

4.1 Exponential Functions

GOALS:

1. Recognize exponential equations as those with variables in exponents.
2. Graph exponential equations.
3. Recognize applications such as compound interest.

Study 4.1 CVC # 1-5 all; # 1, 5, 9, 11, 15;
19-25; 31, 47, 53

Exponential Functions

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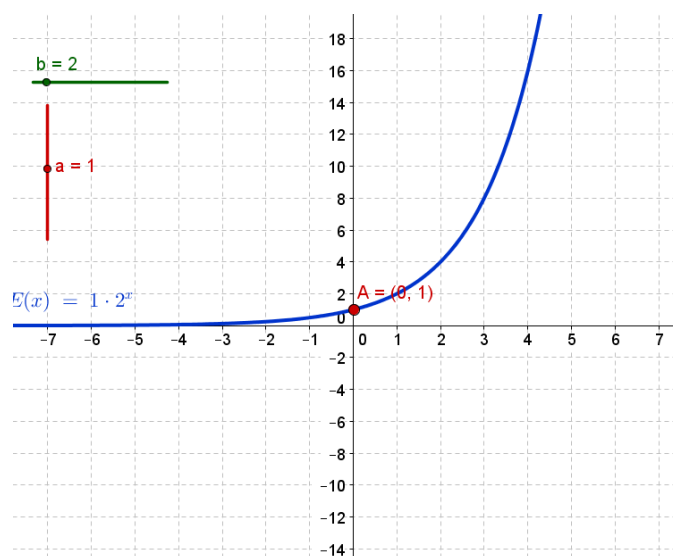
Parabolas

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Homework

4.1 Exponential Functions

$$f(x) = a \cdot b^x$$



http://www.battaly.com/collegealgebra/geogebra/exponential_function/

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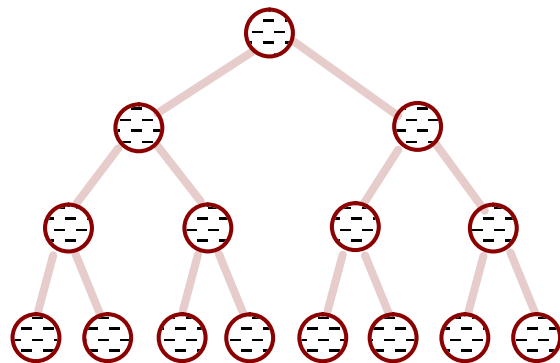
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Homework

4.1 Exponential Functions

$f(x) = a \cdot b^x$ $a \neq 0, b > 0, b \neq 1$

Consider bacteria: one cell divides to two



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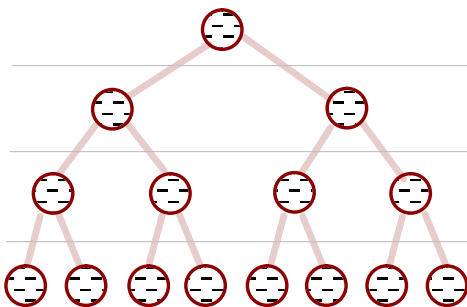
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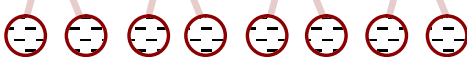
Homework

4.1 Exponential Functions

$f(x) = a \cdot b^x$ $a \neq 0, b > 0, b \neq 1$

Consider bacteria:
one cell divides to two



	Generation	No of cells
	0	1
	1	2
	2	4
	3	8
	4	?
	5	?

Can you guess these?

