\sqrt{3}$. Calculate the angle of emergence and the angle of deviation.  A) angle of emergence=90^0 and the angle of deviation=30^0 B) angle of emergence=60^0 and the angle of deviation= 20^0 C) angle of emergence=30^0 and the angle of deviation=90^0 D) angle of emergence=20^0 and the angle of deviation= 60^0	1

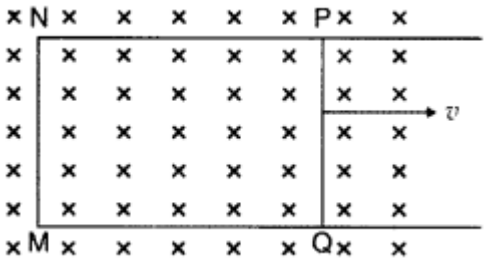
Q.10	The graph showing the variation of stopping potential with the frequency of incident radiation for a photosensitive material having work functions W. On what factors does the (i) slope and (ii) intercept of the lines depend?  Options are: A) (i) slope- Plank's Constant and Charge of electron (ii) intercept of the lines depends on- Work Function and Charge of electron B) (i) slope- Kinetic energy of photo electrons (ii) intercept of the lines depends on- Threshold frequency C) (i) slope- Work Function and Charge of electron (ii) intercept of the lines depends on- Plank's Constant and Charge of electron D) (i) slope- Threshold frequency (ii) intercept of the lines depends on- Kinetic energy of photo electrons	1
Q.11	The following figure shows a cross-section of a 'light pipe' made of a glass fiber of refractive index 1.68. The outer covering of the pipe is made of a material of refractive index 1.44. What is the range of the angles of the incident rays with the axis of the pipe for the following phenomena to occur.  (i) $0 < i < 90°$ (ii) $0 < i < 60°$ (iii) $0 < i < 45°$ (iv) $0 < i < 30°$	1
Q.12	What is the ratio of the energy of electrons belonging to third orbit of hydrogen atom and first excited state of Oxygen atom? (i) 144:1 (ii) 9:16 (iii) 16:9 (iv) 1:144.	1

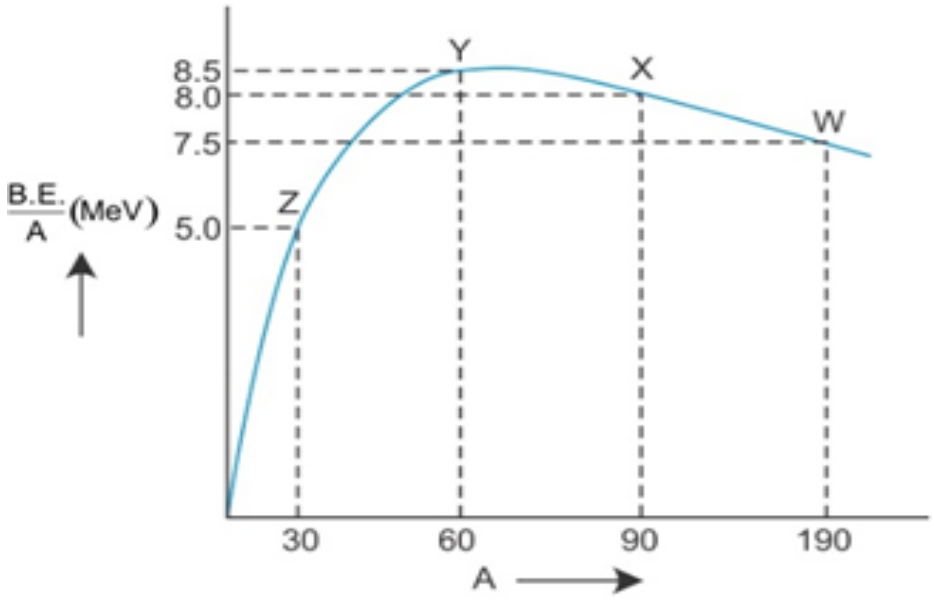
Q.13	Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below. a) Both A and R are true and R is the correct explanation of A b) Both A and R are true and R is NOT the correct explanation of A c) A is true but R is false d) A is false and R is also false **Assertion :** The kinetic energy of photoelectrons emitted from metal surface does not depend on the intensity of incident photon. **Reason :** The ejection of electrons from metallic surface is not possible with frequency of incident photons below the threshold frequency.	1
Q.14	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 and 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 ASSERTION: In an interference pattern observed in Young's double slit experiment, if the separation (d) between coherent sources as well as the distance (D) of the screen from the coherent sources both are reduced to 1/3rd, then new fringe width remains the same. REASON: Fringe width is proportional to (d/D).	1
Q.15	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 and 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 **Assertion (A) :** We cannot get diffraction pattern from a wide slit illuminated by monochromatic light. **Reason (R) :** In diffraction pattern, all the bright bands are not of the same intensity.	1
Q.16	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 and 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	1

