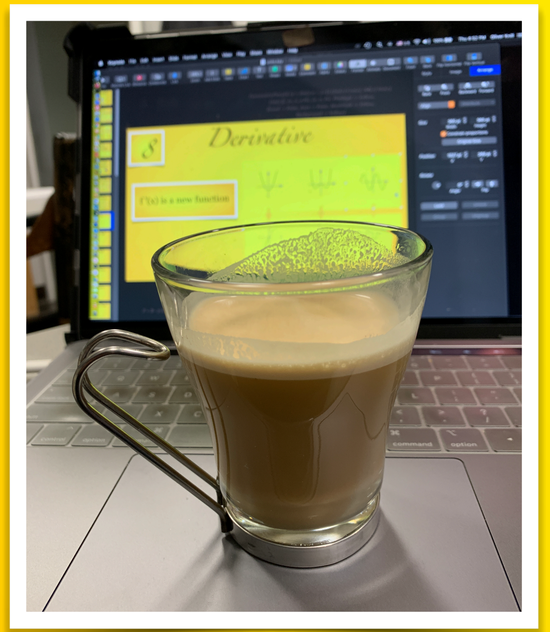
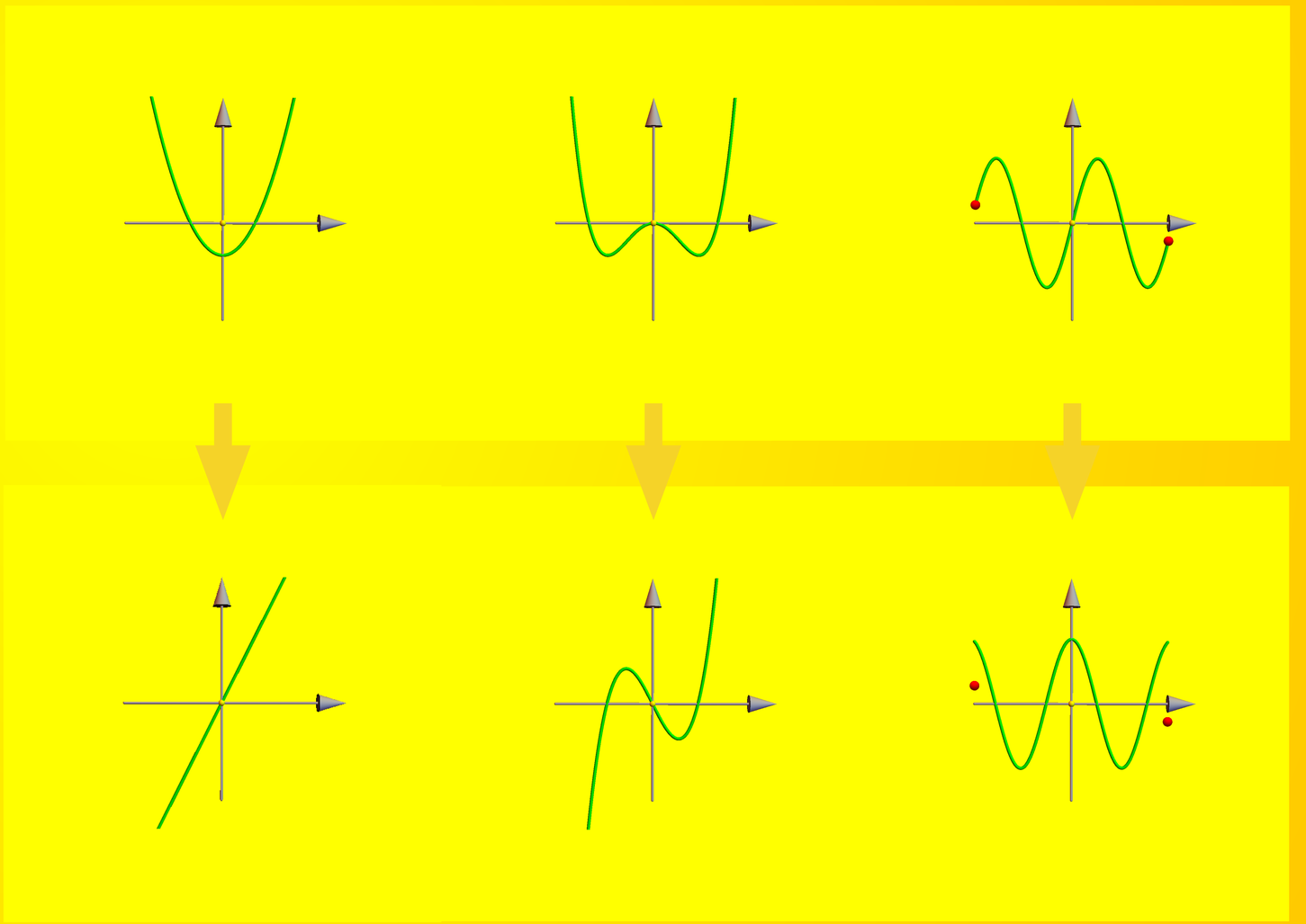
8 Derivative

