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Quiz – February 21, 2006

Find $\int \frac{2x^2-9x-9}{x^3-9x} dx$. **Check your answer.**

Answer: The demoninator factors as $x(x^2 - 9) = x(x - 3)(x + 3)$. Set

$$\frac{2x^2 - 9x - 9}{x^3 - 9x} = \frac{A}{x} + \frac{B}{x - 3} + \frac{C}{x + 3}.$$

Multiply by $x^3 - 9x$ to get

$$2x^2 - 9x - 9 = A(x - 3)(x + 3) + Bx(x + 3) + Cx(x - 3).$$

Plug in $x = 0$ to see that $A = 1$. Plug in $x = 3$ to see that $B = -1$. Plug in -3 to see that $C = 2$. We check what we have so far:

$$\frac{1}{x} + \frac{-1}{x - 3} + \frac{2}{x + 3} = \frac{(x^2 - 9) - (x^2 + 3x) + 2(x^2 - 3x)}{x^3 - 9x} = \frac{2x^2 - 9x - 9}{x^3 - 9x}.$$

So far, so good. The original problem is equal to

$$\int \frac{1}{x} + \frac{-1}{x - 3} + \frac{2}{x + 3} dx = \boxed{\ln |x| - \ln |x - 3| + 2 \ln |x + 3| + C.}$$