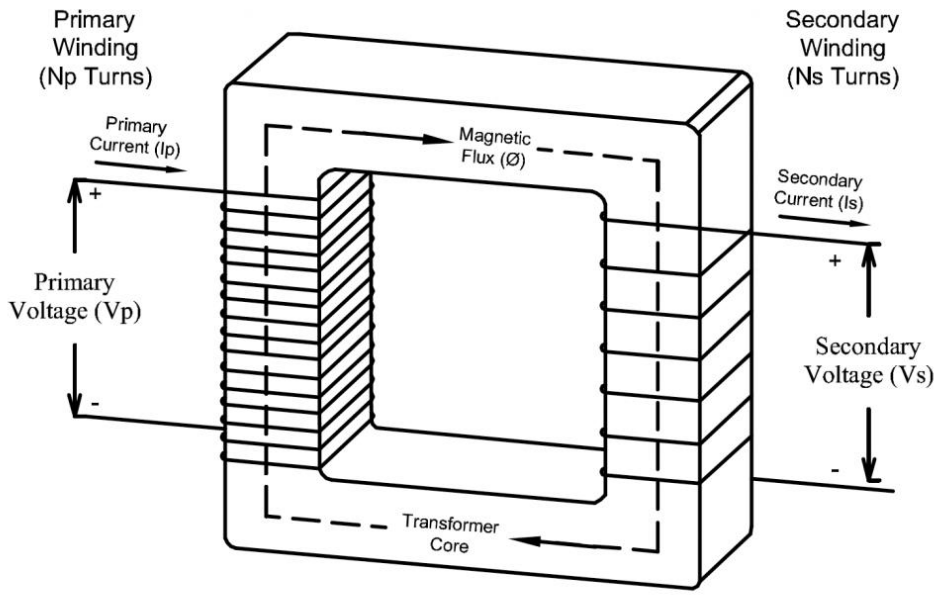
	Assertion (A) : A proton and an alpha particle having the same kinetic energy are moving in circular paths in a uniform magnetic field. The radii of their circular paths will be equal. **Reason (R) : Mass** of alpha particle is four times than mass of proton and charge of alpha particle is double of proton. So both will describe circular trajectories of equal radii.	

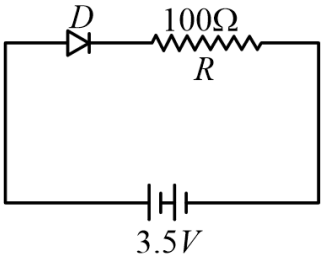
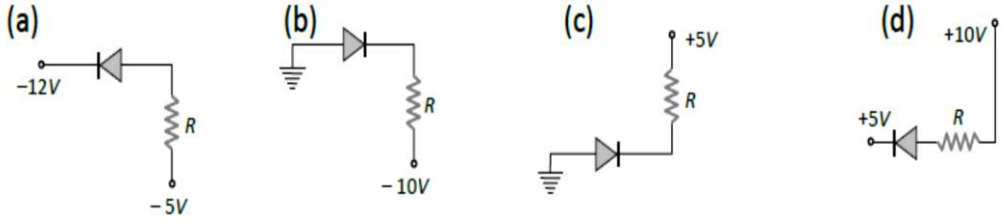
	SECTION B	
Q.17	a) Draw the output wave form if the given input is applied at circuit-1 and circuit-2 and justify the nature of output waveform  circuit-1  circuit-2 b) If the input frequency is 60 Hz what is the output frequency for circuit-1& circuit-2 ?	1+1 = 2
Q.18	An ammeter of resistance 0.80 Ω can measure current upto 1.0 A. (i) What must be the value of shunt resistance to enable the ammeter to measure current upto 5.0A? (ii) What is the combined resistance of the ammeter and the shunt? OR Derive an expression for the force experienced by a current carrying straight conductor placed in a magnetic field. Under what conditions is this force maximum?	2
Q.19	(i) Find equivalent capacitance between A and B in the combination given below. Each capacitor is of 2 μF capacitance  (ii) If a dc source of 7 V is connected across AB, how much charge is drawn from the source and what is the energy stored in the network?	2

