ROMANIAN MATHEMATICAL MAGAZINE

Find a closed form:

$$I=\int_{-\infty}^{\infty}\frac{x(x^2(x(x(x^2(4x-20)-20)+17)-20)-20)+4}{\Big(\Big(\big((4x^2+4)x^2+17\big)x^2+17\Big)x^2+4\Big)x^2+4}dx$$

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Solution by Obiajunwa Januarius-Nigeria

$$I=\int_{-\infty}^{\infty}\frac{x(x^2(x(x(x^2(4x-20)-20)+17)-20)-20)+4}{\Big(\Big(\big((4x^2+4)x^2+17\big)x^2+17\Big)x^2+4\Big)x^2+4}dx$$

$$I=\int_{-\infty}^{\infty}\left(\frac{1}{1+x^2}-\frac{1}{2-2x+x^2}+\frac{1}{2+2x+x^2}-\frac{1}{1-2x+2x^2}+\frac{1}{1+2x+2x^2}\right)dx$$

$$I=\int_{-\infty}^{\infty}\left(\frac{1}{1+x^2}-\frac{1}{1+(x-1)^2}+\frac{1}{1+(x+1)^2}-\frac{1}{2}\frac{1}{(x-\frac{1}{2})^2+\frac{1}{4}}+\frac{1}{2}\frac{1}{(x+\frac{1}{2})^2+\frac{1}{4}}\right)dx$$

$$I=\arctan(x)-\arctan(x-1)+\arctan(x+1)-\arctan\left(2\left(x-\frac{1}{2}\right)\right)+\arctan\left(2\left(x+\frac{1}{2}\right)\right)\Big|_{-\infty}^{\infty}=\pi$$