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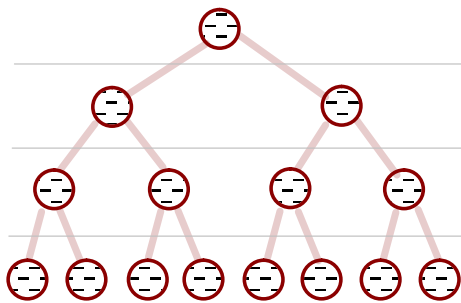
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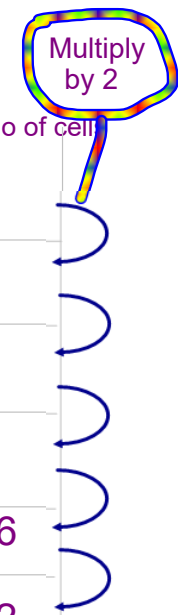
4.1 Exponential Functions

$f(x) = a b^x$ $a \neq 0, b > 0, b \neq 1$

Consider bacteria:
one cell divides to two



Generation	No of cell
0	1
1	2
2	4
3	8
4	16
5	32

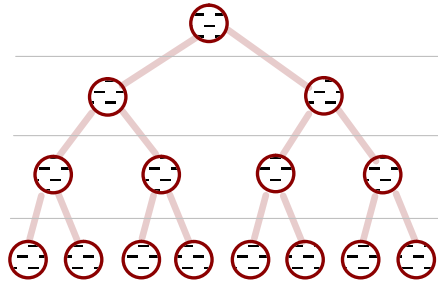


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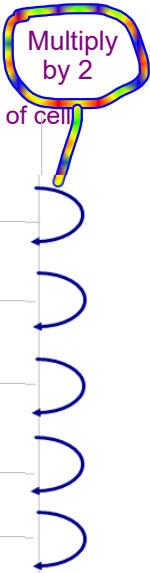
4.1 Exponential Functions

$f(x) = a b^x$ $a \neq 0, b > 0, b \neq 1$

Consider bacteria:
one cell divides to two



Generation	No of cell
0	1
1	2
2	4
3	8
4	16
5	32



$y = 2^x$

$f(x) = a b^x$ where $a = 1, b = 2$

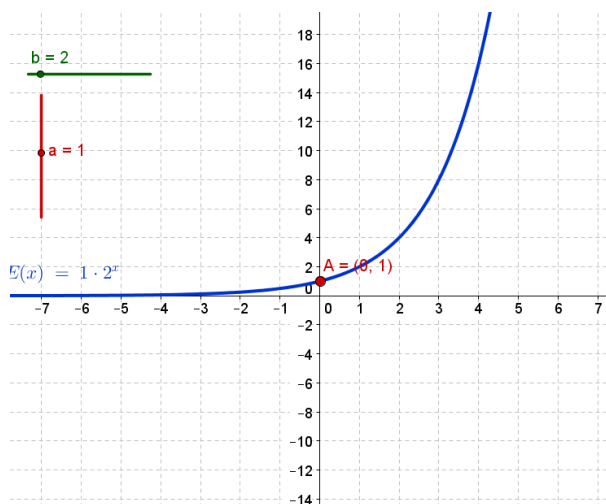
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4.1 Exponential Functions

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

$$y = 2^x$$

x	f(x)
-2	1/4
-1	1/2
0	1
1	2
2	4
3	8



$$f(x) = a b^x \quad \text{where } a = 1, b = 2$$

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Homework

4.1 Exponential Functions

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

$$F: 3^{2.4}$$

$$\text{On calculator: } 3^{2.4} =$$

$$3^{2.4} = 13.9666$$

$$F: 5^{\sqrt{3}}$$

$$\text{On calculator: } 5^{\sqrt{3}} =$$

$$5^{\sqrt{3}} = 16.2425$$

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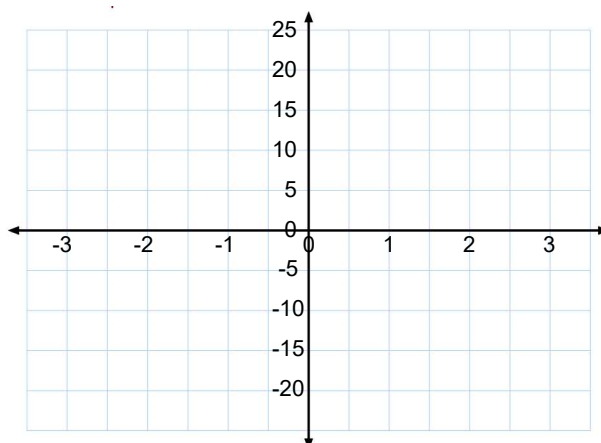
Homework

