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CLASS – XII (PHYSICS)

SESSION – 2020-21

SAMPLE QUESTION PAPER (THEORY)

MAX. MARKS- 70 **TIME ALLOWED- 3HRS.**

General Instructions:

(1) All questions are compulsory. There are 33 questions in all.

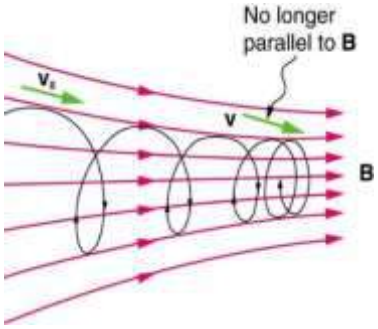
(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

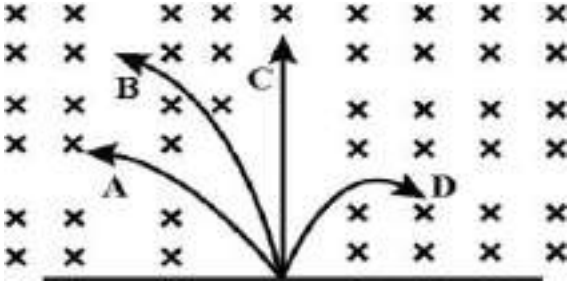
(3) Section A contains ten very short answer questions and four assertion reasoning MCQs of 1 mark each, Section B has two case-based questions of 4 marks each, Section C contains nine short answer questions of 2 marks each, Section D contains five short answer questions of 3 marks each and Section E contains three long answer questions of 5 marks each.

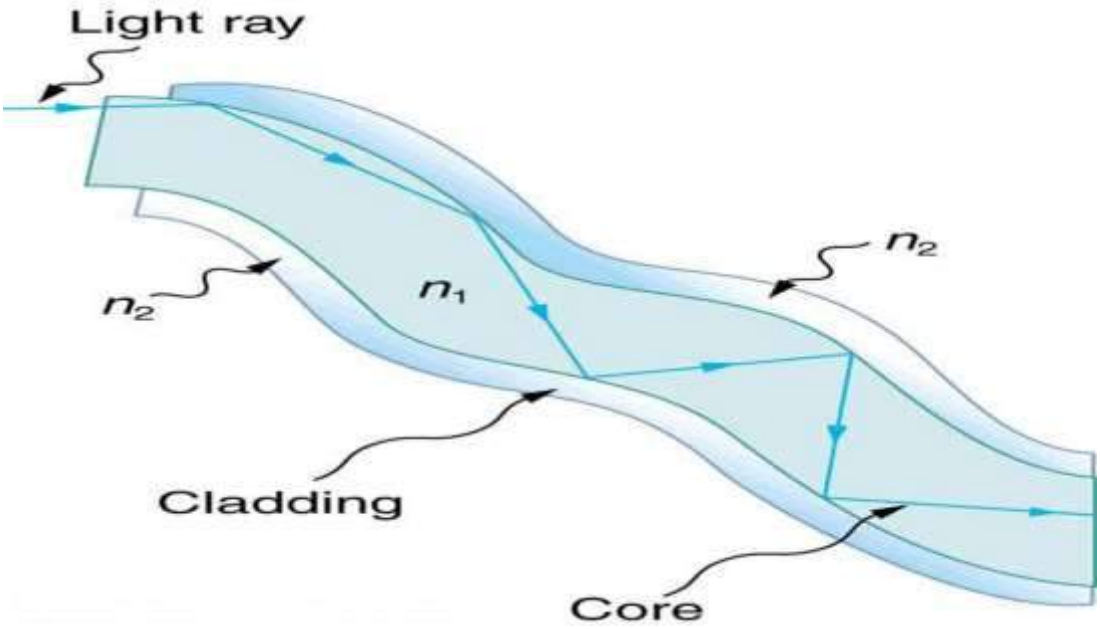
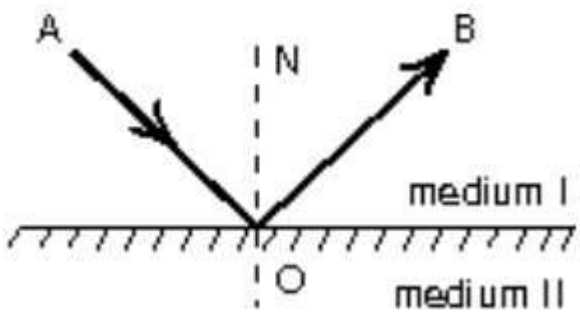
(4) There is no overall choice. However internal choice is provided. You have to attempt only one of the choices in such questions.

