

Precalculus 5.3 Exponential Functions
Objective: able to evaluate & graph exponential functions; define e; solve exponential equations

An **Exponential Function** is a function of the form $f(x) = Ca^x$ where a is a positive real number ($a > 0$), $a \neq 1$, and $C \neq 0$. The domain of f is the set of all real numbers.

Why is $a > 0$ and $a \neq 1$? $a=1$ is a constant function because you can't exclude any #'s from Domain $\rightarrow 2^{\frac{1}{2}} = \sqrt{2}$

x	a^x
-2	$a^{-2} = \frac{1}{a^2}$
-1	$a^{-1} = \frac{1}{a}$
0	$a^0 = 1$
1	$a^1 = a$
2	a^2

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1. Graph $f(x) = a^x$, $a > 1$. What do you observe?

$a > 0$
D: \mathbb{R}
R: $y > 0$
one to one
yint (0,1)
no xint
smooth continuous
increasing $(-\infty, \infty)$

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2	a^2

2. Graph $f(x) = a^x$, $0 < a < 1$. What do you observe?

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2. Graph $f(x) = a^x$, $0 < a < 1$. What do you observe?

x	a^x
-1	$\frac{1}{a} = 2$
0	1 = 1
1	$a = \frac{1}{2}$

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

decreasing $(-\infty, \infty)$

3. Graph $f(x) = 2^x$. Use transformations to graph $g(x) = -2^{x-1} + 3$

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3. Graph $f(x) = 2^x$. Use transformations to graph $g(x) = -2^{x-1} + 3$

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

Vert. Reflect X-axis
reflect $\rightarrow 1$
transformed exp.

x	$-2^{x-1} + 3$
-1	$2^{3/4}$
0	$2^{1/2}$
1	2

$-2^{-1} + 3$ $-2^{-1} + 3$ $-2^0 + 3$
 $-2^0 + 3$ $-2^1 + 3$ $-2^1 + 3$
 $-\frac{1}{2} + 3$ $-1 + 3$

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1) the smaller the base the steeper the graph when $x < 0$

2) the smaller the base the less steep (more horizontal) the graph when $x > 0$

3) $-a^x$ reflection over x-axis

4) a^{-x} reflection y-axis (or $0 < a < 1$)

Nov 5-3:09 PM

$(1 + \frac{1}{n})^n$

$n=500$ $n=1000$ $n=5000$ $n=50000$

2.716 2.717 2.718 2.718

$e \approx 2.718$

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The number e is defined as the number that the expression $\left(1 + \frac{1}{n}\right)^n$ approaches as $n \rightarrow \infty$. In calculus, this is expressed using limit notation as $e = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$

4. Graph $f(x) = e^x$. Use transformations to graph $g(x) = -e^{x-3}$

Handwritten notes: reflect x-axis, reflect 3, y=0, $1/a = 1/e \approx 0.368$, $a \approx 2.718$

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Equations that involve terms of the form $a^x, a > 0, a \neq 1$, are often referred to as exponential equations. Solving these equations requires applying the following Law of Exponents: if $a^u = a^v$, then $u = v$.

5. Solve: $5^{1-2x} = \frac{1}{5}$

Handwritten work: $5^{-1} = 1/5$, $5^{1-2x} = 5^{-1}$, $1-2x = -1$, $-2x = -2$, $x = 1$

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Handwritten work: $(e^4)^x \cdot e^{x^2} = e^{12}$, $e^{4x} \cdot e^{x^2} = e^{12}$, $e^{4x+x^2} = e^{12}$, $4x+x^2 = 12$, $x^2+4x-12=0$, $(x+6)(x-2)=0$, $x = \{-6, 2\}$

$(2^3)^5 = 2^{15}$, $2^3 \cdot 2^5 = 2^8$

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6. Between 5:00p and 6:00p, cars arrive at Jiffy Lube at the rate of 9 cars per hour (0.15 cars per minute). The following formula from statistics can be used to determine the exponential probability that a car will arrive within t minutes of 5:00p.

$F(t) = 1 - e^{-0.15t}$

a. Determine the probability that a car will arrive within 15 minutes of 5:00p (that is, before 5:15p).

Handwritten work: $f(15) = 1 - e^{-0.15(15)} \approx 0.895 = 89.5\%$

b. Determine the probability that a car will arrive within 30 minutes of 5:00p (that is, before 5:30p).

Handwritten work: $f(30) = 1 - e^{-0.15(30)} \approx 0.989 = 98.9\%$

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$F(t) = 1 - e^{-0.15t}$

Handwritten notes: Parent e^x , reflects y-axis, reflects x-axis, Horizontal stretch by $1/15$, Label 3 points

d. What value does F approach as t becomes unbounded in the positive direction? **1**

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Rate yourself on how well you understood this lesson.

I don't get it at all	I sort of get it	I understand most, but I need more practice	I understand it pretty well	I got it!!
1	2	3	4	5

What I still need to work on....

Aug 24-10:50 AM