f '(x) is a new function

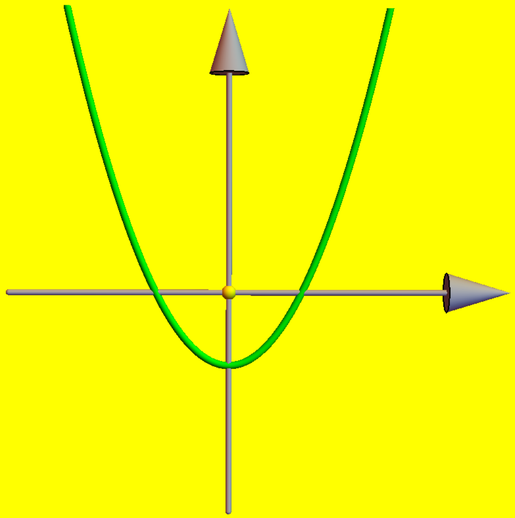


bottle
cali-
bration

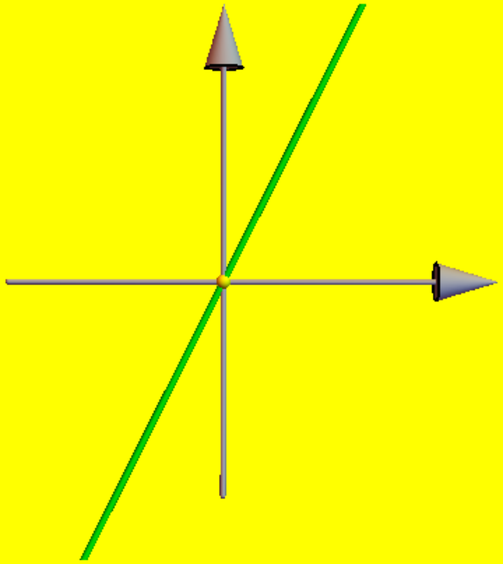


Derivative Operation

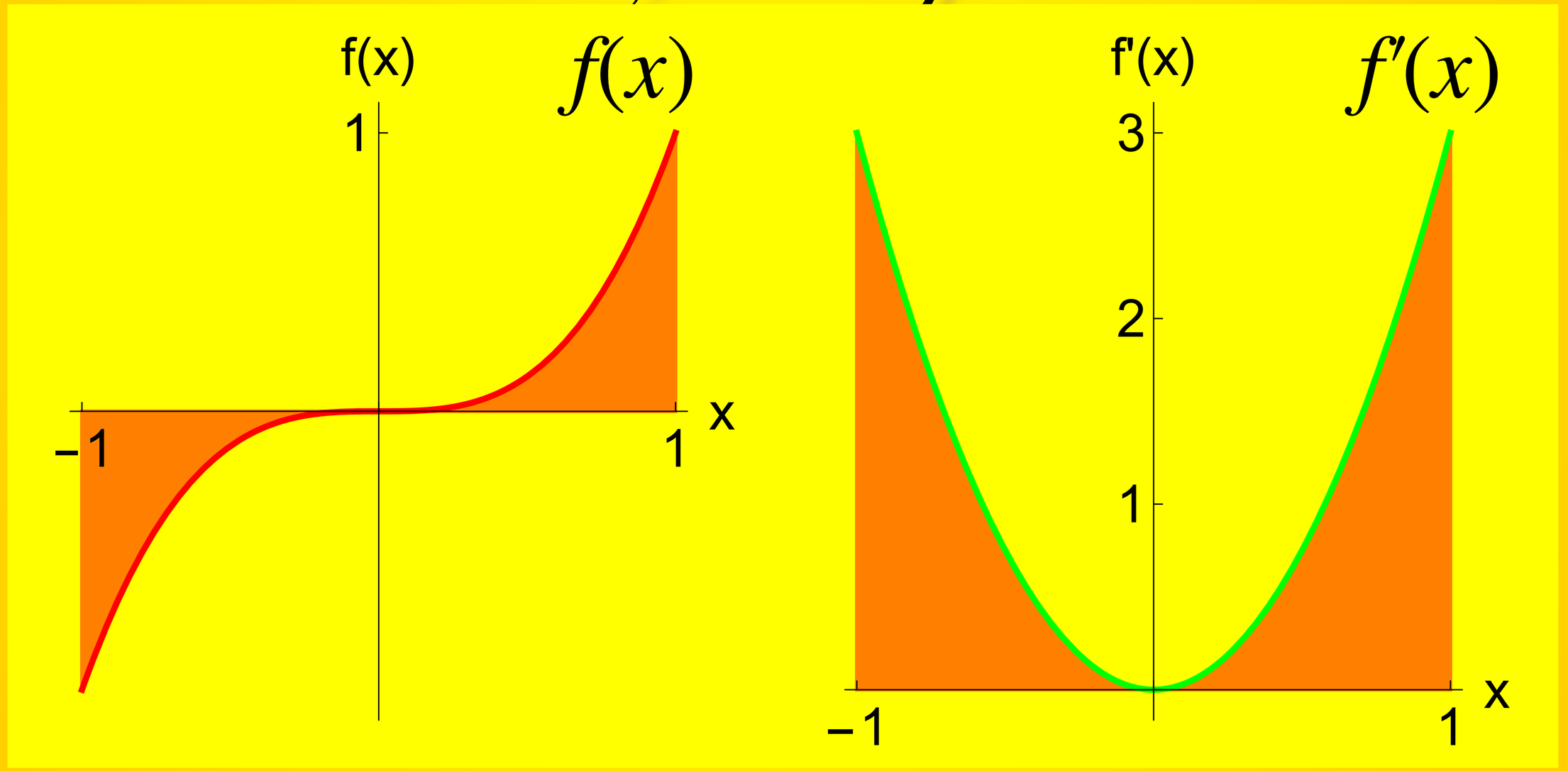
f



g=f



Can you spot it?



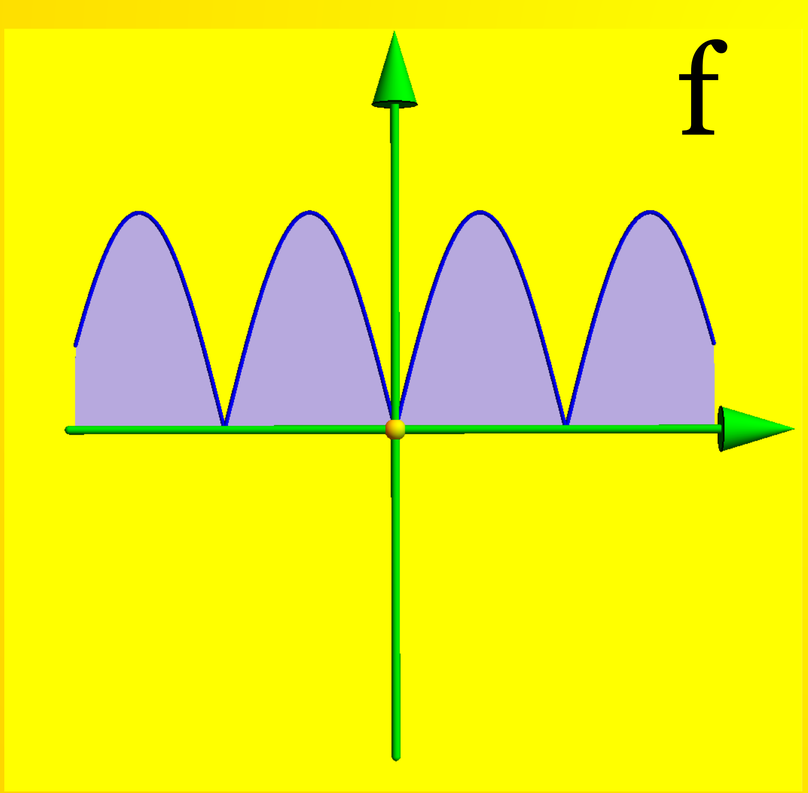
Poll

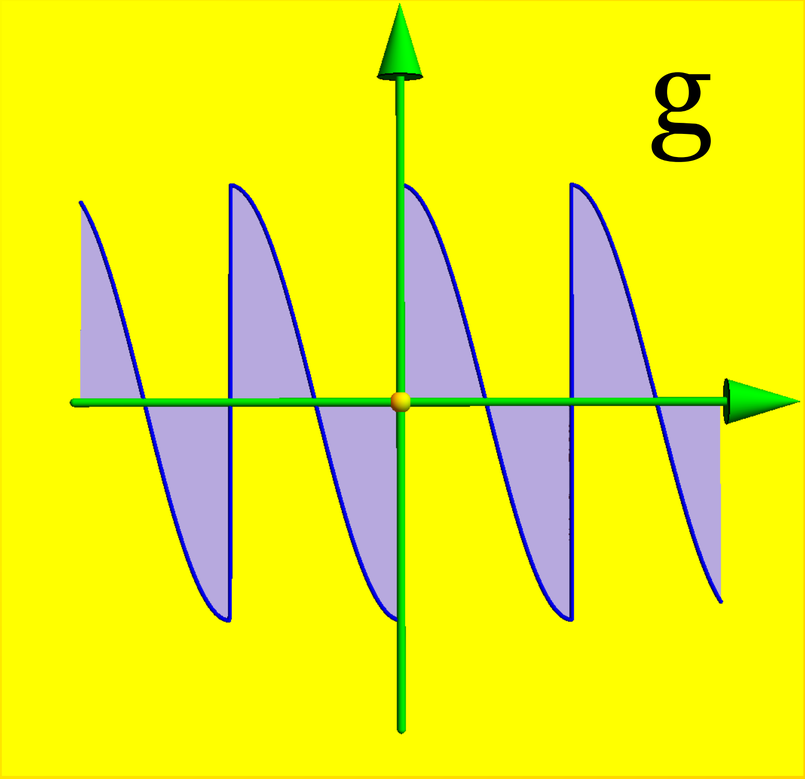
A: f' = g

B: g' = f

C: f'' = g

D: g'' = f

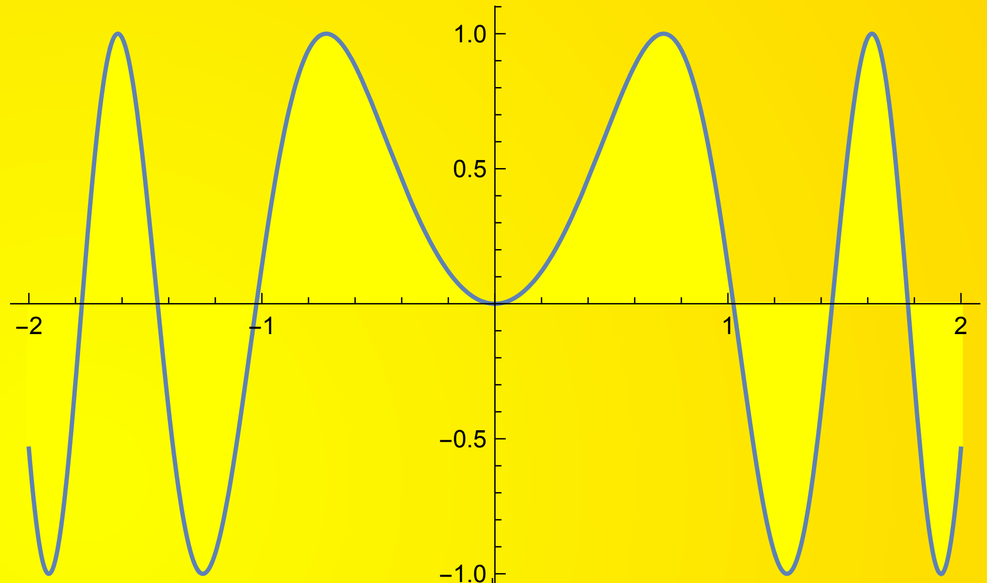




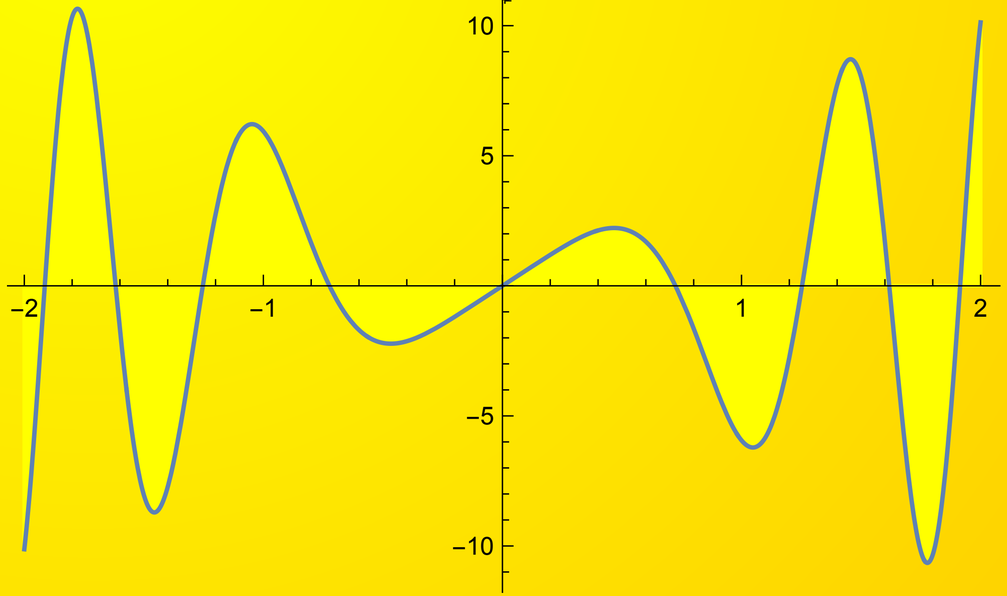
POLL

One of the functions is f and one is f'. Which one is f, A or B?

