1. Question Details

1) Evaluate each expression without using a calculator.
   
   (a) \((-3)^4 = \) 81
   
   (b) \(-3^4 = \) -81
   
   (c) \(3(-4) = \) 1/81
   
   (d) \(\frac{6^{24}}{6^{22}} = \) 36
   
   (e) \(\left(\frac{3}{4}\right)^{-2} = \) 16/9
   
   (f) \(16^{-3/4} = \) 1/8

2) Simplify each expression. Write your answer without negative exponents.
   
   (a) \(\sqrt{192} - \sqrt{108} = \) 2\sqrt{3}
   
   (b) \((4a^2b^3)(4ab^2)^2 = \) 64a^5b^7
   
   (c) \(\left(\frac{4\sqrt[3]{2}x^3}{x^2\sqrt[3]{y}^{-1/2}}\right)^{-2} = \) \(\frac{x}{16y^{1/2}}\)

3) Expand and simplify.
   
   (a) \(2(x + 4) + 6(2x - 6) = \) 14x - 28
   
   (b) \((x + 2)(5x - 4) = \) 5x^2 + 6x - 8
   
   (c) \((\sqrt{7a} + \sqrt{2b})(\sqrt{7a} - \sqrt{2b}) = \) 7a - 2b
   
   (d) \((2x + 4)^2 = \) 4x^2 + 16x + 16
   
   (e) \((x + 5)^3 = \) x^3 + 15x^2 + 75x + 125

4) Factor each expression.
   
   (a) \(36x^2 - 49 = \) (6x - 7)(6x + 7)
   
   (b) \(2x^2 + 4x - 6 = \) (x + 3)(2x - 2)
(c) \( x^3 - 4x^2 - 4x + 16 = (x - 4)(x - 2)(x + 2) \)

(d) \( x^4 + 27x = x(x + 3)(x^2 - 3x + 9) \)

(e) \( 3x^{3/2} - 9x^{1/2} + 6x^{-1/2} = \frac{3(x - 2)(x - 1)}{\sqrt{x}} \)

(f) \( x^3y - 25xy = (x - 5)x(x + 5)y \)

5) Simplify the rational expression.

(a) \( \frac{x^2 + 3x + 2}{x^2 - x - 2} = \frac{x + 2}{x - 2} \)

(b) \( \frac{2x^2 - x - 1}{x^2 - 9} \cdot \frac{x + 3}{2x + 1} = \frac{x - 1}{x - 3} \)

(c) \( \frac{x^2}{x^2 - 64} - \frac{x + 4}{x + 8} = \frac{4}{x - 8} \)

(d) \( \frac{x - x}{3y - 3x} = \frac{1}{3}(-x - y) \)

6) Rationalize the denominator of (a) and the numerator of (b) and simplify.

(a) \( \frac{\sqrt{13}}{\sqrt{10} - 3} = 3\sqrt{13} + \sqrt{130} \)

(b) \( \frac{\sqrt{36 + h} - 6}{h} = \frac{1}{\sqrt{h} + 36 + 6} \)

7) Rewrite by completing the square.

(a) \( x^2 + x + 3 = \left(x + \frac{1}{2}\right)^2 + \frac{11}{4} \)

(b) \( 2x^2 - 16x + 25 = 2(x - 4)^2 - 7 \)

8) Solve the equation. (Find only the real solutions. Enter your answers as a comma-separated list.)

(a) \( x + 4 = 10 - \frac{x}{2} \)

\[ x = 4 \]

(b) \( \frac{3x}{x + 2} = \frac{3x - 2}{x} \)

\[ x = 1 \]

(c) \( x^2 - x - 6 = 0 \)
9) Solve each inequality. Write your answer using interval notation.
   (a) $-5 < 5 - 2x \leq 7$
       $[-1, 5]$
   (b) $x^2 < 2x + 24$
       $(-4, 6]$
   (c) $x(x - 2)(x + 4) > 0$
       $(-4, 0) \cup (2, \infty)$
   (d) $|x - 7| < 4$
       $(3, 11]$
   (e) $\frac{2x - 6}{x + 1} \leq 1$
       $(-1, 7]$

10) State whether each equation is true or false.
   (a) $(4p + 5q)^2 = 16p^2 + 25q^2$
       ○ True
       ○ False
   (b) $\sqrt{ab} = \sqrt{a} \sqrt{b}$, for $a, b > 0$
       ○ True
       ○ False
   (c) $\sqrt{16a^2 + 36b^2} = 4a + 6b$
If you have had difficulty with these problems, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

2. **Question Details**

Simplify the expression. Write your answer without negative exponents.

\[ (3a^2b^3)(5a^4b^4)^2 \]

\[ 756^{10} \]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

3. **Question Details**

Simplify the expression. Write your answer without negative exponents.

