RULES

combine ±, *, ÷, comb		Deriv	Leibniz
$Au \pm Bv$	$(\pm C\cdot)$	$Au' \pm Bv'$	$d(uv) = v\,du + u\,dv$
$u * v$		$u'v + uv'$	
$\frac{u}{v}$	(PROD	$[uv' + u'v]$	$d\left(\frac{u}{v}\right) = \frac{v\,du - u\,dv}{v^2}$
$u \circ v$;	(QUOT)	$\frac{vu' - v'u}{V^2}$; $u'(v) * v'$	$d(u(v)) = \frac{du}{dv}\,dv$
$\frac{d}{dx} f(g(x))$	(CHAIN)	$f'(g(\cdot))\,g'(\cdot)$	

(eval at v)

CHAIN RULE $y = f(u)$ $u = g(x)$

$$\frac{dy}{dx} = \underbrace{\frac{dy}{du}}_{\text{eval where}} \frac{du}{dx} \quad \left(\left.\frac{dy}{du}\right|_{u=u(x)} \cdot \frac{du}{dx} \right) \qquad \text{p. 139}$$

Example

$y = (3x+1)^2$ THE MOVIE $\quad x \longrightarrow (3x+1) \longrightarrow (3x+1)^2$

$\frac{dy}{dx} = 2(\quad)$

Derivative of Sq. fn is $2(\quad)$

where $2(3x+1)\cdot$ eval at "$3x+1$" TIMES

$2(3x+1)\cdot 3$

Ex. $y = (3x^2+1)^2$

$\frac{dy}{dx} = 2(3x^2+1)^{1} \cdot \underbrace{(6x)}_{\text{der of } 3x^2+1}$

$= 6x(3x^2+1)$

Power Rule

$$\frac{d}{dx}u^b = b u^{b-1}\frac{du}{dx}$$

$(x \to u(x) \to (u(x))^b$

$y = \left(\frac{1}{x} + x\right)^2$ ~~$\neq$~~

$\frac{dy}{dx} = 2\left(\frac{1}{x} + x\right)\cdot\left(-\frac{1}{x^2} + 1\right)$

Ex1 $\frac{d}{dx}\sqrt{x^2+5x+4} = \frac{1}{2\sqrt{x^2+5x+4}}\cdot(2x+5)$

"eval"

$\overline{\text{cleanup}}$ $\frac{2x+5}{2\sqrt{x^2+5x+4}}$

Example 2-4-3 $C(x) = \frac{1}{3}x^2 + 4x + 5$

Production level at hours into run

$x(t) = 0.2t^2 + 0.03t$

Find rate of change of cost when $t = 4$ hours

? Prefer particular time

SAY: Formula (all t)

$C(t) = C(x(t)) = ($?!) write?

$\frac{dC}{dx} = \frac{2}{3}x + 4$, $|_{\text{eval } x = \cancel{0.2t}\ 0.2t^2 + .03t}$

$\frac{dx}{dt} = 0.4t + 0.03$) $|_{\text{eval } t}$

Q. Ex 2.4.4. $f(x) = \sqrt{x^2+3x+2} = \sqrt{\square}$ $\square = \ldots$

POWER RULE

$$\frac{d}{dx}[u(x)]^b = b[u(x)]^{b-1}\frac{du}{dx}$$

Ex $\frac{1}{(2x+3)^2}$ $\frac{dy}{dx} = \frac{-2}{(2x+3)^3}\cdot 2 = \underset{\text{cleaned}}{\frac{-4}{(2x+3)^3}}$

Combination $\frac{d}{dx}\left(\frac{1}{v}\right) = \frac{-1}{v^2}\frac{dv}{dx}$

N.B Quotient $\frac{u}{v} = u\cdot\frac{1}{v}$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{d}{dx}\left(u\cdot\frac{1}{v}\right)$$

$$= u'\cdot\frac{1}{v} + u\cdot\left(-\frac{1}{v^2}v'\right)$$

$$\underset{\text{LCD}}{=} \frac{u'v - uv'}{v^2}$$

Combinations ....

2.4. #29 $f(x) = (x+2)^3(2x-1)^5$

Handa. 31. $G(x) = \sqrt{\frac{3x+1}{2x-1}}$

(43) Horizontal Tan line

$f(x) = (x^2+x)^2$; $2(x^2+x)(2x+1)$

$= 0$ when $x = -\frac{1}{2}$; $x = 0, x = -1$