Parent function of exponential functions $f(x) = b^x$

$b > 1; \{exponential\ growth\}$

$0 < b < 1; \{exponential\ decay\}$

Recognizing transformations: $f(x) = a \cdot b^{x \pm h} \pm k$

If there is an $(-a) \cdot b$, then the function is reflected over the $x - axis$ and it is neither growth nor decay(but still an exponential function). If there is a $-x$(in the exponent), the function reflects over the $y - axis$.

$$|a| > 1; vertical\ stretch\ by\ a\ factor\ of\ a$$

$$0 < |a| < 1; vertical\ compression\ by\ a\ factor\ of\ a$$

$$(x + h); shift\ left\ h\ units;\ \ (x - h); shift\ right\ h\ units$$

$$+k; shift\ up\ k\ units;\ \ -k; shift\ down\ k\ units$$

Asymptote: an imaginary line that the function gets really close to but never touches or crosses {hint: look @ k} Write this as an equation: $y = k$

$Y - intercept$: when $x = 0$

Exponential Growth and Decay Many real-world situations can be modeled by exponential functions. One of the equations below may apply.

Exponential Growth or Decay	Continuous Exponential Growth or Decay	Compound Interest
$N = N_0(1 + r)^t$	$N = N_0e^{kt}$	$A = P\left[1 + \frac{r}{n}\right]^{nt}$
N is the final amount, N_0 is the initial amount, r is the rate of growth or decay, and t is time.	N is the final amount, N_0 is the initial amount, r is the rate of growth or decay, r is time, and e is a constant.	P is the principal or initial investment, A is the final amount of the investment, r is the annual interest rate, n is the number of times interest is compounded each year, and t is the number of years.

Example 1 **BIOLOGY A researcher estimates that the initial population of a colony of cells is 100. If the cells reproduce at a rate of 25% per week, what is the expected population of the colony in six weeks?**

$N = N_0(1 + r)^t$ Exponential Growth Formula

$= 100(1 + 0.25)^6$ $N_0 = 100, r = 0.25, t = 6$

≈ 381.4697266 Use a calculator.

There will be about 381 cells in the colony in 6 weeks.

Example 2 **FINANCIAL LITERACY Lance has a bank account that will allow him to invest $1000 at a 5% interest rate compounded continuously. If there are no other deposits or withdrawals, what will Lance's account balance be after 10 years?**

$A = Pe^{rt}$ Continuous Compound Interest Formula

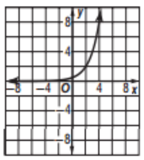
$= 1000e^{(0.05)(10)}$ $P = 1000, r = 0.05$, and $t = 10$

≈ 1648.72 Simplify.

With continuous compounding, Lance's account balance after 10 years will be $1648.72.

Sketch and analyze the graph of each function. Describe its domain, range, intercepts, asymptotes, end behavior, and where the function is increasing or decreasing.

1. $f(x) = 2^{x-1}$



$D = (-\infty, \infty)$;

$R = (0, \infty)$;

y-intercept: $\left(0, \frac{1}{2}\right)$;

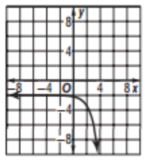
x-intercept: none;

asymptote: x-axis;

end behavior: $\lim_{x \to -\infty} f(x) = 0$ and $\lim_{x \to \infty} f(x) = \infty$;

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

2. $h(x) = -\frac{1}{5}e^{x} - 2$



$D = (-\infty, \infty)$;

$R = (-\infty, -2)$;

y-intercept: $(0, -2.2)$;

x-intercept: none;

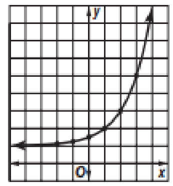
asymptote: $y = -2$;

end behavior: $\lim_{x \to -\infty} f(x) = -2$ and $\lim_{x \to \infty} f(x) = -\infty$;

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

Sketch and analyze the graph of each function. Describe its domain, range, intercepts, asymptotes, end behavior, and where the function is increasing or decreasing.

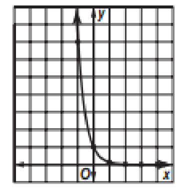
1. $h(x) = 2^{x-1} + 1$



$D = (-\infty, \infty)$;
$R = (1, \infty)$;
intercept: $\left(0, 1\frac{1}{2}\right)$;
asymptotes: $y = 1$;
end behavior:
$\lim_{x \to -\infty} f(x) = 1$ and
$\lim_{x \to \infty} f(x) = \infty$;

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

2. $k(x) = e^{-2x}$



$D = (-\infty, \infty)$;
$R = (0, \infty)$;
intercept: $(0, 1)$;
asymptote: x-axis;
end behavior:
$\lim_{x \to -\infty} f(x) = \infty$ and
$\lim_{x \to \infty} f(x) = 0$;

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

Identify: domain, range, y-intercept, x-intercept, asymptote, end behavior, interval increasing/decreasing, transformations from parent function: $f(x) = (\frac{4}{3})^{x+5} - 10$

Identify: domain, range, y-intercept, x-intercept, asymptote, end behavior, interval increasing/decreasing, transformations from parent function: $f(x) = (0.75)^{x-2} + 3$