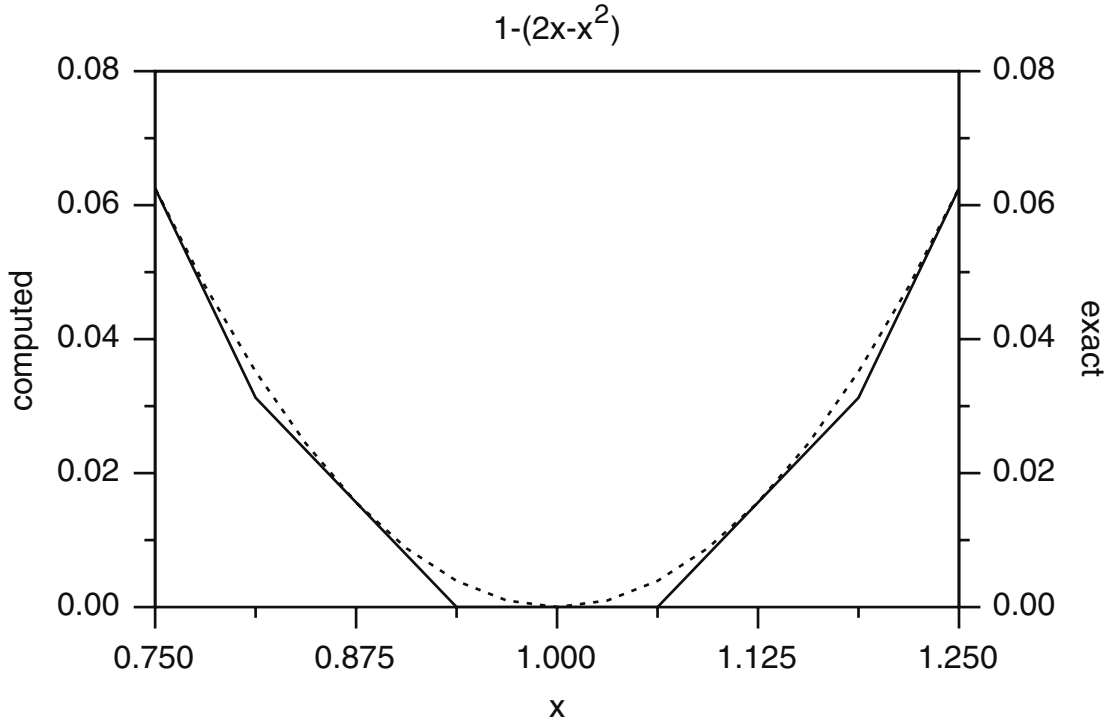

Figure 3.1: Evaluation of $1 - (2x - x^2)$ exactly (dashed curve) and in a floating-point representation with $\beta = 2$ and $p = 6$ (solid line).

