Due Dates for Homework Assignments are on our calendar on LATTE

Homework Assignments

I. Section 2.1.
Part A. Do the following problems on pages 149–152. Note: Make sure you simplify your answers.

#21, 23, 30, 31, 36–38, 48–56 evens only, 71ab.

Part B. Suppose that the state income tax in a midwestern state is assessed as follows: Income that is \( \leq \$20,000 \) is taxed at a rate of 2.5%; income that is greater than $20,000 but less than $100,000 is taxed at a rate of 7%; income \( \geq \$100,000 \) is taxed at a rate of 10%.

1. Write a piecewise function that gives the state tax rate \( R \) as a function of income \( I \).

2. How much state income tax does a resident of this state who earning an income of \$99,000 have to pay? How much tax does a person earning an income of $100,000 have to pay?

II. Section 2.2
Part A. Do the following problems on pages 159–62.

#4, 11, 12, 14, 16, 20, 24, 36, 38, 45, 50, 51abc.

Part B. Graph the following functions. Be sure to label your axes carefully.

1. \( f(x) = \begin{cases} 
-2 & \text{if } x \leq -2 \\
|x| & \text{if } -2 < x \leq 1 \\
\sqrt{x} & \text{if } x > 1 
\end{cases} \)

2. \( g(x) = \begin{cases} 
\frac{1}{x^2} & \text{if } x \leq -1 \\
x^3 & \text{if } -1 < x < 1 \\
4 & \text{if } x \geq 1 
\end{cases} \)

3. \( h(x) = \begin{cases} 
3 & \text{if } x \leq -2 \\
\frac{1}{x} & \text{if } -2 < x < 1 \\
4 - x & \text{if } x \geq 1 
\end{cases} \)

4. \( k(x) = \begin{cases} 
3x + 2 & \text{if } x \leq -1 \\
\frac{1}{x^2} & \text{if } x \geq -1 
\end{cases} \)
III. Section 2.3

Part A. Do the following problems on pages 168–71. In Problem 5e, write your answer using interval notation.

#5, 7, 8, 44, 48.

Part B. Consider the function $f(x)$ whose graph is shown on the next page. Use the graph to answer the following questions.

1. What is $f(-2)$? What is $f(0)$?
2. For what values of $x$ is $f(x) = 0$?
3. On what interval(s) is $f(x)$ positive? On what interval(s) is $f(x)$ negative?
4. On what interval(s) is $f(x)$ increasing? On what interval(s) is $f(x)$ decreasing?

Graph of $f(x)$:

IV. Section 2.4.

Part A. Do the following problems on pages 177–79.

#6, 8, 11, 16, 19, 22, 25, 29.

Part B. The drain on a water tank is opened and water starts flowing out. The volume of water in the tank $t$ minutes after the valve is opened is given by the function $V(t) = 50 - 15t + t^2$ gallons. Find the average rate at which the volume of water changes from $t = 1$ minutes to $t = 3$ minutes. Your answer should be negative. Why does this make sense?

V. Section 2.5.

Part A. Do the following problems on pages 187–190.

#37, 38, 39, 40, 42, 44, 45, 46, 47, 48, 50, 52, 58, 60, 64.

Part B. Make an accurate sketch of the graph of each of the following functions:

1. $y = -2(x + 1)^3$
2. $y = 1 - \sqrt{x-1}$

3. $f(x) = \begin{cases} 
\frac{1}{x} + 1 & \text{if } x \leq -1 \\
x^3 + 1 & \text{if } -2 < x \leq 1 \\
-\sqrt{x} & \text{if } x > 1 
\end{cases}$

4. $g(x) = \begin{cases} 
2|x+2| & \text{if } x \leq -1 \\
-2x^2 + 1 & \text{if } -1 < x < 1 \\
-\frac{x}{2} + 3 & \text{if } x \geq 1 
\end{cases}$

5. $h(x) = \begin{cases} 
-x - 2 & \text{if } x \leq -1 \\
\frac{1}{x^2} - 2 & \text{if } x \geq -1 
\end{cases}$

Part C. The annual sales of a company can be modeled by the function $f(t) = 3 + .02t^2$, where $t$ represents years since 1995 and $f(t)$ is measured in millions of dollars. Suppose you want $t$ to represent years since 2005, rather than years since 1995. What transformation could you apply to the function $f(t)$ to accomplish this? Write the new function $g(t)$ that results from this transformation. (You don’t need to simplify $g(t)$.)