Sr. No.	QUESTIONS	Marks
	SECTION- A **All the questions are compulsory. In case of internal choices, attempt any one of them.**	
1.	What is the SI unit of electric flux and its dimensions?	½ + ½
2.	Give one use of Infra-red radiation. OR Find the wavelength of electromagnetic waves of frequency 6×10^{12} Hz in free space.	1
3.	An electron moving with a velocity of 10^7 m/s enters a uniform magnetic field of 1 T along a direction parallel to the magnetic field. What would be its trajectory in this field?	1
4.	A coil of wire of certain radius has 600 turns and inductance of 108 mH. What will be the inductance of another similar coil with 500 turns? OR Calculate the frequency at which the inductive reactance of 0.7 H inductor is 220 Ω.	1
5.	Calculate the electrons velocity in terms of 'c' for the ground state of hydrogen?	1

6.	If h is the Plank's constant, then what is the momentum of photon of wavelength 0.01 A?	1
7.	In the following reactions- $X_Z^A \longrightarrow Y_{Z+1}^A \longrightarrow K_{Z-1}^{A-4} \longrightarrow K_{Z-1}^{A-4}$ What is the sequence of emitted radioactive reactions? OR A nucleus ruptures into nuclear parts which have their volume ratio equal to 2:1. What will be the ratio of their radii?	1
8.	What type of biasing gives a semiconductor diode (i) A very high resistance. (ii) a very low resistance. OR If input frequency of 50 Hz is applied to a (i) half wave rectifier (ii) full wave rectifier. Then what is the output frequency in both cases?	½ + ½
9.	A radioactive substance has a half-life period of 30 days. Calculate the average life of the substance.	1
10.	Determine the current through resistor R (20 Ω) of the circuit shown. Assume the diodes to be ideal.	1
For question numbers 11, 12, 13 and 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 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.**		
11.	**Assertion(A):** For a charged particle moving from point A to point B, the net work done by an electric field on the particle is independent of the path connecting point a to point B. **Reason(R):** The net work done by a conservative force on an object moving along a closed loop is zero.	1
12.	**Assertion(A):** Capacity of parallel plate capacitor remains same on introducing a conducting or insulating slab between two plates.	1

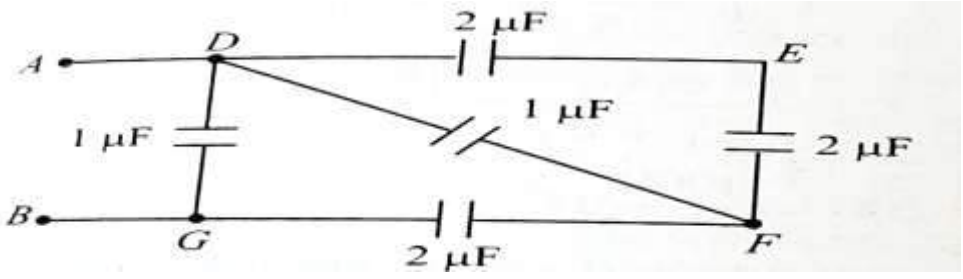
	Reason(R): In both cases, electric field intensity between plates increases.	
13.	**Assertion(A):** Focal length of an equiconvex lens of μ = 3/2 is equal to radius of curvature of each surface. **Reason(R):** If follows from $\frac{1}{f}$ = (μ-1) $[\frac{1}{R_1} - \frac{1}{R_2}]$	1
14.	**Assertion(A):** Two prisms joined in opposition alone can produce dispersion without deviation or deviation without dispersion. **Reason(R):** Dispersion is due to different deviation only.	1
	SECTION- B **Questions 15 and 16 are Case Study based questions and are compulsory. Attempt any 4 sub parts from each question. Each question carries 1 mark.**	
15.	**Bubble Chamber:** Trails of bubbles are produced by high-energy charged particles moving through the superheated liquid hydrogen in this artist's rendition of a bubble chamber. There is a strong magnetic field perpendicular to the page that causes the curved paths of the particles. The radius of the path can be used to find the mass, charge, and energy of the particle.   Magnetic forces can cause charged particles to move in circular or spiral paths. Particle accelerators keep protons following circular paths with magnetic force. Cosmic rays will follow spiral paths when encountering the magnetic field of astrophysical objects or planets (one example being Earth's magnetic field). The bubble chamber photograph in the figure below shows charged particles moving in such curved paths.	

