

**Section 4.4 Indeterminate forms and l'Hospital's rule****Learning outcomes**

After completing this section, you will inshaAllah be able to

1. **use l'Hospital's rule** to **compute limits of indeterminate forms** of the following types

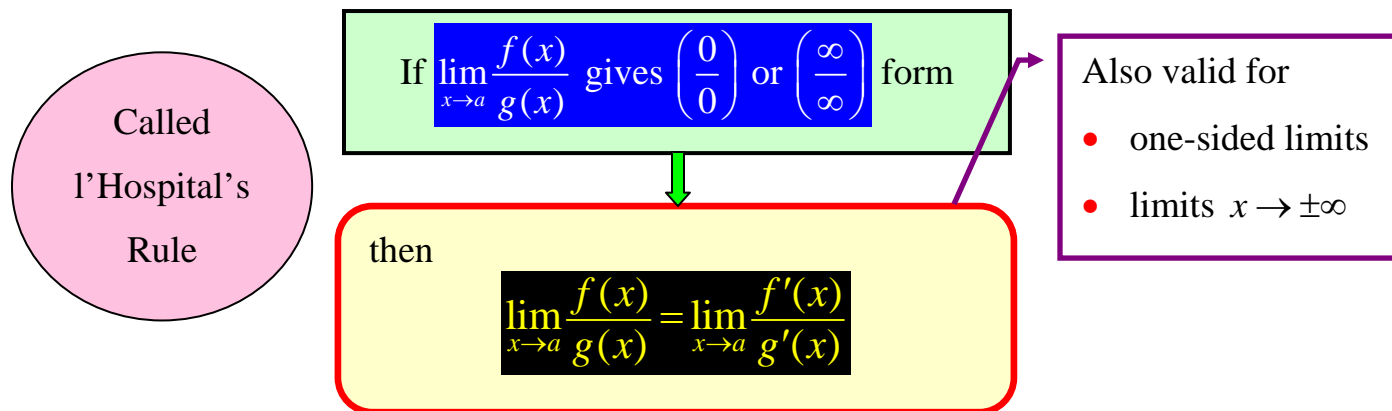
**a.**  $\left(\frac{0}{0}\right), \left(\frac{\infty}{\infty}\right)$  type

**b.**  $(0 \cdot \infty), (\infty - \infty)$  type

**c.**  $0^0, \infty^0, 1^\infty$  type

## Limits of indeterminate forms of $\left(\frac{0}{0}\right)$ or $\left(\frac{\infty}{\infty}\right)$ type

- Use l'Hospital's rule explained below



See examples 1, 2, 3, 4, 5, 6 done in class

## Limits of indeterminate forms of $(0 \cdot \infty)$ or $(\infty - \infty)$ type

- Reduce to previous case  $\left(\frac{0}{0}\right)$  or  $\left(\frac{\infty}{\infty}\right)$  type
- And use l'Hospital's rule

See examples 7, 8, 9 done in class

## Limits $\lim_{x \rightarrow a} (f(x))^{g(x)}$ of the form $0^0, \infty^0, 1^\infty$

- Take 'ln' and reduce to previous cases

### Procedure for finding limit

- Set  $y = (f(x))^{g(x)}$

$$\Rightarrow \lim_{x \rightarrow a} y = \lim_{x \rightarrow a} (f(x))^{g(x)} = ?$$

- Take ln and compute  $\ln\left(\lim_{x \rightarrow a} y\right)$

$$\begin{aligned} \Rightarrow \ln\left(\lim_{x \rightarrow a} y\right) &= \ln\left[\lim_{x \rightarrow a} (f(x))^{g(x)}\right] \\ &= \lim_{x \rightarrow a} \left[\ln(f(x))^{g(x)}\right] \\ &= \lim_{x \rightarrow a} \left[g(x) \cdot \ln(f(x))\right] \\ &= L \end{aligned}$$

Gives  $(0 \cdot \infty)$  form.  
This can be solved  
as explained above

- Then  $\lim_{x \rightarrow a} y = e^L$

See examples 10, 11, 12 done in class

*End of 4.4*