

**Q. 1.** Why is shortwave band used for long distance radio broadcast? **1**

**Q. 2.** Two metals A and B have work functions respectively. Which metal has lower threshold wavelength? **1**

**Q. 3.** Draw the voltage current characteristic of a zener diode. **1**

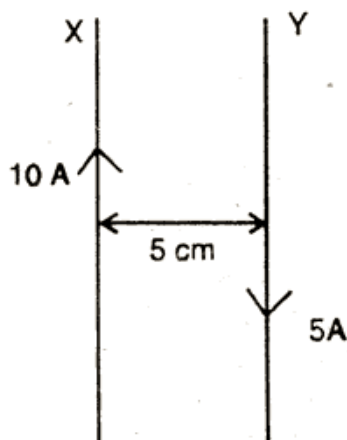
**Q. 4.** A solenoid with an iron core and a bulb are connected to a d.c. source. How does the brightness of the bulb change, when the iron core is removed from the solenoid? **1**

**Q. 5.** Peak value of emf of an a.c. source is  $E_0$ . What is its r.m.s. value? **1**

**Q. 6.** An electric dipole of length 4 cm, when placed with its axis making an angle of  $60^\circ$  with a uniform electric field experiences a torque  $4\sqrt{3}$  of Nm. Calculate the (i) magnitude of the electric field. (ii) potential energy of the dipole, if the dipole has charges of  $\pm 8 \mu\text{C}$ . **2**

**Q. 7.** Explain how does the resistivity of a conductor depend upon (i) number density 'n' of free electrons, and (ii) relaxation time ' $\lambda$ '. **2**

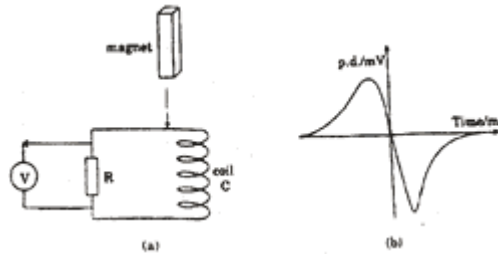
**Q. 8.** Two long parallel straight wires X and Y separated by a distance of 5 cm in air carry currents of 10 A and 5 A respectively in opposite directions. Calculate the magnitude and direction of the force on a 20 cm length of the wire Y. **2**



A circular coil of 100 turns, radius 10 cm carries a current of 5 A. It is suspended vertically in a uniform horizontal magnetic field of 0.5 T, the field lines making an angle of  $60^\circ$  with the normal to the plane of the coil. Calculate the torque that must be applied on it to prevent it from turning.

**Q. 9.** A bar magnet M is dropped so that it falls vertically through the coil C. The graph obtained for voltage produced across the coil vs. time is shown in figure (b).

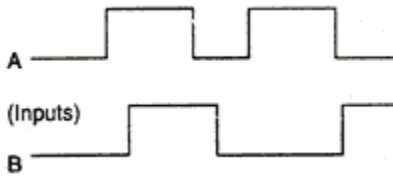
- (i) Explain the shape of the graph.  
 (ii) Why is the negative peak longer than the positive peak?



**Q. 10.** A T.V. tower has a height of 400 m at a given place. Calculate its coverage range, if the radius of the earth is 6400 km. **2**

**Q. 11.** Draw a ray diagram of an astronomical telescope in the normal adjustment position. Write down the expression for its magnifying power. **2**

**Q. 12.** Give the logic symbol for an OR gate. Draw the output wave form for input wave forms A and B for this gate. **2**

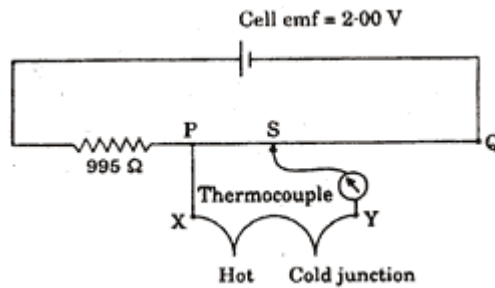


**Q. 13.** State Gauss' theorem in electrostatics. Using this theorem, derive an expression for the electric field intensity due to an infinite plane sheet of charge of charge density  $\sigma \text{ C/m}^2$ . **3**

**Q. 14.** A  $10 \mu\text{F}$  capacitor is charged by a 30 V d.c. supply and then connected across an uncharged 50 pF capacitor. Calculate (i) the final potential difference across the combination, and (ii) the initial and final energies. How will you account for the difference in energy? **3**

**Q. 15.** Define the term 'electrochemical equivalent'. Deduce the relation connecting electrochemical equivalent, chemical equivalent and Faraday. **3**

