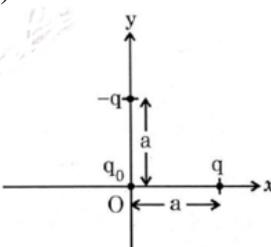
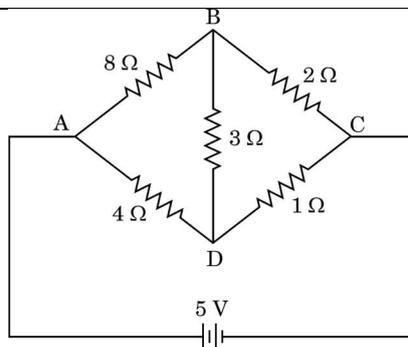
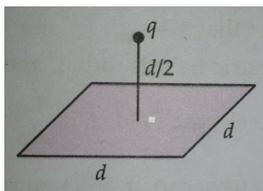


7.	The potential energy of an electron in the second excited state in hydrogen atom is: (a) -3.4 eV (b) -3.02 eV (c) -1.51 eV (d) -6.8 eV	1
8.	Three charges q , $-q$ and q_0 are placed as shown in figure. The magnitude of the net electrostatic force on charge q_0 at point O is: ($k = 1 / 4\pi\epsilon_0$) 	1
	(a) Zero (b) $2kqq_0 / a^2$ (c) $\sqrt{2}kqq_0 / a^2$ (d) $kqq_0 / \sqrt{2}a^2$	
9.	Whenever a magnet is moved either towards or away from a conducting coil, an emf is induced whose magnitude is independent of the: (a) number of turns in the coil (b) resistance of the coil (c) speed with which the magnet is moved (d) area of the coil	1
10.	The average value of voltage of 220 V ac mains during its positive half cycle will be: (a) 156 V (b) 198 V (c) 220 V (d) zero	1
11.	The radius of ${}_{13}\text{X}^{27}$ nucleus is R. The radius of ${}_{53}\text{Y}^{125}$ nucleus will be: (a) $5R / 3$ (b) $R(13 / 53)^{1/3}$ (c) $(5R / 3)^{1/3}$ (d) $(13R / 53)^{1/3}$	1
12.	A bar magnet of pole strength (m) and magnetic moment (M) is cut perpendicular to its axis in two equal halves. The new pole strength (m') and magnetic moment (M') of each part are respectively? (a) m and M (b) m and M/2 (c) m/2 and 2M (d) 2m and M/2	1
<p>For Questions 13 to 16, two statements are given one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.</p> <p>(a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion. (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertion. (c) Assertion is true but Reason is false. (d) Both Assertion and Reason are false.</p>		
13.	Assertion (A): The image of an object placed between f and $2f$ from a convex lens can be seen on a screen. If the screen is removed, image is not formed. Reason (R): Rays from a given point on the object placed between f and $2f$, after passing through a convex lens, do not converge on a point in space.	1
14.	Assertion (A): The total energy of an electron in hydrogen atom is negative. Reason (R): The centripetal force is provided by electrostatic force.	1
15.	Assertion (A): In Young's double slit experiment all fringes are of equal width. Reason (R): The fringe width depends upon wavelength of light used, distance of screen from plane of slits and slit separation.	1
16.	Assertion (A): If there exists coulomb attraction between two bodies, both of them may not be charged. Reason (R): The coulomb attraction between two bodies varies linearly with distance.	1
<u>SECTION B</u>		
17.	Explain the following, giving proper reason: (a) During charging of a capacitor, displacement current exists in the capacitor. But there is no displacement current when it gets fully charged. (b) Infrared waves are also known as heat waves.	2
18.	The figure shows a network of resistors connected across a battery. Find the current supplied by the battery of emf 5 V and internal resistance $2/3 \Omega$.	2



19. A point charge 'q' is at a distance of $\frac{d}{2}$ directly above the centre of a square of side d, as shown in figure. Find the electric flux through the square. 2



If the point charge is now moved to a distance 'd' from the centre of the square and the side of the square is doubled, explain how the electric flux will be affected.