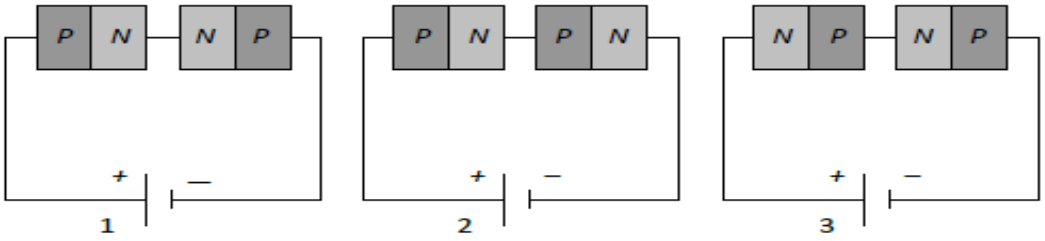
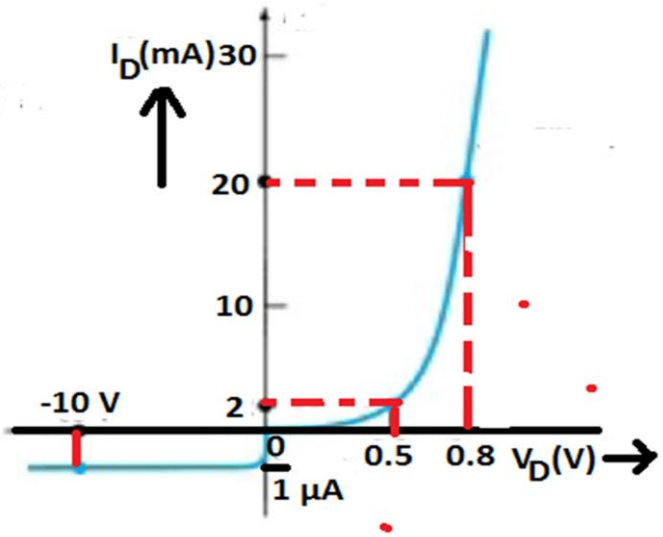
Q.20	Calculate the energy released in MeV in the following nuclear reaction: $^{238}_{92}U \longrightarrow {}^{234}_{90}Th + {}^{4}_{2}He + Q$ [Mass of $^{238}_{92}U = 238.05079$ u, Mass of $^{234}_{90}Th = 234.043630$ u, Mass of $^{4}_{2}He = 4.002600$ u, $1u = 931.5$ MeV/c^2]	2
Q.21	a) Define 'drift velocity' and obtain an expression for the current flowing in a wire, in terms of the 'drift velocity' of the free electrons. (b) Use the above expression to show that the 'resistivity', of the material of a wire, is' inversely proportional to the 'relaxation time' for the 'free electrons' in the metal.	2
	SECTION C	
Q.22	a) Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point. b) What is the expression for its magnifying power when the final image is formed at infinity. OR a) In a compound microscope, an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eyepiece has a focal length of 5 cm and the final image is formed at the near point. Estimate the magnifying power of the microscope. b) Why must both the objective and the eyepiece of a compound microscope have short focal lengths?	3
Q.23	a) When an ideal capacitor is charged by a dc battery, no current flows. However, when an ac source is used, the current flows continuously. How does one explain this, based on the concept of displacement current? b) The oscillating magnetic field in a plane electromagnetic wave is given by $B_y = (8 \times 10^{-6}) \sin [2 \times 10^{-11} t + 300 \pi x]$ T (i) Calculate the wavelength of the electo-magnetic wave. (ii) Write down the expression for the oscillating electric field.	1+ 1+ 1=3
Q.24	An inductor 200 mH, capacitor 500 μF, resistor 10 Ω are connected in series with a 100 V variable frequency a.c. source. Calculate the (i) frequency at which the power factor of the circuit is unity (ii) current amplitude at this frequency (iii) Q-factor **OR** The current through two inductors of self-inductance 12 mH and 30 mH is increasing with time at the same rate. Draw graphs showing the variation of the (a) emf induced with the rate of change of current in each inductor	1+ 1+ 1=3 ½

