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- 1) For the Function described by $f(x) = \sqrt{x-2}$, find:

$$\lim_{h \rightarrow 0} \frac{f(x+h) - f(x)}{h}$$

- 2) Given the following function:

$$f(x) = 3x - x^2$$

- a) Use the definition of the derivative to find the slope of the tangent line at the point(1,2).
b) Write the equation of the tangent line to the function that passes through this point.

- 3) Differentiate the following functions:

a) $f(x) = \frac{x^3 + 2x^2 + x - 1}{\sqrt{x}}$

b) $g(x) = (3x^2 - 1)\left(x^2 - \frac{1}{x}\right)$

- 4) Given that $f(x) = 3x^2\sqrt{4-x^2}$

a) Find $\frac{df}{dx}$.

- b) What values make $\frac{df}{dx} = 0$ or become undefined?

c) Find $\frac{d^2f}{dx^2}$.

- 5) The functions $h(x)$ and $k(x)$ below are combinations of the differentiable functions $f(x)$ and $g(x)$.

$$h(x) = \frac{f(x)g(x)}{f(x) - g(x)}, \quad k(x) = f(g(x) + x^2)$$

- a) Find $h'(x)$.
b) Find $k'(x)$.

The following table lists some of the values of functions $f(x)$, $f'(x)$, $g(x)$ and $g'(x)$.

	$x = 1,$	$x = 0,$	$x = -1,$
$f(x)$	2	0	-1
$f'(x)$	-1	2	4
$g(x)$	-2	1	-3
$g'(x)$	3	-1	2

- c) Find $h'(1)$
d) Find $k'(1)$



- 6) Let $p(x) = -0.3x + 20$ and $C(x) = 5x + 12$ be the demand and cost functions, respectively, which model a particular company's new product when production is between 0 and 100 units.
- Find the profit function, $P(x)$.
 - Find the marginal profit when the company produces 25 units.
 - Use differentials to estimate the change in the company's profit between producing 25 units to 28 units.
 - Approximately, what is the company's profit when they produce 28 units.
 - For which range of production levels is the company's Profit increasing and decreasing?
 - Suppose the company's weekly production can be modeled by $x(t) = 2t^2 + 8t + 15$. Where x is the number of units produced per week and t is the number of weeks since the company began producing the new product. Find $\frac{dP}{dt}$ one week after the production started and two weeks after the production started.

- 7) A business is currently selling 1000 novelty wind chimes for \$100 each. It is estimated that for each decrease in price of \$20, the monthly sales will increase by 200 chimes.
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- 8) Find the x-values where the function below has horizontal tangent lines, then find where it is increasing and decreasing. Sketch a graph of the function.

$$f(x) = (2x - 1)^3(3x - 1)^4$$

- 9) A ball is thrown up off of a rooftop 320 feet above the ground with an initial velocity of 128 ft/sec.
- Using the generic formula for the height of a ball (modeled by a parabolic path):
$$h(t) = -16t^2 + v_0t + h_0$$
where v_0 is the ball's initial velocity, and h_0 is the ball's initial height, find the equation describing the height of ball at every time, t.
 - Find the velocity, $v(t)$, and acceleration, $a(t)$, functions.
 - What is the velocity of the ball just as it hits the ground?
 - Find the average velocity on the interval $[1,3]$.

- 10) Gator. P. Ballers (GPBL on NASDAQ) sells "student enhancement" products. The cost of producing x units of "enhancement" products is modeled by the function

$$C(x) = 400 + 50x + 0.03x^2$$

- Find the average cost function.
- Find the average cost at a 100 units.
- Find the marginal cost at a 100 units and the marginal average cost at a 100 units.
- Using differentials, Estimate the cost increase or decrease between producing 100 and 102 units.



11) Find a and b so that $g(x)$ is continuous and differentiable for all values of x , where

$$g(x) = \begin{cases} ax + 4, & x < 1 \\ 3x^2 + b, & x \geq 1 \end{cases}$$

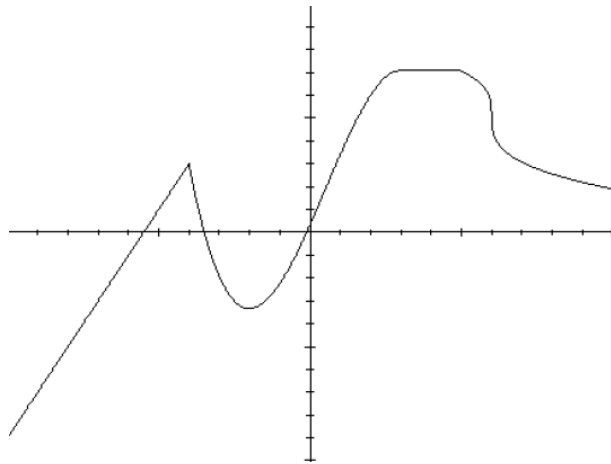
12) Find the values of a so that the tangent line to $y = x^2 - 2\sqrt{x} + 1$ is perpendicular to the line $ay + 2x = 2$ at $x = 4$.

13) There is an implicit relationship between the variables x and y in the following relation:

$$x^2y^3 - y^2 = 1 - xy$$

Find the equation of the tangent line to the graph of this relation at the point $(1,1)$.

14) Given the graph below:



Identify where the function...

- a) ...is increasing,
- b) ...is decreasing,
- c) ...is constant,
- d) ...has horizontal tangent lines,
- e) ...is not differentiable. Can you classify the types of non-differentiability.
- f) Now use the answers above to sketch the graph of the derivative.

15) For some strange reason a diabolical math teacher has asked you to calculate the area between a 10 ft wooden plank, a wall, and the smooth concrete ground. As you began to calculate, the wooden plank begins moving at a rate of 3 ft/sec. How fast is the area between the plank, wall, and ground changing when the height of the plank is only 6 ft off the ground?

16) Explain why the intermediate value theorem does or does not guarantee a solution of the given equation in the specified interval:

- a) $(x - 1)^4 + x - 4 = 0$ on the interval $(2,3)$
- b) $\frac{2x-x^2}{3x^4} = 0$ on the interval $(-1,1)$
- c) $\sqrt[3]{x-2} = 3 - x$ on the interval $(-2, -1)$