Lesson 3.1 - Properties and Graphs of Exponential Functions

## I. **Graphs of Exponential Functions**

Graph each of the following on the same plot and state the end behavior for each function. Specify at least 3 ordered pairs for each graph.

															_			
CK Desmos																		+
		++	_	$\square$				+	_	$\left  \right $	_		_		+	$\left  \right $	_	+
		++	-	++				++	+	$\vdash$	+	+	-	$\vdash$	+	$\vdash$	+	+
															_			
	$\vdash$	++	_	$\vdash$				++	+	$\vdash$	+	+	-	$\vdash$	+	$\vdash$	+	+-
		++	-	++				++	+	$\vdash$	+	+		$\square$	+	$\square$	+	+
	$\vdash$	++	+	++	+			++	+	$\left  \right $	+	+		$\left  \right $	+	$\vdash$	+	+
																		+
											_				_			
		++	-	++	+			++	+	$\vdash$	+	+	+	$\vdash$	+	$\vdash$	+	+
ck Desmos		++	_	$\vdash$		_		+	_	$\vdash$	+	+	_	$\vdash$	+	$\vdash$	+	+
		++	+	++				++	+	$\vdash$	+	+	+	$\vdash$	+	$\vdash$	+	+
Check Desmos	E T y (V Frince (V (E If A ass If A -	<b>Exponential Functions</b> The simplest exponential function has the form $y = b^x$ where $b > 0$ , and $b \neq 1$ . (Why do we define $b > 0$ ?) Let b be a negative number, and x be a fraction. Fractional exponents are the same as radicals. Having a negative base b underneath a radical is undefined). (Why do we define $b \neq 1$ ?) I to any power is just 1 so you just get a line here. (End behavior of an exponential function?) If $b > 1$ , this is called <b>exponential growth</b> . As $x \to \infty$ , $f(x) \to \infty$ . As $x \to -\infty$ , $f(x) \to$ horizontal asymptote. ( <i>Give or take transformations to the function</i> ) If $0 < b < 1$ , this is called <b>exponential decay</b> . As $x \to \infty$ , $f(x) \to$ horizontal asymptote. As $x \to -\infty$ , $f(x) \to \infty$ . ( <i>Give or take transformations</i> ).																
	eck Desmos Check Desmos	eck Desmos	eck Desmos   eck Desmos   Exp   The $y =$ (Why   Fract   negat   (Why   (End   If $b =$ As x   asym   If $0 <$ As x $-\infty$	eck DesmosExponsExponsExponsCheck DesmosFractional negative (Why doCheck DesmosFractional negative (Why doIf $b > 1$ , $As x \to co-\infty, f(x)$	eck DesmosExponenti The simple $y = b^x$ with (Why do we I to (End behavior If $b > 1$ , this As $x \to \infty$ , f asymptote. (If If $0 < b < 1$	eck Desmoseck DesmosExponentialThe simplest of $y = b^x$ where (Why do we define Let b be Fractional exponise negative base bit) (Why do we define I to any (End behavior of If $b > 1$ , this is of $As x \to \infty, f(x)$ asymptote. (Giv If $0 < b < 1$ , thi $As x \to \infty, f(x)$ $-\infty, f(x) \to \infty$ .	eck Desmoseck DesmosExponential Fun The simplest expo $y = b^x$ where $b >$ (Why do we define $b$ Let $b$ be a na Fractional exponents negative base $b$ under (Why do we define $b$ I to any pow (End behavior of an e If $b > 1$ , this is called As $x \to \infty, f(x) \to \infty$ asymptote. (Give or If $0 < b < 1$ , this is called As $x \to \infty, f(x) \to \infty$ (Give or)	eck DesmosExponential FunctionThe simplest exponent $y = b^x$ where $b > 0$ .(Why do we define $b > 1$ .I to any power i(End behavior of an expoIf $b > 1$ , this is called exponent.As $x \to \infty$ , $f(x) \to \infty$ . AAsymptote. (Give or takeIf $0 < b < 1$ , this is calledAs $x \to \infty$ , $f(x) \to \infty$ . (Give or take)	eck Desmosck Desmos <b>Exponential Functions</b> The simplest exponentia $y = b^x$ where $b > 0$ , an (Why do we define $b > 0$ ?) Let b be a negative 1 Fractional exponents are the $z$ negative base b underneath a (Why do we define $b \neq 1$ ?) I to any power is just (End behavior of an exponent If $b > 1$ , this is called <b>expon</b> $As x \to \infty, f(x) \to \infty$ . As x asymptote. (Give or take traditional $-\infty, f(x) \to \infty$ . (Give or take traditional $-\infty, f(x) \to \infty$ . (Give or take traditional)	xck Desmosxck DesmosExponential FunctionsThe simplest exponential fu $y = b^x$ where $b > 0$ , and $b$ (Why do we define $b > 0$ ?) Let b be a negative num Fractional exponents are the sam negative base b underneath a rad (Why do we define $b \neq 1$ ?) I to any power is just 1 (End behavior of an exponential If $b > 1$ , this is called <b>exponential</b> If $0 < b < 1$ , this is called <b>exponential</b> $sx \to \infty$ , $f(x) \to \infty$ . As $x \to -$ asymptote. ( <i>Give or take transfo</i> If $0 < b < 1$ , this is called <b>exponential</b> $sx \to \infty$ , $f(x) \to \infty$ . ( <i>Give or take transfo</i> )	xck Desmosxck DesmosExponential FunctionsThe simplest exponential funct $y = b^x$ where $b > 0$ , and $b \neq$ (Why do we define $b > 0$ ?)Let b be a negative number