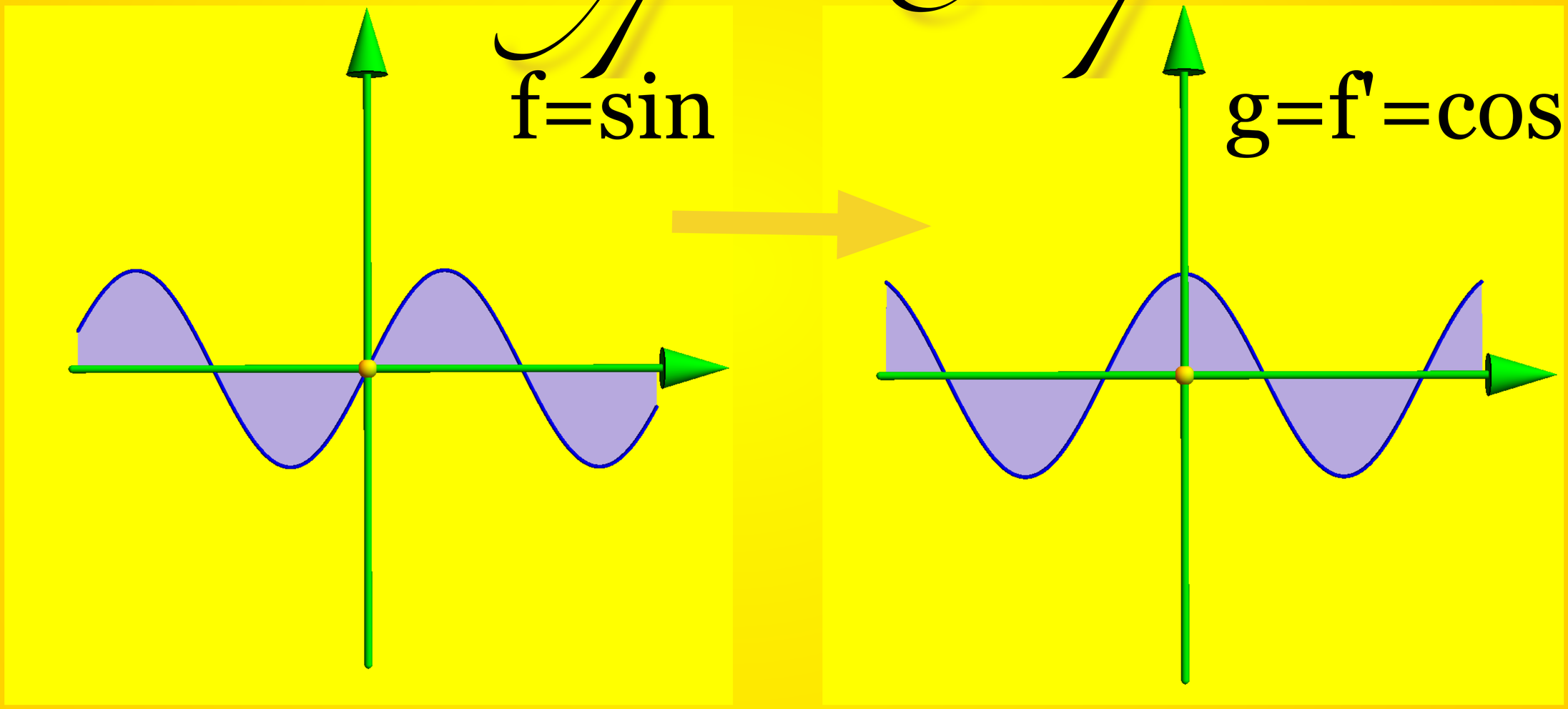
A



B



Prototype example

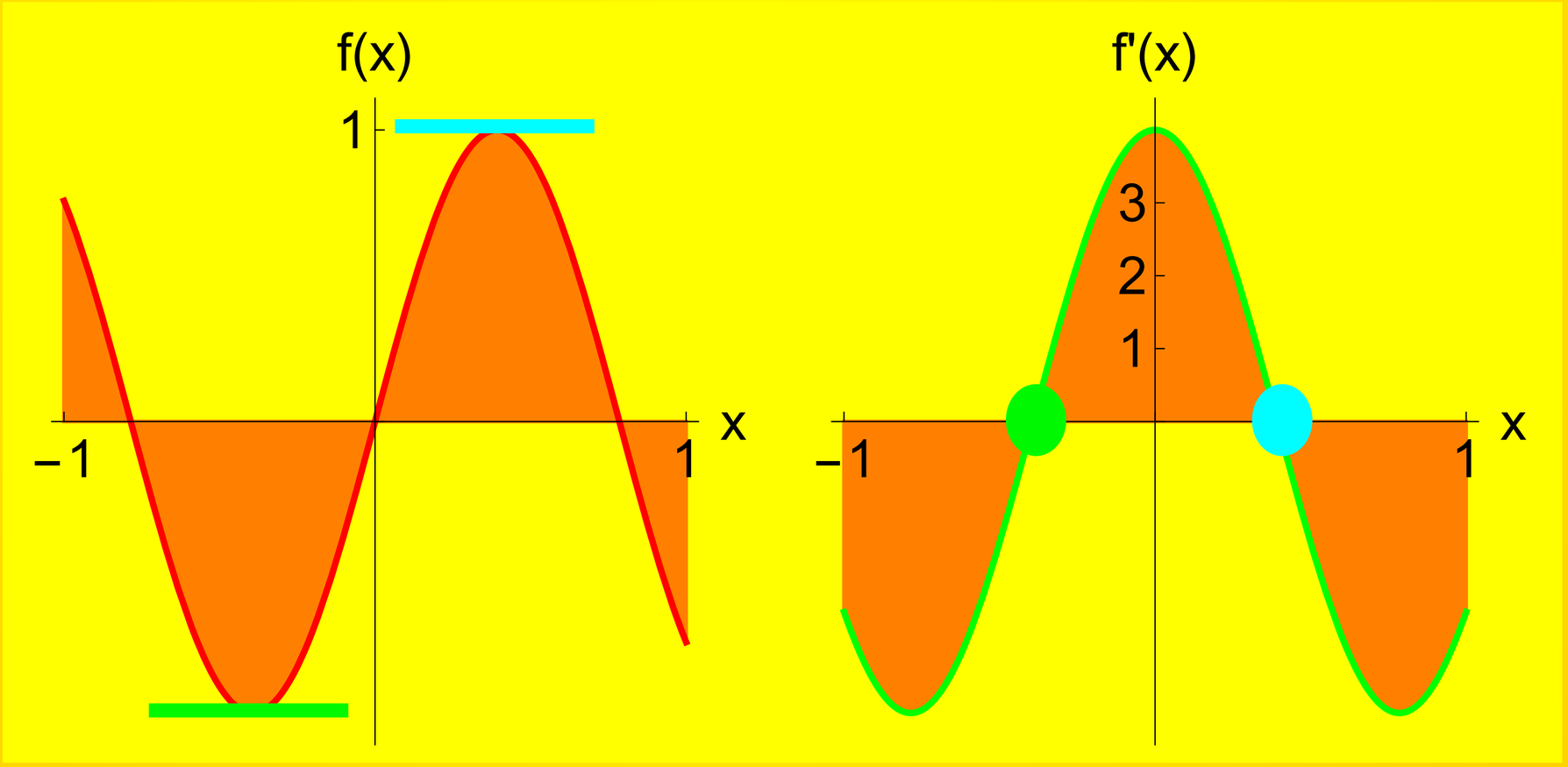


More Proto types

f	f'	f''
x^2	$2x$	2
x^3	$3x^2$	$6x$
$\sqrt{x}$	$\frac{1}{2\sqrt{x}}$	$\frac{-1}{4x^{3/2}}$
$\log(x)$	$\frac{1}{x}$	$\frac{-1}{x^2}$
$\exp(x)$	$\exp(x)$	$\exp(x)$

