# Extra Practice
Exponential Growth and Decay

Sketch the graph of each of the following functions. Label the key point for each.

**1.** $f(x) = 2^{x+1} - 4$ (0,1)
−1 −4
(−1,3)

(−1,−3)   y = −4

2. $f(x) = \left(\dfrac{1}{3}\right)^{x-4} + 2$ (0, 1)
+4 +2
(4, 3)

(4,3)   y=2

3. $f(x) = -3^x - 2$ (0,−1)
−2
(0,−3)

y = −2
(0,−3)

4. $f(x) = \left(\dfrac{1}{2}\right)^{x+2}$ (0,1)
−2
(−2,1)

(−2,1)   y=0

5. $f(x) = 2^{x-3} + 1$ (0, 1)
+3 +1
(3,2)

(3,2)   y=1

6. $f(x) = \left(\dfrac{3}{2}\right)^{x-1}$ (0,1)
−1
(1, 1)

(−1,1)   y = 0
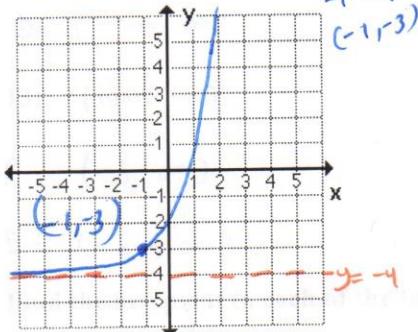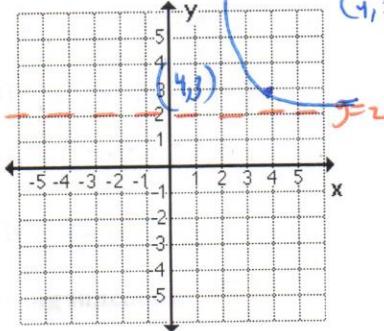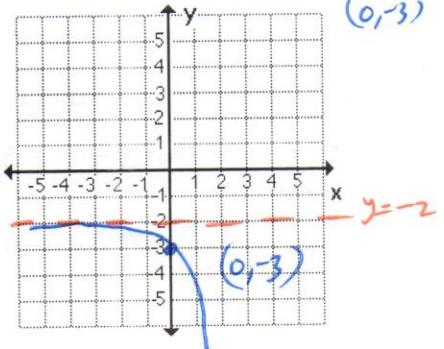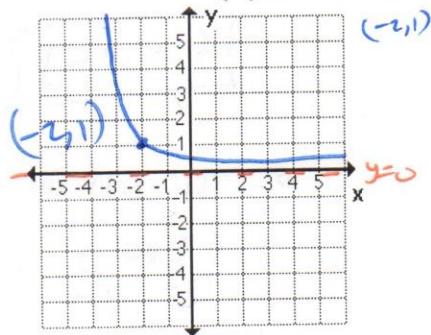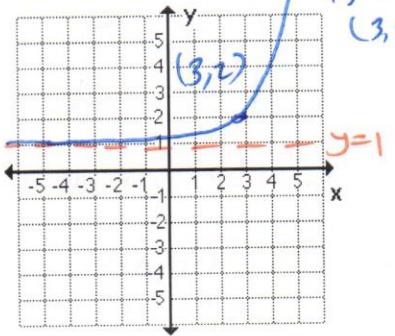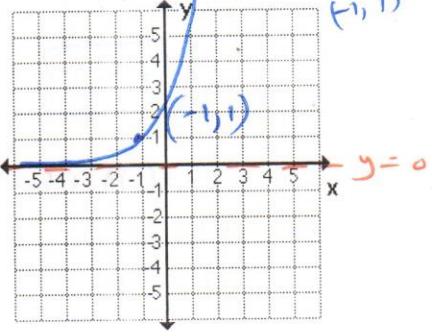
Solve each of the following equations for x. (Remember, get the bases to match and use the one to one property to solve.)

