1. Evaluate these integrals. If you use the integral table, give the number of
the integral used.
(a) \( \int \frac{x}{x^2 - 2x - 8} \, dx \)
(b) \( \int e^{\sin(x)} \sin(x) \cos(x) \, dx \)
(c) \( \int \frac{1}{x \sqrt{1 - (\ln(x))^2}} \, dx \)

2. Pictured here is the graph of \( f(x) = 2x(2 - x)(\mod 1) \) for \( 0 \leq x \leq 1 \).

(a) On the graph, circle all fixed points and determine their stability. You need
not compute derivatives to answer the stability question. Justify your answers
by graphical arguments.

(b) Suppose \( x_a \) and \( x_b \) are the 2-cycle pictured in the graph. Write an equation
expressing \( x_a \) as a function of \( x_b \), and write an equation expressing \( x_b \) as a
function of \( x_a \). Do not attempt to solve these equations.

3. Consider the system
\[
\begin{align*}
x' &= x^3 + xy^2 - x \\
y' &= x^2 - y^2
\end{align*}
\]
(a) Find the nullclines and sketch them. Indicate which are the \( x \)-nullclines and
which are the \( y \)-nullclines.

(b) On your sketch of the nullclines, locate the fixed points of the system. Find
their coordinates.
4. Consider the system

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

where \(a\) is a constant. Find all the values of \(a\) for which the origin is an unstable spiral. Explain how you arrived at your answer.