4.1 Exponential Functions

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

F: sketch $f(x) = 5^x$

x	f(x)
-2	_____
-1	_____
0	_____
1	_____
2	_____



x	f(x)
-2	1/25
-1	1/5
0	1
1	5
2	25


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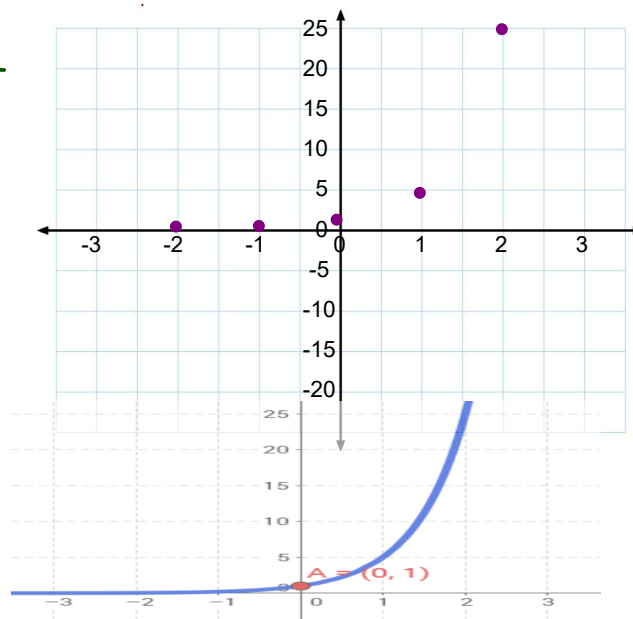
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$$f(x) = a b^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = 5^x$

x	f(x)
-2	1/25
-1	1/5
0	1
1	5
2	25


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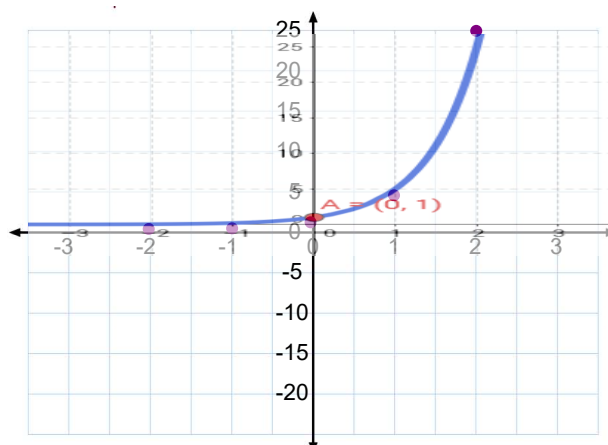
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$$f(x) = a \cdot b^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = 5^x$

x	f(x)
-2	1/25
-1	1/5
0	1
1	5
2	25


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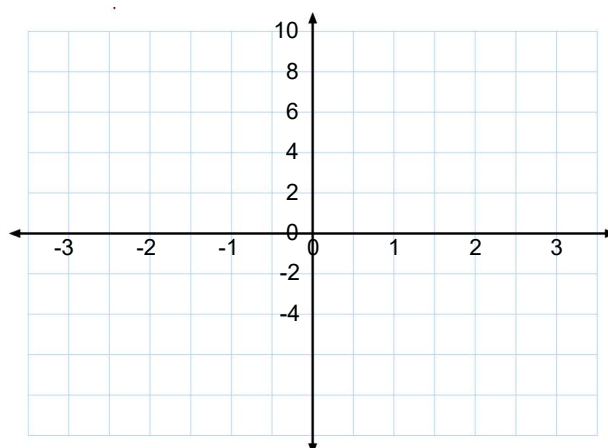
Homework

