



Theorem: π is irrational.

Proof: Assume $\pi = a/b$ and consider the polynomial $P(x) = \frac{x^n(a-bx)^n}{n!}$ For n quite large. Clearly

$P(x)$ is positive yet small, hence

satisfies $0 <$
other hand,

integration by parts shows that

$I = (\text{boundary terms}) \pm \int p^{(n+1)}(x) \cos x dx$. The second term is 0 because P is a polynomial of degree $2n$, and the first term is an integer for clearly $P^{(k)}(0)$ is always an integer, for $P(\pi-x) = P(x)$ hence same is true for $P^{(k)}(\pi)$ and for \sin & \cos of 0 & π are all integers. Ergo

I is an integer between 0 and 1, and these are rare indeed. \square

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