\[ \left( \frac{5x^{7/2}y^{5}}{x^{6}y^{3/2}} \right)^{-2} \]

\[ x^{5} \]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.
4. Expand and simplify.
   \((\sqrt{7} + \sqrt{a})(\sqrt{7} - \sqrt{a})\)
   \(f - a\)
   If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

5. Expand and simplify.
   \((x + 3)^3\)
   \(x^3 + 9x^2 + 27x + 27\)
   If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

6. Factor the expression.
   \(2x^2 + 7x - 30\)
   \((x + 6)(2x - 5)\)
   If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

7. Factor the expression.
   \(x^3 - 2x^2 - 16x + 32\)
   \((x - 4)(x - 2)(x + 4)\)
   If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

8. Factor the expression.
   \(4x^{3/2} - 12x^{1/2} + 8x^{-1/2}\)
   \(4x^{-1/2}(x - 1)(x - 2)\)
   If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.
9. Question Details

Simplify the rational expression.

\[
\frac{x^2 + 9x + 8}{x^2 - 7x - 8}
\]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

10. Question Details

Simplify the rational expression.

\[
\frac{x^2}{x^2 - 64} - \frac{x + 4}{x + 8}
\]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

11. Question Details

Simplify the rational expression.

\[
\frac{4x^2 - 3x - 1}{x^2 - 49} \cdot \frac{x + 7}{4x + 1}
\]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

12. Question Details

Simplify the rational expression.

\[
\frac{\frac{x}{x} - \frac{y}{y}}{\frac{3}{y} - \frac{3}{x}} = \frac{1}{3}(-x - y)
\]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.
### Question 13
Rationalize the numerator and simplify.
\[
\frac{\sqrt{16 + h} - 4}{h} = \frac{1}{\sqrt{h + 16} + 4}
\]
If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

### Question 14
Rewrite by completing the square.
\[
2x^2 - 4x + 13 = 2(x - 1)^2 + 11
\]
If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

### Question 15
Solve the equation. (Find only the real solutions. Enter your answers as a comma-separated list.)
\[
\frac{2x}{x + 2} = \frac{2x - 2}{x}
\]
\[
x = 2
\]
If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

### Question 16
Solve the equation. (Find only the real solutions. Enter your answers as a comma-separated list.)
\[
7|x - 2| = 10
\]
\[
x = \frac{4}{7}, \frac{24}{7}
\]
If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.
17. Solve the equation. (Find only the real solutions. Enter your answers as a comma-separated list.)

\[ 4x(5 - x)^{-1/2} - 3\sqrt{5 - x} = 0 \]

\[ x = \frac{15}{7} \]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

18. Solve the inequality. Write your answer using interval notation.

\[ x^2 < 4x + 12 \]

\[ (-2, 6) \]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

19. Solve the inequality. Write your answer using interval notation.

\[ x(x - 2)(x + 7) > 0 \]

\[ (-\infty, -7) \cup (2, \infty) \]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.

20. Solve the inequality. Write your answer using interval notation.

\[ \frac{2x - 9}{x + 1} \leq 1 \]

\[ (-1, 10] \]

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website StewartCalculus.com.
21. Question Details

State whether the equation is true or false.

\[ \sqrt{16a^2 + 16b^2} = 4a + 4b \]

- True
- False

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website [StewartCalculus.com](http://StewartCalculus.com).

22. Question Details

State whether the equation is true or false.

\[ \frac{1}{\frac{4a}{x} - \frac{8b}{x}} = \frac{1}{4a - 8b} \text{ for } a, b, x \neq 0 \text{ and } 4a \neq 8b \]

- True
- False

If you have had difficulty with this problem, you may wish to consult the Review of Algebra on the website [StewartCalculus.com](http://StewartCalculus.com).

23. Question Details

1) Find an equation for the line that passes through the point \((2, -7)\) where the following is true.

   (a) has slope \(-5\)
   \[ y = -7 - 5x \]

   (b) is parallel to the \(x\)-axis
   \[ y = -7 \]

   (c) is parallel to the \(y\)-axis
   \[ x = 2 \]

   (d) is parallel to the line \(4x - 8y = 8\)
   \[ y = \frac{x}{2} - 8 \]

2) Find an equation for the circle that has center \((-2, 4)\) and passes through the point \((1, -3)\).

\[ (x + 2)^2 + (y - 4)^2 = 58 \]

3) Find the center and radius of the circle with equation \(x^2 + y^2 - 6x + 8y + 9 = 0\).

   center \((x, y) = (3, -4)\)
   radius \(4\)
4) Let \( A(-5, 0) \) and \( B(1, -8) \) be points in the plane.

(a) Find the slope of the line that contains \( A \) and \( B \).
\[
\frac{-4}{3}
\]

(b) Find an equation of the line that passes through \( A \) and \( B \).
\[
y = \frac{-4}{3}(x + 5)
\]

What are the intercepts?