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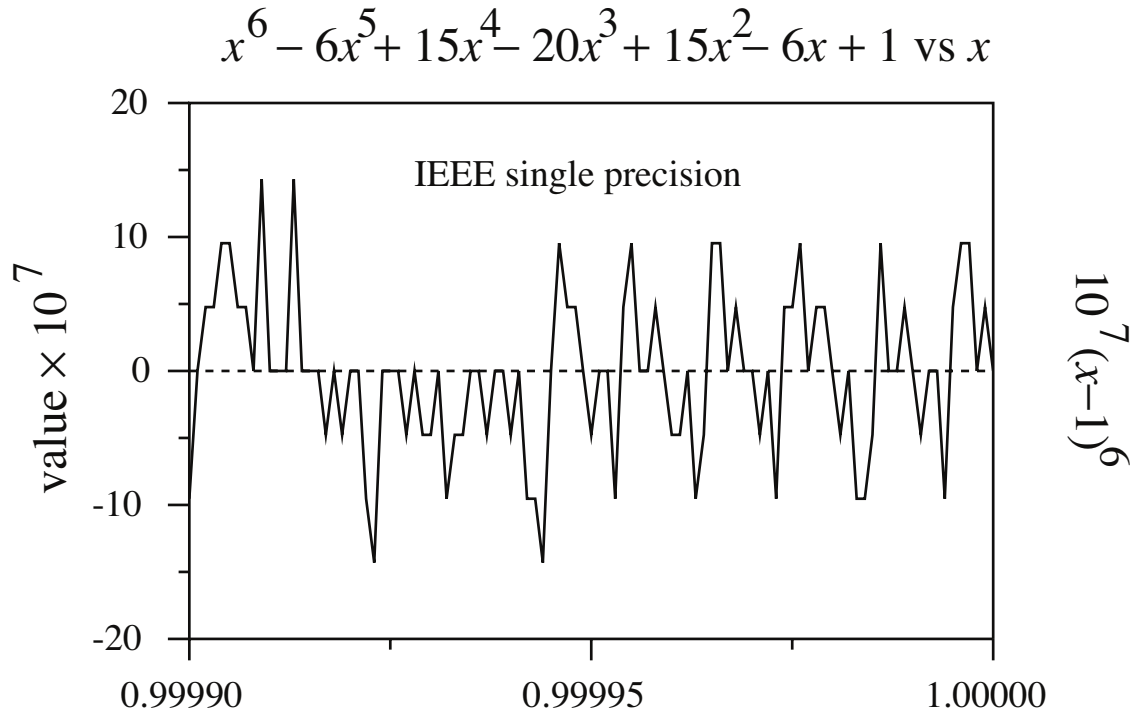

Figure 3.2: Numerical evaluation of a polynomial in the power form $(1-x)^6$ (dashed line and right vertical axis) and in the expanded form $x^6 - 6x^5 + 15x^4 - 20x^3 + 15x^2 - 6x + 1$ (solid line and left vertical axis), using IEEE single-precision floating-point arithmetic in both cases. The computed values plotted on the vertical axes have been multiplied by 10^7. The value of ϵ_{mach} is 1.192×10^{-7}; the value of one ulp is 5.96×10^{-8} in the range shown.

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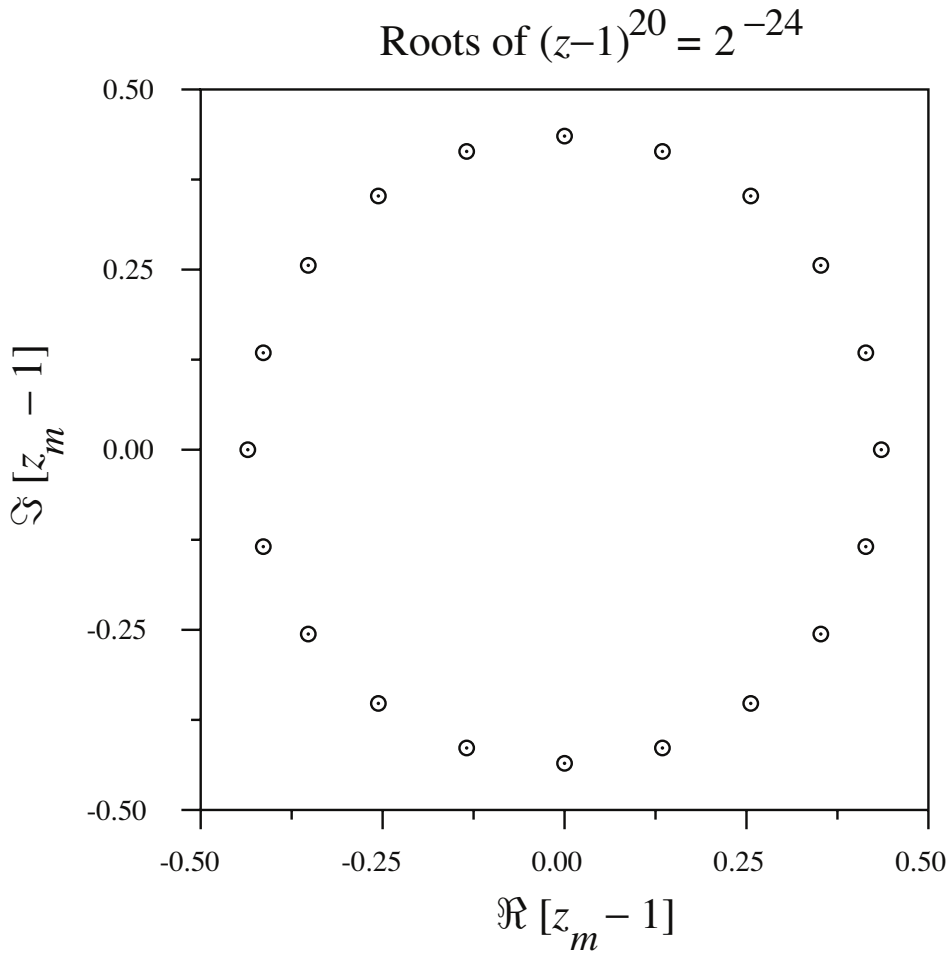

