

**Q. 1.** Name the type of radio wave propagation involved when TV signals, broadcast by a tall antenna, are intercepted directly by the receiver antenna. **1**

**Q. 2.** Define work function for a given metallic surface. **1**

**Q. 3.** A nucleus, of mass number  $A$  has a mass defect  $\Delta m$ . Give the formula, for the binding energy per nucleon, of this nucleus. **1**

**Q. 4.** Which of the two main parts of an optical fibre has a higher value of refractive index? **1**

**Q. 5.** The distance, of the field point, on the equatorial plane of a small electric dipole, is halved. By what factor will the electric field, due to the dipole change? **1**

**Q. 6.** You are given a low resistance  $R_1$ , a high resistance  $R_2$  and a moving coil galvanometer. Suggest how you would use these to have an instrument that will be able to measure (i) currents, (ii) potential differences. **2**

**Q. 7.** A coil of inductance,  $L$ , a capacitor of capacitance,  $C$ , and a resistor of resistance  $R$ , are all put in series with an alternating source of emf  $E (= E_0 \sin \omega t)$ . Write an expression for the

(i) total impedance of the circuit.

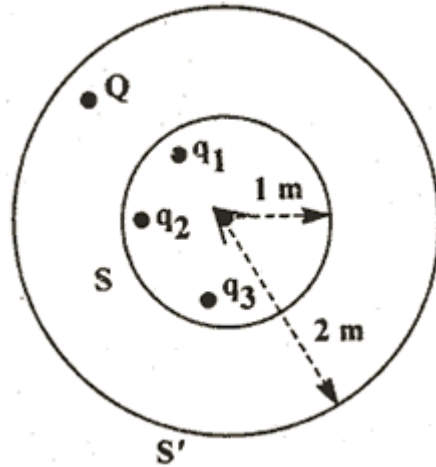
(ii) frequency of the source emf for which the circuit will show resonance. **2**

**Q. 8.** Plot a graph to show the variation of the angle of deviation as a function of angle of Incidence for light rays passing through a prism.

Write the relation for the refractive index of the prism in terms of the angle of minimum deviation and the angle of the prism. **2**

**Q. 9.** The flux of the electrostatic field, through the closed spherical surface  $S'$ , is found to be four times that through the closed spherical surface  $S$ . Find the magnitude of the

charge  $Q$ . Given :  $q_1 = 1 \mu\text{C}$ ,  $q_2 = -2 \mu\text{C}$  and  $q_3 = 9.854 \mu\text{C}$ . **2**



**Q. 10.** When the cold junction, of an aluminium-lead thermocouple, is maintained at  $0^{\circ}\text{C}$  the thermo emf,  $E$ , of this thermocouple, has the temperature dependence given by the

$$E = \left[ -0.760 + \frac{1}{2}(0.0039)\theta^2 \right] \times 10^{-6}$$

relation

Where  $E$  is in volts and  $\theta$  is the temperature of the hot junction, in  $^{\circ}\text{C}$  Find the neutral temperature for this thermocouple. **2**

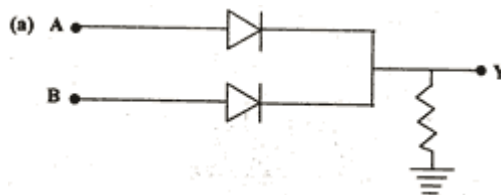
**Q. 11.** A plane electromagnetic wave travels, in vacuum, along the  $y$ -direction. Write the (i) ratio of the magnitudes, and (ii) the directions of its electric and magnetic field vectors. **2**

**Q. 12.** Which special type of diode can act as a voltage regulator? Give the symbol of this diode and draw the general shape of its  $V - I$  characteristics. **2**

Or

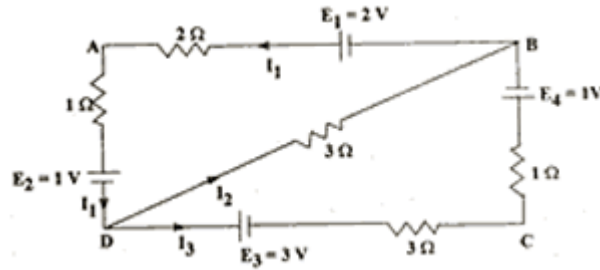
Name the p-n junction diodes which emit spontaneous radiation when forward biased. How do we choose the semiconductor, to be used in these diodes, if the emitted radiation, is to be in the visible region? **2**

**Q.13.** Give the symbol, and the truth table, of each of the two logic gates, obtained by using the two circuits, shown below. **3**



**Q. 14.** Explain briefly with the help of diagrams, the terms: (i) amplitude modulation, (ii) frequency modulation. Which of these (a) gives better quality transmission, (b) has a larger coverage? **3**

**Q. 15.** In the given network, find the values of the currents,  $I_1$ ,  $I_2$  and  $I_3$ . **3**



**Q. 16.** In a potentiometer, a standard cell of emf 5 V and of negligible resistance maintains a steady current through the potentiometer wire of length 5 m. Two primary cells of emf  $E_1$  and  $E_2$  are joined in series with (i) same polarity, and (ii) opposite polarity. The combination is connected through a galvanometer and a jockey to the potentiometer. The balancing lengths in the two cases are found to be 350 cm and 50 cm respectively.

- (i) Draw the necessary circuit diagram.
- (ii) Find the value of the emfs of the two cells.

