1. Evaluate these integrals. If you use the integral table, give the number of the integral used.

(a) \[ \int \frac{x}{x^2 + 4x - 5} \, dx \]

(b) \[ \int e^{\tan(x)} \sec^2(x) \, dx \]

(c) \[ \int e^{\tan(x)} \frac{\sin(x)}{\cos^3(x)} \, dx \]

2. Suppose \( A \) is the product of a Cantor middle-thirds set along the \( x \)-axis and the interval \([0, 1]\) along the \( y \)-axis, and \( B \) is the product of a Cantor middle-halves set along the \( x \)-axis and the interval \([0, 2]\) along the \( y \)-axis. Which has the larger box-counting dimension, \( A \) or \( B \)? Give a reason for your answer.

3. Pictured here is the graph of \( f(x) = r(x^2 - x^3) \) for some value of \( r \) for which \( x_{n+1} = f(x_n) \) has three fixed points.

(a) Find the \( x \) values of these fixed points as functions of \( r \).

(b) Without computing derivatives or doing any messy algebra, show the middle fixed point always is unstable. Hint: look at the graph. What do you see?

4. Consider the system

\[ \begin{align*}
\frac{dx}{dt} &= x^3 - xy^2 \\
\frac{dy}{dt} &= yx^2 - y
\end{align*} \]

(a) (10pts) Find the nullclines and sketch them. Indicate which are the \( x \)-nullclines and which are the \( y \)-nullclines.

(b) Locate the fixed points of the system. Find their coordinates.
5. Consider the system

\[
\begin{bmatrix}
x' \\
y'
\end{bmatrix} = \begin{bmatrix} 1 & a \\ b & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix}
\]

where \(a\) and \(b\) are constants. In the graph below, shade the regions for which the origin is an unstable spiral for this system. Explain how you arrived at your answer.