4.1 Exponential Functions

$$f(x) = a \cdot b^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = (1/3)^x$

x	f(x)
-2	9
-1	3
0	1
1	1/3
2	1/9


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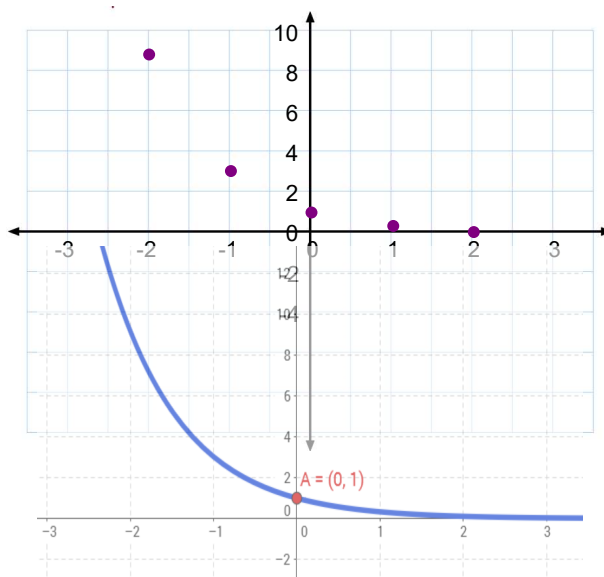
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$$f(x) = a b^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = (1/3)^x$

x	f(x)
-2	9
-1	3
0	1
1	1/3
2	1/9


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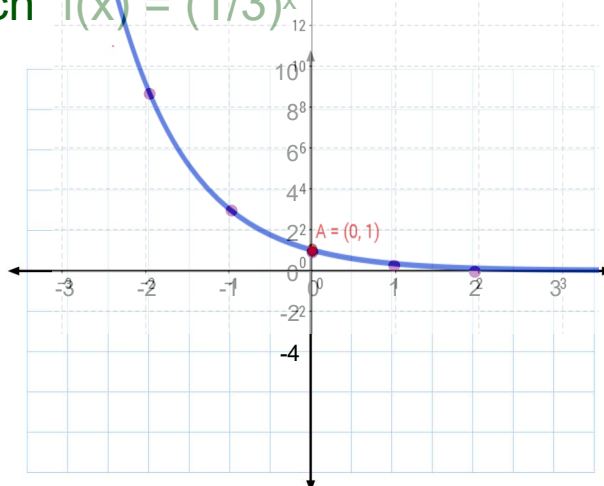
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$$f(x) = a b^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = (1/3)^x$

x	f(x)
-2	9
-1	3
0	1
1	1/3
2	1/9


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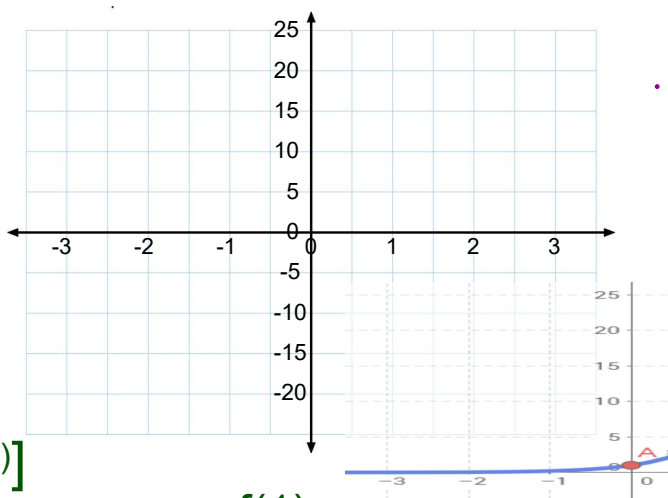
Homework

