

1. **(8 points)** Find an equation of the tangent line to the curve $y = \sqrt{25 - x^2}$ at $(3, 4)$.

2. **(8 points)** Answer the following derivative-related questions.

(a) **(4 points)** Find $\frac{d}{dx} \cos(e^{\sqrt[3]{x}})$

(b) **(2 points)** If $f(x) = \frac{\sec x}{e^x}$, find $f'(x)$.

(c) **(2 points)** For $y = t \cot(t)$, find $\frac{dy}{dt}$.

3. **(8 points)** Imre is twelve miles north of the Parliament, jogging southwards at six miles per hour; János is five miles to the east of Parliament, walking eastwards at three miles per hour.
- (a) **(4 points)** Is the distance between Imre and János increasing or decreasing, and at what rate?

- (b) **(4 points)** In an hour, will the distance between Imre and János increasing or decreasing, and at what rate?

4. **(8 points)** Differentiate $\frac{\arctan t}{\ln(\sin t)}$ with respect to t .

5. **(8 points)** The *folium of Descartes* is a curve satisfying the equation $x^3 + y^3 - 5xy = 0$.

(a) **(6 points)** Find a formula for $\frac{dy}{dx}$ on this curve.

(b) **(2 points)** Identify conditions on x and y for the tangent lines to the folium to be horizontal and vertical (label which is which!).

6. **(8 points)** A collection of biological samples is taken from a -200°F deep-freeze into a 50°F lab. After 10 minutes it has warmed up to -150°F .
- (a) **(4 points)** Produce a function $T(t)$ modeling the samples' temperature t minutes after they are brought into the lab.

(b) **(2 points)** The samples will become biologically active when they reach 0°F . How long will it take for this to occur?

(c) **(2 points)** How quickly are the samples' temperature changing ten minutes after being brought into the lab?

(d) **(8 points)** Calculate $\frac{d}{dx} \arcsin(x^2 \tan x)$.