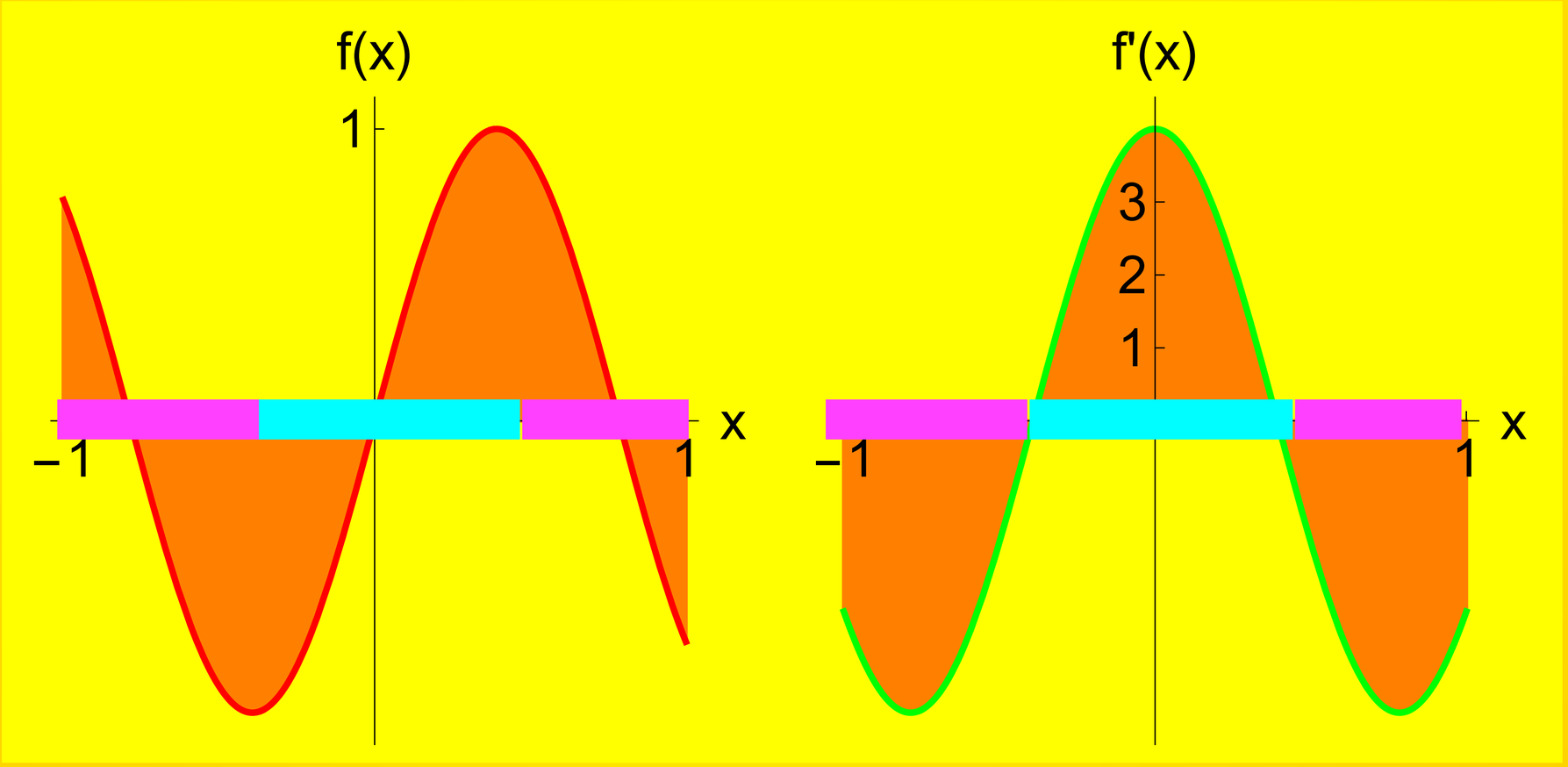
LOOK FOR: FLAT POINTS

$f'(x) = 0$ $f(x)$ is flat



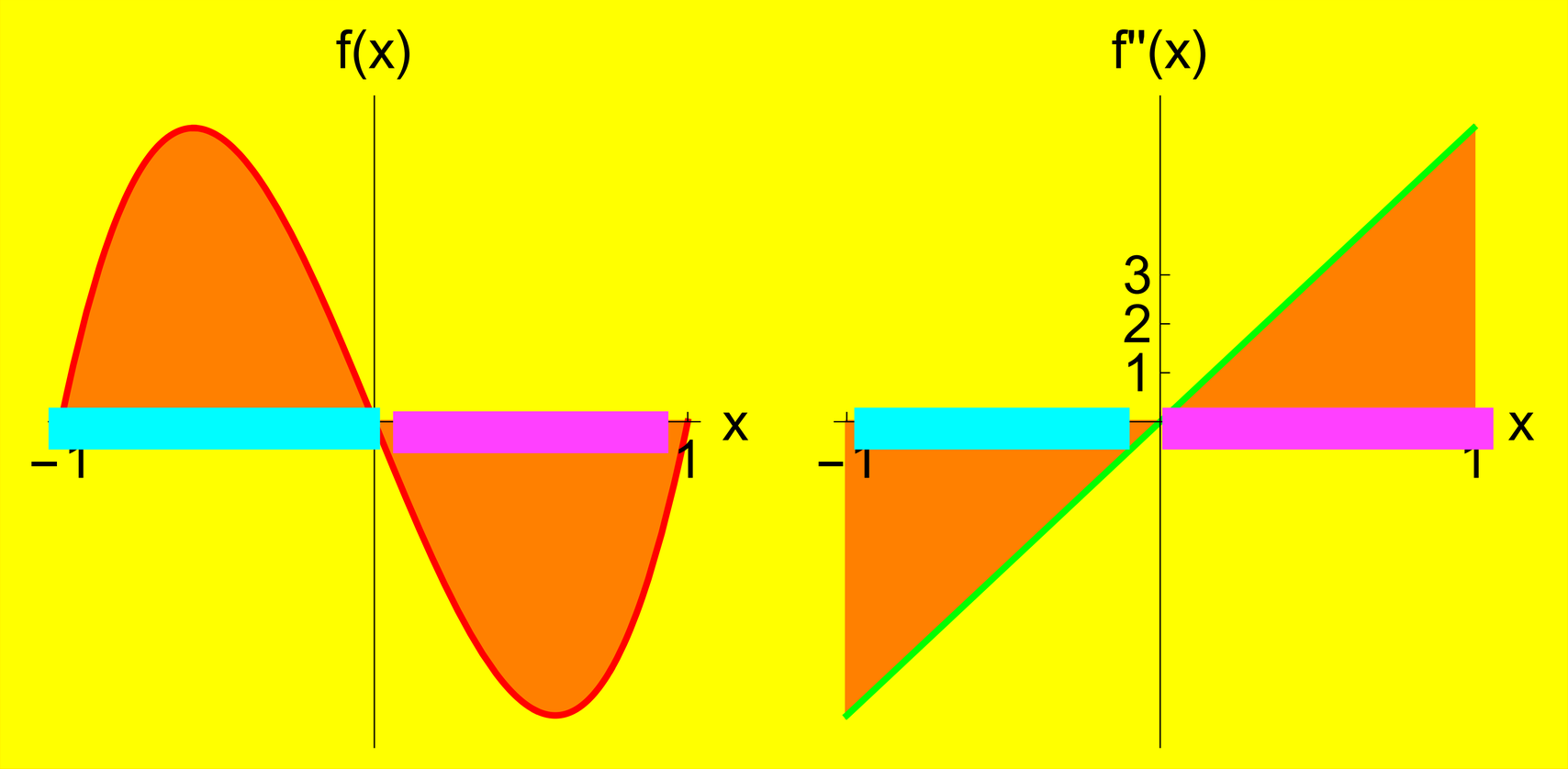
LOOK FOR UPS OR DOWNS

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



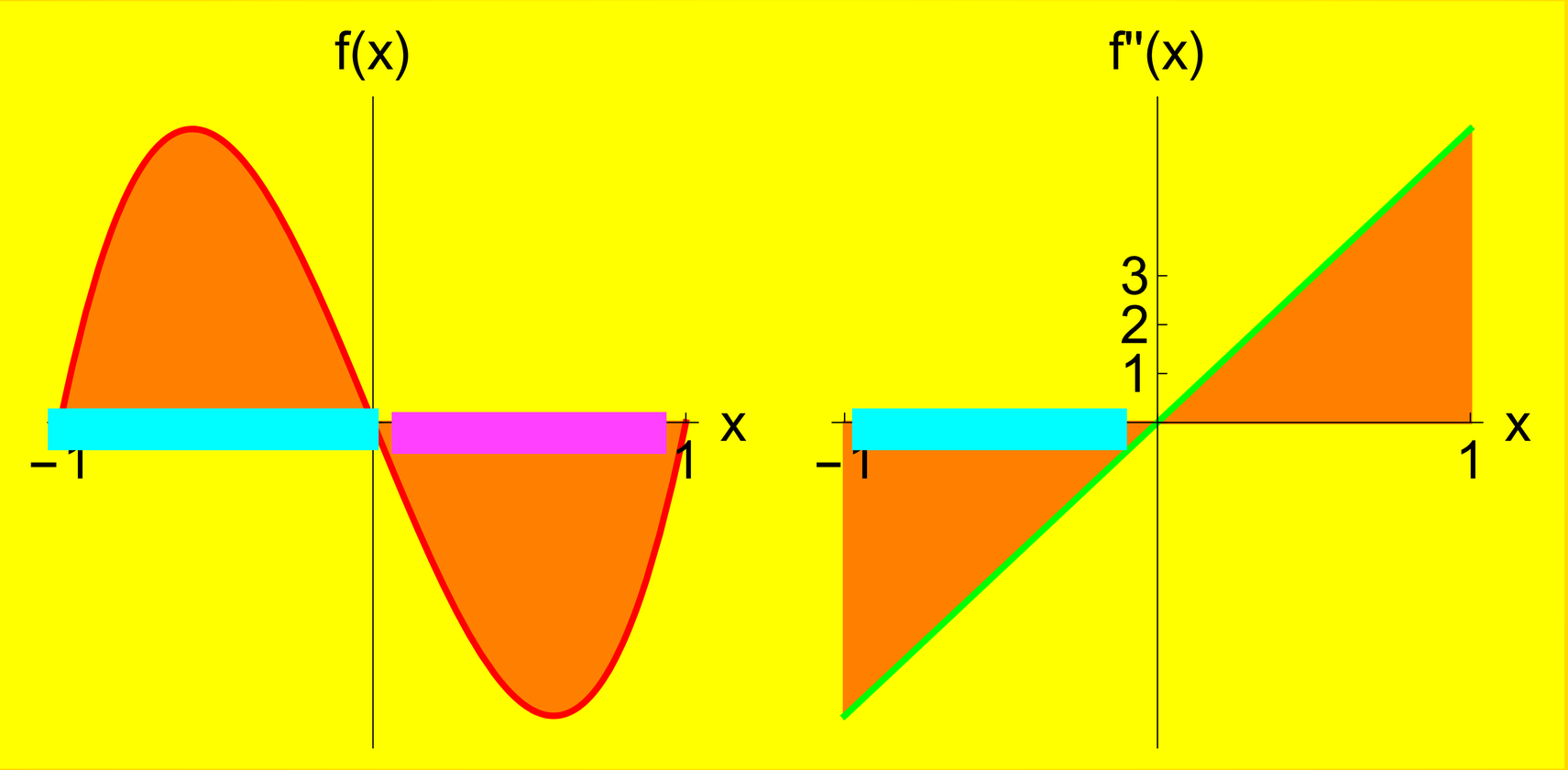
TO LOOK FOR!