Figure 3.3: The points represent the error in the mth root, $z_m - 1$, of the polynomial equation $(z-1)^{20} = 2^{-24}$, for $m \in (0:19)$.

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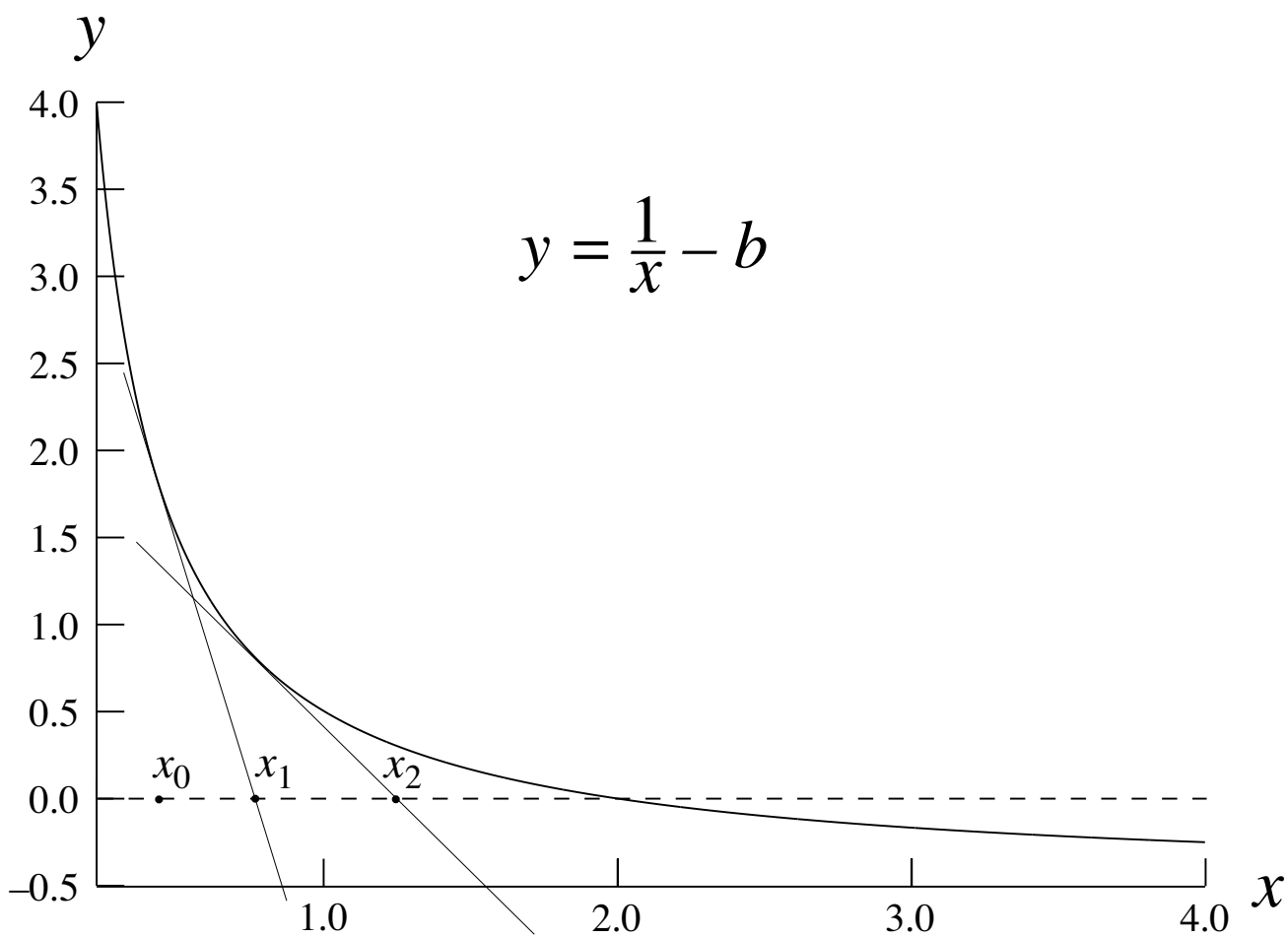