**Q. 16.** The circuit diagram shows the use of a potentiometer to measure a small emf produced by a thermocouple connected between X and Y. The cell C, of emf 2V, has negligible internal resistance. The potentiometer wire PQ is 1.00 m long and has resistance  $5 \Omega$ . The balance point S is found to be 400 mm from P. Calculate the value of emf V, generated by the thermocouple. **3**



**Q. 17.** Using Biot-Savart law, deduce an expression for the magnetic field on the axis of a circular current loop. Draw the magnetic field lines due to a circular current carrying loop. **3**

Or

A hydrogen ion of mass 'm' and charge 'q' travels with a speed 'v' in a circle of radius 'r' in a magnetic field of intensity 'B'. Write the equation in terms of these quantities only, relating the force on the ion to the required centripetal force. Hence derive an expression for its time period.

**Q. 18.** A uniform magnetic field gets modified as shown below, when two specimens X and Y are placed in it.



- (i) Identify the two specimens X and Y.
- (ii) State the reason for the behaviour of the field lines in X and Y. **3**

**Q. 19.** Two narrow slits are illuminated by a single monochromatic source. Name the pattern obtained on the screen. One of the slits is now completely covered. What is the name of the pattern now obtained on the screen? Draw Intensity pattern obtained in the two cases. Also write two differences between the patterns obtained in the above two cases. **3**

**Q. 20.** Red light, however bright it is, cannot produce the emission of electrons from a clean zinc surface. But even weak ultraviolet radiation can do so. Why?

X-rays of wavelength ' $\lambda$ ' fall on photosensitive surface, emitting electrons. As sinning X-rays of wavelength ' $\lambda$ ' fall on a photosensitive Surface, emitting electrons. Assuming that the work function of the surface can be neglected, prove that the de Broglie wavelength

of electrons emitted will be  $\sqrt{\frac{h\lambda}{2mc}}$  **3**

**Q. 21.** Define the terms: 'half-life period' and 'decay constant' of a radioactive sample. Derive the relation between these terms. **3**

**Q. 22.** When a deuteron of mass 2.0141 u and negligible kinetic energy is absorbed by a lithium ( ${}^6_3\text{Li}$ ) nucleus of mass 6.0155 u, the compound nucleus disintegrates spontaneously into two alpha particles, each of mass 4.0026 u. Calculate the energy in joules carried by each alpha particle ( $1\text{u} = 1.66 \times 10^{-27}\text{kg}$ ) **3**

**Q. 23.** What is meant by 'remote sensing'? Briefly explain, how it is carried out. Mention any two applications of remote sensing. **3**

**Q. 24.** What is an optical detector? State its three essential characteristics. Name the factor which decides how good a detector is. **3**

**Q. 25.** With the help of a labelled circuit diagram, explain how an n-p-n transistor can be used as an amplifier in common-emitter configuration. Explain how the input and output voltages are out of phase by  $180^\circ$  for a common-emitter transistor amplifier. **5**

Or

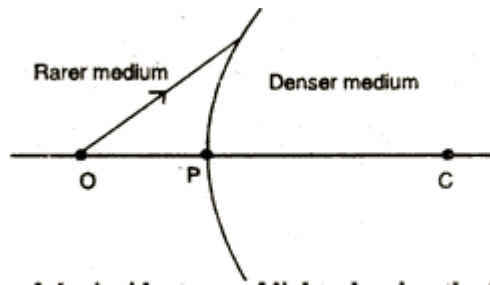
For an n-p-n transistor in the common-emitter configuration, draw a labelled circuit diagram of an arrangement for measuring the collector current as a function of collector-emitter voltage for at least two different values of base current. Draw the shape of the curves obtained. Define the terms: (i) 'output resistance' and (ii) 'current amplification factor'.

**Q. 26.** What is induced emf? Write Faraday's law of electromagnetic induction. Express it mathematically.

A conducting rod of length  $l$  with one end pivoted is rotated with a uniform angular speed  $\omega$  in a vertical plane, normal to a uniform magnetic field 'B'. Deduce an expression for the emf induced in this rod.

In India, domestic power supply is at 220 V, 50 Hz, while in USA it is 110 V, 50 Hz. Give one advantage and one disadvantage of 220 V supply over 110 V supply. **5**

**Q. 27.** A spherical surface of radius of curvature R, separates a rarer and a denser medium as shown in the figure.



Complete the path of the incident ray of light, showing the formation of a real image. Hence derive the relation connecting object distance 'u', image distance 'v', radius of curvature R and the refractive indices  $\mu_1$  and  $\mu_2$  of the two media. Briefly explain, how the focal length of a convex lens changes, with increase in wavelength of incident light. **5**