4.1 Exponential Functions

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

F: sketch $f(x) = 5(2^x)$

x	f(x)
-2	_____ •
-1	_____ •
0	_____ •
1	_____ •
2	_____ •



$$f(\underline{\quad}) = 5[2^{(\underline{\quad})}]$$

$$f(0) = 5(2^0) = 5$$

$$f(\underline{-2}) = 5[2^{(-2)}] = \underline{\quad}$$

$$f(1) = \underline{\quad}$$

$$f(2) = \underline{\quad}$$

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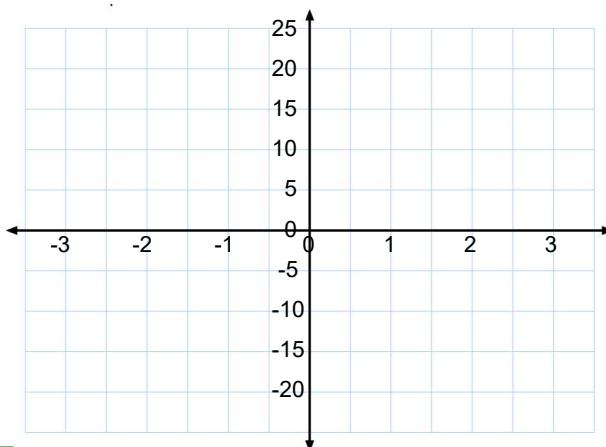
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$$f(x) = a^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = 5(2^x)$

x	f(x)
-2	_____ •
-1	_____ •
0	_____ •
1	_____ •
2	_____ •



$$f(0) = 5(2^0) = 5$$

$$f(-1) = 5(2^{-1}) = 5(1/2) = 5/2$$

$$f(-2) = 5(2^{-2}) = 5(1/4) = 5/4$$

$$f(1) = 5(2^1) = 10$$

$$f(2) = 5(2^2) = 20$$

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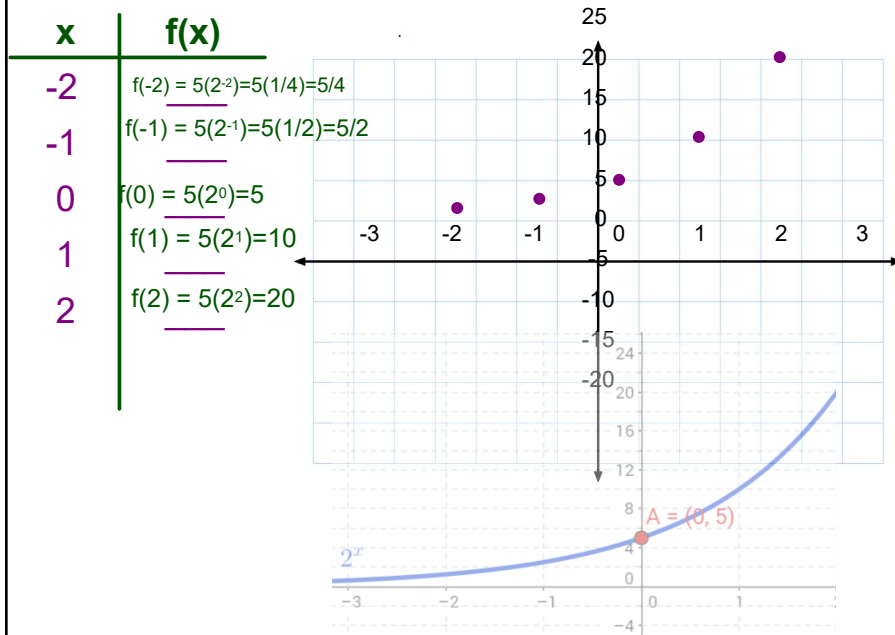
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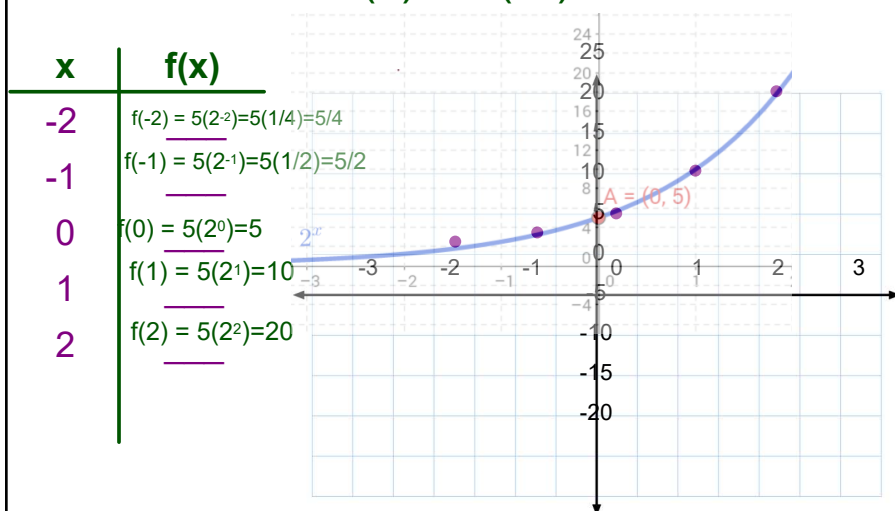
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$$f(x) = a b^x \quad a \neq 0, b > 0, b \neq 1$$