Figure 3.4: Illustration of the first two steps of Newton-Raphson iteration for the function $f(x) = 1/x - b$, with $b = 0.5$.

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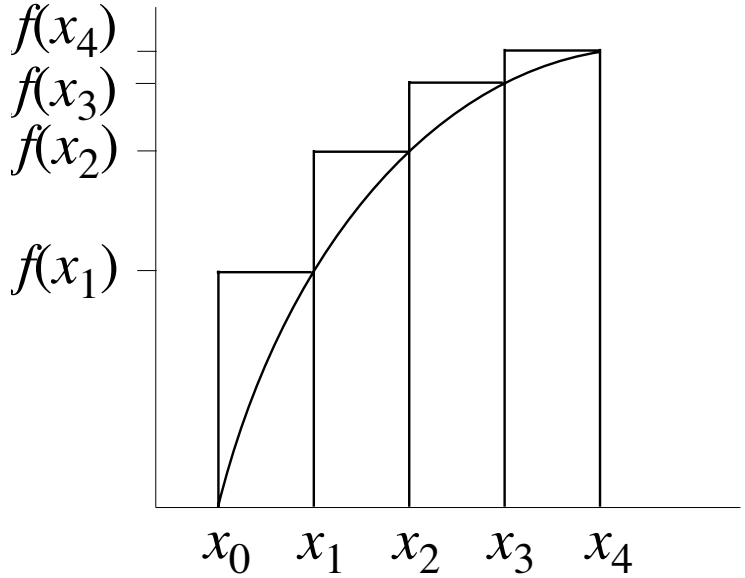

Figure 3.5: Approximate evaluation of the integral $\int_{x_0}^{x_4} f(x)\,dx$ using the right-hand rectangle rule.