Fractional exponents are the same a negative base b underneath a radical (Why do we define $b \neq 1$ ?) I to any power is just 1 so (End behavior of an exponential funct If $b > 1$ , this is called <b>exponential</b> If $0 < b < 1$ , this is called <b>exponential</b> $As x \to \infty, f(x) \to \infty$ . As $x \to -\infty$ asymptote. (Give or take trans	teck Desmosteck DesmosExponential FunctionsThe simplest exponential function $y = b^x$ where $b > 0$ , and $b \neq 1$ (Why do we define $b > 0$ ?) Let b be a negative number, at Fractional exponents are the same as ra negative base b underneath a radical is (Why do we define $b \neq 1$ ?) I to any power is just 1 so you (End behavior of an exponential function If $b > 1$ , this is called <b>exponential group</b> As $x \to \infty$ , $f(x) \to \infty$ . As $x \to -\infty$ , $f(x)$ asymptote. (Give or take transformation If $0 < b < 1$ , this is called <b>exponential</b> and the transformation $-\infty$ , $f(x) \to \infty$ . (Give or take transformation)	xck Desmosxck DesmosExponential FunctionsThe simplest exponential function h $y = b^x$ where $b > 0$ , and $b \neq 1$ .(Why do we define $b > 0$ ?)Let b be a negative number, and xFractional exponents are the same as radica negative base b underneath a radical is under (Why do we define $b \neq 1$ ?)I to any power is just 1 so you just (End behavior of an exponential function?)If $b > 1$ , this is called <b>exponential growth</b> $As x \to \infty, f(x) \to \infty$ . As $x \to -\infty, f(x) \to$ asymptote. (Give or take transformations the $f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the $-\infty, f(x) \to \infty$ . (Give or take transformations the tax is the transformation the tax is the t	vck Desmosvck DesmosCheck DesmosCheck DesmosCheck DesmosImage: State Stat	eck Desmoseck DesmosExponential FunctionsThe simplest exponential function has the $y = b^x$ where $b > 0$ , and $b \neq 1$ . (Why do we define $b > 0$ ?) Let b be a negative number, and x be a fra Fractional exponents are the same as radicals. Hav negative base b underneath a radical is undefined). (Why do we define $b \neq 1$ ?) I to any power is just 1 so you just get a li (End behavior of an exponential function?) If $b > 1$ , this is called <b>exponential growth</b> . As $x \to \infty_{j}f(x) \to \infty$ . As $x \to -\infty_{j}f(x) \to$ horizontal asymptote. As $x \to -\infty_{j}f(x) \to \infty$ .	cck Desmoscck Desmos <b>Exponential Functions</b> The simplest exponential function has the for $y = b^x$ where $b > 0$ , and $b \neq 1$ . (Why do we define $b > 0$ ?) Let b be a negative number, and x be a fractic Fractional exponents are the same as radicals. Having negative base b underneath a radical is undefined). (Why do we define $b \neq 1$ ?) I to any power is just 1 so you just get a line 1 (End behavior of an exponential function?) If $b > 1$ , this is called <b>exponential growth</b> . As $x \to \infty$ , $f(x) \to \infty$ . As $x \to -\infty$ , $f(x) \to$ horizontal asymptote. (Give or take transformations).	eck Desmosexk DesmosExponential FunctionsThe simplest exponential function has the form $y = b^x$ where $b > 0$ , and $b \neq 1$ . (Why do we define $b > 0$ ?) Let be a negative number, and x be a fraction. Fractional exponents are the same as radicals. Having a negative base b underneath a radical is undefined). (Why do we define $b \neq 1$ ?) I to any power is just 1 so you just get a line here (End behavior of an exponential function?) If $b > 1$ , this is called <b>exponential growth</b> . $As x \to \infty, f(x) \to \infty$ . As $x \to -\infty, f(x) \to$ horizontal asymptote. (Give or take transformations).	vck Desmosxck DesmosExponential FunctionsThe simplest exponential function has the form $y = b^x$ where $b > 0$ , and $b \neq 1$ .(Why do we define $b > 0$ ?)Let be a negative number, and x be a fraction.Fractional exponents are the same as radicals. Having a negative base b underneath a radical is undefined).(Why do we define $b \neq 1$ ?)I to any power is just 1 so you just get a line here.(End behavior of an exponential function?)If $b > 1$ , this is called <b>exponential growth</b> .As $x \to \infty, f(x) \to \infty$ . As $x \to -\infty, f(x) \to$ horizontal asymptote. (Give or take transformations).

## II. Practice

Graph each of the following and state the end behavior for each function. They have been grouped to graph together on the same plot. Specify at least 3 ordered pairs for each graph, along with the equation for any asymptotes. Check you graphs using Desmos or a graphing calculator.

