Unit 4 – Contextual Application of Derivative

4.1 Interpreting the Meaning of the Derivative in Context
4.2 Straight-Line Motion: Connecting Position, Velocity and Acceleration ** WATCH AP LIVE #10 "8.2" **
4.3 Rates of Change in Applied Contexts Other Than Motion
4.4 Introduction to Related Rates / 4.5 Solving Related Rates Problems
4.6 Tangent Line Approximations
4.7 L'Hospital's Rule (sometimes L'Hôpital's)

4.1 The function $C(x)$ gives the cost of digging a hole x feet deep.

$\boldsymbol{C(20) = 140}$ means that a hole __________ deep costs ___________ to dig.

$\boldsymbol{C'(20) = 5}$ means that when the hole is _____________________, the cost of digging is _______________ at a rate of __________________________.

4.2 A particle moves back and forth on a horizontal track for $0 \le t < \frac{\pi}{2}$ minutes. The particle's position, in feet, is given by the function $s(t) = \frac{1}{2}\tan t$. Find the acceleration of the particle at time $t = \frac{\pi}{6}$ minutes and indicate units of measure.

4.3 If $P(t)$ models the size of a population at time $t > 0$, which of the following differential equations describes linear growth in the size of the population? Which describes exponential growth?

$\frac{dP}{dt} = 200$	$\frac{dP}{dt} = 200t$	$\frac{dP}{dt} = 100t^2$	$\frac{dP}{dt} = 200P$	$\frac{dP}{dt} = 100P^2$

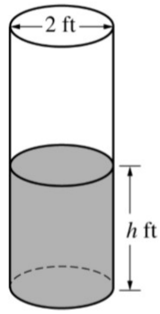
4.4 Determine $\frac{dz}{dt}$ if you know that $z = xy^2,\ z = 3,\ y = \frac{1}{2},\ \frac{dx}{dt} = -2,$ and $\frac{dy}{dt} = 5.$

4.5 Free Response Question (FRQ) Practice in a bit!!

4.6 Given $g(x)$ is a differentiable function about which little else is known other that $g(-3) = 2$ and $g'(-3) = 7$. Use the tangent line of $g(x)$ at $x = -3$ to approximate $g(-2.9)$.

4.7 $\lim_{x\to 5} \frac{x^4-625}{x^2-25}$

2019 AB/BC 4



4. A cylindrical barrel with a diameter of 2 feet contains collected rainwater, as shown in the figure above. The water drains out through a valve (not shown) at the bottom of the barrel. The rate of change of the height h of the water in the barrel with respect to time t is modeled by $\frac{dh}{dt} = -\frac{1}{10}\sqrt{h}$, where h is measured in feet and t is measured in seconds. (The volume V of a cylinder with radius r and height h is $V = \pi r^2 h$.)

(a) Find the rate of change of the volume of water in the barrel with respect to time when the height of the water is 4 feet. Indicate units of measure.

(b) When the height of the water is 3 feet, is the rate of change of the height of the water with respect to time increasing or decreasing? Explain your reasoning.

2018 AB/BC 4

(d) The height of the tree, in meters, can also be modeled by the function G, given by $G(x) = \dfrac{100x}{1 + x}$, where x is the diameter of the base of the tree, in meters. When the tree is 50 meters tall, the diameter of the base of the tree is increasing at a rate of 0.03 meter per year. According to this model, what is the rate of change of the height of the tree with respect to time, in meters per year, at the time when the tree is 50 meters tall?

2017 AB/BC 4

4. At time $t = 0$, a boiled potato is taken from a pot on a stove and left to cool in a kitchen. The internal temperature of the potato is 91 degrees Celsius (°C) at time $t = 0$, and the internal temperature of the potato is greater than 27°C for all times $t > 0$. The internal temperature of the potato at time t minutes can be modeled by the function H that satisfies the differential equation $\frac{dH}{dt} = -\frac{1}{4}(H - 27)$, where $H(t)$ is measured in degrees Celsius and $H(0) = 91$.

(a) Write an equation for the line tangent to the graph of H at $t = 0$. Use this equation to approximate the internal temperature of the potato at time $t = 3$.

(b) Use $\frac{d^2H}{dt^2}$ to determine whether your answer in part (a) is an underestimate or an overestimate of the internal temperature of the potato at time $t = 3$.