	The curved paths of charged particles in magnetic fields are the basis of a number of phenomena and can even be used analytically, such as in a mass spectrometer. shows the path traced by particles in a bubble chamber.	
	(i) When a charged particle moves perpendicular to a uniform electric field, it follows- (a) circular path (b) parabolic path (c) translational path (d) helical path	1
	(ii) A charged particle moving with velocity v in X direction is subjected to a magnetic field B in negative X direction. As a result, the charge will (a) retard along X-axis (b) start moving in a circular path in YZ plane (c) remains unaffected (d) move in a helical path around X-axis	1
	(iii) An α- particle and proton having same momentum enter into a region of uniform magnetic field and move in a circular path. The ratio of the radii of curvature of their paths (a) 1 (b) ¼ (c) ½ (d) 4	1
	(iv) A neutron, a proton, an electron and an α- particle enter in a region of uniform magnetic field with equal velocities. The magnetic field is perpendicular and directed into the paper. The tracks of the particles are shown in figure. The electron will follow the track-  (a) A (b) B (c) C (d) D	1
	(v) If magnetic force experienced by the charged particle is perpendicular to the velocity of the particle, then work done is- (a) zero (b) maximum (c) minimum (d) none of these	1
16.	**Fiber Optics: Endoscopes to Telephones** Fiber optics is one application of total internal reflection that is in wide use. In communications, it is used to transmit telephone, internet, and cable TV signals. Fiber optics employs the transmission of light down fibers of plastic or glass. Because the fibers are thin, light entering one is likely to strike the inside surface at an angle greater than the critical angle and, thus, be totally reflected (See Figure). The index of	

	refraction outside the fiber must be smaller than inside, a condition that is easily satisfied by coating the outside of the fiber with a material having an appropriate refractive index.  Fibers in bundles are surrounded by a cladding material that has a lower index of refraction than the core. The cladding prevents light from being transmitted between fibers in a bundle. Lasers emit light with characteristics that allow far more conversations in one fiber than are possible with electric signals on a single conductor. This property of optical fibers is called *high bandwidth*. Optical signals in one fiber do not produce undesirable effects in other adjacent fibers. This property of optical fibers is called *reduced crosstalk.*	
	(i) The outer concentric shell in fiber optic is called (a) cladding (b) core (c) coat (d) mantle	
	(ii) The diagram shows total internal reflection. Which of the following statements is NOT true?  	

	(a) angle AON = angle BON (b) angle AON must be the critical angle (c) the speed of light in medium II is greater than that in medium I (d) if angle AON were increased, there would still be total internal reflection.	
	(iii) The critical angle of water when refracted angle is 90 ° and refractive index for water and air is 1.33 and 1 is (a) 48.8 ° (b) 49.1 ° (c) 50 ° (d) 51 °	1
	(iv) Mirage is a phenomenon due to (a) refraction of light (b) reflection of light (c) total internal reflection of light (d) diffraction of light.	
	(v) Critical angle of glass is θ2 and that of water is θ2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$). (a) less than θ_2 (b) between θ_1 and θ_2 (c) greater than θ_2 (d) less than θ_1	
	SECTION – C **All questions are compulsory. In case of internal choices, attempt any one.**	
17.	Deduce the condition of maxima and minima in Young's double slit experiment. OR In an interference pattern at a point, we observe 16^{th} order maxima for $\lambda_1 = 6000\ A^0$. What order will be visible here if the source is replaced by light of wavelength $\lambda_2 = 4800\ A^0$?	2
18.	Four equal charges are brought from infinity to the four corners of a square of each side a. What is the potential energy of the system of charges? OR Consider a uniform electric field $E = 3 \times 10^3\ \hat{i}$ N/C. What is the flux of this field through a square of 10cm on a side whose plane is parallel to the YZ plane?	2
19	Deduce the expression for the torque on a current carrying loop in uniform magnetic field.	2

