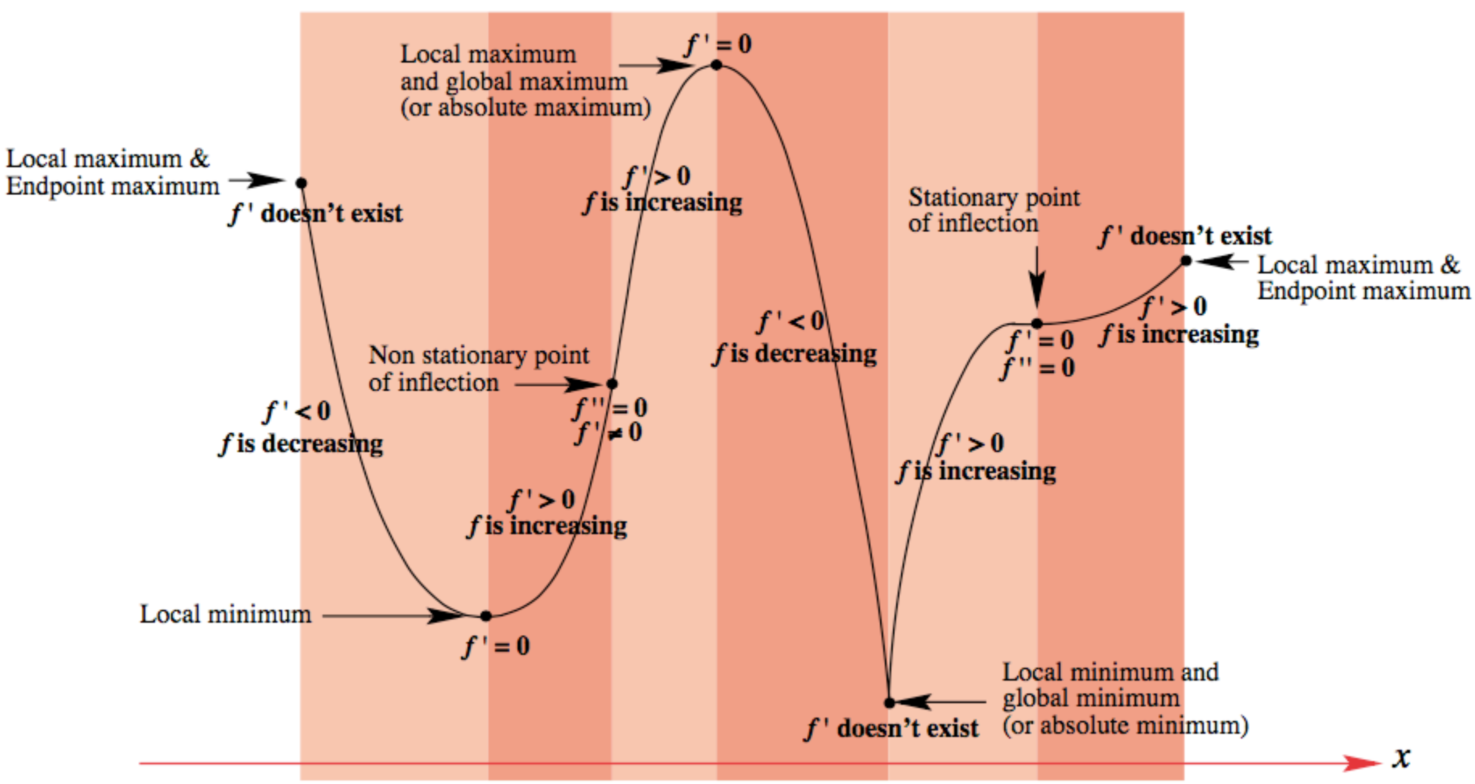
A. Lesson Context

CONTEXT of this LESSON:	Where we've been We know how to determine the equations of derivative functions using the Power Rule	Where we are Can we now work with and analyze functions (and function models) using the Power Rule	Where we are heading Can I find generalized methods/techniques for working with instantaneous RoC for ANY function types?