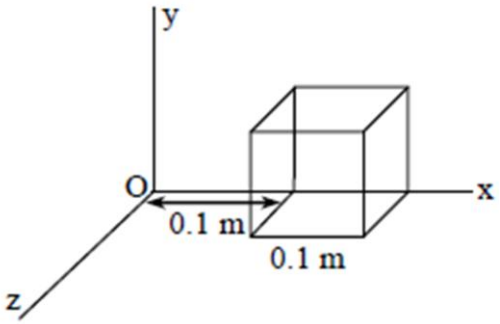
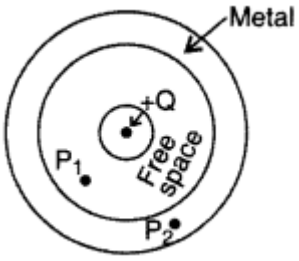
	(b) energy stored in each inductor with the current flowing through it. Compare the energy stored in the coils, if the power dissipated in the coils is the same. C) A rectangular loop PQMN with movable arm PQ of length 20 cm and resistance 5 Ω is placed in a uniform magnetic field of 0.2 T acting perpendicular to the plane of the loop as is shown in the figure.  The resistances of the arms MN, NP and MQ are negligible. Calculate the (i) emf induced in the arm PQ and (ii) current induced in the loop when arm PQ is moved with velocity 15m/s	½ 1 ½ ½
Q.25	(i) An electron and alpha particle have the same de-Broglie wavelength associated with them. How are their kinetic energies related to each other? (ii) An a-particle and a proton are accelerated from rest by the same potential. Find the ratio of their de-Broglie wavelengths. OR a) Plot a graph showing the variation of photo current vs collector potential for three different intensities $I3>I_2>I1$ two of which (I_1 & I_2) have same frequency ($\upsilon 1$) and third has frequency $\upsilon 2 > \upsilon 1$ b) In which case the Stoping potential will be different and in which case the saturation current is same- justify your answer ? c) Calculate the shortest wavelength of the spectral lines emitted in Balmer series. [Given Rydberg constant, R = 10^7 m^{-1}]	3 1 ½ ½
Q.26	(i) Binding energy per nucleon vs mass number curve for nuclei is shown in the figure. W, X, Y and Z are four nuclei indicated on the curve. Identify which of the following nuclei is most likely to undergo (i) Nuclear Fission (ii) Nuclear Fusion. Justify your answer. (ii) Two nuclei have mass numbers in the ratio 1: 2. Calculate the ratio of their nuclear densities?	1+ 1+ 1=3

