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Section 22

① Find the limit if it exists, or show that the limit does not exist

$$\lim_{(x,y)\to(0,0)} \frac{2x}{2x+3y}$$

① Plug in $(0,0) \to \frac{2(0)}{2(0)+3(0)} = \frac{0}{0}$

② Plug in $y=cx$

$$\to \frac{2x}{2x+3cx} = \frac{2x}{x(2+3c)} = \frac{2}{2+3c}$$

This limit depends on c which varies based on different lines, thus the limit varies and is not always the same. Thus, the limit does not exist. ✓

② Find the limit if it exists, or show that the limit does not exist:

$$\lim_{(x,y)\to(0,0)} \frac{x^5}{x^2+y^2}$$

a) Plug in $(0,0) \to \frac{0^5}{0^2+0^2} = \frac{0}{0}$

b) Plug in $y=cx \to \lim_{x\to 0} \frac{x^5}{x^2+(cx)^2} = \lim_{x\to 0} \frac{x^5}{x^2(1+c^2)} = 0$

$= \lim_{x\to 0} \frac{x^3}{1+c^2}$ → Does Not Depend on slope c

Convert To Polar Coordinates; $x^2+y^2=r$

$$f(r\cos\theta, r\sin\theta) = \frac{(r\cos\theta)^5}{r} = \frac{r^5\cos^5\theta}{r}$$

$$\lim_{r\to 0} r^4\cos^5\theta = 0^5\cos^5\theta = 0$$ → limit exists & equals 0