3.1 Exponential Functions and their Graphs

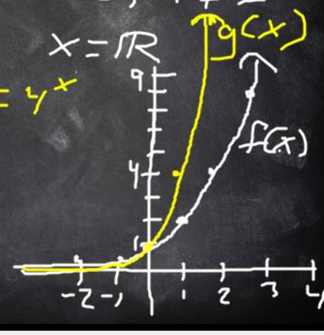
Def. $f(x)=a^x$ $\quad a>0,\ a\neq 1$

$x=\mathbb{R}$

Graphing

$f(x)=2^x$ $\quad g(x)=4^x$

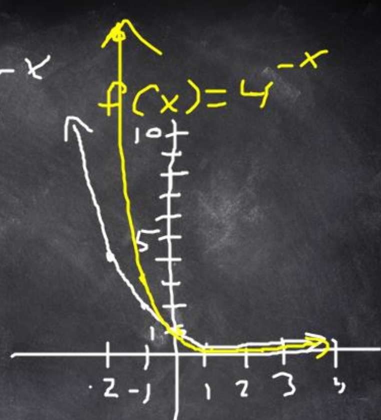
x	-2	-1	0	1	2
$f(x)$	$1/4$	$1/2$	1	2	4
$g(x)$	$1/16$	$1/4$	1	4	16