B. Concept Review

A lot of ground has been covered with the many definitions encountered. So, below is a visual summary of the definitions we have covered to date.



Opening (REVIEW) Example

a. Ex 1: Differentiate the following:

i. $g(x) = 5\sqrt{x} - \frac{10}{x^2} + \frac{1}{2\sqrt{x}} - 3x^4 + 1$ ii. $b(x) = 4x^{-\frac{3}{2}} + 2x^{\frac{5}{2}} - x$

iii. $b(x) = 0.1x^3 + 2x^{\sqrt{2}} - \frac{2}{x^{\pi}}$

b. Find the second derivatives of :

i. $a(x) = \frac{1}{x^2}$ ii. $g(x) = \mathrm{x}^{1/2} + x^3$ iii. $b(x) = 4x^{-\frac{3}{2}} + 2x^{\frac{5}{2}} - x$

C. Examples: Working with Polynomial Functions

1. Find the equation of the line which is orthogonal to the curve $y = 5x - 32\sqrt{x}$ at $x = 4$.

2. Determine the equation of the line that is tangent to $y(t) = \frac{1-2t}{\sqrt{t}}$ at $t = 4$.

3. Find all critical points of $s(t) = t - 4\sqrt{t}$.

4. Determine the interval(s) in which $g(x) = x + \frac{1}{x}$ is increasing and decreasing.

D. Examples: Working with Polynomial Models

1. The average speed (in m/s) of a gas molecule is calculated by $v^2 = \frac{8RT}{\pi M}$, where T is temperature in Kelvin, M is the molar mass (in kg/moles) and $R = 8.31$.

   a. Rearrange the equation so you have the velocity as a function of the temperature ➔i.e $v(T) =$.

   b. Find the molar mass of one kilogram of oxygen molecules.

   c. Determine the value of $\frac{dv}{dT}$ when $T = 300$K and when $T = 3000$K. Interpret your answer.

   d. Is there a maxiumum speed possible for the oxygen molecule? Why/why not?

2. Biologists have observed that the pulse rate (P, in beats per minute) in animals is related to body mass (m, in kilograms) by the approximate formula $P(m) = \frac{200}{\sqrt[4]{m}}$.

   a. Is $P(m)$ an increasing or decreasing function? Show the mathematica analysis that leads to your answer.

   b. Find the equation of the tangent lines to the function at $m = 35$ (say the weight of an adult goat) and $m = 75$ (say the weight of an HL1 student).

   c. What does this model suggest about the pulse rate of a child as they get older? Explain.

E. Further Polynomial Function Analysis: Intervals of Increase & Decrease

1. Given the following functions, use calculus to determine: (and then your TI-84 to verify)

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

   $(b)\ g(x) = 2\sqrt{x} - x$

   a. the co-ordinates of the extrema
   b. the intervals of increase & decrease

2. Use the FDT to classify all extrema of the function $y = x\left(x - 8\sqrt{x}\right)$.

3. Determine the intervals of increase and decrease of the following functions:

   (i) $f(x) = x^{\frac{3}{2}} - \frac{4}{\sqrt{x}}$

   (ii) $g(x) = 6x^{\frac{3}{2}} - 4\sqrt{x}$

   (iii) $h(x) = x^4 - 4x^{\frac{5}{2}}$

4. Determine the absolute extrema for $g(x) = x^{\frac{5}{2}} - x^2$ on $(0,2]$.

5. Go online and find out what the **Mean Value Theorem** states. Then, verify the MVT with:

   a. $f(x) = \sqrt{x}$ and $x_1 = 1$ and $x_2 = 9$.
   b. $g(x) = x^3 - 2x + 5$ and $x_1 = -1$ and $x_2 = 2$.