F: sketch $f(x) = 5(2^x)$ 
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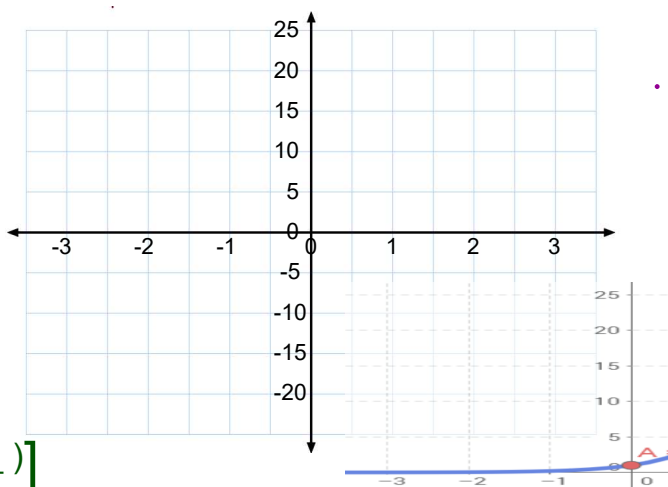
Homework

4.1 Exponential Functions

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

F: sketch $f(x) = -3(2^x)$

x	f(x)
-2	_____ •
-1	_____ •
0	_____ •
1	_____ •
2	_____ •



$$f(\underline{\quad}) = -3[2^{(\underline{\quad})}]$$

$$f(0) = -3(2^0) = -3$$

$$f(-2) = -3[2^{(-2)}] = \underline{\hspace{2cm}}$$

$$f(1) = \underline{\hspace{2cm}}$$

$$f(2) = \underline{\hspace{2cm}}$$

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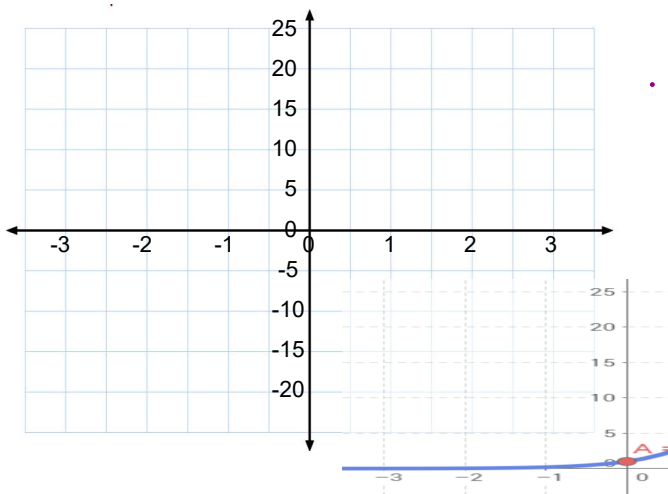
Homework

