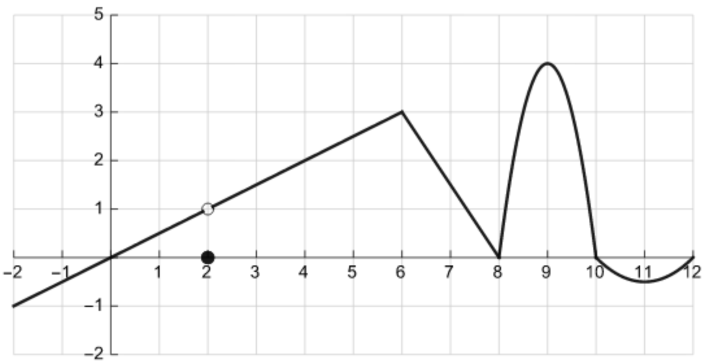
1. Find the equation of the tangent line to the curve $x^2 + xy + y^2 = 7$ at the point $(2, 1)$. Give your answer in the form $y = mx + b$. Use the tangent line approximation to find estimate of the y-coordinate when the x-coordinate is 2.01.

2. The graph of the function $y = f(x)$ on the interval $[-2, 12]$ is given below.



   (a) Find $\lim_{x\to 7} \frac{f(x)}{x}$.
   (b) Find sub-intervals where f is continuous.
   (c) Let D be the domain of f'. Find D, sub-intervals where f' is increasing and draw a rough sketch of the graph of $f' : D \to \mathbb{R}$.

3. Find the maximum and minimum of the function $f(x) = x^2 - 6x + 10$, on $[0, 4]$.

4. Suppose Indira has a wire of length l cm. Indira cuts the wire into 2 pieces.With one of the pieces Indira makes a circle and makes a square with the other. Find the minimum total area occupied by both circle and square.

5. Let $f : \mathbb{R} \to \mathbb{R}$ be given by $f(x) = x^4 - 4x^2$. Find the
   (a) Zeros of f.
   (b) Critical points and characterise them as local maxima, local minima and inflection points.

6. *Extra Credit:* A train is backing away from a vertical wall. The headlight of the train is pointed at the wall, and the beam from the headlight is in the shape of a right circular cone. The headlight illuminates a circular region on the wall, which is the base of the cone of illumination. The lateral surface of the cone of illumination makes an angle of 45° with the horizontal line joining the headlight and the center of the circle on the wall. When the radius of this circle is 4 feet, the *area* of the circle is increasing at a rate of 24π square feet per second. How fast is the train moving away at that time?