$f''(x) > 0$ $f(x)$concave up



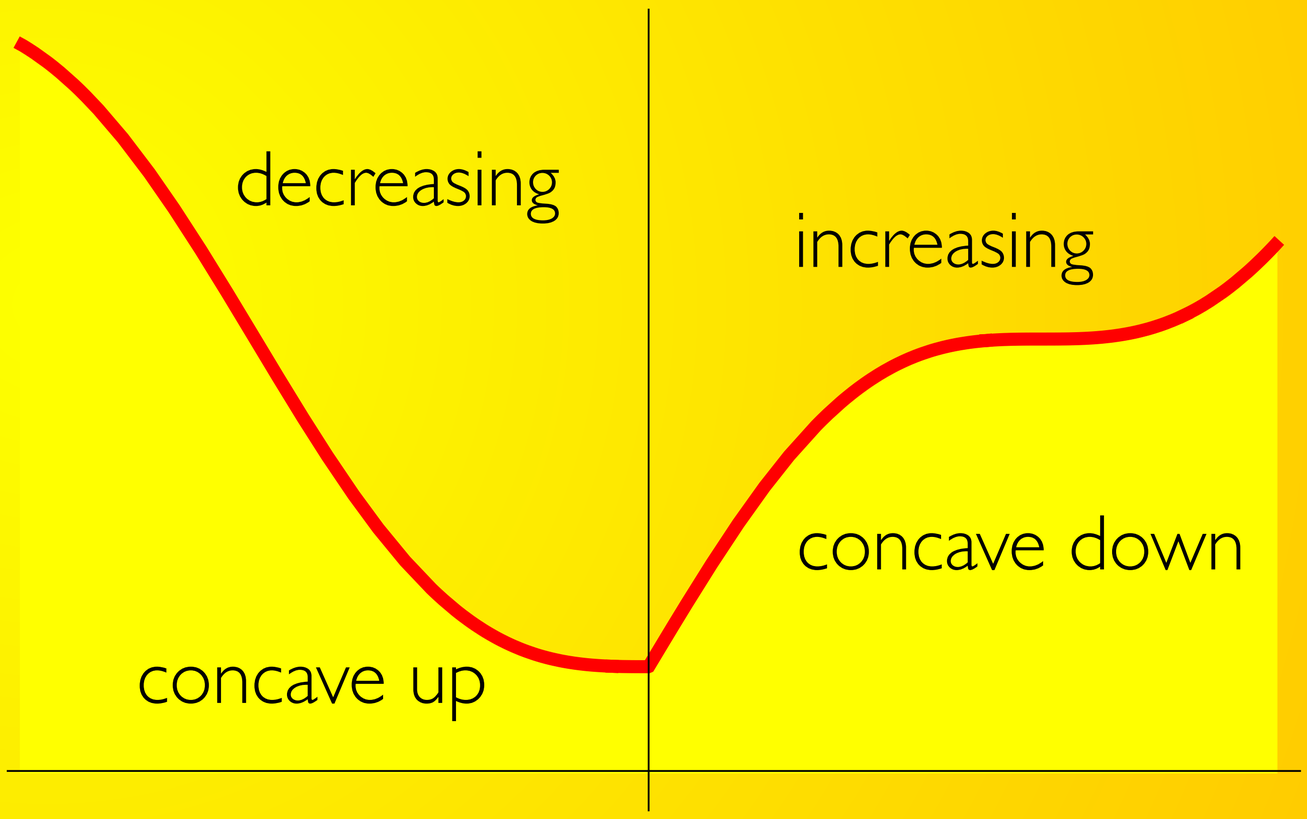
LOOK FOR CONCAVITY

$f''(x) > 0$ $f(x)$concave up



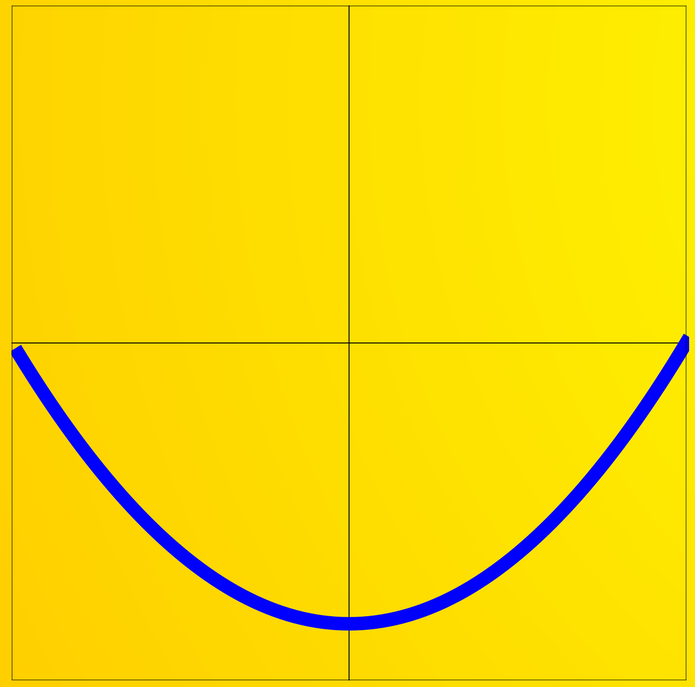
FUNCTIONS

$$f(x) = |x| + \sin(x) + 1$$

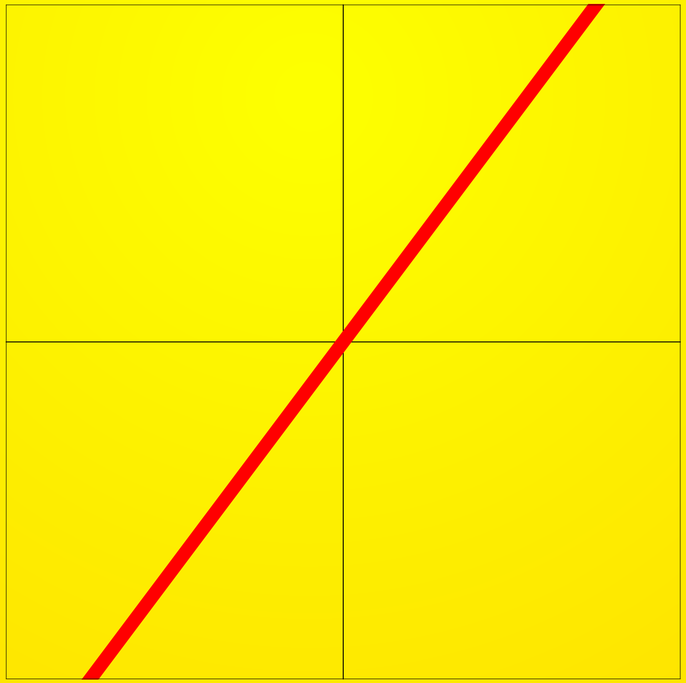


MATCHING

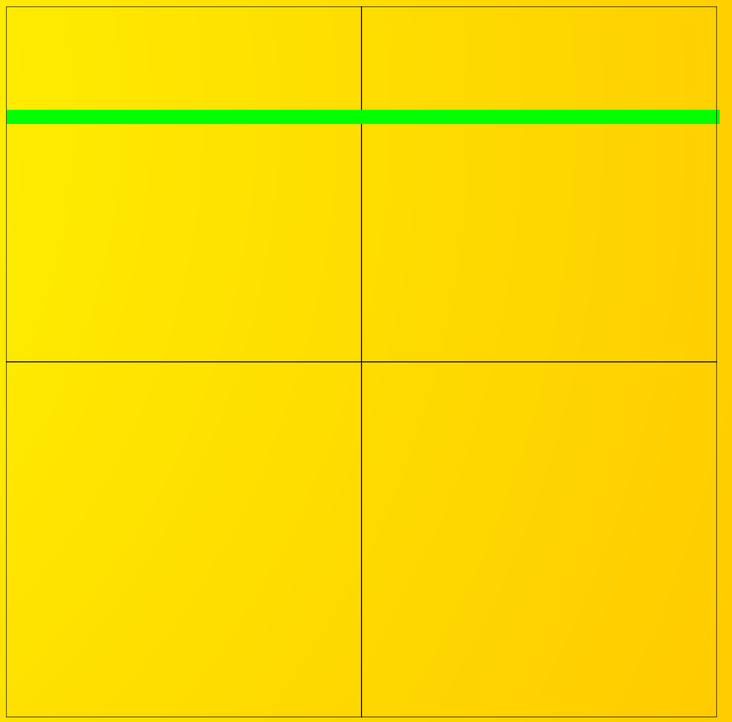
f



f'

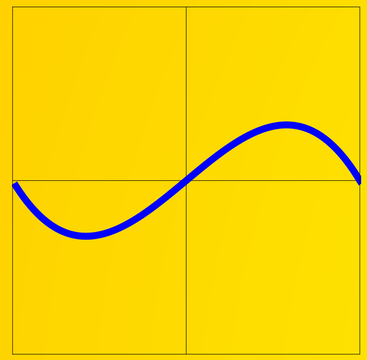


f''

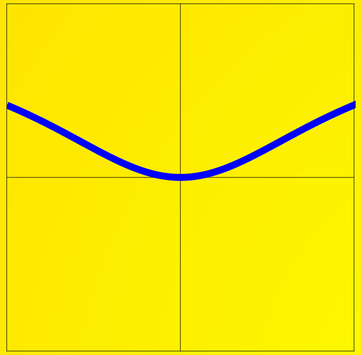


LETS MATCH

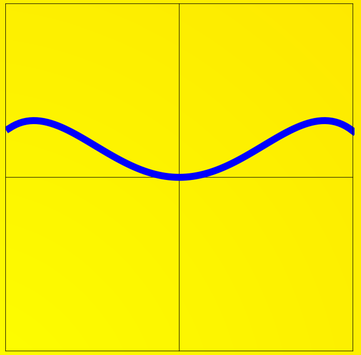
a



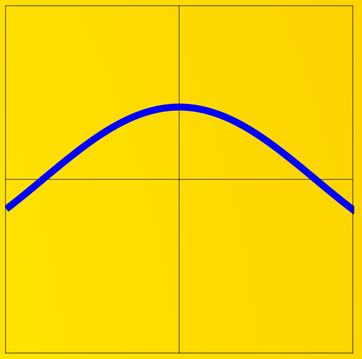
b



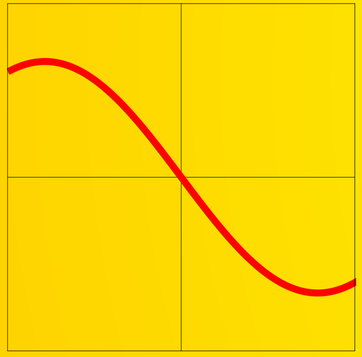
c



