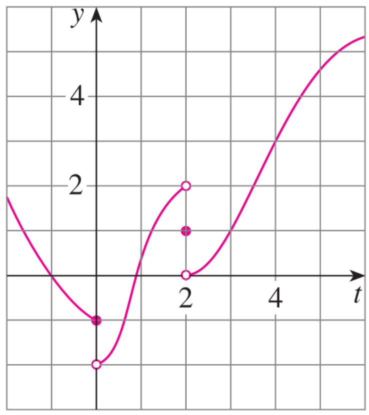
1. For the function $y = g(x)$ depicted in the graph state the value of each quantity, if it exists. If it does not, explain why.



(i) $\lim_{t\to 0^-} g(t)$

(ii) $\lim_{t\to 0^+} g(t)$

(iii) $\lim_{t\to 0} g(t)$

(iv) $g(2)$

(v) $\lim_{t\to 4} g(t)$

2. Precisely define $\lim_{x\to a} f(x) = L$ using inequalities in terms of δ and ϵ.

3. Show $\lim_{x\to 5} \frac{1}{x} = \frac{1}{5}$ using the δ-ϵ definition of limit.

4. Given that

$$\lim_{x\to 2} f(x) = 9, \qquad \lim_{x\to 2} g(x) = -2 \qquad \text{and} \qquad \lim_{x\to 2} h(x) = 0$$

find each limit, if it exists. If it does not exist, explain why.

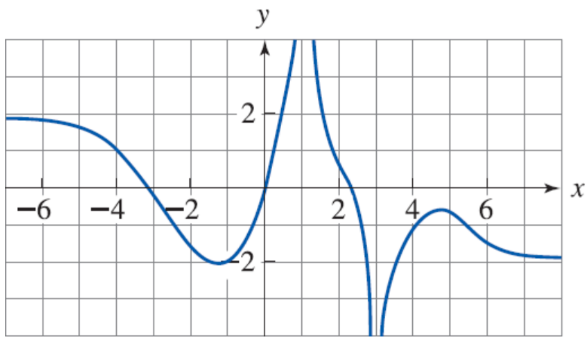
(i) $\lim_{x\to 2} \big(f(x) + 4g(x)\big)$

(ii) $\lim_{x\to 2} \big(g(x)\big)^3$

(iii) $\lim_{x\to 2} \sqrt{f(x)}$

(iv) $\lim_{x\to 2} \dfrac{2f(x)}{g(x)}$

5. For the function $y = f(x)$ whose graph is



state the value of each limit, if it exists. If the limit is infinity, write ∞ or $-\infty$ as appropriate. If the limit does not otherwise exist, write DNE.

(i) $\lim_{x\to\infty} f(x)$

(ii) $\lim_{x\to\infty} f(x)$

(iii) $\lim_{x\to-\infty} f(x)$

(iv) $\lim_{x\to 1} f(x)$

(v) $\lim_{x\to 3} f(x)$

6. Find the following limits:

(i) $\lim_{x \to 2} \dfrac{x^2 + x - 6}{x - 2}$

(ii) $\lim_{x \to \infty} \dfrac{1 + x - 4x^2}{2 + x^2}$

(iii) $\lim_{h \to 0} \dfrac{\sqrt{3 + h} - \sqrt{3}}{h}$

(iv) $\lim_{t \to 0} \dfrac{(\sin 5t)^2}{t^2}$

7. Define the derivative $f'(x)$ of a function $f(x)$ using limits.

8. Use the limit definition to explain why the derivative of $f(x) = x^2$ is $f'(x) = 2x$.

9. Suppose g is differentiable and $f(x) = g(x)/x$. Use the limit definition of derivative to explain why $f'(x) = g'(x)/x - g(x)/x^2$ when $x \neq 0$. No points will be awarded for applying the quotient rule.

10. State the following derivative rules from memory:

$\frac{d}{dx}\sin x = \boxed{}$

$\frac{d}{dx}(fg)(x) = \boxed{}$

$\frac{d}{dx}\cos x = \boxed{}$

$\frac{d}{dx}(f \circ g)(x) = \boxed{}$

$\frac{d}{dx}\tan x = \boxed{}$

$\frac{d}{dx}\left(\frac{f}{g}\right)(x) = \boxed{}$

$\frac{d}{dx}x^{\alpha} = \boxed{}$

$\frac{d}{dx}\frac{1}{x^{\beta}} = \boxed{}$

$\frac{d}{dx}\ln x = \boxed{}$

$\frac{d}{dx}\arccos x = \boxed{}$

$\frac{d}{dx}\sec x = \boxed{}$

$\frac{d}{dx}\log_b x = \boxed{}$

$\frac{d}{dx}\arcsin x = \boxed{}$

$\frac{d}{dx}\csc x = \boxed{}$

$\frac{d}{dx}e^{x} = \boxed{}$

$\frac{d}{dx}\arctan x = \boxed{}$

$\frac{d}{dx}\cot x = \boxed{}$

$\frac{d}{dx}a^{x} = \boxed{}$

11. Use the rules of calculus to compute the following derivatives:

(i) $\dfrac{d}{dx}\big((1+\sqrt{x})\sin x\big)$

(ii) $\dfrac{d}{dx}\arccos(1+x^2)$

(iii) $\dfrac{d}{dx}\Big(\dfrac{x^3-2}{x^2+1}\Big)$

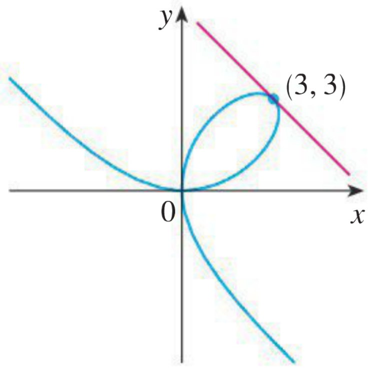
(iv) $\dfrac{d}{dx}\log_{10}(3+\sin x)$

(v) $\dfrac{d}{dx}5^x$

12. Consider the curve defined by the equation $x^3 + y^3 = 6xy$.

(i) Use implicit differentiation to find y' in terms of x and y.

(ii) Find the equation of the line tangent to this curve at the point $(3, 3)$.



(iii) At what point in the first quadrant is the tangent line horizontal?

13. A man walks along a straight path at a speed of 5 ft/s. A searchlight is located on the ground 3 ft from the path and is kept focused on the man. At what rate is the searchlight rotating when the man is 4 ft from the point on the path closest to the searchlight?