20	Explain the construction and working of a photo-diode.	2
21	The self-inductance of a coil of 500 turns is 0.25 H. If 60% of the flux is linked with a second coil of 1000 turns, calculate the mutual inductance between two coils.	2
22	Two coherent light waves of intensity 5×10^{-2} W/m^2 each super-impose and produce the interference pattern on a screen. At a point where the path difference between the waves is $\lambda/6$, where λ is the wavelength of the wave, find the (i) phase difference between waves. (ii) resultant intensity at the point.	2
23	With a neat diagram, explain the working of a full-wave rectifier using junction diodes.	2
24	A magnet suspended at 30^0 with the magnetic meridian makes an angle of 45^0 with the horizontal. What is the actual value of dip? OR Define the terms- (i) magnetic declination (ii) magnetic dip	2 2
25	A screen is placed 80 cm from an object. The image of the object on the screen is formed by a convex lens placed between them at two different locations separated by a distance 20cm. Determine the focal length of the lens.	
	SECTION -D **All questions are compulsory. In case of internal choices, attempt any one.**	
26.	(i) A rod of length *l* is moved horizontally with a uniform velocity v in a in a direction perpendicular to its length through a region in which a uniform magnetic field is acting vertically downward. Derive the expression for the emf induced across the ends of the rod. (ii) How does one understand this motional emf by invoking the Lorentz force acting on the free charge carriers of the conductor? Explain	3
27	State the principle of potentiometer and deduce the expression for internal resistance of the cell. OR A cell of emf $E_1 = 2V$ and internal resistance 1 Ω is connected in parallel with another cell of emf $E_2 = 1.5V$ and internal resistance 2 Ω. When the combination is in parallel with a resistance of 4 Ω. Find the current through each branch and also the potential difference across the 4 Ω resistor.	3
28	Draw graphs related to photoelectric effect and show (i) variation of photoelectric current with intensity of incident radiation. (ii) variation of stopping potential with frequency of incident radiation.	1+1+1

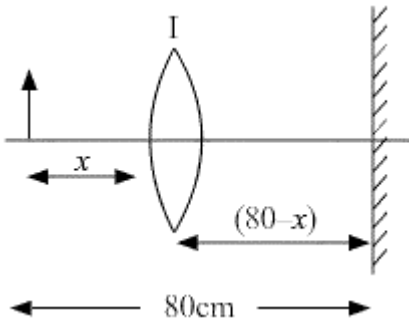
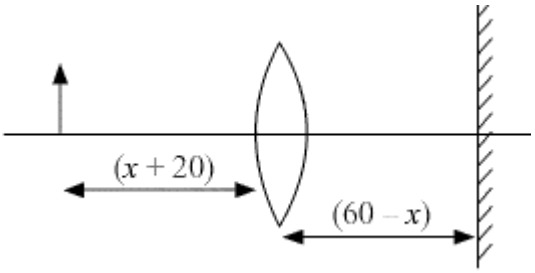
	(iii) variation of photo-electric current with retarding potential. OR Write the important properties of photons which are used to establish Einstein's photo-electric equation. Use this equation to explain the concept of threshold frequency.	3
29	Using the Bohr's postulates, obtain the expression for (i) kinetic energy and (ii) potential energy of the electron in stationary state of hydrogen atom. Draw the energy level diagram showing how the transitions between energy levels result in the appearance of Lyman series.	
30	(i) Calculate the energy (Q 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 $^{234}_{90}Th$ = 234.04630 u, Mass of $^{4}_{2}He$ = 4.002600u, and 1u = 931.5 MeV/c^2] (ii) Plot a graph showing the variation of potential energy of a pair of nucleons as a function of their separation.	2+1
	SECTION- E	
31	(i) Gauss's law in electrostatics. Derive an expression for potential at a point P lies on the axial line of dipole. (ii) A metal sphere 30cm in radius is positively charged with 2 μC. Find the potential (a) at the centre of the sphere. (b) on the surface of the sphere. **OR** (i) What is the capacitance? Write its SI unit. (ii) Deduce an expression for capacitance when a dielectric slab introduced in-between the plates of parallel plate capacitor. (iii) Find the total capacitance between A and B of in the circuit shown. 	3+1+1 1+2+2
32	(i) Draw the diagram of a device which is used to decrease high ac voltage into a low ac voltage and states its working principle. Write four sources of energy loss in this device. (ii) A transformer step-down the voltage from 220V to 11V. What is the transformation ratio?	3+1

