Derivative of the Exponential Function With Base e

Objectives: Find the derivative of exponential functions.

Warm up: Estimations of *e*

If you began walking at 1 km/h and then doubled your speed over a one-minute interval, you would be walking at 2 km/h. But suppose you increased your speed by 50% every half-minute. How fast would you be walking at the end of one minute?

Suppose you increased your speed by 25% every quarter-minute. What would your speed be at the end of one minute? Remember, your speed would be 1.25 times as fast every quarter-minute. Complete the chart below

Time Elapsed (s)	0	15	30	45	60
Speed (km/h)					

Generate an expression to find your speed at the end of one minute.

Suppose you increased your speed by $\frac{1}{10}$ for every tenth of a minute. What would your speed be at the end of one minute?

Complete the table for each increase in speed for and equal portion of a minute.

Increase in speed	**Speed at the end of 1 minute**
$\frac{1}{10}$	
$\frac{1}{1000}$	
$\frac{1}{100000}$	
$\frac{1}{10000000}$	
$\frac{1}{1000000000}$	

Derivatives of $y = e^x$

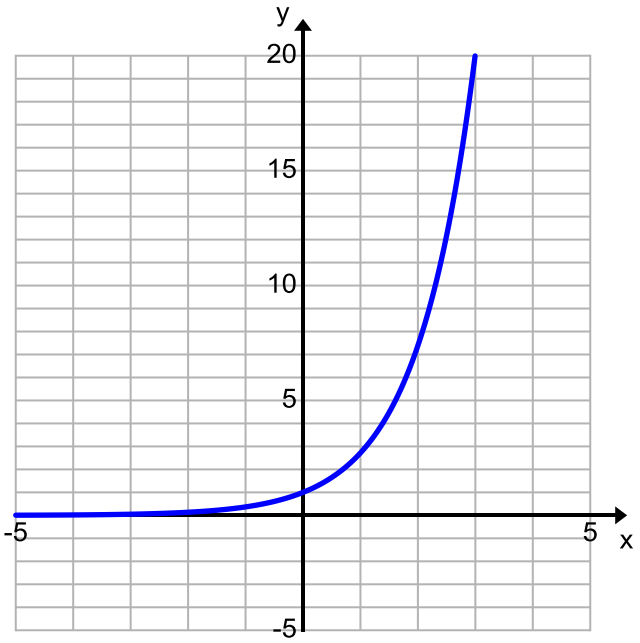
e can be defined as: $e = \lim_{n\to\infty}\left[1+\frac{1}{n}\right]^n$

Investigate:
Why is *e* such a special number?

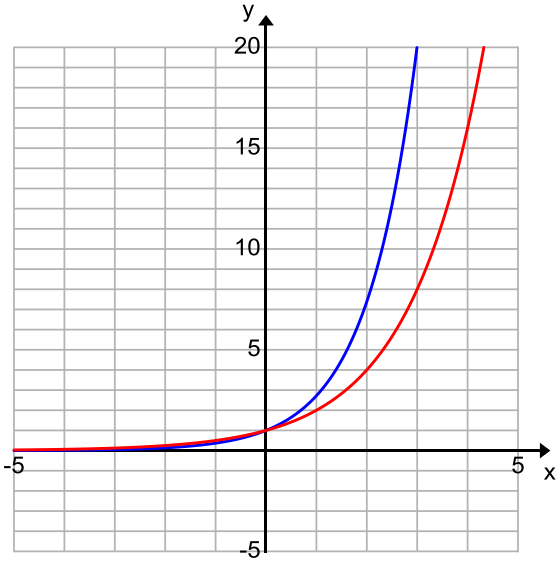
Use your calculator to sketch $y = e^x$.
Find the values of e^x at x = 1,3,5

Find the derivative of $y = e^x$ at x = 1,3,5 using your calculator.

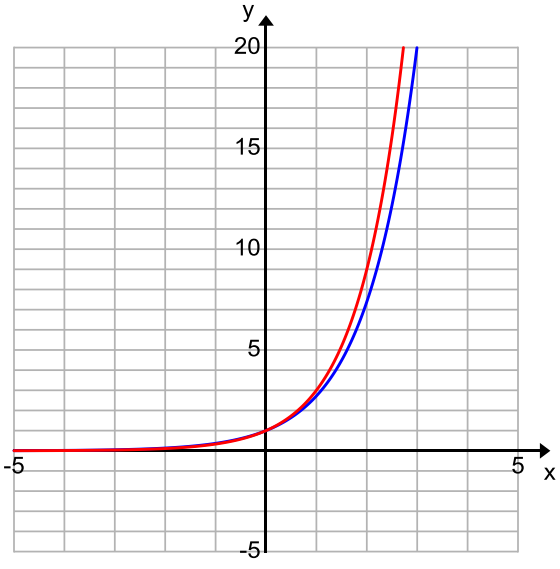
State the value of $\frac{dy}{dx}e^x$



$y = 2^x$ and $y = e^x$



$y = 3^x$ and $y = e^x$



Chain Rule: $\boldsymbol{f(x) = e^u}$ then $\boldsymbol{f'(x) = e^u \cdot \frac{du}{dx}}$

1. Differentiate
   a) $y = x^3 e^x$ b) $y = e^{x^2}$ c) $y = x^5 e^{x^5}$

2. Find the absolute maximum value of the function $f(x) = xe^{-x}$

3. Sketch the graph of $f(x) = e^{-x^2}$

Homework: Page 366 # 1, 4 (a,b,d,g,h,k,l) , 5, 8, 10, 11(a,b)