7. $16^{2x-3} = 8^{x+2}$

$\left(2^4\right)^{2x-3} = \left(2^3\right)^{x+2}$

$2^{8x-12} = 2^{3x+6}$

$8x - 12 = 3x + 6$
$-3x \quad +12 \quad -3x \quad +12$
$5x = 18$

$\boxed{x = \dfrac{18}{5}}$

8. $9^{x+2} = 27^{x-5}$

$\left(3^2\right)^{x+2} = \left(3^3\right)^{x-5}$

$3^{2x+4} = 3^{3x-15}$

$2x + 4 = 3x - 15$
$-2x + 15 \quad -3x \quad +15$
$19 = x$

$\boxed{x = 19}$

9. $\left(\dfrac{1}{2}\right)^{x-4} = 4^{2x-3}$

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

$2^{-x+4} = 2^{4x-6}$

$-x + 4 = 4x - 6$
$+x \quad +6 \quad +x \quad +6$
$10 = 5x$

$\boxed{x = 2}$

Find the range and domain of each of the following exponential functions.

10) $f(x) = 2^{x+6} - 4$

R: $(-4, \infty)$

D: $(-\infty, \infty)$

11) $f(x) = -\left(\dfrac{1}{2}\right)^{x-1} + 3$

R: $(-\infty, 3)$

D: $(-\infty, \infty)$

12) $f(x) = 2(3)^{x+1} - 5$

R: $(-5, \infty)$

D: $(-\infty, \infty)$

13) $f(x) = 5^{-x} - 3$

R: $(-3, \infty)$

D: $(-\infty, \infty)$

14) $f(x) = -2(5)^{x+2} - 3$

R: $(-\infty, -3)$

D: $(-\infty, \infty)$

15) $f(x) = e^{x+2} - 3$

R: $(-3, \infty)$

D: $(-\infty, \infty)$

Find the key point to each of the following functions.

16) $f(x) = 3^{x+4} - 2$

$(\ 0, \quad 1\ )$
$-4 \qquad -2$

$\boxed{(-4, -1)}$

17) $f(x) = -4^{x-2} + 1$

$(\ 0, \quad -1\ )$
$+2 \qquad +1$

$\boxed{(2, 0)}$

18) $f(x) = 2^{4-x} + 5$

$y - x = 0 \qquad f(4) = 2^0 + 5$
$x = 4 \qquad\qquad f(4) = 6$

$\boxed{(4, 6)}$

19) $f(x) = 3(2)^{x+1} - 5$

$(\ 0, 3\ )$
$-1 \qquad -5$

$\boxed{(-1, -2)}$

20) $f(x) = 2\left(\dfrac{1}{2}\right)^{x+4} - 3$

$(0, 2)$
$-4 \qquad -3$

$\boxed{(-4, -1)}$

21) $f(x) = -3^{x+2} - 4$

$(\ 0, -1)$
$-2 \qquad -4$

$\boxed{(-2, -5)}$

Simplify each of the following expressions.

22) $x^{\sqrt{2}} \cdot x^{3\sqrt{2}}$

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

$= x^{4\sqrt{2}}$

23) $\left(2^{\sqrt{3}}\right)^{\sqrt{3}}$

$= 2^3$

$= 8$

24) $16^{\pi/2}$

$= \left(16^{1/2}\right)^{\pi}$

$= 4^{\pi}$

25) $\dfrac{25^{\sqrt{3}+4}}{125} = \dfrac{\left(5^2\right)^{\sqrt{3}+4}}{5^3}$

$= 5^{2\sqrt{3}+8 \quad -3}$

$= 5^{2\sqrt{3}+5}$

26) $\left(\sqrt{2}\right)^{\sqrt{3}}\left(\sqrt{2}\right)^{-\sqrt{3}}$

$= \left(\sqrt{2}\right)^{\sqrt{3} + (-\sqrt{3})}$

$= \left(\sqrt{2}\right)^0$

$= 1$

27) $\dfrac{3^{\sqrt{3}} \cdot 81^{\sqrt{27}}}{9^{2\sqrt{3}}}$

$= \dfrac{3^{\sqrt{3}} \cdot \left(3^4\right)^{3\sqrt{3}}}{\left(3^2\right)^{2\sqrt{3}}}$

$= 3^{\sqrt{3} + 12\sqrt{3} - 4\sqrt{3}}$

$= 3^{9\sqrt{3}}$

28) $\dfrac{36^{\sqrt{7}}}{4^{\sqrt{7}}}$

$= \left(\dfrac{36}{4}\right)^{\sqrt{7}}$

$= 9^{\sqrt{7}}$

29) $-81^{3/4}$

$- \left(81^{1/4}\right)^3$

$- (3)^3$

-27