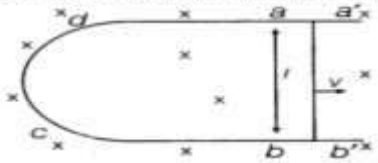
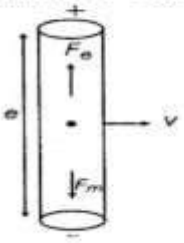
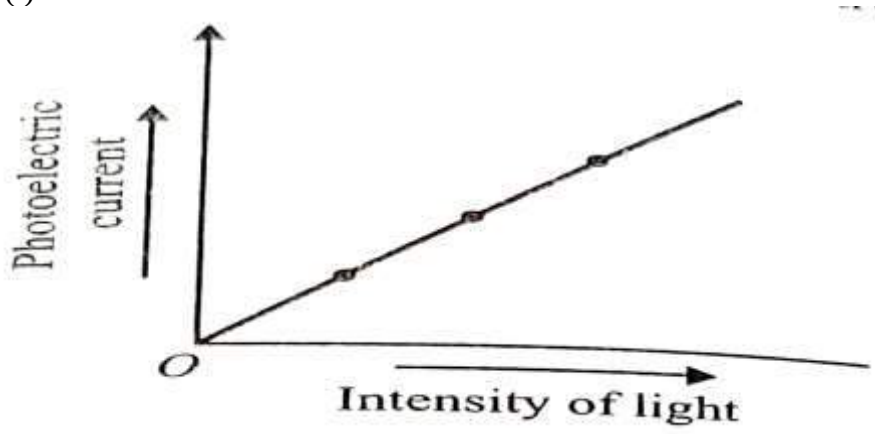
	OR (i) Explain the phenomenon of mutual induction. Derive an expression for the co-efficient of mutual inductance between two long solenoids. (ii) A wheel with 10 metal spokes each 0.5m long is rotated with a speed of 12 r.p.m. (round per meter) in a plane normal to the earth's magnetic field at a place. If the magnitude of the field is 0.4G, what is the magnitude of induced emf between the axle and rim of the wheel?	3+2
33	(i) State Huygens's principle. Verify the phenomenon of refraction on the basis of wave theory by using Huygens's principle. (ii) In a Young's double slit experiment, the separation of four bright fringes is 2.5 mm when the wavelength used is 6200 A^0. The distance from the slits to the screen is 0.8m. calculate the separation of the two slits. **OR** (i) Describe the construction and working of an astronomical telescope and derive the expression of its magnifying power. (ii) An astronomical telescope has eyepiece of focal length 5cm. If it gives magnification of 10 in normal adjustment, what is the distance between objective lens and eyepiece?	3+2 3+2