VI. Section 2.6.

Part A. Do the following problems.

1. Let $f(x) = \sqrt{x+3}$ and let $g(x) = x^2 - 4$. Find the following. You do not have to simplify your answers.

   a. $(f + g)(x)$
   b. $(fg)(x)$
   c. $(f - g)(1)$
   d. $(\frac{g}{f})(2)$
   e. $(\frac{f}{g})(2)$
   f. $(f \circ g)(x)$
   g. $(g \circ f)(x)$
   h. $(f \circ f)(1)$
   i. $(g \circ g)(13)$

2. Let $f(x) = \frac{x-1}{x}$ and $g(x) = x + 5$. For what value(s) of $x$ so that $(f \circ g)(x) = 0$?

Part B. Do the following problems on pages 196–8.

#26ab, 27–32, 61, 66.

Part C. For each of the following functions, find two functions $f$ and $g$ such that $h(x) = (f \circ g)(x)$. (You may not use $f(x) = x$ or $g(x) = x$.)

a. $h(x) = (x - 7)^5$
   b. $h(x) = \sqrt[3]{2x^3 - 1}$
   c. $h(x) = \frac{1}{\sqrt{3x^2 + 5}}$
   d. $h(x) = \frac{2}{x^5 - 4x}$
   e. $h(x) = |7x - 2| + 5$
VII. Section 2.7. Do the following problems on pages 204–06.

# 7, 8, 12–14, 20, 22ab, 28, 40, 41, 43, 79, 81, 86.

Hint for homework problems #12–14, 20: it’s easiest to do these problems graphically, using the horizontal line test.

VIII. Modeling with Functions.

1. A rectangular box with a square base is constructed out of wood. The volume of the box is 12 cubic feet.
   (a) Express the surface area of the box as a function of the length of the side of the base. Assume that the box has a top.
   (b) The top and the bottom of the box are made of birch, which costs $4.00 per square foot. The four sides of the box are made of pine, which costs $2.50 per square foot. Express the total cost of making the box as a function of the length of the side of the base. (Assume no wood is wasted during construction.)

2. A cylindrical soda can holds 25 cubic centimeters of liquid. Express the surface area of the cylinder as a function of the radius of the base.

3. A car leaves an intersection and travels due south at a constant speed of 30 mph. Two hours later, a second car leaves the same intersection and travels due east at a constant speed of 40 mph. Find the distance between the two cars \(t\) hours after the second car left the intersection. Note: you do not have to simplify your answer.

4. A hot-air balloon rises vertically into the air at a rate of 3 meters per second. A camera is mounted on the ground 50 meters away from the point of lift-off (see below). Express the distance between the camera and the balloon as a function of the number of seconds that have passed since the balloon lifted off.

5. The inside of a cylindrical thermos is covered with glass on its bottom and its sides. The total surface area of the glass is \(300\pi\) square cm. Express the volume of the thermos as a function of the radius of its base.
6. A computer workstation was purchased for $10000. Thereafter, its value $v$ depreciated as a linear function of time $t$, and 2 years later the machine was worth $2000.

(a) Express $v$ as a function of $t$. (Hint: let the date of purchase count as $t = 0$.)

(b) At what point does the graph of the function cross the $t$-axis? What interpretation does this point have for the value of the computer workstation?

7. The stopping distance $D$ (at some fixed speed) of regular tires on glare ice is a function of the air temperature $F$, in degrees Fahrenheit. Tests have shown that when the temperature is $10^\circ$ the stopping distance is 135 ft, and when the temperature is $-20^\circ$ the stopping distance is 75 ft.

(a) Express $D$ as a linear function of $F$.

(b) Note that the domain of the function $D$ has certain restrictions. The stopping distance of a vehicle can’t be negative. Moreover, ice occurs only when $F \leq 32^\circ$. Find the domain of the function $D$. 