

- 1) A particle is moving along the x -axis and its position for $x \geq 0$ is given by the formula $x = \frac{1}{3}t^3 - 2t^2 + 3t$. On what interval(s) is the **velocity** of the particle decreasing ?
- 2) A rock is thrown vertically upward from the edge of a stand on the moon's surface, which is 10 feet above the surface. Its height in meters after t seconds is given by $h(t) = 24t - 0.8t^2 + 10$ (e.g. $h(0) = 10$).
Find the **total distance** traveled by the rock from the time it is thrown up until the time it passes the stand on its way down.
- 3) Find an equation for the **normal line** to the curve $y = x \tan(x)$ at the point $(\pi, 0)$.
- 4) Eliminate the parameter to find a **Cartesian equation** for the curve
 $x = -1 + 3 \sec(t)$ $y = 2 + 3 \tan(t)$
- 5) From the parametric equations $x = t - \sin(t)$, $y = 1 - \cos(t)$,
find the second derivative, $\frac{d^2y}{dx^2}$, at $t = \frac{\pi}{3}$.
- 6) If $f(x) = x \cdot \ln(e^{\sqrt{x}})$, find $f'(1)$.
- 7) Find an equation for the **tangent line** to the curve $x^3 + y^3 = 9xy$
at the point $(2, 4)$.
- 8) If $f(x) = (\tan^{-1}(x))^2$ then $f'(1) =$:
- 9) Find the **slope** of the tangent line to the curve $x \cdot \arctan(y) + x \cdot y = \frac{\pi+4}{4}$
at the point $(1, 1)$.
- 10) If $f(x) = x \cdot \log_3(2^{\sqrt{x}})$, find $f'(1)$.

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- 11) If $f(x) = x^{e^x}$ then find $f'(1)$.
- 12) If $f(x) = \sin^{-1}(\tan(x))$ then find $f'(x)$.
- 13) If $f(x) = x \cdot 4^{-x^2}$ then find $f'(x)$.
- 14) Use logarithmic differentiation to find $\frac{dy}{dx}$ if $y = \sqrt[4]{\frac{x^3+1}{\tan(x) \cdot \sec(x)}}$.
- 15) For $f(x) = 12 \log_8(\ln(x))$, find $f'(e)$.
- 16) There are two points where the curve $x^2 + xy + y^2 = 9$ crosses the x -axis.
At those two points the **tangent lines** are parallel. Find the common **slope**.
(Hint: Point on the x -axis has coordinates $(a, 0)$).
- 17) Find $\lim_{\theta \rightarrow 0} \cos\left(\frac{\pi\theta}{\sin(\theta)}\right)$. (Recall that $\lim_{\theta \rightarrow 0} \frac{\sin(\theta)}{\theta} = 1$)
- 18) At 2:00 PM sailboat **B** is 4 km south of sailboat **A**. After that **A** starts moving east at 4 km/hr and **B** starts moving east at 1 km/hr.
Find the **rate of change** of the distance between the two boats at 3:00 PM.
- 19) When a circular plate of metal is heated in an oven, its radius increases at the rate of 0.01 cm/min. At what rate is the plate's **area** increasing when the radius is 50 cm?
- 20) The length of a rectangle is decreasing at the rate of 5 cm/sec while the width is increasing at the rate of 3 cm/sec. Find the rate of change of the **diagonal** when the length is 10 cm and the width is 15 cm. Is it increasing or decreasing?