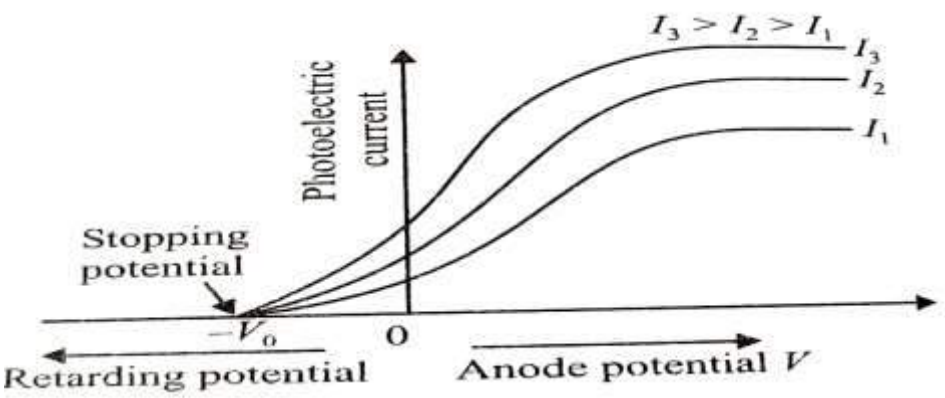
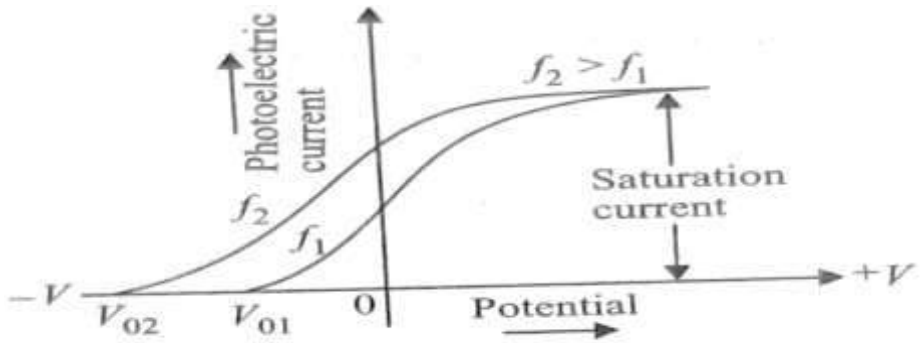
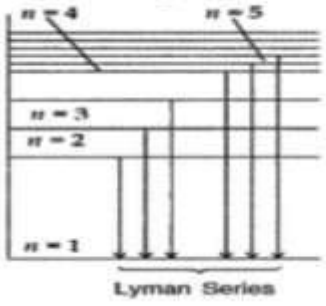
MARKING SCHEME OF SQP

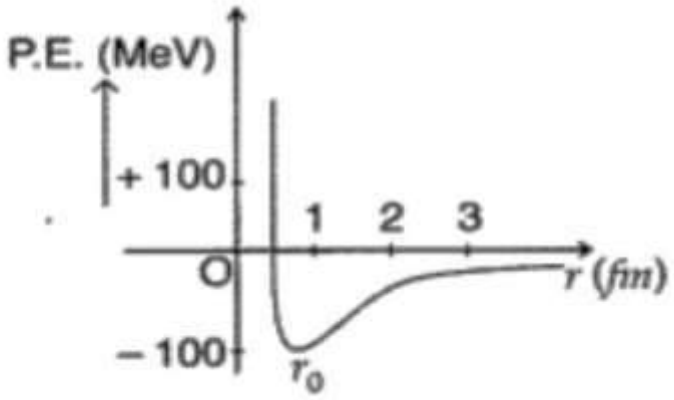
S. No.	VALUE POINTS	Marks
1.	Correct definition and $[ML^3T^{-3}A^{-1}]$	½ + ½
2.	Any correct use of I. R rays OR $\lambda = 5 \times 10^{-5}$ m	1
3.	Electron will move in the same direction without any deflection. Trajectory will be straight line.	1
4.	Ans- 75 mH OR f = 50 Hz	1
5.	Ans- $v = 7.3 \times 10^{-3}$ c	1
6.	Ans- h x 10^{12}	1

7.	Ans- β, α, γ OR $r_1 : r_2 = 1 : 2^{1/3}$	1
8.	Ans- (i) reverse biasing (ii) forward biasing OR (i) 50 Hz (ii) 100 Hz	½ + ½
9.	Ans- average life = 43.29 days	1
10.	Ans- I = 0.1 A	1
11.	Ans- option A	1
12.	Ans- option D	1
13.	Ans- option A	1
14.	Ans- option B	1
15.	Ans- (i) option B (ii) option C (iii) option C (iv) option D (v) option A (Any four parts to be attempted.)	4
16.	Ans- (i) option A (ii) option D (iii) option A (iv) option C (v) option C (Any four parts to be attempted.)	4
17.	Ans- correct expression for torque $\tau = nIAB\cos\theta$ with proper diagram.	2
18.	Ans- correct expressions for maxima and minima with diagram. OR $N_2 = 20$	2
19.	Ans- $U = \frac{1}{4\pi\varepsilon_0}\sum\frac{q_i q_j}{r_{jk}}$ $U = \frac{q^2}{4\pi\varepsilon_0 a}(4+\sqrt{2})$ OR $\Phi = E.dA = 3 \times 10^3 .(10 \times 10^{-2})^2$ $\Phi = 30\ Nm^2C^{-1}$	2
20.	Ans- correct explanation with proper diagram and graph between intensity of light and reverse current.	2
21.	Ans- the value of M = 3 H.	2.
22.	Ans- (i) $\Delta\varphi = k\Delta x$ $= (2\pi/\lambda)\,\Delta x$ $= (2\pi/\lambda)\,(\lambda/6) = \pi/3$ (ii) resultant intensity $I_R = 0.15\ W/m^2$	1 + 1
23.	Ans- correct explanation with neat diagram and correct expression for efficiency and ripple factor.	2
24.	Ans- solved by using formula $\tan\delta = V/H$ $\delta = \tan^{-1}(\sqrt{3}/2) = 40.9^0$ OR Correct definitions of magnetic declination and magnetic dip	2