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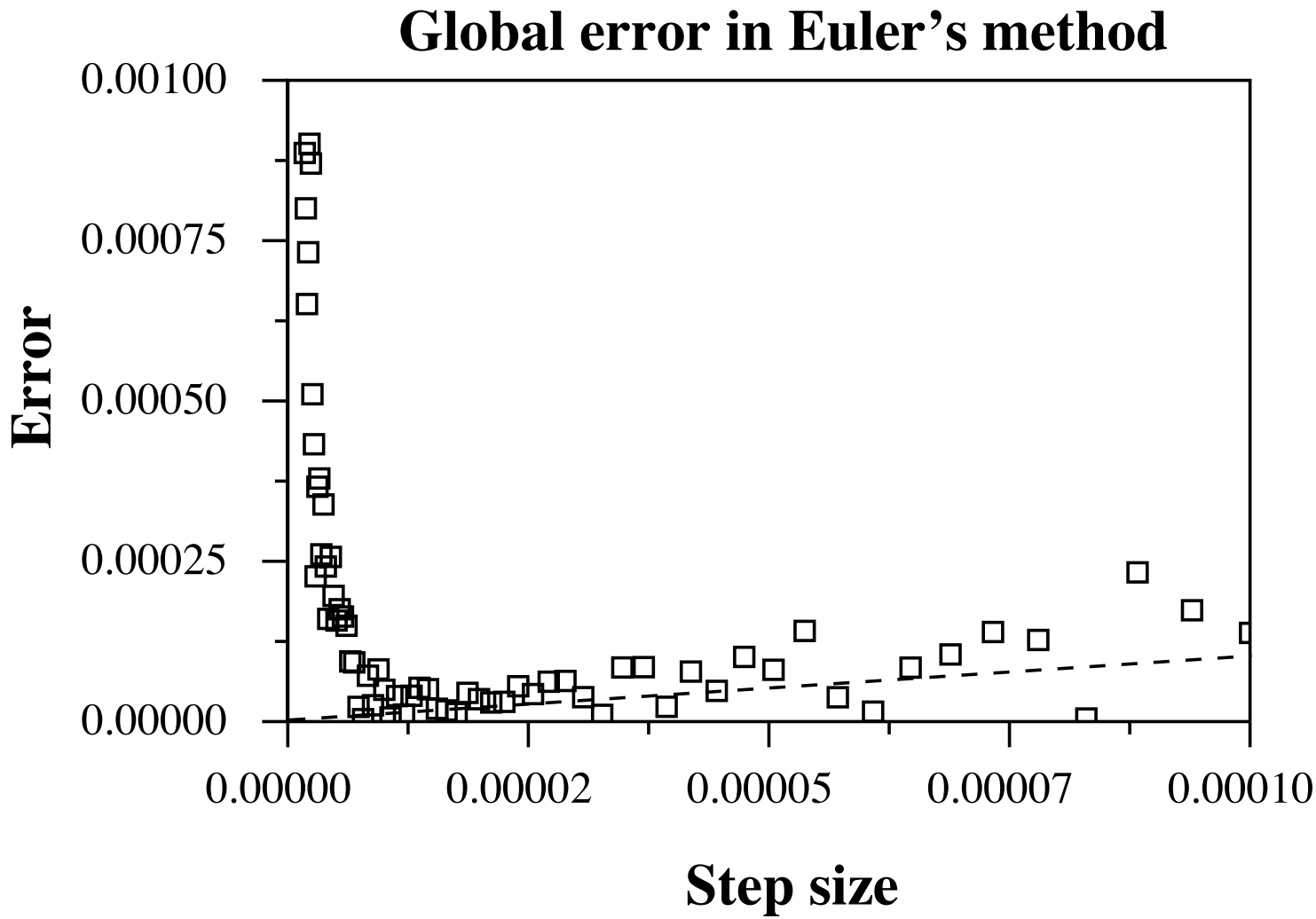

Figure 3.6: Absolute value of the global error in Euler's method for $L = 1$ and $a = 1$. The computation was performed using IEEE-754 single-precision arithmetic. The global truncation error predicted by Eq. (3.111) is shown as a dashed line. For step sizes larger than approximately $h = 0.00001$, the error decreases roughly linearly in h, with considerable scatter due to rounding error. For step sizes much smaller than $h = 0.00002$, the error increases rapidly because of an accumulation of rounding errors.

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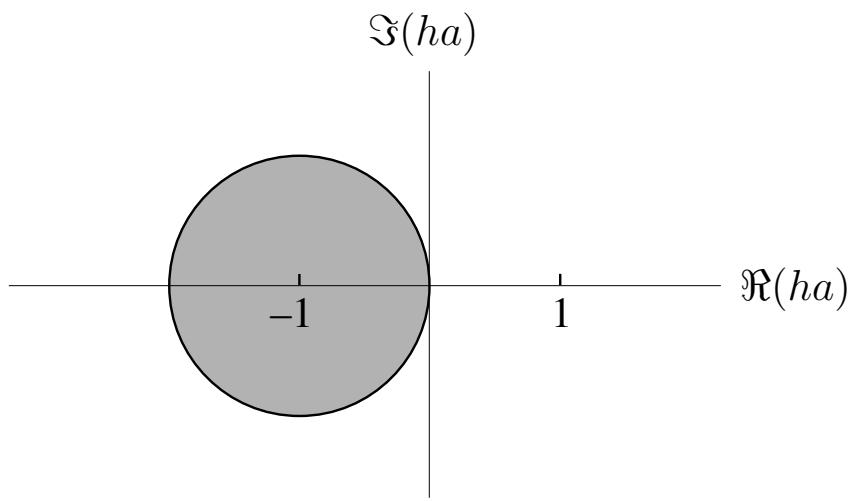

Figure 3.7: The region of stability of Euler's method, computed using the test equation $y' = ay$, is a disk of radius 1 centered at $z = -1$, where $z = ha$.

