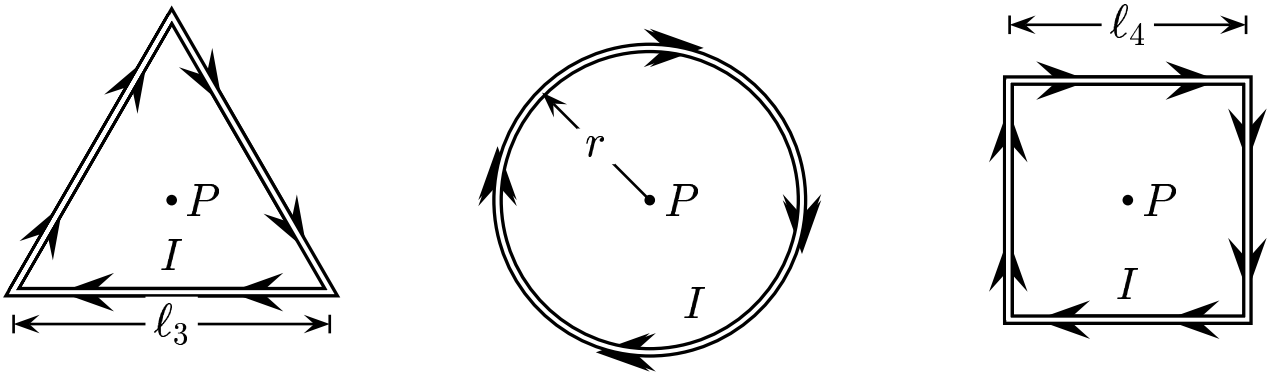
Given: Three conductors (same length, L) have the shape of an equilateral triangle (whose sides are of length ℓ_3), a ring (whose radius is of length r), a square (whose sides are of length ℓ_4).

These conductor's lenghts are all equal (perimeters: $L = 3\,\ell_3 = 2\,\pi\,r = 4\,\ell_4$). All conductors carry the same current I.



Select the correct comparison for the magnitude of the magnetic field at the center points P of the current loops shown above.

A) $B_{square} > B_{triangle} > B_{ring}$

B) $B_{triangle} > B_{ring} > B_{square}$

C) $B_{ring} > B_{triangle} > B_{square}$

D) $B_{triangle} > B_{square} > B_{ring}$

E) $B_{square} > B_{ring} > B_{triangle}$

Using $B = \dfrac{\mu_0\, I}{4\,\pi\, a}\displaystyle\int_{\theta_1}^{\theta_2} \sin\theta\; d\theta$, at point P, we have

Triangle: $B_{triangle} = \dfrac{9}{2\,\pi}\,\dfrac{\mu_0\, I}{\ell_3} \approx 1.4324\,\dfrac{\mu_0\, I}{\ell_3}$, largest

Square: $B_{square} = \dfrac{8\sqrt{2}}{3\,\pi}\,\dfrac{\mu_0\, I}{\ell_3} \approx 1.2004\,\dfrac{\mu_0\, I}{\ell_3}$

Ring: $B_{ring} = \dfrac{\pi}{3}\,\dfrac{\mu_0\, I}{\ell_3} \approx 1.0472\,\dfrac{\mu_0\, I}{\ell_3}$, smallest

Therefore, $B_{triangle} > B_{square} > B_{ring}$.

Note: We expect B to be smallest at its center point for the wire ring since the wire is fartherest from its center point.

Note: We expect B to be largest at its center point for the wire triangle since the wire is (on average) the closest to its center point.

Answer D.

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