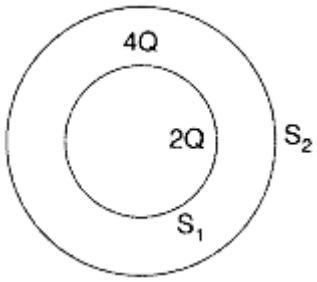
		
Q.27	a) State Kirchhoff's laws. b) Derive the balance condition for Wheatstone's network.	1+2=3
Q.28	Draw a ray diagram for the formation of image of a point object by a thin double convex lens having radii of curvature R1 and R2. Hence derive lens maker's formula.	1+2=3
	SECTION D	
Q.29	CASE STUDY 1: **Read the following paragraph and answer the questions:** A group of students is preparing for their physics exam, focusing on transformers and their applications in electrical systems. They explore how transformers operate based on electromagnetic induction principles, emphasizing their role in efficiently transferring electrical energy between circuits. They learn that transformers can step up or step down voltages, which is crucial for long-distance power transmission, reducing energy losses. During their study session, they discuss various types of transformers, such as step-up and step-down transformers, and how the turns ratio influences their functionality. They also consider real-world applications, like how high-voltage transmission lines minimize current and thus reduce resistive losses in the wires. As they prepare for practical questions, they recognize the importance of understanding the limitations of transformers, such as energy losses due to heat and the necessity for alternating current (AC) for operation.	4 x1 =4

		
Q.29	i) A power company uses transformers to step up the voltage to 500 kV for transmission over long distances. If a fault occurs, resulting in the voltage dropping to 100 kV at the substation, what could be the immediate consequences for the electrical grid? a) Increased power loss due to higher current flow. b) Improved efficiency in power transmission. c) Immediate shutdown of all connected devices. d) Decrease in voltage regulation across the grid.	
Q.29	ii) An electric vehicle charging station utilizes a transformer to convert 480 V AC from the grid to 240 V AC for charging. If the transformer has an efficiency of 95% and the charging station requires 6 kW of power, what is the minimum input power required from the grid? a) 5.7 K W b) 6.3 kW c) 6.7 kW d) 5.9 K W	
Q.29	iii) In a renewable energy application, a solar power system uses a transformer to convert the generated voltage from the solar panels (typically low voltage) to a higher voltage suitable for feeding into the grid. If the transformer steps up the voltage from 48 V to 240 V, what is a key benefit of this voltage transformation in terms of energy transmission? a) It allows for lower current, reducing resistive losses over long distances. b) It increases the overall energy produced by the solar panels. c) It eliminates the need for batteries in the system. d) It increases the efficiency of solar panel operation	

Q.29	iv) A transformer operates at an efficiency of 90%. If the input power is 1000 W, what is the maximum output power it can deliver? 900 W b) 1000 c) 1100 W d) 100 W OR iv) Which of the following factors primarily affects the voltage transformation ratio in a transformer? a) The frequency of the alternating current. b) The material of the wire used for the coils. c) The number of turns in the primary and secondary coils. d) The temperature of the transformer	
Q.30	CASE STUDY 2: **Read the following paragraph and answer the questions:** A semiconductor diode is basically a pn junction with metallic contacts provided at the ends for the application of an external voltage. It is a two terminal device. When an external voltage is applied across a semiconductor diode such that p-side is connected to the positive terminal of the battery and n-side to the negative terminal, it is said to be forward biased. When an external voltage is applied across the diode such that n-side is positive and p-side is negative, it is said to be reverse biased. An ideal diode is one whose resistance in forward biasing is zero and the resistance is infinite in reverse biasing. When the diode is forward biased, it is found that beyond forward voltage called knee voltage, the conductivity is very high. When the biasing voltage is more than the knee voltage the potential barrier is overcome and the current increases rapidly with increase in forward voltage. When the diode is reverse biased, the reverse bias voltage produces a very small current about a few microamperes which almost remains constant with bias. This small current is reverse saturation current.	4 x1 =4
Q.30	(i) In the given figure, a diode *D* is connected to an external resistance *R* = 100 ohm and an emf of 3.5 *V*. If the barrier potential developed across the diode is 0.5 *V*, the current in the circuit will be:  (a) 40 mA (b) 20 mA (c) 35 mA (d) 30 mA	
Q.30	(ii) In which of the following figures, the pn diode is reverse biased? 	

