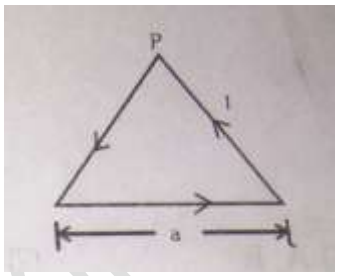
Q - An equilateral triangle of side a has a current I in anti-clockwise direction. Find the strength of magnetic field and its direction at one of its vertex.

The magnetic field at a point, due to a current carrying wire of finite length is given by the formula

$$B = \frac{\mu_0 I}{4\pi d}\ (\sin\alpha - \sin\beta)$$



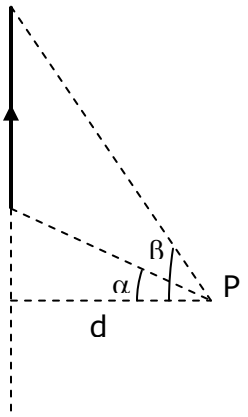
Here I is the current through the wire, d is the distance (perpendicular) of the point from the wire and α and β are the angle subtended by the ends of wire at the point P with the perpendicular on the wire

Now to our question

According to Biot-Savart law, magnetic field at any point along the line of the current is zero (sin θ = 0), the field due to the two sides passing through the point P will be zero and only due to the third side.

The perpendicular distance of point P from the third side will be a sin 60^0

The ends of the thirds side are on different sides thus the angles are α = 30^0 and β = - 30^0.



Thus the field at P is given by

$$B = \frac{\mu_0 I}{4\pi\, a \sin 60^0}\ (\sin 30^0 - \sin(-30^0))$$

Or $$B = \frac{\mu_0 I}{4\pi a\frac{\sqrt{3}}{2}}\left(\frac{1}{2} - \left(-\frac{1}{2}\right)\right)$$

Or $$B = \frac{\mu_0 I}{2\sqrt{3}\,\pi\, a}$$

Using right hand rule we can say that the field at point P in to the paper.