1. Find $\dfrac{d^2y}{dx^2}$ for the parametric curve given by $\quad x = 3\cos t + 1, \quad y = t^3$

   - We start with the first derivative:

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\boxed{}}{\boxed{}}$$

   - The second derivative is found as

$$\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}},$$

   which means we need to find the derivative with respect to t of the first derivative:

$$\frac{d}{dt}\left(\frac{dy}{dx}\right) = \frac{d}{dt}\left(\frac{\boxed{}}{\boxed{}}\right) = \boxed{}$$

   - Finally we divide this by dx/dt to find the second derivative:

$$\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}} =$$

2. Find $\dfrac{d^2y}{dx^2}$ at the point $(1, -1)$ for the parametric curve given by $\quad x = 2t + 1, \quad y = t^3 - 1$

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\boxed{}}{\boxed{}}$$

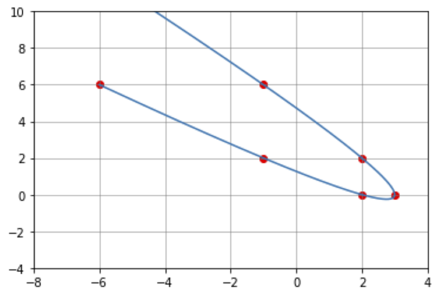
$$\frac{d^2y}{dx^2} = \frac{\frac{d}{dt}\left(\frac{dy}{dx}\right)}{\frac{dx}{dt}} =$$

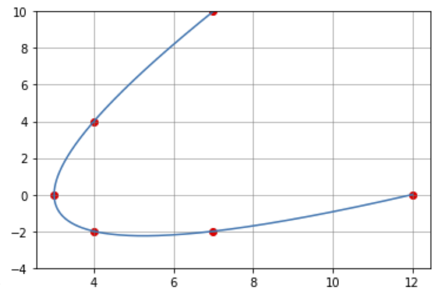
Evaluate at the point

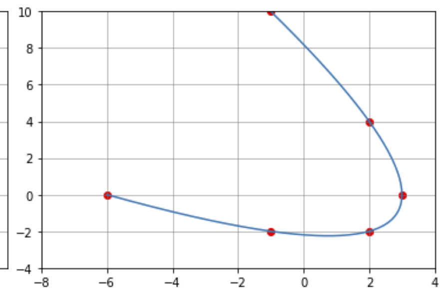
$$\left.\frac{d^2y}{dx^2}\right|_{t=\boxed{}} =$$

3. Consider the parametric curve defined as $\left(3 - t^2, t^2 + 3t\right)$.

    (a) Which graphs corresponds to the given curve?





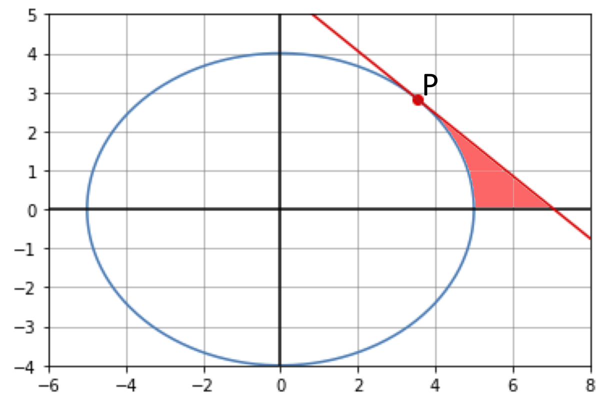


4. Find the slope of the tangent line at the point on the curve where it crosses the positive y-axis.

5. Find the point (x, y) on the curve where the tangent line is horizontal.

6. At the point where $t = 1/2$ is the graph increasing or decreasing?

7. The figure shows a curve with parametric equations $x = 5\cos\theta$, $y = 4\sin\theta$, $0 \leq \theta \leq 2\pi$ and the point P in the curve corresponding to $\theta = \pi/4$.



   (a) Find the equation of the tangent line at P

   (b) Find the area of the shaded region

We first find the slope of the tangent line and the coordinates of the point P.

- $$\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{\boxed{\qquad\qquad}}{\boxed{\qquad\qquad}} =$$

$$\left.\frac{dy}{dx}\right|_{\theta=\pi/4} = \boxed{\qquad\qquad}$$

- The coordinates of P are $\left(\boxed{\qquad\qquad}, \boxed{\qquad\qquad}\right)$

(a) The equation of the tangent line can be found as

$$y - \boxed{\qquad} = \left(\left.\frac{dy}{dx}\right|_{\theta=\pi/4}\right) \cdot \left(x - \boxed{\qquad}\right) \quad \Rightarrow \quad y =$$

(b) To find the area we identify two subareas: A_1 is the area enclosed by the curve for $0 \leq \theta \leq pi/4$, while A_2 is the area of the triangle formed by the tangent line and the coordinate axes. Finally the shaded area is given by

$$A_2 = A_T \boxed{} A_1.$$

- To find A_1 we solve the integral

$$\int_{\boxed{}}^{\boxed{}} y(\theta)\, x'(\theta)\, d\theta =$$

- To find the area of the triangle, A_T, we need to find the point R where the tangent line crosses the x-axis and use the equation for the area of a triangle.
  - Finding R
  - Area of a triangle is base times height divided by two.

Finally the area of the shaded region is