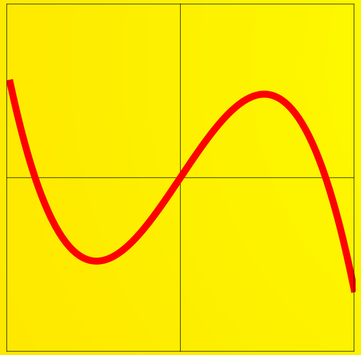
d



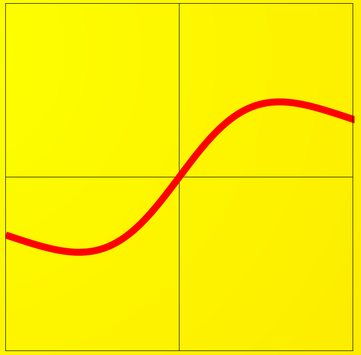
1



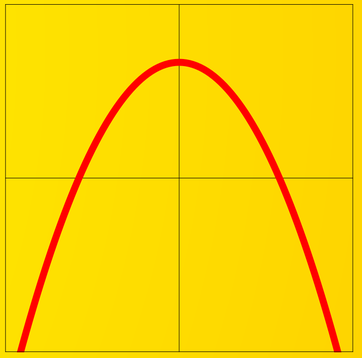
2



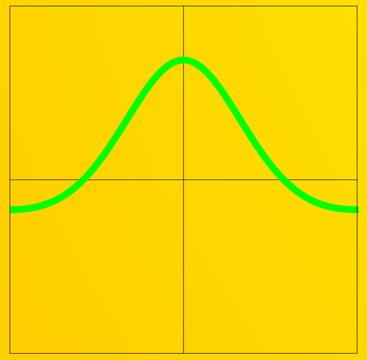
3



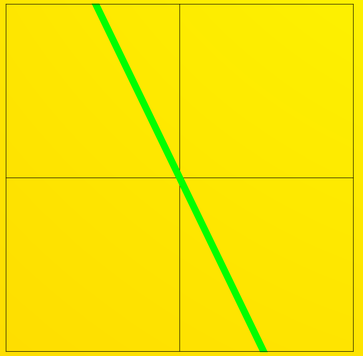
4



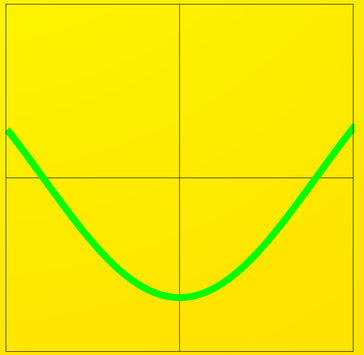
A



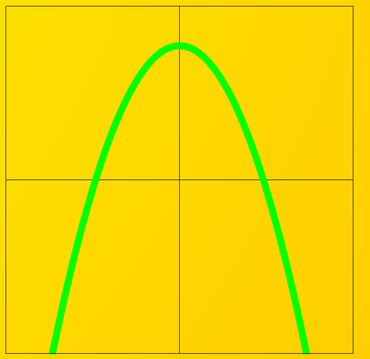
B



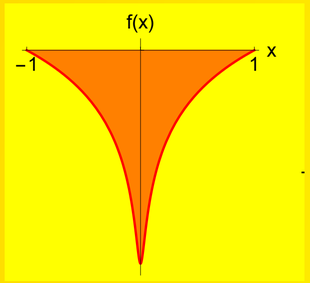
C

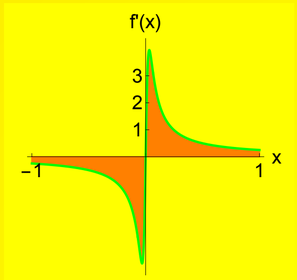


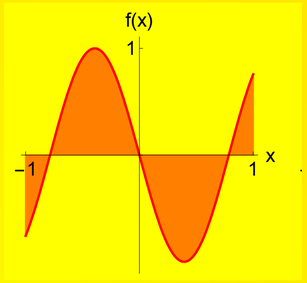
D

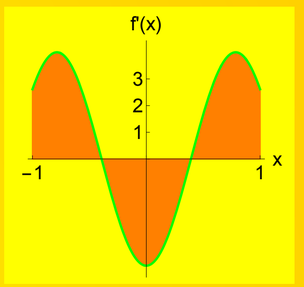


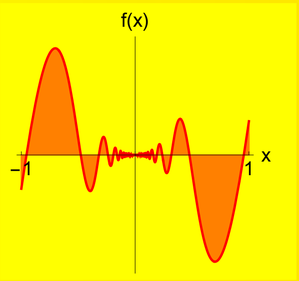
JAM: MATCH f AND f'

