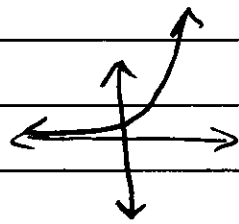# Algebra 5.1 Exponential Functions

Bases greater than 1 - exponential growth

$f(x) = a^x \quad a > 1$
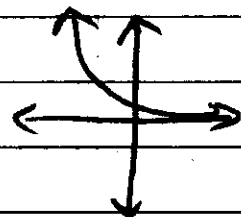
ex. - population, bacterial growth, compound interest
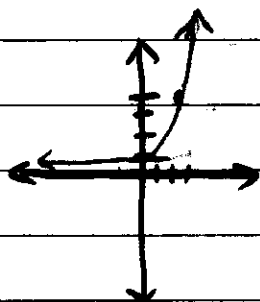
Bases less than 1 - exponential decay

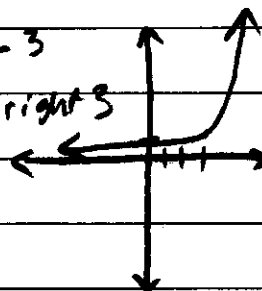$f(x) = a^x \quad a < 1$

ex - radioactive decay

$f(x) = 2^x$

x	y
-3	$\frac{1}{8}$
-2	$\frac{1}{4}$
0	1
2	4
3	8

$g(x) = 2^{x-3}$
Shift right 3

$h(x) = 2^{x+5}$
Shift up 5
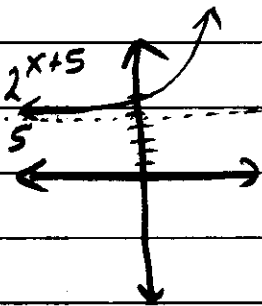
Graph $f(x) = \left(\frac{1}{2}\right)^x$

x	f(x)
-3	8
-2	4
0	1
2	$\frac{1}{4}$
3	$\frac{1}{8}$
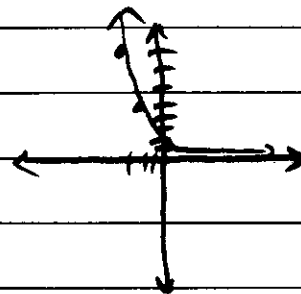
Solve for x

① $2^{3x} = 2^{-7x-5}$

$3x = -7x - 5$

$10x = -5$

$x = -\frac{1}{2}$

② $3^{2x+3} = 3^{x^2}$

$2x + 3 = x^2$

$x^2 - 2x - 3 = 0$

$(x+1)(x-3) = 0$

$x = -1, 3$

③ $9^{x^2} = 3^{3x+2}$ ← Bases must be the same

$(3^2)^{x^2} = 3^{3x+2}$

$3^{2x^2} = 3^{3x+2}$

$2x^2 = 3x + 2$

$2x^2 - 3x - 2 = 0$

$(2x+1)(x-2) = 0$

$x = -\frac{1}{2}, 2$

alg 5.1

④ $4^x \cdot \left(\frac{1}{2}\right)^{3-2x} = 8(2^x)^2$

$(2^2)^x \cdot (2^{-1})^{3-2x} = 2^3(2^{2x})$

$2^{2x} \cdot 2^{-3-2x} = 2^3 \cdot 2^{2x}$

$2^{4x-3} = 2^{3+2x}$

$4x - 3 = 3 + 2x$

$2x = 6$

$x = 3$

— remember, the bases must be the same

Ex Find an exponential function of the form $f(x) = ba^x$ given y-int 8, and $P(3,1)$

y-int $8 = (0,8)$

1st $f(x) = ba^x$

$8 = ba^0$

$8 = b \cdot 1$

$\boxed{b = 8}$

2nd $f(x) = ba^x$

$1 = 8a^3$

$a^3 = \frac{1}{8}$

$a = \sqrt[3]{\frac{1}{8}}$

$a = \frac{1}{2}$

$\boxed{f(x) = 8\left(\frac{1}{2}\right)^x}$