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show sinx-cosx as single harmonic function

To express

$$\sin x - \cos x$$

as a **single harmonic function**, write it in the form:

$$R\sin(x - \phi)$$

Step 1: Use the identity

$$R\sin(x - \phi) = R\sin x\cos\phi - R\cos x\sin\phi$$

Match coefficients with:

$$\sin x - \cos x$$

So we need:

$$R\cos\phi = 1$$

$$R\sin\phi = 1$$

Step 2: Find R

Square and add:

$$R^2(\cos^2\phi + \sin^2\phi) = 1^2 + 1^2$$

$$R^2 = 2$$

$$R = \sqrt{2}$$

Step 3: Find ϕ

From:

$$\cos\phi = \frac{1}{\sqrt{2}}, \quad \sin\phi = \frac{1}{\sqrt{2}}$$

So:

$$\phi = \frac{\pi}{4}$$

Final Answer

$$\boxed{\sin x - \cos x = \sqrt{2}\,\sin\left(x - \frac{\pi}{4}\right)}$$

Alternative Equivalent Form

It can also be written as:

$$\boxed{\sin x - \cos x = \sqrt{2}\,\cos\left(x + \frac{\pi}{4}\right)}$$

Both are correct single harmonic forms.