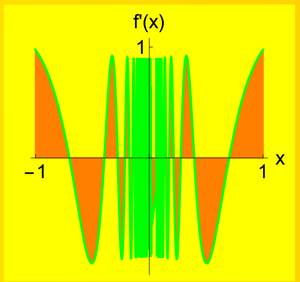


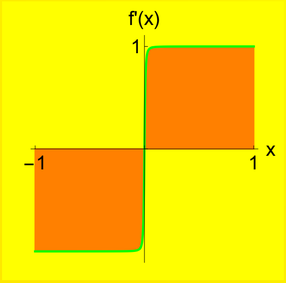


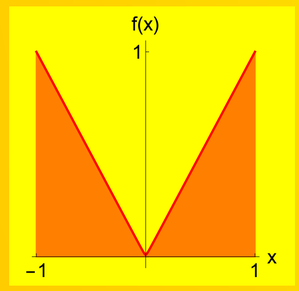


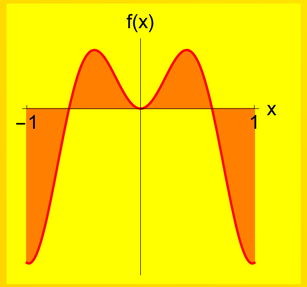


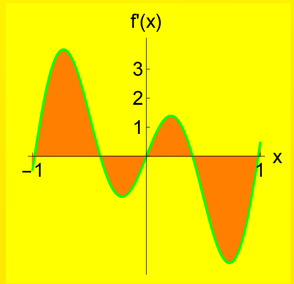


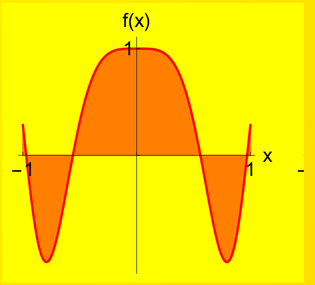


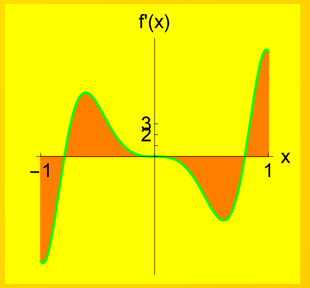




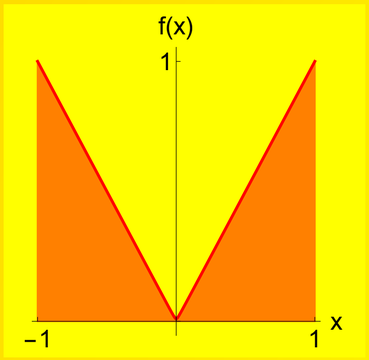


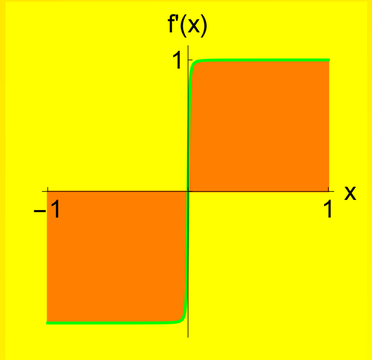


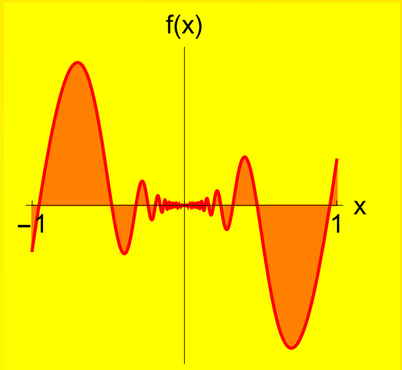


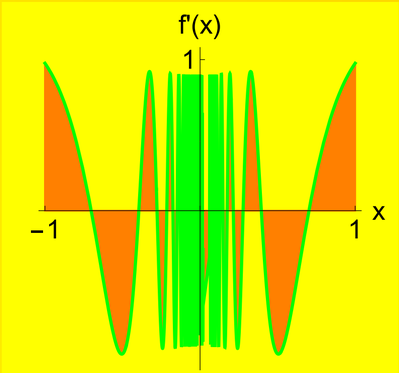


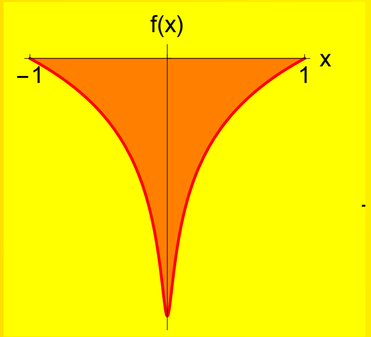
SOLUTION

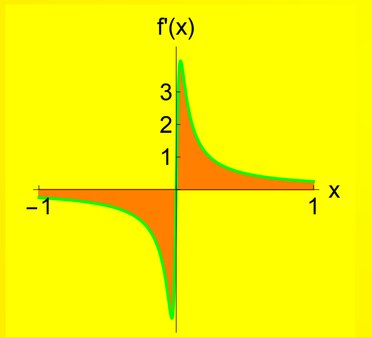

f(x)
1
−1
1
x

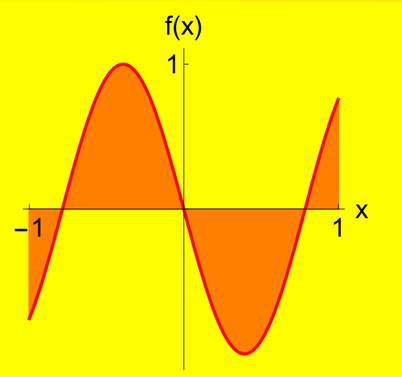

f'(x)
1
−1
1
x

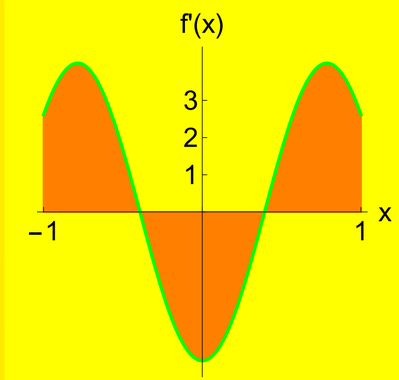

f(x)
−1
1
x

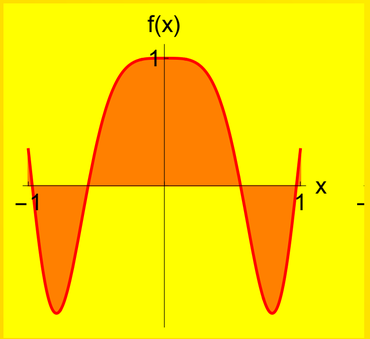

f'(x)
1
−1
1
x

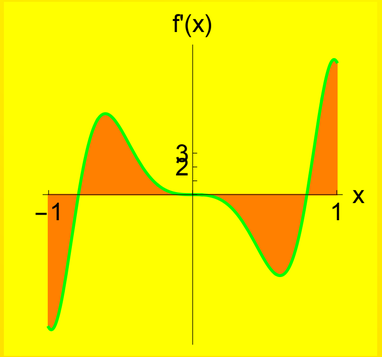