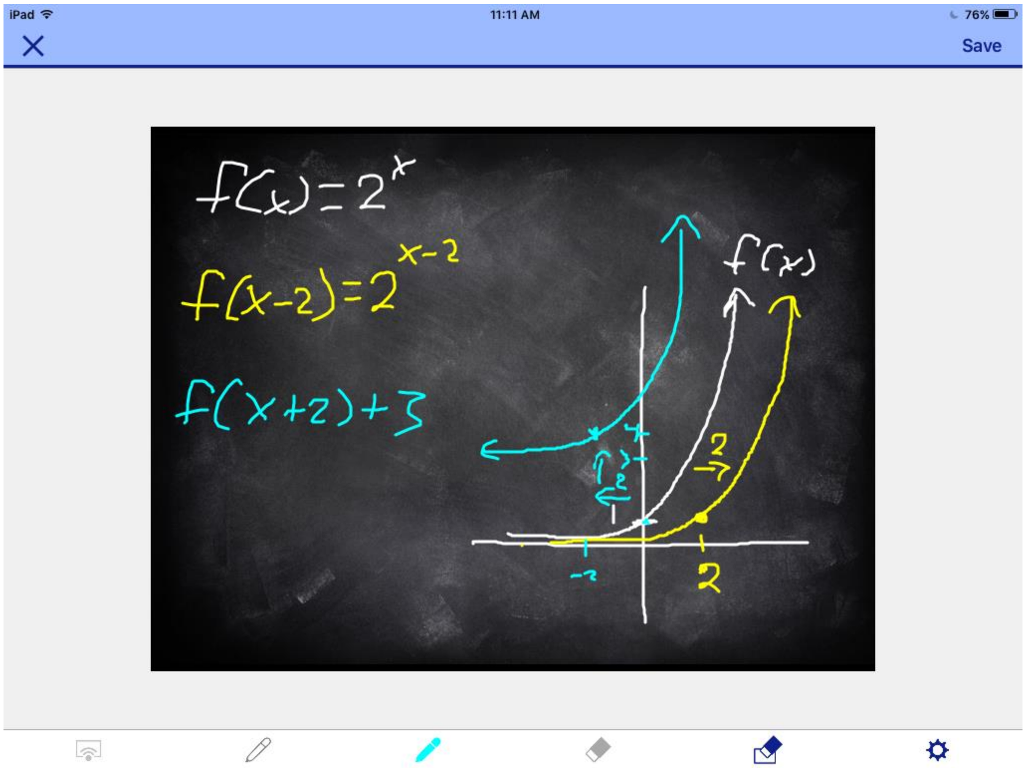


ex graph

$f(x)=2^{-x}$ $\quad f(x)=4^{-x}$

x	$f(x)$	$g(x)$
-2	4	16
-1	2	4
0	1	1
1	$1/2$	$1/4$
2	$1/4$	$1/16$

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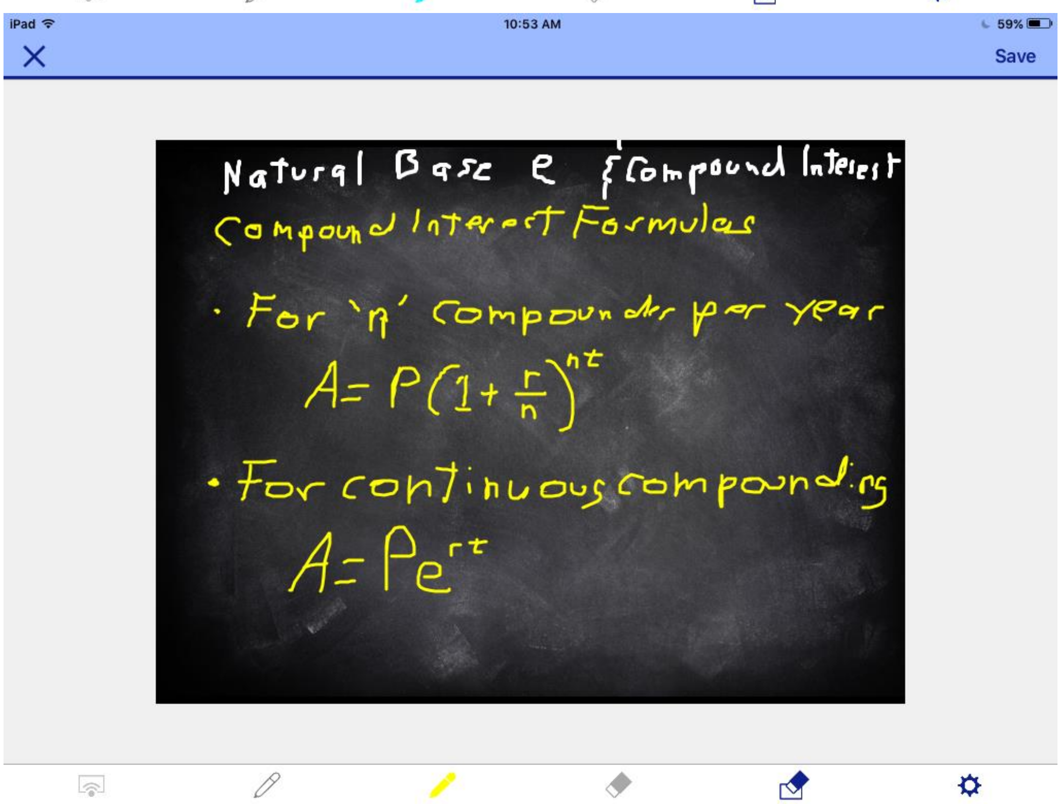
$f(x)=2^x$
$f(x-2)=2^{x-2}$
$f(x+2)+3$
$f(x)$
2
-2
2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Natural Base e {Compound Interest
Compound Interest Formulas
· For 'n' compounds per year
$A=P(1+\frac{r}{n})^{nt}$
· For continuous compounding
$A=Pe^{rt}$

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ex

Compound Interest

P = Principle

rate 3%

ex $r = .03$

Time (yrs)	Balance	
0	$P = P$	$1000 = 1000$
1	$P_1 = P(1+r)$	$1000(1+.03) = 1030$
2	$P_2 = P_1(1+r)$	
	or $= P(1+r)(1+r)$	$= 1060.90$
	or $= P(1+r)^2$	
3	$P_3 = P(1+r)^3$	
⋮		
t	$P_t = P(1+r)^t$	

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Compounding quarterly, monthly

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

A = total amt.

P = initial principle

r = int. rate

n = # of comp. per year

t = # of years

$$A = P\left(1+\frac{r}{n}\right)^{nt}$$

Money for ten years compounded...

$P=1000$ $r=3\%$ $t=10$ years

quarterly	monthly	daily
$A=1000\left(1+\frac{.03}{4}\right)^{4\cdot 10}$	$=1000\left(1+\frac{.03}{12}\right)^{12\cdot 10}$	$=1000\left(1+\frac{.03}{365}\right)^{365\cdot 10}$
$A=1348.35$	$=\$1349.35$	$=\$1349.84$

every hour? every minute? seconds?

