Student handout The formula for the inverse Fourier transform shows that a function $f(x)$ can be written in terms of its Fourier transform via

$$f(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} \tilde{f}(k)\, e^{ikx}\, dk \tag{1}$$

Take the derivative of both sides of this equation with respect to x and simplify. Interpret your expression as the inverse Fourier transform of something.

1 Instructor's Guide

1.1 Introduction

Students will need a short lecture giving the definition of the inverse Fourier Transform

$$\mathcal{F}^{-1}(\tilde{f}) = f(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(k)\, e^{ikx}\, dk \tag{2}$$

1.2 Student Conversations

The logic of this problem may feel a little backwards to students. Be prepared to be more directive than normal in helping the groups that get stuck. Or consider doing this problem as a mini-lecture, rather than a group activity, especially if time is tight.

1.3 Wrap-up

The result if this calculation is an essential formula in solving differential equations with Fourier transforms.