f(x)
−1
1
x

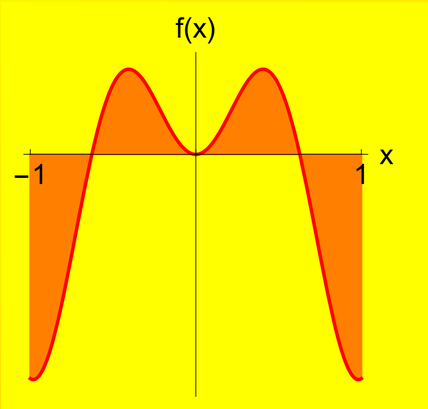

f'(x)
3
2
1
−1
1
x

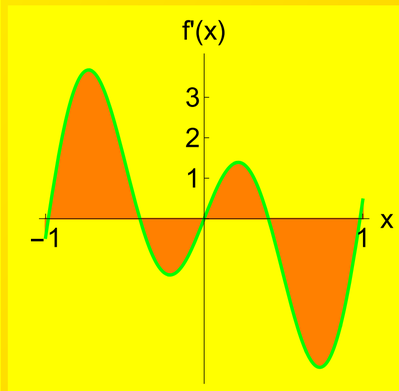

f(x)
1
−1
1
x


f'(x)
3
2
1
−1
1
x


f(x)
1
−1
1
x


f'(x)
3
2
−1
1
x

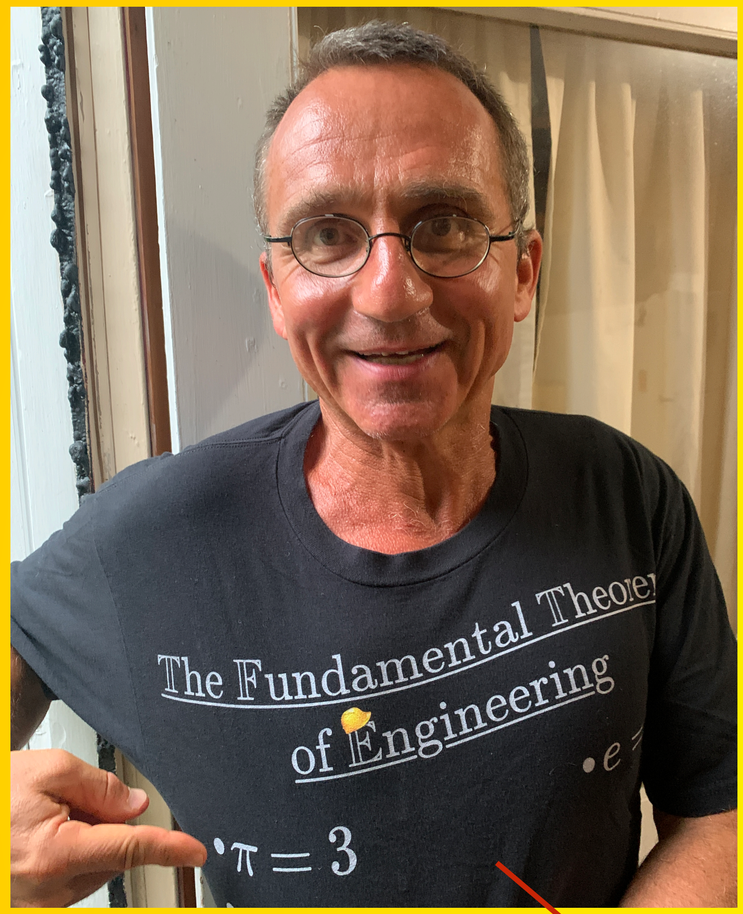

f(x)
−1
1
x

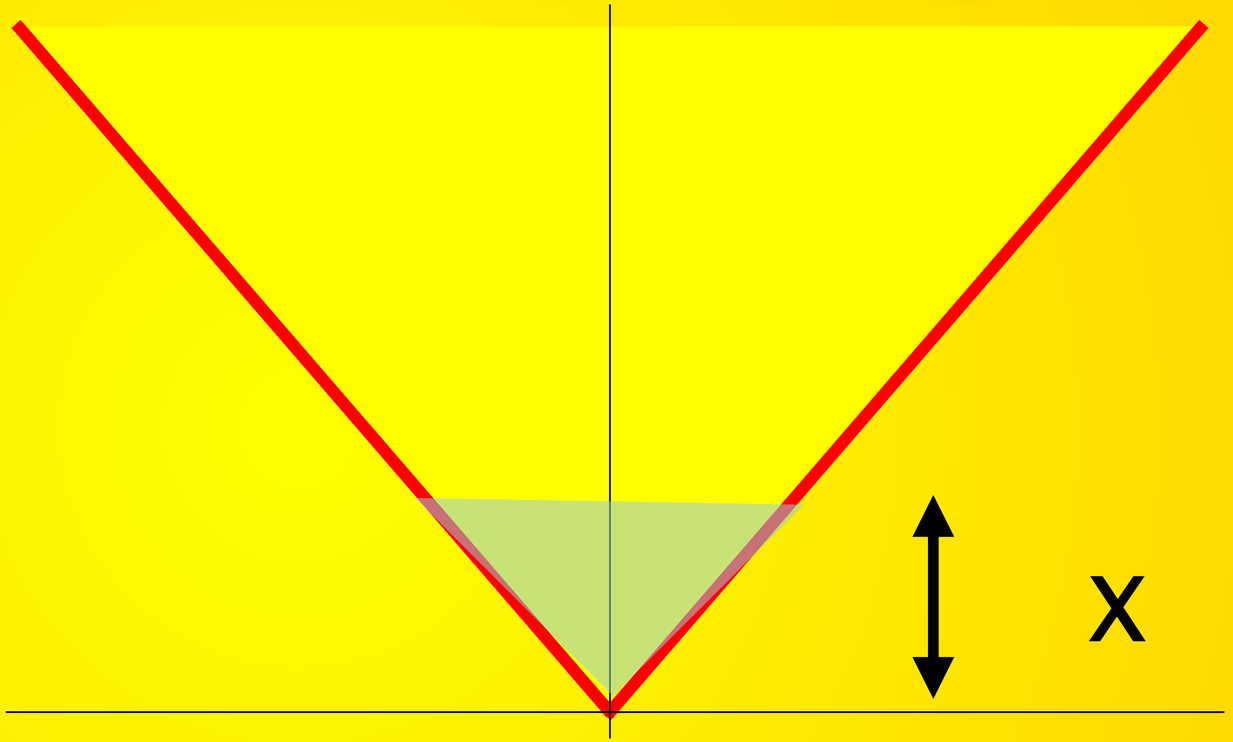

f'(x)
3
2
1
−1
1
x

Question

What is the 5th derivative of $\exp(2x)$?

FILLING A GLASS

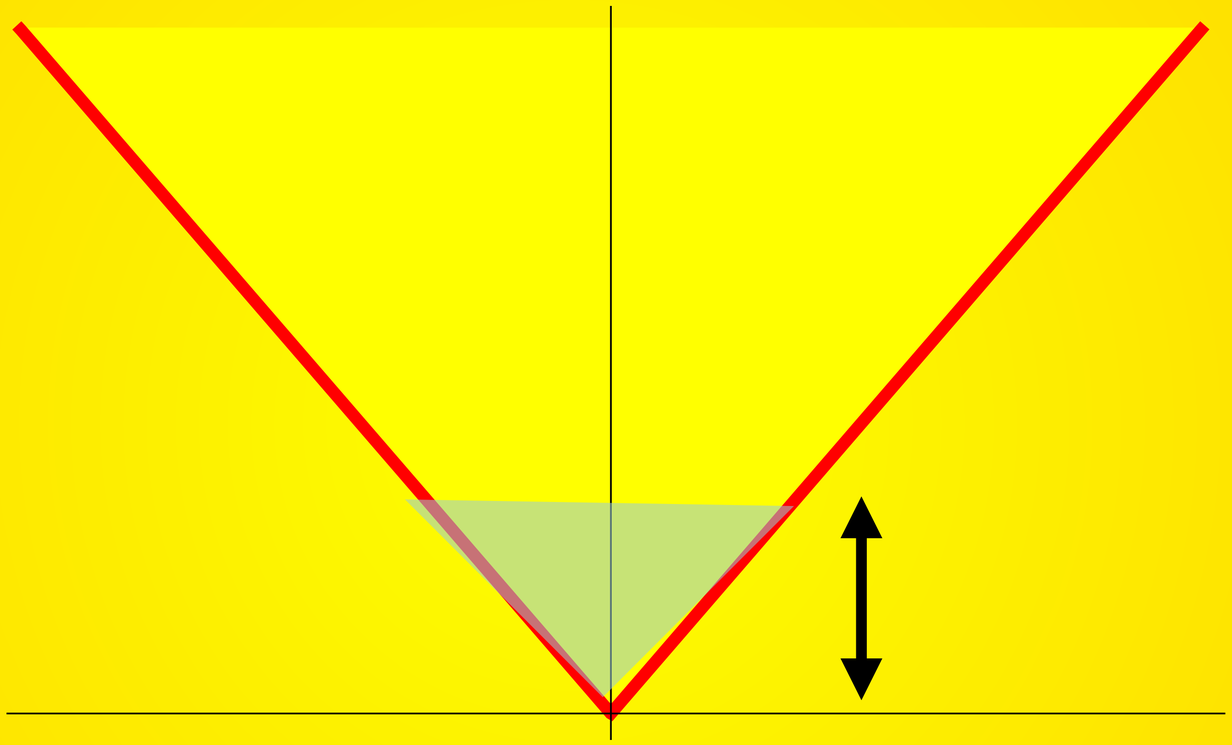




$$V(x) = \frac{x^3\pi}{3} = x^3$$

How fast does the volume change depending on x?

ANSWER



Can we compute x'(V)?

$$V(x) = x^3$$

$$x = V^{1/3}$$

$$x'(V) = \frac{1}{3V^{2/3}}$$

Infinite speed at V=0!

Remember HW

$$(x+h)^{1/3} - x^{1/3} =$$

$$\frac{[(x+h)^{1/3} - x^{1/3}][(x+h)^{2/3} + (x+h)^{1/3}x^{1/3} + x^{2/3}]}{[(x+h)^{2/3} + (x+h)^{1/3}x^{1/3} + x^{2/3}]}]$$

End