Continuous Compounding

Through Algebra Magic

$$A = P\left[\left(1+\frac{1}{x}\right)^{x}\right]^{rt}$$

explore $\left(1+\frac{1}{x}\right)^{x}$ for increasing values of x

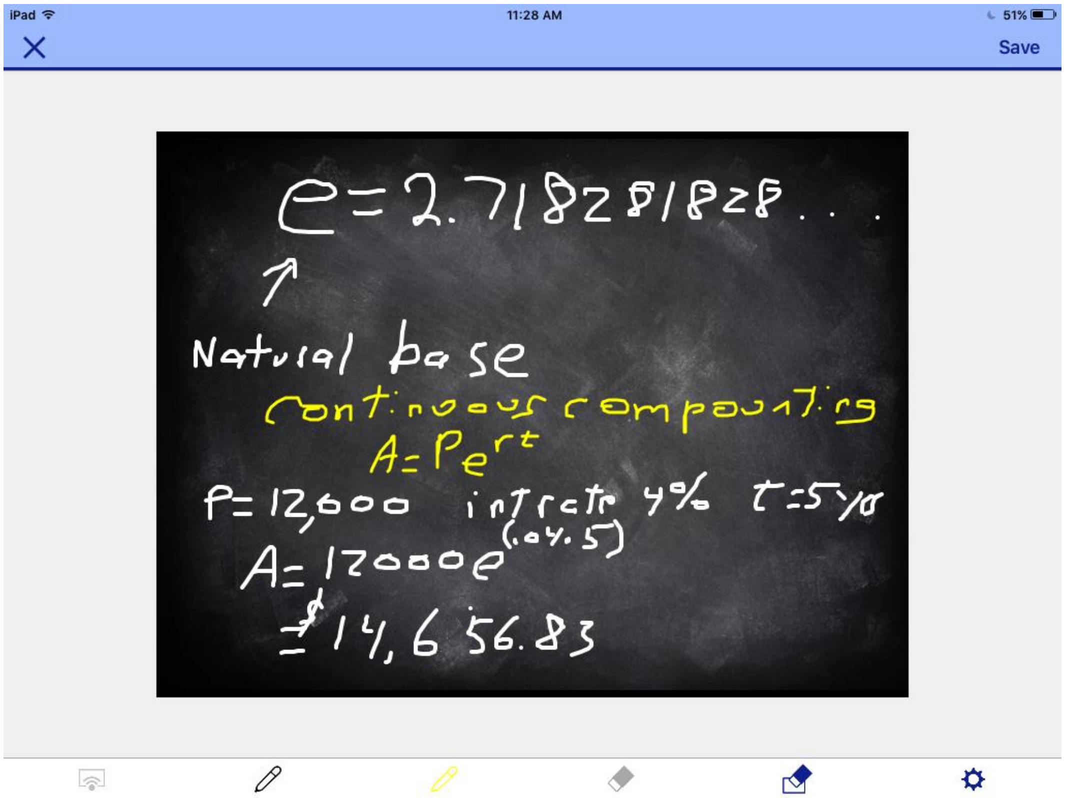
$f(x)=\left(1+\frac{1}{x}\right)^{x}$

$f(10)=2.5937$

$f(100)=2.7048$

$f(1000)=2.7169$

$f(10000)=2.7183$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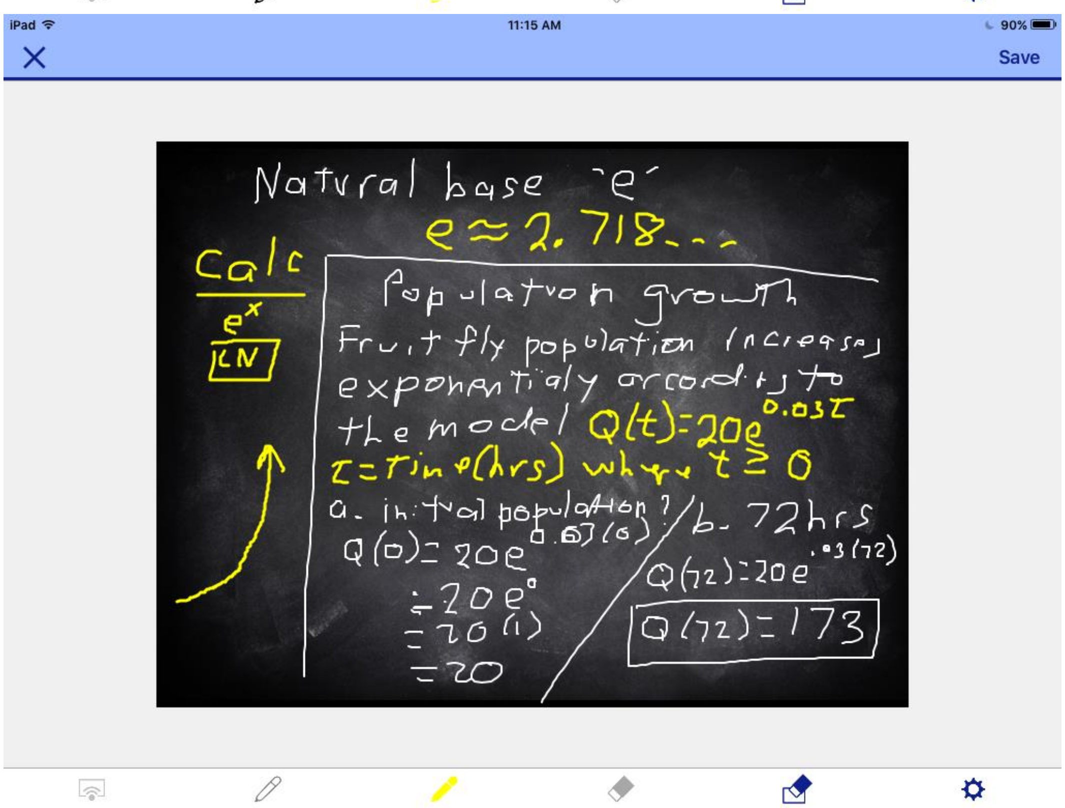
$e = 2.718281828...$
Natural base
continuous compounding
$A = Pe^{rt}$
$P = 12{,}000$ int rate 4% $t = 5$ yr
$A = 12000e^{(.04 \cdot 5)}$
$\doteq \$14{,}656.83$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Natural base 'e'
$e \approx 2.718...$
Calc
e^x
LN
Population growth
Fruit fly population increases exponentially according to the model $Q(t) = 20e^{0.03t}$
t = time (hrs) where $t \geq 0$
a. initial population?
$Q(0) = 20e^{0.03(0)}$
$= 20e^0$
$= 20(1)$
$= 20$
b. 72 hrs
$Q(72) = 20e^{.03(72)}$
$Q(72) = 173$