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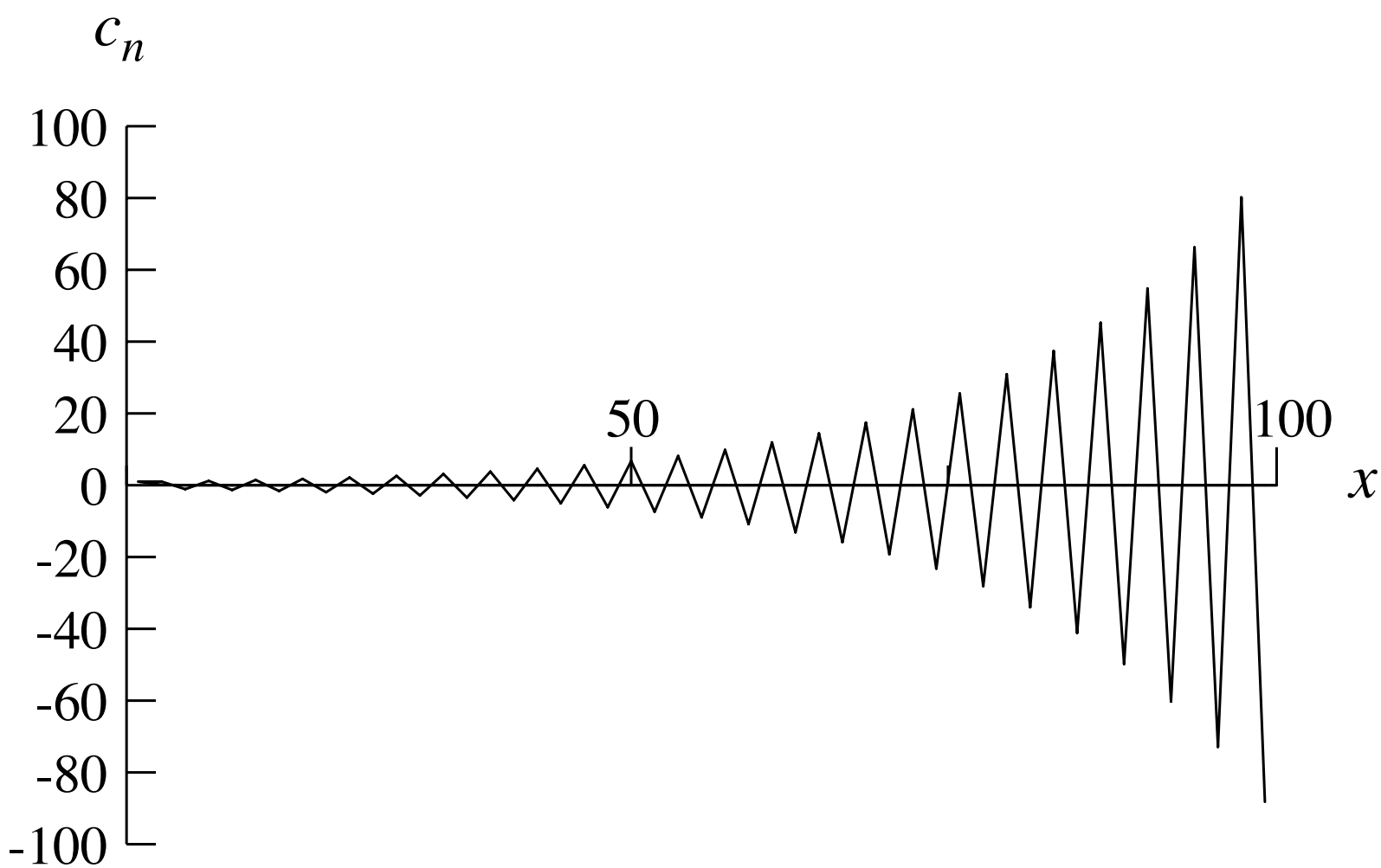

Figure 3.8: The solution computed to the equation $y' = -y$ by Euler's method with a step size $h = 2.1$, which is outside of the region of stability. The initial condition is $y(0) = 1$. The analytical solution is so heavily damped, and is of such a small magnitude, that on the scale of this graph it nearly coincides with the horizontal axis.