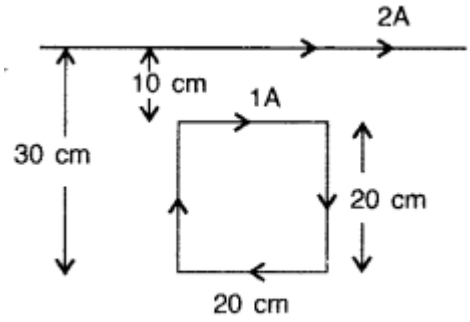
Q.30	(iii) Two identical *PN* junctions can be connected in series by three different methods as shown in the figure. If the potential difference in the junctions is the same, then the correct connections will be  (a) in the circuits (1) and (2) (b) in the circuits (2) and (3) (c) in the circuits (1) and (3) (d) only in the circuit (1)	
Q.30	(iv) The V-I characteristics of a diode is shown in the figure. The ratio of forward to reverse bias resistance is a) 1.67 X 100 b) 1.67 X 10^{6} c) 1.67 X 10^{-3} d) 1.67 X 10^{-6}  OR	
Q.30	(iv) How the width of the depletion layer of p-n junction changes when it is in a) Forward bias b) Reverse bias ?	

	SECTION E	
Q.31	(a)State Gauss 'law in electrostatics. Use this law determine the electric field at a point due to a thin plane sheet of charge density σ '.	**2½**
	(b)The electric field components in Figure are $E_x = \beta x^{1/2}$, $E_y = E_z = 0$, where $\beta = 800\ N/C\ m^{1/2}$. Calculate the flux through the cube and the charge within the cube. Assume that a = 0.1 m.	**+2½ =5**
		
	OR	
	(a) A dielectric is an insulating material or a very poor conductor of electricity. When a dielectric slab is introduced between the two plates of an air-filled parallel plate capacitor, the capacitance of the capacitor becomes a function of dielectric constant. Derive the expression for the capacitance of a parallel plate capacitor when a dielectric slab of thickness t and dielectric constant K is introduced between the plates where thickness of the dielectric slab is less than that of the separation between the two plates(t<<d) as a function of t and K ?	**(2½ + 1 + 1½)=5**
	(b) Draw the pattern of electric field lines in this arrangement.	
		
	(c) Consider two hollow concentric spheres, S_1 and S_2, enclosing charges 2Q and 4Q respectively as shown in the figure.	
	(i) Find out the ratio of the electric flux through them.	
	(ii) How will the electric flux through the sphere S_1 change if a medium of dielectric constant 'ε_r' is introduced in the space inside S_1, in place of air? Deduce the necessary expression.	



Q.32

(i) A square loop of side 20 cm carrying current of 1A is kept near an infinite long straight wire carrying a 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.

(ii) An electron of mass m_e revolves around a nucleus of charge +Ze. Show that it behaves like a tiny magnetic dipole. Hence find the magnetic moment associated with it (where L is the orbital angular momentum of the electron)

(iii) At a place, the horizontal component of earth's magnetic field is B and angle of dip is 60°. What is the value of horizontal component of the earth's magnetic field at the equator?

OR

(i) Derive an expression for the torque applied on a current carrying rectangular loop of N turns placed in a uniform magnetic field.

(ii) What is the Principle of A.C. Generator?
Derive the expression for the instantaneous value of the emf induced in the coil and induced current flow through external resistance R

2+2+1 =5

Q.33

(i) Draw a diagram to show refraction of a plane wave front incident on
a convex Lens and hence draw the refracted wave front
a convex Mirror and hence draw the reflected wave front

(ii) Draw the Intensity vs Phase Graph for Single slit diffraction pattern and explain its important features

(iii) In Young's double slit experiment, fringes of certain width are produced on the screen kept at a certain distance from the slits. When the screen is moved away from the slits by 0.1m, fringe width increases by 6×10^{-5} m. The separation between the slits is 1 mm. calculate the wavelength of the light used.

(1+ 2½ + 1½) =5

	OR (i) Draw a ray diagram of a reflecting type telescope. State two advantages of this telescope over a refracting telescope. (ii) In Young's double slit experiment using mono-chromatic light of wavelength X, the intensity of light at a point on the screen where path difference is X, is K units. Find out the intensity of light at a point where path difference is 2λ/3. (iii) How does the angle of minimum deviation of a glass prism of refractive index 1.5 change, if it is immersed in a liquid of refractive index 1.3. Angle of prism is 60^0?	

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