Definition of *e* (Johann Bernoulli): $$e = \lim_{x \to \infty}\left(1+\frac{1}{x}\right)^x$$

***e* from compound interest**

Finding interest compounded *n* times in 1 year at an annual rate of *r*:

$$\left(1+\frac{r}{n}\right)^n$$

How can I move *r* to somewhere more convenient?

Substitute:

$$\frac{1}{x} = \frac{r}{n}$$

So:

$x =$ and $n =$

so if $n \to \infty$ then $x \to$

Substituting in for *n* and *r*, we get

$$\left(1+\frac{r}{n}\right)^n = \left(1+\frac{1}{x}\right)$$

Fill in exponent

So, finally we get:

$$\lim_{n \to \infty}\left(1+\frac{r}{n}\right)^n = \lim_{x \to}\left(1+\frac{1}{x}\right)$$

Another useful form for defining *e*:

$$e = \lim_{x \to \infty}\left(1+\frac{1}{x}\right)^x$$

Substitute $h = \frac{1}{x}$, so $x =$

and if $x \to \infty$ then $h \to$

Making those substitutions, we get the form:

$$e = \lim_{x \to \infty}\left(1+\frac{1}{x}\right)^x = \lim_{h \to}(1+h)^{\boxed{}}$$

So we can use

$$e = \lim_{h \to}(1+h)$$

Definition/formula of derivative:

Geometrically a derivative is the slope of a tangent line.

The function is $f(x)$. We want the derivative at the value *x*. The number $x+h$ is *h* distance from *x*.

The point at *x* is $(x, f(x))$ The point at $x+h$ is: $(\quad , \quad)$

The slope between these two points is: $\frac{rise}{run} = \underline{\qquad\qquad}$

If we want the slope of a tangent line, then we want the distance between the x-coordinates very small. That distance is *h*, so we use the limit:

$$\lim_{h \to 0} \underline{\qquad\qquad}$$

The derivative of e^x

$$\lim_{h \to 0}\frac{e^{x+h}-e^x}{h} = \underbrace{\lim_{h \to 0}\frac{\qquad}{h}}_{\text{factor using exponent rules}} = \underbrace{\lim_{h \to 0}\frac{\qquad}{h}}_{\text{Substitute for one of the e's using the defn}} =$$