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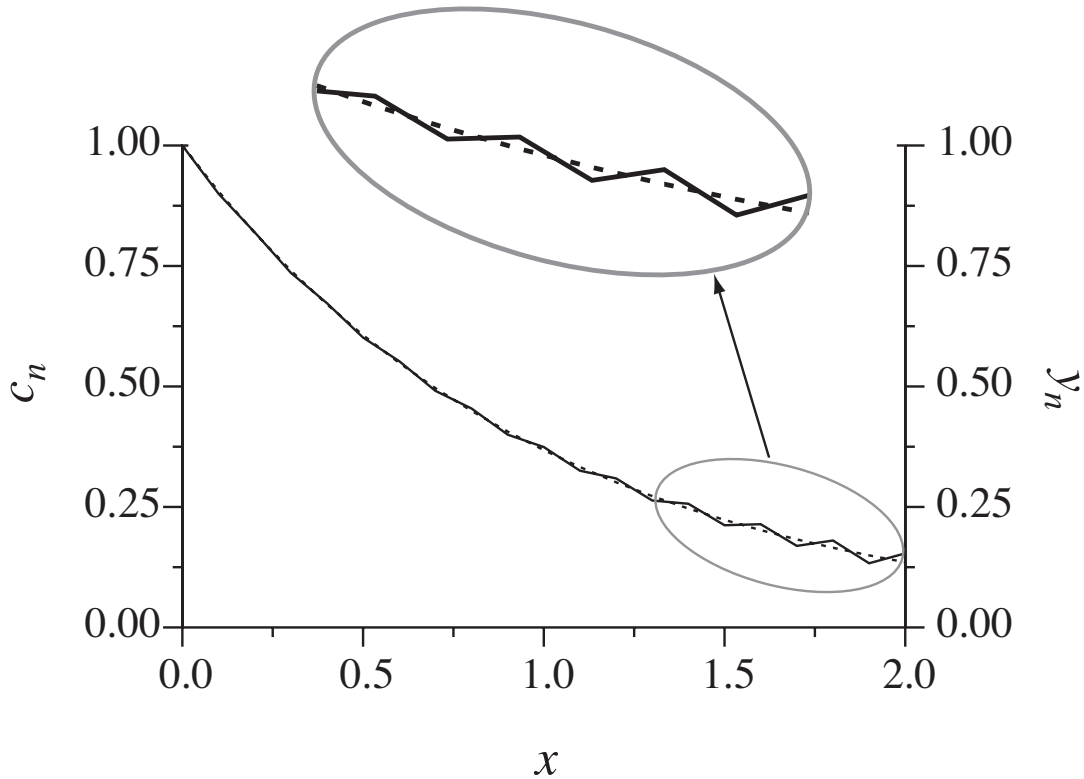

Figure 3.9: The computed (solid line) and exact (dashed line) solutions of the differential equation $y' = -y$, illustrating a weak instability. The first step of the computed solution was taken using Euler's method; the remaining steps were taken with the midpoint method.

