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| **Qn** | **Answer** | **Marks** |
| 1. (a) | (i)  O  N  I  M  P  α  α  α  α  Q  A ray ON from O, normal to the mirror, is reflected back along NO.  Another ray OM is reflected at M at the same angle, α, to the normal QM and moves along MP.  The point I where the reflected rays appear to emerge from, is therefore the image of O  According to the geometry of the figure, ΔNOM is similar to ΔNIM and since the two triangles share a common side MN, ON must be equal to IN.  Thus, the image is as far behind the | ½  ½  ½  ½  ½  ½ |
| (b) | θ  X  Y  O  P  d  β  α  α  R  Q  β  The net deviation is d – clockwise  Now, at P the glancing angle is α, while the glancing angle at Q is β.  From the geometry of the figure, d = ∠RPQ + ∠RQP  i.e. d = 180o - 2α + 180o - 2β ………… (1)  But β = 180o - α - θ  Substituting for β in (1), we have  d = 360o - 2α - 360o + 2α + 2θ  = 2θ | 1  1  1  1 |
| (c) | I  O  P1  P2  P3  P4  *r i*  *i r*  M  M′  A1 A2  E1 N1 N2 E2   * A straight line is drawn on a white sheet of paper to divide the paper into about two equal parts. * Using four drawing pins, the paper is fixed onto a soft board on a horizontal bench. * A strip of plane mirror is placed vertically so that its silvered surface lies on the straight line. * An object pin O is stuck about 5 cm from the straight line. * While observing from position E1, sighting pins P1 and P2 are stuck so that they appear to be in a straight line with the image I of the object O as seen through the mirror. * The sighting pins are removed and their positions marked with small crosses. * The mirror and the pins are removed and the points P1, P2 are joined to intersect the mirror line MM′ at A1. * The same procedure is repeated while observing from position E2 and using sighting pins P3 and P4. * Normals A1N1 and A2N2 are drawn and the angles *i* and *r* are measured * The above steps are repeated for different positions of the eye, at least two on each side of the object.   It is observed that in each case ∠*i* = ∠*r* | 1  ½  ½  ½  ½  ½  ½  ½  ½ |
| (d) | P  A  2θ  B  M2  M1  O  C  α  θ  (i)  Consider a ray AO incident at O on a plane mirror M1, at a glancing angle α. If OB is the reflected ray, then angle BOC = 2α.  Suppose M1 is now rotated through an angle θ to position M2, the direction of AO remaining constant. Then the glancing angle becomes α + θ and ∠ POC = 2(α + θ). Thus the reflected ray has rotated through an angle POB = ∠POC - ∠BOC  = 2(α + θ) - 2α = 2θ.  Thus the reflected ray moves through twice the angle turned through by the mirror. | 1  1  1  1 |
| (ii) Optical Lever in Mirror Galvanometer  Here light is used as a weightless pointer.  In such instruments a small mirror M1 is rigidly attached to a system which rotates when a current flows in it.    M2 M1  A  2θ  X  O  L  Lamp  Y  θ            A beam of light from a fixed lamp L is directed on to the mirror.  When no current is flowing through the system, the beam is normal to M1, and it is reflected directly back to give a spot of light at O on scale Y (just above L).  If a current passes through the system so that the system rotates by θ, the reflected beam rotates through 2θ, thus making the system sensitive.  **OR**  2. The sextant  It is an instrument used for measuring the angle of elevation of the sun or stars.      (i)  Sun S  2θ  θ  O  M1  M2  H  H'  B  Telescope  T  Fixed glass  (ii)  B                    B is plane glass silvered on a vertical half as shown in figure (ii).  Looking through the telescope T, the mirror O is turned about a horizontal axis until the view H' of the horizon seen directly through the unsilvered half of B, and also a view of it, H, seen by successive reflection at O and the silvered half of B, are coincident.  This is when mirror O is parallel to B in position M1. The position M1 is noted.  O is now rotated until a position M2 in which the image of the sun S is seen on horizon H’.  The angle of rotation, θ, between positions M1 and M2 of O is found.  The elevation SOH of the sun S is equal to 2θ. | ½  1  ½  1  1 |
| ***Total = 20*** | | |
| 2.(a) | (i) Like charges repel each other while unlike charges attract. | 1 |
| (ii) The leaf collapses as the conductor approaches the cap.  Conductor  (i) Before approach of the conductor  When the conductor is near the cap, electrostatic induction occurs in the conductor resulting positive charge residing near the cap.  This brings about a neutralizing effect on the negative charge of the cap.  So electrons are withdrawn from the leaf and plate to the cap so as to restore the initial state.  So the leaf collapses | 1  1  1  ½  ½ |
| (b) | * The charging source is not affected * A great charge can be concentrated onto the receiver at once | 1  1 |
| (c) | A  (i)  Suppose a pointed conductor A is charged positively.   * Most of the charge concentrates at the tip creating an intense electric field there. * This ionises the air there. * The negative ions are attracted to the tip and are neutralised while the positive ions are repelled. * The net result is that positive charge is being sprayed from the tip into the air. | 1  ½  ½  ½  ½ |
| E2  P2  S  Insulating cylinder  Silk belt  E1  P1  Motor  h.t  battery  (ii)  *Features*: It consists of a hollow metal sphere S supported on an insulating cylinder T several metres high. A silk belt B runs over pulleys P1 and P2, the lower being driven by a motor. Near the top and bottom the belt passes close to the electrodes E1 and E2, which are sharply pointed combs.  *Action:*   * E1 is given a potential of about 10,000 volts, positive with respect to the earth, by a battery. * The high electric field at the points of E1 ionises the air there, positive charges being repelled to the belt. * The belt carries them up into the sphere. * The positive charge induces a negative charge on the points of E2 and a positive charge on the sphere. * The high electric field at the points of E2 ionises the air there, and negative charge is repelled to the belt thereby discharging it before it passes over the pulley P2. * Thus, the sphere gradually charges up positively to millions of volts with respect to the earth.   The electrical energy generated by this machine comes from the work done by the motor in driving a positively charged belt into a positively charged sphere. | ½  ½  ½  ½  ½  ½  ½  ½  ½  ½  1  ½  ½ |
| (iii) - Height of the metal sphere above the ground – a greater height gives a greater  maximum potential.  - Size of the sphere – the bigger the sphere the greater the maximum potential.  - Condition of the atmosphere – whether dump or dry. Dry atmosphere results in a  greater maximum potential. | 1  1  1 |
| ***Total 20*** | | |