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

F: sketch $f(x) = -3(2^x)$

x	f(x)
-2	_____ •
-1	_____ •
0	_____ •
1	_____ •
2	_____ •



$$f(\underline{\quad}) = -3[2^{(\underline{\quad})}]$$

$$f(0) = -3(2^0) = -3$$

$$f(-1) = -3[2^{-1}] = -3/2$$

$$f(-2) = -3[2^{(-2)}] = -3(1/4) = -3/4$$

$$f(1) = -3[2^1] = -6$$

$$f(2) = -3[2^2] = -3(4) = -12$$

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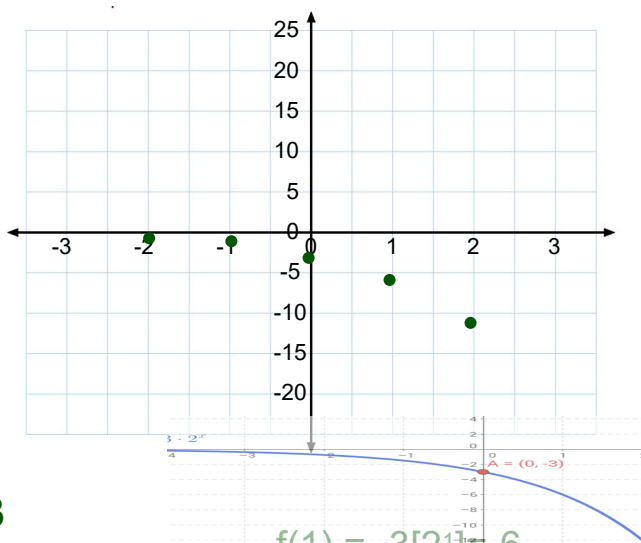
Homework

4.1 Exponential Functions

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

F: sketch $f(x) = -3(2^x)$

x	f(x)
-2	-3/4
-1	-3/2
0	-3
1	-6
2	-12



$$f(_) = -3[2^{(_) }]$$

$$f(0) = -3(2^0) = -3$$

$$f(-1) = -3[2^{-1}] = -3/2$$

$$f(-2) = -3[2^{(-2)}] = -3(1/4) = -3/4$$

$$f(1) = -3[2^1] = -6$$

$$f(2) = -3[2^{(2)}] = -3(4) = -12$$

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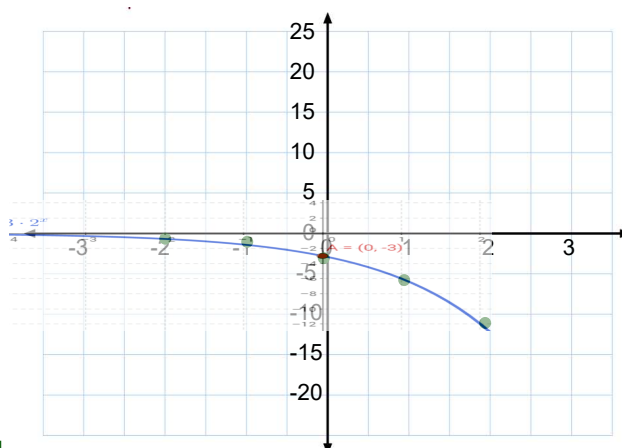
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F: sketch $f(x) = -3(2^x)$

x	f(x)
-2	-3/4
-1	-3/2
0	-3
1	-6
2	-12



$$f(_) = -3[2^{(_) }]$$

$$f(0) = -3(2^0) = -3$$

$$f(-1) = -3[2^{-1}] = -3/2$$

$$f(-2) = -3[2^{(-2)}] = -3(1/4) = -3/4$$

$$f(1) = -3[2^1] = -6$$

$$f(2) = -3[2^{(2)}] = -3(4) = -12$$

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4.1 Exponential Functions

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

Interest Formulas: variations of the exponential function that provide very useful computations.

Compounding Interest:

n periods per year

continuously

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

$$A = P e^{rt}$$

A = balance after **t** years

P = principal or amount invested

r = annual interest rate

n = number of periods per year

e ≈ 2.718

$$\lim_{n \rightarrow \infty} \left(1 + \frac{1}{n} \right)^n \rightarrow e$$

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4.1 Exponential Functions

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

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **semiannually**.

G: P = _____

F: A

r = _____

n = _____

t = _____

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

$$A = \boxed{} \left(1 + \frac{\boxed{}}{\boxed{}} \right)^{\boxed{}\boxed{}}$$

On Calc: $y1 = 5,000(1+0.065/x)^{(10x)}$ variable x is n periods

Then: graph zoom fit

2nd Calc | 1value | 2

http://www.battaly.com/collegealgebra/geogebra/exponential_function/ $A = P e^{rt}$

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Homework

A = balance after **t** years
P = principal or amount invested
r = annual interest rate
n = number of periods per year
e ≈ 2.718

4.1 Exponential Functions $f(x) = a b^x$ $a \neq 0, b > 0, b \neq 1$

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **semiannually**.