20. (1) Derive the expression for the force per unit length acting between two long straight parallel conductors carrying steady currents 'I₁' and 'I₂' are separated by a distance 'd'. Mention the nature of this force if currents in both the conductors are flowing in the same direction. 2

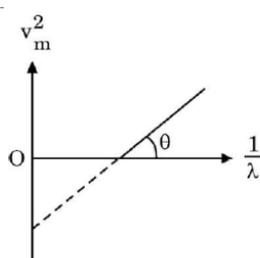
Or

(2) The susceptibility of a magnetic material is 0.9853. Identify the type of magnetic material. Draw the modification of the field pattern on keeping a piece of this material in a uniform magnetic field.

21. (1) Briefly explain Geiger-Marsden experiment. Show the variation of the number of particles scattered (N) with scattering angle (θ) in this experiment. What is the main conclusion that can be inferred from this plot? 2

Or

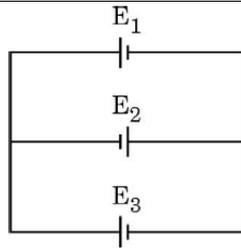
(2) The figure shows v_m^2 versus $1/\lambda$ graph for photoelectrons emitted from a surface where v_m is the maximum speed of electrons and λ is the wavelength of incident radiation. Using this graph and Einstein's photoelectric equation, obtain the expression for Planck's constant and work function of the surface.



SECTION C

22. With the help of suitable diagram, explain briefly the two important processes involved in the formation of a p-n junction. Define the terms depletion region and potential barrier. 3

23. Three batteries E₁, E₂ and E₃ of emfs and internal resistances (4 V, 2 Ω), (2 V, 4 Ω) and (6 V, 2 Ω) respectively are connected as shown in the figure. Find the values of the currents passing through batteries E₁, E₂ and E₃. 3



24.	<p>(a) Define the term 'mass defect'. (b) Draw the graph showing the variation of binding energy per nucleon with mass number A of nuclei ($2 < A < 170$). Use this graph to explain the release of energy in nuclear fission.</p>	3
25.	<p>Explain with the help of a suitable diagram, the phenomena on which an optical fibre works. Write any two uses of optical fibre.</p>	3
26.	<p>State Huygens principle of secondary wavelets. Use it to draw a diagram showing the passage of a plane wavefront from a denser into a rarer medium. Hence verify the Snell's law of refraction.</p>	3
27.	<p>(1) A galvanometer is converted into a voltmeter of range $(0-V)$ volt using a resistor of 9900Ω. If a resistor of 4900Ω is used, the range becomes half, i.e. $(0-V/2)$ volt. Calculate: (a) resistance of the galvanometer (b) resistance required to convert it into a voltmeter of range $(0-2V)$ volt.</p> <p style="text-align: center;">Or</p> <p>(2) A solenoid has a core of material with relative permeability 200. The windings of the solenoid are insulated from the core and carry a current of 1A. If the number of turns is 2000 per metre, calculate: (a) magnetic intensity (b) magnetic field and (c) magnetisation</p>	3
28.	<p>Figure below shows a rectangular conductor PQRS in which the conductor PQ is free to move in a uniform magnetic field B perpendicular to plane of paper. The field extends from $x = 0$ to $x = b$ and is zero for $x > b$. Assume that only the arm PQ possess resistance r. When the arm PQ is pulled outwards from $x = 0$ to $x = 2b$, and then moved back to $x = 0$ with constant speed v, Find the expressions for the flux and the induced emf. Sketch the variation of these quantities with distance.</p>	3

