Warm-up

Find $f'(x)$:

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

2) $f(x) = 5x^2 \tan x$

3) $f(x) = (6x+4)^9$

4) $f(x) = \frac{7x^2}{2x+1}$

1) $f(x) = 2x^3 + x^{-1} + 3$

$f'(x) = 6x^2 - x^{-2}$

$= 6x^2 - \frac{1}{x^2}$

2) $f'(x) = 10x\tan x + 5x^2\sec^2 x$

3) $f'(x) = 9(6x+4)^8 \cdot 6$

$= 54(6x+4)^8$

4) $f'(x) = \frac{14x(2x+1) - 7x^2 \cdot 2}{(2x+1)^2}$

$= \frac{28x^2 + 14x - 14x^2}{(2x+1)^2}$

$= \boxed{\frac{14x^2 + 14x}{(2x+1)^2}}$

14) $y = \dfrac{-1}{\sqrt{x^2-4}}$

$y = -(x^2-4)^{-\frac{1}{2}} - 1$

$y' = \frac{1}{\cancel{2}}(x^2-4)^{-\frac{3}{2}} \cdot \cancel{2}x$

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

$= \dfrac{x}{(x^2-4)^{3/2}}$

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9) $y = \left(1 - \underset{(x^{-1})}{\frac{1}{x}}\right)^2$

$$y' = 2\left(1 - \frac{1}{x}\right) \cdot x^{-2}$$

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

$$= \frac{2 \cdot x - \frac{2}{\cancel{x}} \cdot \cancel{x}}{x^2 \cdot x} = \frac{2x - 2}{x^3} = \frac{2x}{x^3} - \frac{2}{x^3}$$

$$= \boxed{\frac{2}{x^2} - \frac{2}{x^3}}$$

Derivative applications

(1) slope of the tangent line

(2) rate of change

ex: Write an equation of the tangent line to $f(x) = x^3 + 2$ at $x = -1$

$(-1, 1)$ point

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

$f'(-1) = 3$

$\boxed{y - 1 = 3(x + 1)}$

1^{st} derivative

$f'(x) > 0 \Rightarrow f(x)$ increasing

$f'(x) < 0 \Rightarrow f(x)$ decreasing

$f'(x) = 0$ or undef. c.p. (possible extrema)

1st deriv. test

f' $+ \;|\; -$ $- \;|\; +$

c.p.   c.p.

max   min

2nd deriv. test

$f''(c.p.) > 0$ min.

$f''(c.p.) < 0$ max.

$f''(c.p.) = 0$ TEST FAILS!

2nd deriv.

* $f'' > 0 \Rightarrow f'$ increasing $\Rightarrow f$ concave up

* $f'' < 0 \Rightarrow f'$ decreasing $\Rightarrow f$ concave down

$f'' = 0$ or undef. p.p.o.i.

f'' $\quad + \mid - \quad\quad - \mid +$

the p.o.i. on f are extrema on f'

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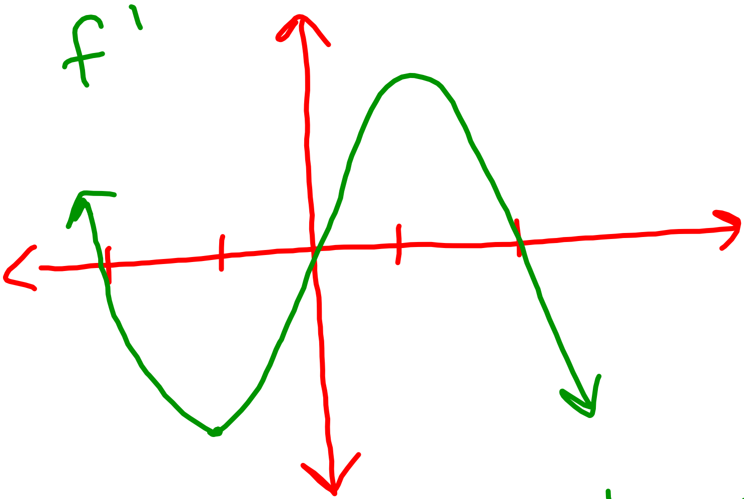
ex: f'



a) Find the intervals where f is increasing or dec.

b) Find any relative extrema

c) Find any p.o.i's.

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