25.	Ans- Case -1  According to lens formula- 1/f = 1/v – 1/u From diagram, u= x, v = 80 – x 1/f = 1/ (80 – x) – 1/x …… (1) Case – 2  u = x + 20, v = 60 – x then 1/f = 1/(60-x) – 1/ (x + 20). …… (2) from equation (1) & (2) x = 30 cm f = 18.75 cm	2

26.	**Ans**.(i)Consider a straight conductor moving with velocity v and U shaped conductor placed in perpendicular magnetic field as shown in the figure.  Let conductor shifts from ab to $a'b'$ in time dt, then change in magnetic flux $d\phi = B \times$ change in area $= B \times$ (area $a'b'ab$) $= B \times (l \times v\,dt)$ $\therefore \quad \frac{d\phi}{dt} = Bvl$ (1) $\therefore$ Induced emf $\lvert e \rvert = \frac{d\phi}{dt} = Bvl$ (*ii*) During motion, free e^- are shifted at one end due to magnetic force so due to polarisation of rod electric field is produced which applies electric force on free e^- on opposite direction.  At equilibrium of Lorentz force, $\mathbf{F}_e + \mathbf{F}_m = 0$ $q\mathbf{E} + q(\mathbf{v} \times \mathbf{B}) = 0$ $\mathbf{E} = -\mathbf{v} \times \mathbf{B} = \mathbf{B} \times \mathbf{v}$ $\lvert E \rvert = \lvert Bv \sin 90 \rvert$ $\frac{dv}{dr} = Bu$ $\therefore \quad P_D = Bvl$ (1)	3
27.	Ans- correctly defined principal of potentiometer. Correct expression for internal resistance of a cell by using potentiometer. $r = \left(\frac{l_1 - l_2}{l_2}\right)R$ OR Correct answer is – I_1 = 3/7 A, I_2 = -1/28 A, I = 11/28 A, potential difference = 11/7 V.	3
28.	Ans- (i)  	3

	(ii)  (iii)  OR Correct explanation with expression of Einstein's photoelectric equation.	
29.	Ans- expression for kinetic energy of electron in stationary orbit- $E_n = kZe^2/2r_n$ Expression for potential energy- $U_n = - kZe^2/r_n$ Energy level diagram for hydrogen atom- **Energy level diagram for Lyman series :**  	

30.	Ans- (i) Nuclear reaction $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He + Q$ Energy released, $Q = \Delta mC^2$ $= (M_U - M_{Th} - M_{He})C^2$ $= 0.00456 \times 931.5$ MeV $= 4.25$ MeV (ii)  	
31.	Ans- correct statement of Gauss's law. Expression for electric potential at axial point- $V_p = kp/r^2$ where $k = 1/4\pi\varepsilon_0$ (ii) (a) V = 60 kV (b) V = 80 kV OR Ans- (i) correct definition of capacitance and its SI unit (ii) $C = \frac{\varepsilon_0 A}{d-\left(1-\frac{1}{K}\right)}$ (iii) C = 2μF	½ + 2.5 1+ 1 1+2+2
32.	Ans- (i) explanation of working of transformer with its proper diagram and derivation. (ii) K = 0.05 OR (i) Correct explanation and derivation of the mutual inductance between two long solenoids. (ii) $e = 6.28 \times 10^{-5}$ V.	2 + 1
33.	Ans- (i) correct explanation of the phenomenon of refraction on the basis of wave theory. (ii) d = 0.8 mm OR (i) correct explanation of working and construction of telescope with proper diagram and also expression for magnifying power of telescope. (ii) distance between objective lens and eyepiece- L = 55 cm.	1+ 2+ 2