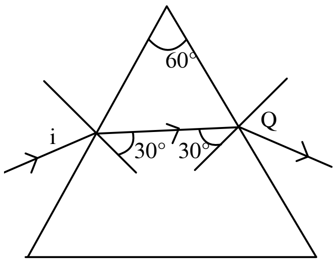
Sol.



$n_1 = n_2 = \frac{3}{2}$

$\frac{\sin 30°}{\sin e} = \frac{1}{n_1 + \Delta n}$

$\frac{1}{2\sin e} = \frac{1}{n_1 + \Delta n}$

$2\sin e = n_1 + \Delta n$

$2\sin(I + \Delta e) = n_1 + \Delta n$ ....(i)

$2\sin i = n_1$ .....(ii)

By (i) , (ii)

$2[\sin(I + \Delta e) - \sin i] = \Delta n$

$2[\sin\left(\frac{\Delta Q}{2}\right)\cos i] = \Delta n$

$\Delta n = 4\sin\left(\frac{\Delta e}{2}\right)\cos i$

$= 2(\Delta e)\cos i$

(ii) $\Delta n = 2(\Delta e)\cos i$

$2.8 \times 10^{-3} = 2(\Delta e)\cos i$

$1.4 \times 10^{-3} = \Delta e \cos i$

(iv) $Dn = 2\Delta e \cos i$

$\Delta n < 2\Delta e$

$\frac{\sin i}{\sin 30°} = \frac{2}{3}$

$\sin i = \frac{1}{3}$

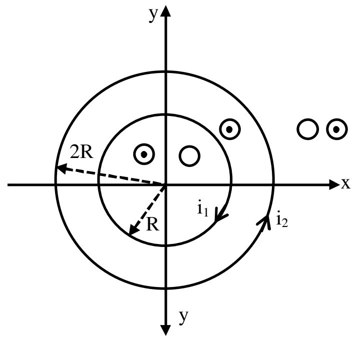
$I = \sin^{-1}\left(\frac{1}{3}\right)$

$2.8 \times 10^{-3} = 4\sin\left(\frac{\Delta e}{2}\right) \times \frac{2\sqrt{2}}{3}$

$\frac{\Delta e}{2} = 0.74 \times 10^{-3}$

$\Delta e = 1.48 \times 10^{-3}$

16. Two concentric circular rings of radii R & 2R lie in x-y plane. They carry currents in opposite directions as shown in diagram. $i_1 > 2i_2$ and r is radial distance from centres of the two rings in xy plane.



(A) for r < R, |B| is never zero

(B) for r < 2R, |B| is in wards

(C) B depends only on radial distance r

(D) B is always perpendicular to the x-y plane.

Ans. (A,C,D)

Sol. At r < R and at r > 2R, |B| can become zero as the two rings produce B in opposite directions.

Also in x-y plane B will be perpendicular to x-y plane

Also because of symmetry B will depend only on r and not on θ.

17. For earth-sun system, earth rotates about sun in a orbit of average radius R. Time period of earth is T_0. For a binary star system having two stars of masses $4M_S$ and $5\ M_S$ and separation 9R, time period is nT_0 . Find n.

Ans. 9

Sol. For earth-sun system

$$T_0^2 = \frac{4\pi^2}{GM_S} \times R^3 \qquad \ldots(i)$$

For binary system

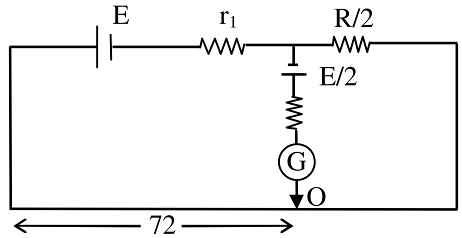
$$T^2 = \frac{4\pi^2}{G[4M_S + 5M_S]} \times (9R)^3 \qquad \ldots(ii)$$

using (i) and (ii)

$T = 9T_0$

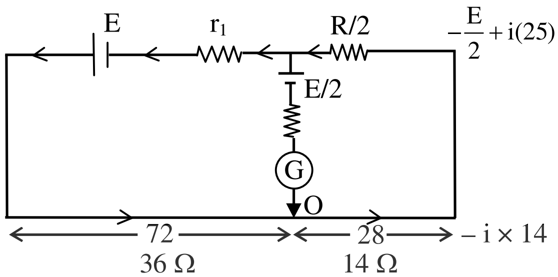
So, $n = 9$

18. In the given circuit galvanometer shows zero deflection for length 72 cm on the potentiometer wire of length 1 meter. Find the internal resistance (in Ω) of the cell if resistance of potentiometer wire is R = 50Ω



Ans. 3

Sol.



$$-\frac{E}{2}+i(25)=-i(14)$$

$$i(25+14)=\frac{E}{2}$$

$$\frac{39E}{r_1+75}=\frac{E}{2}$$

$r_1 = 3\ \Omega$

19. Photon of same energy is thrown on metals P, Q while different photon is used for metal R. Maximum kinetic energy in these cases are $E_P = 2\ E_Q = 2E_R$ and work function of P, Q, R are 4 ev, 4.5 ev, 5.5 ev respectively.

Find then energy (ev) of photon that is used in metal R.

Ans. 6

Sol. $h\nu = E_P + 4$

$h\nu = E_Q + 4.5$

$1 = \frac{E_P+4}{E_Q+4.5} \Rightarrow E_Q + 4.5 = E_P + 4$

$E_Q + 4.5 = 2E_Q + 4$

$E_Q = 0.5$ ev

For metal R

$h\nu_1 = E_R + 5.5$

$h\nu_1 = 0.5 + 5.6$

$h\nu_1 = 6$ ev