SECTION D

29.	<p>The process of converting AC into DC is called rectification and the device used is called a rectifier. When AC signal is fed to a junction diode during positive half cycle, the diode is forward biased and current flows through it. During the negative half cycle, the diode is reverse biased and it does not conduct. Thus, the AC signal is rectified. The p-n junction diodes can be used as half-wave and full-wave rectifiers.</p> <p>(i) Which bulb / bulbs will glow in the given circuit?</p> <p>(a) B_1 only (b) B_2 only (c) Both B_1 and B_2 (d) Neither B_1 nor B_2</p>	4
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	<p>(ii) The output in a half-wave rectifier is: (a) unidirectional without ripple (b) steady and continuous (c) unidirectional with ripple (d) steady but discontinuous</p> <p>(iii) In a p-n junction diode, the majority charge carriers on p-side and on n-side are, respectively: (a) electrons, electrons (b) electrons, holes (c) holes, holes (d) holes, electrons</p> <p>(iv) If the frequency of the half-wave rectifier is 50 Hz, the frequency of full-wave rectifier is: (a) 25 Hz (b) 50 Hz (c) 100 Hz (d) 200 Hz</p>	
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30.	<p>The phenomena of ejection of the electrons from the surface of a metal when a radiation of suitable frequency is incident on it is called photoelectric effect. Figure shows the variation of photoelectric current measured in a photo cell circuit as a function of the potential difference between the plates of the photo cell when light beams A, B, C and D of different wavelengths are incident on the photo cell. Examine the given figure and answer the following questions:</p> <div style="text-align: center;"> </div> <p>(i) Which light beam has the highest frequency and why? (ii) Which light beam has the longest wavelength and why? (iii) What is the effect on threshold frequency and stopping potential on increasing the frequency of incident beam of light? Justify your answer.</p>	4
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SECTION E

31.	<p>(1) (a) Two large plane sheets P_1 and P_2 having charge densities $+\sigma$ and -3σ respectively are arranged parallel to each other as shown in figure. Find the net electric field (\mathbf{E}) at points A, B and C.</p> <div style="text-align: center;"> </div> <p>(b) An electric dipole of dipole moment $\mathbf{p} = (0.8 \mathbf{i} + 0.6 \mathbf{j}) 10^{-29}$ Cm is placed in an electric field $\mathbf{E} = 1.0 \times 10^7 \mathbf{k}$ V/m. Calculate the magnitude of the torque acting on it and the angle it makes with the X-axis, at this instant.</p> <p style="text-align: center;">Or</p> <p>(2) (a) A parallel plate capacitor A of capacitance C is charged by a battery to a potential 'V'. The battery is disconnected and an uncharged identical capacitor B is connected across it. Calculate for the capacitor A the new value of the: (i) charge (ii) potential difference (iii) energy stored Justify your answers. (b) Draw the equipotential surfaces for: (i) a point charge, and (ii) an electric dipole.</p>	5
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32.	<p>(1) (a) What are the two main considerations for designing the objective and eyepiece lenses of an astronomical telescope? Obtain the expression for magnifying power of the telescope when the final image is formed at infinity.</p>	5
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(b) A ray of light is incident at an angle of 45° at one face of an equilateral triangular prism and passes symmetrically through the prism. Calculate:

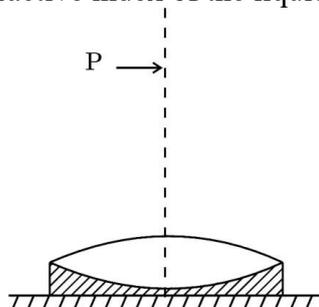
(i) the angle of deviation produced by the prism.

(ii) the refractive index of the material of the prism.

Or

(2) (a) Derive the lens maker's formula for a double convex lens.

(b) The figure below shows an equiconvex lens (of refractive index 1.50) in contact with a liquid layer on top of a plane mirror. A small needle with its tip on the principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of the needle from the lens is measured to be 45.0 cm. When the liquid is removed and the experiment is repeated, the new distance is 30.0 cm. Find the refractive index of the liquid.



33. (1) (a) (i) Draw a labelled diagram of a step-down transformer. State the principle of its working.
(ii) Express the turn ratio in terms of voltages.
(iii) Find ratio of primary and secondary currents in terms of turn ratio in an ideal transformer.
(b) How much current is drawn by the primary coil of a transformer connected to 220 V supply when it delivers power to a 110 V-550 W refrigerator?

Or

- (2) (a) Write Biot-Savart's law in vector form. Use it to derive the expression for the magnetic field at a point on the axis of a current carrying circular loop of radius 'R'.
(b) Define the terms (i) current sensitivity and (ii) voltage sensitivity of a moving coil galvanometer. Why does increasing the current sensitivity not necessarily increase voltage sensitivity?

5