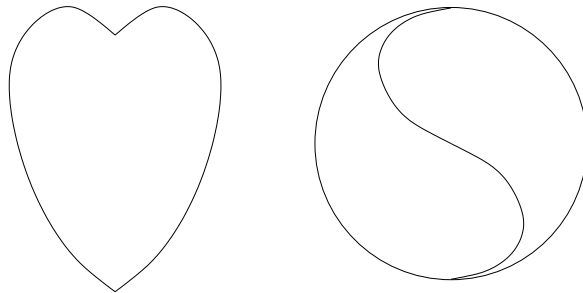


Problems proposed by David Bellamy.

1. Find a function $r = f(\theta)$ whose graph yields a heart shape or a yin yang shape.

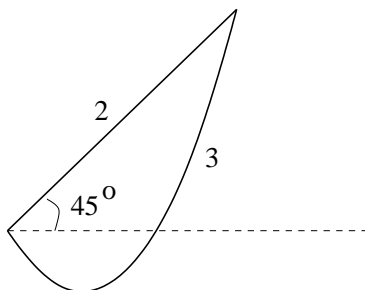


2. Find a polynomial function $y = f(x)$ such that $f(5) = 6$ and is a local max, $f(0) = 0$, and $f(-2) = -3$ and is a local minimum. Use fractions not decimals.
3. Given that $f(x) = ax + b \ln x + c$, and the maximum value of f is zero and occurs at $x = 5$, find a, b, c . There is more than one correct answer and please use exact values.
4. Maple cannot directly evaluate

$$\int_1^5 \sqrt{\sqrt{x} - \sqrt{x-1}} dx .$$

Compute the exact value, with or without Maple.

5. A string of length 3 units hangs from the ends of a rod of length 2 units which is tilted at 45 degrees. Where is the lowest point of the string. (Pick a coordinate system to specify the position of the lowest point.)



6. Let $f(x) = \tan^{-1}x$ and $g(x) = \pi \tanh(2x/\pi)/2$. These graphs have roughly the same shape, the same slope at $x = 0$, and the same limits as $x \rightarrow \pm\infty$. Could one be used as an approximation of the other?
- (a) Over what range of values of x would this approximation be accurate to four decimal places?
- (b) What is the maximum error, and at what x values does it occur. The answers should be accurate to 5 decimal places.
7. Let $x = x(t)$, $y = y(t)$ be the coordinates of the point of inflection of the graph $y = 1/(x^2 + t^2)$ in the right half plane. Describe and plot the curve given by these parametric equations.