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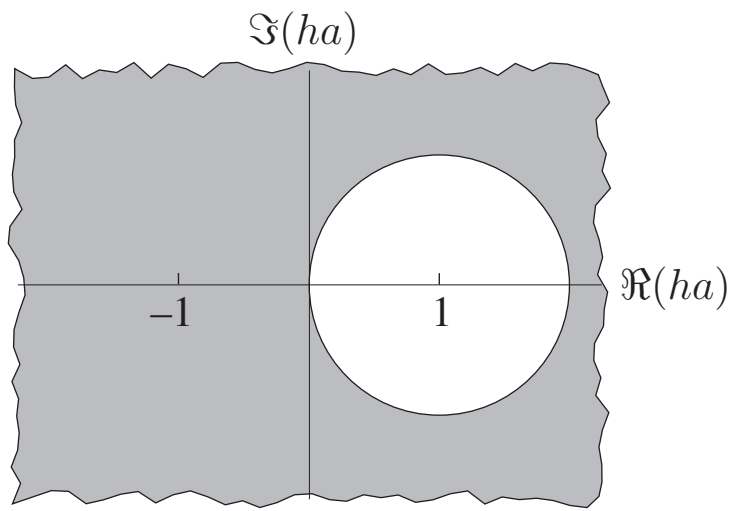

Figure 3.10: The region of stability of the backward Euler method, computed using the test equation $y' = ay$, is the set of points outside, and on the circumference of, a disk of radius 1 centered at $z = 1$, where $z = ha$.

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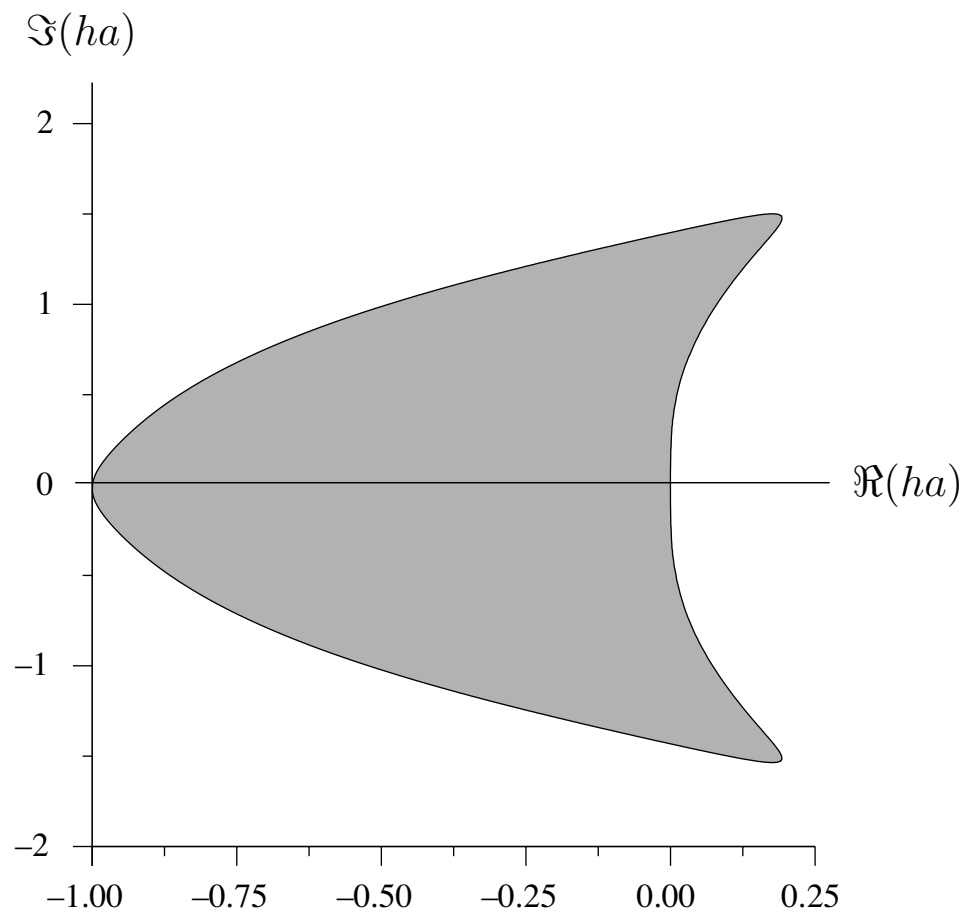

Figure 3.11: The region of absolute stability of the midpoint-trapezoidal predictor-corrector method, computed using the test equation $y' = ay$, in the plane of complex $z = ha$.

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