1. Find the limit (either a number, ∞, or $-\infty$) or explain why it does not exist: $\lim_{x\to 1^+} \dfrac{x^2}{1-x^2}$

2. Find the limit (either a number, ∞, or $-\infty$) or explain why it does not exist: $\lim_{x\to\infty} \dfrac{6x^2-x+1}{2x^2+7x}$

3. Is the function $f(\theta) = \begin{cases} \sin\theta & \text{if } \theta \le 0 \\ 1-\cos\theta & \text{if } \theta > 0 \end{cases}$ continuous at $x = 0$? Explain why or why not.

4. Use the definition of the derivative to find $f'(2)$ for $f(x) = (x-1)^2$.

5. Is the function $f(x) = \dfrac{x+1}{x^2-1}$ continuous at $x = 1$? Explain why or why not.

6. Is the function $f(x) = |x-2|$ differentiable at $x = 2$? Explain why or why not.

7. Find the slope of the tangent line to the curve $y + y^3 = 2x^2 - 8$ at the point $(3, 2)$.

8. Find the second derivative of the function $f(x) = \cos(x^2)$.

9. A particle moves along the curve $x^2 + y^2 = 25$. When the particle reaches the point $(3, 4)$ its x-coordinate is increasing at a rate of 8 m/s. At what rate is the y-coordinate changing at this moment?

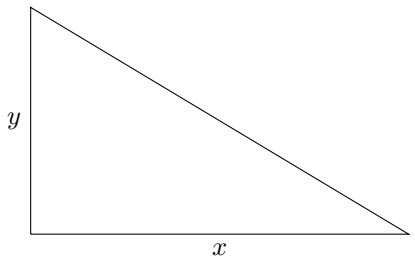
10. A cylinder with volume 64π cm^3, radius r, and height h is being crushed so that $\frac{dh}{dt} = -3$ cm/s (and its volume, given by $V = \pi r^2 h$, remains constant). Find $\frac{dr}{dt}$, the rate at which the radius is changing, when $r = 8$ cm.

11. Find the derivative of the function $g(x) = \displaystyle\int_1^{3x} t^2(1-t)^2\, dt$

12. Use the Intermediate Value Theorem to show that the equation $2\left(x^3+17\right)^{\frac{1}{2}} - 9 = 0$ has a solution between -1 and 2.

13. Find the absolute maximum and absolute minimum values of $f(x) = x - \sin(x)$ over the interval $[-\pi, \pi]$.

14. A right triangle has base length x and height y satisfying the equation $2x + y = 12$. Find the dimensions x and y that maximize the area of the triangle.



15. Sketch the graph of $f(x) = \dfrac{x^2-1}{x^2+1}$. Clearly indicate the location of all axis intercepts, asymptotes, and local extremes.

16. The velocity of a particle at time t is given by the function $v(t) = 3 - 6t^2$ and after 1 second its position is $p(1) = 5$. Find an equation for the position of the particle at time t.

17. Find the average value of the function $f(x) = (2-x)^4$ over the interval $[0, 2]$.

18. Find the area above the curve $y = 2x + x^2$ below the x-axis.

19. The velocity of an object at time t is $v(t) = \dfrac{t}{2} - 1$. Find the total distance traveled from $t = 0$ to $t = 4$.

20. Evaluate the integral $\displaystyle\int \frac{\cos x}{\sqrt{\sin x}}\, dx$.

21. Evaluate the integral $\displaystyle\int_2^3 (10-5x)^4\, dx$.