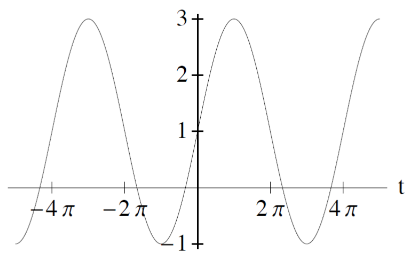
1. Consider the trigonometric function $f(t)$ whose graph is shown below. Write down a possible formula for $f(t)$.



2. Find the domain of the function $f(x) = \sqrt{4 - 5x}$.

3. What is the domain and range of the function $f(x) = (x + 3)^2 - 4$?

4. Use the limit definition of derivative to compute the derivative of the function $f(x) = \frac{4}{x}$ at $x = 2$.

5. The table below gives the depth of snow that has fallen in inches as a function of time in hours past 8am. What is $d(1.5)$ (including units) and what does it represent? What time did it start snowing? Next, estimate $d'(1)$ and $d'(2)$. Include units in your answer and say in a full English sentence what the meaning of these numbers are.

x	.75	1	1.25	1.5	1.75	2	2.25	2.5
$d(x)$	0	.3	.8	1.25	1.85	2.0	2.2	2.4

6. Say $f(x) = 3x^2 + x$. Use the definition of derivative to find $f'(1)$. Then write the equation of the tangent line to the curve at $x = 1$.

7. Say that the position of an object moving horizontally is given by $s(t) = \sqrt{6t + 7}$, where position is measured in miles and time is measured in hours. Find the instantaneous velocity at an arbitrary $t = a$, and then the instantaneous velocity at $t = 7$. Include units.

8. Consider the function

$$f(x) = \begin{cases} x^2 + \cos x & \text{when } -5 < x < 0 \\ 5 & \text{when } x = 0 \\ e^{3x/2} & \text{when } 0 < x < 5 \end{cases}$$

   (a) Define what it means for a function $f(x)$ to be continuous at a point $x = a$.

   (b) $\lim_{x \to 2^+} f(x) =$

   (c) $\lim_{x \to 0^+} f(x) =$

   (d) $\lim_{x \to 0^-} f(x) =$

   (e) $\lim_{x \to 0} f(x) =$

   (f) Is $f(x)$ continuous at $x = 0$? Fully explain your answer. If it is not continuous, state what type of discontinuity it is and why.

9. Sketch the graph of a function $g(x)$ that satisfies ALL of the following properties:

   (a) $\lim_{x \to 1^+} g(x) = 2$

   (b) $\lim_{x \to 1} g(x)$ does not exist.

   (c) $\lim_{x \to \infty} g(x) = -4$

   (d) $\lim_{x \to -4^+} g(x) = -\infty$

   (e) $\lim_{x \to -\infty} g(x) = \infty$

10. A car is first driven at an increasing speed and then the speed begins to decrease until the car stops. Sketch a graph of the distance the car has traveled as a function of time.

11. Find the average velocity over the interval $0.2 \leq t \leq 0.3$ of a car whose position $s(t)$ is given by the following table. Then estimate the velocity at $t = 0.3$. Include units.

t (sec)	0.1	0.2	0.3	0.4	0.5
$s(t)$ (ft)	0	0.5	1.0	1.8	2.8

12. The function $f(t) = -16t^2 + 64t$ gives the distance above the ground of a ball that is thrown from ground level straight up into the air at time $t = 0$, with an initial velocity of 64 ft/sec.

   (a) How high is the ball above the ground at $t = 1$ second?

   (b) How fast is the ball moving at $t = 1$, $t = 2$, $t = 3$ and $t = 4$ seconds?

   (c) What is the maximum height of the ball? (Hint: you should have gotten a velocity of 0 for one of the values of t in the last part)

13. Precisely state the Intermediate Value Theorem. A polynomial $p(x)$ has $p(-2) = 13$ and $p(0) = -1$ and $p(1) = 1$. Show that $p(x)$ has at least two zeroes.

