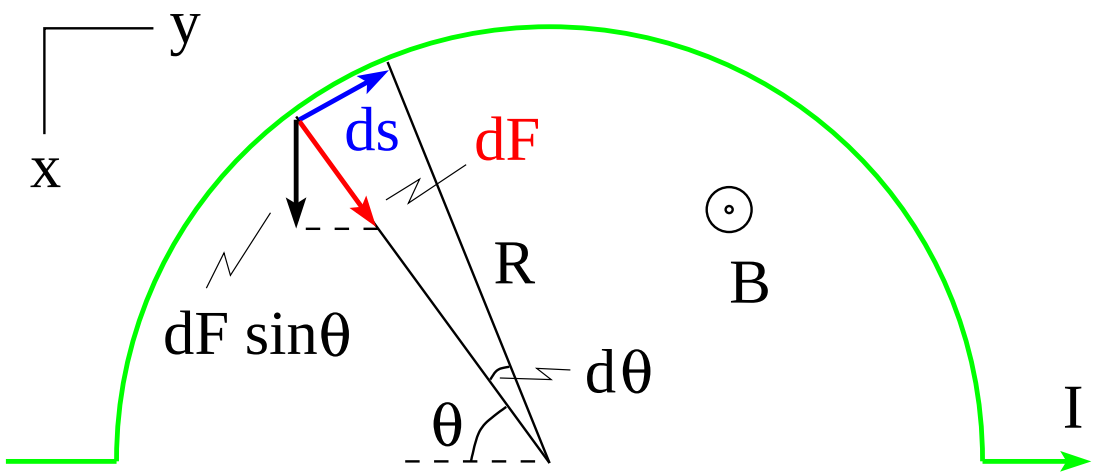
Magnetic Force on Semicircular Current (1)

Fancy solution:

- Uniform magnetic field $\vec{B}$ points out of the plane.
- Magnetic force on segment ds: $dF = IBds = IBRd\theta$.
- Integrate $dF_x = dF\sin\theta$ and $dF_y = dF\cos\theta$ along semicircle.
- $F_x = IBR\int_0^\pi \sin\theta d\theta = 2IBR, \quad F_y = IBR\int_0^\pi \cos\theta d\theta = 0.$



Magnetic Force on Semicircular Current (2)

Clever solution:

- Replace the semicircle by symmetric staircase of tiny wire segments.
- Half the vertical segments experience a force to the left, the other half a force to the right. The resultant horizontal force is zero.
- All horizontal segments experience a downward force. The total length is $2R$. The total downward force is $2IBR$.
- Making the segments infinitesimally small does not change the result.