G: $P = \underline{\quad 5000 \quad}$ F: A
 $r = \underline{\quad 0.065 \quad}$
 $n = \underline{\quad 2 \quad}$
 $t = \underline{\quad 10 \quad}$

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

$$A = \boxed{} \left(1 + \frac{\boxed{}}{\boxed{}} \right)^{\boxed{} \boxed{}}$$

On Calc: $y1 = 5,000(1+0.065/x)^{(10x)}$ variable x is n periods
 Then: graph zoom fit
 2nd Calc | 1:value | 2

http://www.battaly.com/collegealgebra/geogebra/exponential_function/ $A = P e^{rt}$

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A = balance after t years
 P = principal or amount invested
 r = annual interest rate
 n = number of periods per year
 $e \approx 2.718$

4.1 Exponential Functions $f(x) = a b^x$ $a \neq 0, b > 0, b \neq 1$

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **semiannually**.

G: $P = \underline{\hspace{2cm}}$ F: A
 $r = \underline{\hspace{2cm}}$
 $n = \underline{\hspace{2cm}}$
 $t = \underline{\hspace{2cm}}$

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

$$A = 5000 \left(1 + \frac{0.065}{2} \right)^{2(10)} = 9479.19$$

On Calc: $y1 = 5000(1+0.065/x)^{(10x)}$ variable $x = n$ periods
 Then: graph zoom fit
 2nd Calc | 1:value | 2

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$A = P e^{rt}$
 A = balance after t years
 P = principal or amount invested
 r = annual interest rate
 n = number of periods per year
 $e \approx 2.718$

4.1 Exponential Functions

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

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **quarterly**.

G: P = _____

F: A

r = _____

n = _____

t = _____

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

$$A = \boxed{} \left(1 + \frac{\boxed{}}{\boxed{}} \right)^{\boxed{}\boxed{}}$$

On Calc: $y1 = 5000(1+0.065/x)^{(10x)}$ variable $x = n$ periods

Then: graph zoom fit

2nd Calc | 1:value | 4

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A = balance after t years
P = principal or amount invested
r = annual interest rate
n = number of periods per year
 $e \approx 2.718$

4.1 Exponential Functions

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

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **quarterly**.

G: P = _____

F: A

r = _____

n = _____

t = _____

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

$$A = 5000 \left(1 + \frac{0.065}{4} \right)^{4(10)} = 9527.79$$

On Calc: $y1 = 5000(1+0.065/x)^{(10x)}$ variable $x = n$ periods

Then: graph zoom fit

2nd Calc | 1:value | 4

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A = balance after t years
P = principal or amount invested
r = annual interest rate
n = number of periods per year
 $e \approx 2.718$

4.1 Exponential Functions

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

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **continuously**.

G: P = _____

F: A

r = _____

n = _____

t = _____

$$A = P e^{rt}$$

$$A = \boxed{} e^{\boxed{} \boxed{}}$$

On Calc: $y1 = 5000e^{(0.065 \cdot x)}$ variable x = number of years

Then: graph zoom fit

2nd Calc | 1:value | 10

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A = balance after t years

P = principal or amount invested

r = annual interest rate

n = number of periods per year

e = 2.718

4.1 Exponential Functions

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

Invest \$5,000 for 10 years at an interest rate of 6.5%.
Find the value if compounded **continuously**.

G: P = _____

F: A

r = _____

n = _____

t = _____

$$A = P e^{rt}$$

$$A = 5000 e^{0.065(10)} = 9577.70$$

On Calc: $y1 = 5000e^{(0.065 \cdot x)}$ variable x = number of years

Then: graph zoom fit

2nd Calc | 1:value | 10

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A = balance after t years

P = principal or amount invested

r = annual interest rate

n = number of periods per year

e = 2.718

Attachments

slope_intercept.mp4