14. Find the following limits. Show all of your work.

    (a) $\lim_{x\to 2} \dfrac{x^2+4x-12}{x-2}$

    (b) $\lim_{x\to 9} \dfrac{3-\sqrt{x}}{x-9}$

    (c) $\lim_{x\to 4} \dfrac{\frac{2}{x}-\frac{1}{2}}{x-4}$

    (d) $\lim_{x\to \infty} \dfrac{3x^4+2x-1}{4-x^4}$

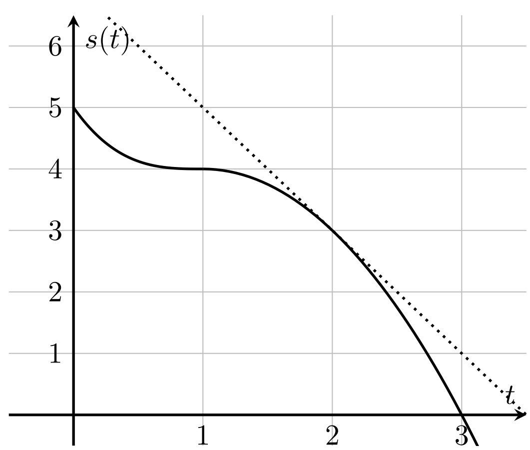
    (e) $\lim_{x\to \infty} \dfrac{3x^2+2x-1}{4-x}$

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

    (g) $\lim_{x\to -\infty} (\sqrt{9x^2+x}-3x)$

    (h) $\lim_{x\to \infty} (\sqrt{9x^2+x}-3x)$

15. The curve below shows position s, measured in feet, as a function of time t, measured in seconds. The dotted line is tangent to the curve.

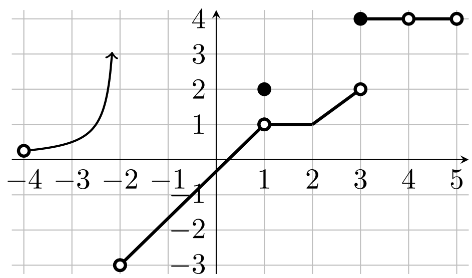


    (a) Find the average velocity over the interval from $t = 0$ to $t = 3$. Include units.

    (b) Find the instantaneous velocity at $t = 2$. Include units.

    (c) Find the equation of the tangent line.

16. Here's a graph of the function $f(x)$:



Meanwhile, here is a definition of the function $g(x)$:

$$g(x) = \begin{cases} -(x-3)^2 + 1 & x > 3 \\ -x + 6 & x < 3 \end{cases}$$

(a) Explain why the graph defines f as a function of x.
(b) Is the f function invertible?
(c) Is the function g invertible?
(d) What is the domain and the range of f?
(e) What is the domain and the range of g?
(f) Find the limit of $f(x)$ as x approaches -2, as x approaches 1, as x approaches 2, as x approaches 3, as x approaches 4. Clearly explain your results.
(g) What is the limit of $g(x)$ as x approaches 3? What about as x approaches 0?
(h) List all of the discontinuities of f and g and clearly explain why these are discontinuities. State what type of discontinuities they are and why.
(i) $\lim_{x\to 2}(f(x) + g(x)) =$
(j) $\lim_{x\to 3}(f(x) + g(x)) =$

17. Find two values of the constant b so that the following function is continuous:

$$h(x) = \begin{cases} x^2 + x - 11 & x \geq b \\ -3x + 1 & x < b \end{cases}$$

18. If $4x - 9 \leq f(x) \leq x^2 - 4x + 7$ for $x \geq 0$, then find $\lim_{x\to 4} f(x)$.

19. Suppose $f(2) = 3$ and $f'(2) = 1$. Find $f(-2)$ and $f'(-2)$ if f is assumed to be even.

20. Given all of the following information about a function f, sketch its graph.

- $f(x) = 0$ at $x = -5$, $x = 0$, and $x = 5$
- $\lim_{x\to -\infty} f(x) = \infty$
- $\lim_{x\to \infty} f(x) = -3$
- $f'(x) = 0$ at $x = -3$, $x = 2.5$, and $x = 7$