**Q. 17.** A long solenoid with closely wound turns has a turns, per unit of its length. A steady current  $I$  flows through this solenoid. Use Ampere's circuital law to obtain an expression, for the magnetic field, at a point on its axis and close to its mid point. **3**

**Q. 18.** Two similar bars made from two different materials P and Q, are placed, one-by-one, in a non-uniform magnetic field. It is observed that

- (i) bar P tends to move from the weak to the strong field region.
- (ii) bar Q tends to move from the strong to the weak field region.

What is the nature of the magnetic materials used for making these two bars? Show, with the help of a diagram, the behaviour of the field lines, due to an external magnetic field, near each of these two bars. **3**

**Q. 19.** Show diagrammatically two different arrangements used for winding the primary and secondary coils in a transformer.

Assuming the transformer to be an Ideal one, write expressions for the ratio of its

- (i) output voltage to input voltage
- (ii) output current to Input current

in terms of the number of turns in the primary and secondary coils. Mention two reasons for energy losses in an actual transformer. **3**

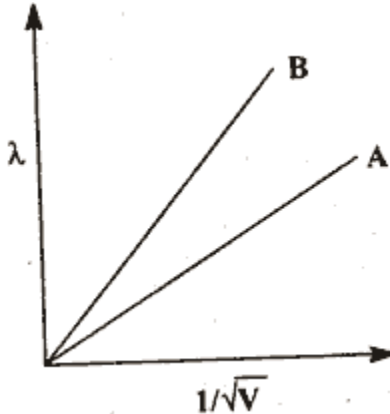
**Q. 20.** Show that a convex lens produces an  $N$  times magnified image when the object

distances, from the lens, have magnitudes  $(f \pm \frac{f}{n})$ . Here  $f$  is the magnitude of the focal length of the lens.

Hence find the two values of object distance, for which a convex lens, of power 2.5 D, will produce an image that is four times as large as the object? **3**

**Q. 21.** Obtain the expression for the wavelength of de Broglie wave associated with an electron accelerated from rest through a potential difference  $V$ .

The two lines A and B shown in the graph plot the de Broglie wavelength ( $\lambda$ ) as a function of  $1/\sqrt{V}$  ( $V$  is the accelerating potential) for two particles having the same charge. Which of the two represents the particle of heavier mass? **3**



**Q. 22.** (a) In the working of a transistor, emitter-base (EB) junction is forward biased while collector-base (CB) junction is reverse biased. Why?

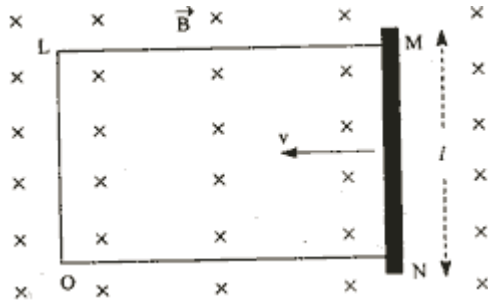
(b) The input resistance, in the common emitter amplifier circuit of a given transistor, has a value of  $1.5 \text{ k}\Omega$ . The output of this circuit, is obtained across a collector resistance of  $7.5 \text{ k}\Omega$ . What would be the output voltage, corresponding to an input voltage of 5 mV, if the current amplification factor, of this transistor, has a value of 60? **3**

**Q. 23.** An optical communication system, having an operating wavelength, (in metres) can use only  $x\%$  of its source frequency as its channel bandwidth. The system is to be used for transmitting TV signals requiring a bandwidth of  $F$  hertz. How many channels can this system transmit simultaneously?

Assuming all other factors to remain constant, show graphically, the dependence of the number of channels that can be transmitted simultaneously, on the operating wavelength of the system. **3**

**Q. 24.** A rectangular conductor, LMNO, is placed in a uniform magnetic field  $\vec{B}$ , directed perpendicular to the plane of the conductor (as shown in the fig.). Obtain an expression, for the emf induced in the arm MN, when the arm is moved towards the left with a speed  $v$ .

Use the above expression to find the emf induced between the ends of an axle, of length  $L$ , of a railway carriage, travelling on level ground with a speed  $v$ . Assume the value of earth's magnetic field at the place, to be  $B$  and the angle of dip to be  $\theta$ . **3**



**Q. 25.** (a) Define the term ‘electrostatic potential’.  
Give the dependence of electrostatic potential due to a small electric dipole at a far off point lying on (i) the axial line and (ii) equatorial line.  
(b) Briefly explain the principle of a capacitor. Obtain the expression for the capacitance of a parallel plate capacitor. **5**

**Q. 26.** Explain the phenomenon of diffraction of light at a single slit, to show the formation of diffraction fringes. Show graphically the variation of the Intensity, with angle, in this single slit diffraction pattern. What is meant by the term ‘angular resolution’ of a telescope? **5**

Or

Which special characteristic of light is demonstrated only by the phenomenon of polarisation? Distinguish clearly between linearly polarized light and unpolarized light. Light is incident, at the Brewster angle, from air, on to a transparent medium. How are the resulting reflected and refracted rays oriented with respect to each other? Obtain a relation between the refractive index of the medium and the Brewster angle. What is the nature of polarisation, of the reflected light, in this case? **5**

**Q. 27.** Explain how radioactive nuclei can emit  $\beta$  - particles even though atomic nuclei do not contain these particles. Hence explain why the mass number of a radioactive nuclide does not change during  $\beta$  - decay.  
Use the basic law of radioactive decay, to show that radioactive nuclei follow an exponential decay law. Hence obtain a formula, for the half-life of a radioactive nuclide, in terms of its disintegration constant. **5**