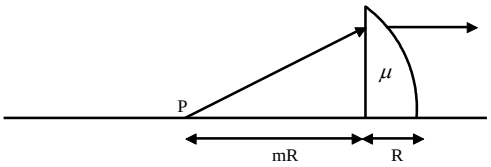
A quarter cylinder of radius R and refractive index μ is placed on a table. A point object P is kept at a distance of mR from it. Value of m for which a ray will emerge parallel to the table as shown in the figure is: (more than one option may be correct)



(A) $\frac{1}{\mu(\mu-1)}$ (B) $\frac{1}{\mu(\mu+1)}$ (C) $\frac{1}{\mu-1}-\frac{1}{\mu}$ (D) $\frac{1}{\mu}+\frac{1}{\mu+1}$

Solution

There are two refractions taking place – one from the flat surface and the other from the curved surface. The formula $\frac{\mu_2}{v}-\frac{\mu_1}{u}=\frac{\mu_2-\mu_1}{R}$ can be used twice once for the flat surface refraction and the once again for the curved surface refraction.

For the flat surface, $\frac{\mu}{v}-\frac{1}{-mR}=\frac{\mu-1}{\infty}$

$\therefore v=-\mu mR$

The image formed due to flat surface refraction will act as object for the curved surface refraction.

For the curved surface, $\frac{1}{\infty}-\frac{\mu}{-(R+\mu mR)}=\frac{1-\mu}{-R}$

$\therefore m=\frac{1}{\mu(\mu-1)}$

Hence, (A) & (C)