$\underline{8 \mid d_2}$

$$\int_{-\infty}^{\infty} \frac{\cos x}{(1+x^2)^3}\,dx = \operatorname{Re} \int_{-\infty}^{\infty} \underbrace{\frac{e^{ix}}{(1+x^2)^3}}_{f(x)}\,dx$$

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$$\int_{\langle -R, R\rangle} f(z)\,dz = 2\pi i \operatorname{Res}(f, i) = (**)$$

$$\operatorname{Res}(f,i) = \lim_{z\to i} \left(\frac{e^{iz}(z-i)^3}{\underbrace{(1+z^2)^3}} \right)'' \frac{1}{2} = \frac{1}{2} \lim_{z\to i} \underbrace{\left(\frac{e^{iz}}{(z+i)^3} \right)''}_{g(z)} = \frac{1}{2e}\,\frac{28}{32i}$$

$(*)$

$$g'(z) = \left(\frac{e^{iz}}{(z+i)^3} \right)' = \frac{e^{iz}(iz-4)}{(z+i)^4}$$

$$\frac{ie^{iz}(z+i)^3 - e^{iz}\,3(z+i)^2}{(z+i)^6} = \frac{e^{iz}\big(i(z+i)-3\big)}{(z+i)^4}$$

$$g''(z) = \frac{e^{iz}(-z^2 - 8iz + 19)}{(z+i)^5}$$

$$(*) = \frac{7}{16i}e \qquad (**) = \frac{7\pi}{8e}$$

$$g''(z) = \frac{\big(ie^{iz}(iz-4) + e^{iz}\cdot i\big)(z+i)^4 - e^{iz}(iz-4)\,4(z+i)^3}{(z+i)^8}$$

$$= \frac{e^{iz}}{(z+i)^5}\Big[\big(i(iz-4)+i\big)(z+i) - 4(iz-4)\Big]$$

$-4i+i$