

1 Related Rates

1. A circle's area is expanding at a constant rate of $5m^2/s$. How fast is its radius changing when its area is $100\pi m^2$?
2. A conical cup that is $6cm$ wide at the top and $5cm$ tall is filled with water is punctured at the bottom and water is coming out at a rate of $10^{-6}m^3/s$. Initially, the cup is filled. How fast is the height of the water changing when the height is $2cm$?
3. A lamppost is $5m$ tall. A woman who is $2m$ tall is walking away from it at a constant rate of $10cm/s$. When she is $2m$ away from the lamppost, how fast is her shadow length changing?
4. Sand is being dumped in a conical pile whose width and height always remain the same. If the sand is being dumped in at a rate of $2m^3/hr$, how fast is the height of the sand changing when the pile is $10cm$ tall?
5. A ladder $5m$ tall is lying against a wall. The bottom of the ladder is pulled out at a rate of $10cm/s$. How fast is the area of the triangle formed by the ladder, wall, and floor changing when the bottom of the ladder is $3m$ away from the wall?
6. A conical volcano is $100m$ tall and the base has a radius of $50m$. It is filling with lava at a rate of $\pi m^3/s$. At what rate is the height of the lava rising with it is $50m$ tall?

2 L'Hopital's Rule

7. Find $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{2x}\right)^{3x}$.
8. Find $\lim_{x \rightarrow 4} \frac{x-4}{\sqrt{x}-2}$.
9. Find $\lim_{x \rightarrow 0} \frac{x \tan x}{\sin 3x}$.
10. Find $\lim_{x \rightarrow 0} \frac{\sin(x^2)}{x \tan x}$.
11. Find $\lim_{x \rightarrow 0} \frac{x^2 e^x}{\tan^2 x}$.

12. Find $\lim_{x \rightarrow \infty} (\sqrt{x^2 + 1} - \sqrt{x + 1})$.

13. Find $\lim_{x \rightarrow 0^+} \ln x \cdot \tan x$.

14. Find $\lim_{x \rightarrow 0^+} x^{\sin x}$.