- x-intercept \( (x, y) = \left( \frac{-5}{3}, 0 \right) \)
- y-intercept \( (x, y) = \left( 0, \frac{20}{3} \right) \)

(c) Find the midpoint of the segment \( AB \).
\[
(x, y) = \left( \frac{-2}{2}, \frac{-4}{2} \right)
\]

(d) Find the length of the segment \( AB \).

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(e) Find an equation of the perpendicular bisector of \( AB \).
\[
y + 4 = \frac{3(x + 2)}{4}
\]

(f) Find an equation of the circle for which \( AB \) is a diameter.
\[
(x + 2)^2 + (y + 4)^2 = 25
\]

If you have had difficulty with these problems, you may wish to consult the Review of Analytic Geometry on the website StewartCalculus.com.

24. Question Details

Find an equation for the line that passes through the point \( (x, y) = (4, -7) \) and has slope \(-4\).
\[
y = 9 - 4x
\]

If you have had difficulty with this problem, you may wish to consult the Review of Analytic Geometry on the website StewartCalculus.com.

25. Question Details

Find an equation for the line that passes through the point \( (2, -5) \) and is parallel to the line \( 2x - 4y = 3 \).
\[
y = \frac{x}{2} - 6
\]

If you have had difficulty with this problem, you may wish to consult the Review of Analytic Geometry on the website StewartCalculus.com.
26. Question Details

Find an equation for the circle that has center \((-4, 3)\) and passes through the point \((3, -4)\).

\[ (x + 4)^2 + (y - 3)^2 = 98 \]

If you have had difficulty with this problem, you may wish to consult the Review of Analytic Geometry on the website StewartCalculus.com.

27. Question Details

Find the center and radius of the circle with equation \(x^2 + y^2 - 18x + 16y + 81 = 0\).

Center \((x, y) = \left(9, -8\right)\)

Radius \(8\)

If you have had difficulty with this problem, you may wish to consult the Review of Analytic Geometry on the website StewartCalculus.com.

28. Question Details

Let \(A(-12, 2)\) and \(B(0, -14)\) be points in the plane.

(a) Find the slope of the line that contains \(A\) and \(B\).

\[-\frac{4}{3}\]

(b) Find an equation of the line that passes through \(A\) and \(B\).

\[y = -\frac{4x}{3} - 14\]

What are the intercepts?

\(x\)-intercept \((x, y) = \left(\frac{21}{2}, 0\right)\)

\(y\)-intercept \((x, y) = \left(0, -14\right)\)

(c) Find the midpoint of the segment \(AB\).

\((x, y) = \left(-6, -6\right)\)

(d) Find the length of the segment \(AB\).

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(e) Find an equation of the perpendicular bisector of \(AB\).

\[y = \frac{3x}{4} - \frac{3}{2}\]

(f) Find an equation of the circle for which \(AB\) is a diameter.

\[(x + 6)^2 + (y + 6)^2 = 100\]

If you have had difficulty with this problem, you may wish to consult the Review of Analytic Geometry on the website StewartCalculus.com.
29. Question Details

1) The graph of a function \( f \) is given.

(a) State the value of \( f(-1) \).
\[ f(-1) = -2 \]

(b) Estimate the value of \( f(2) \).
\[ f(2) = 2.8 \]

(c) For what values of \( x \) is \( f(x) = 2 \)?
\[ x_1 = -3 \] (smaller value)
\[ x_2 = 1 \] (larger value)

(d) Estimate the values of \( x \) such that \( f(x) = 0 \).
\[ x_1 = -2.5 \] (smaller value)
\[ x_2 = 0.3 \] (larger value)

(e) State the domain and range of \( f \). (If you need to use \(-\infty\) or \(\infty\), enter -INFINITY or INFINITY.)
Domain: \([-3, 3]\)
Range: \([-2, 3]\)

2) If \( f(x) = x^3 \), evaluate the difference quotient and simplify your answer.
\[ f(2 + h) - f(2) \]
\[ \frac{12 + 6h + h^2}{h} \]

3) Find the domain of the function. (Enter your intervals in ascending order. If you need to use \(-\infty\) or \(\infty\), enter -INFINITY or INFINITY.)

(a) \( f(x) = \frac{2x + 1}{x^2 + x - 2} \)
\[ \left( -\infty, -2 \right) \cup \left( -2, 1 \right) \cup \left( 1, \infty \right) \]

(b) \( g(x) = \frac{\sqrt{x}}{x^2 + 1} \)
\[ \left( -\infty, \infty \right) \]

(c) \( h(x) = \sqrt{4 - x} + \sqrt{x^2 - 1} \)
\[ \left( -\infty, -1 \right) \cup \left( 1, 4 \right) \]

4) How are the graphs of the functions obtained from the graph of \( f \)?
(a) \( y = -f(x) \)
6) Let \( f(x) \) be defined as below.
\[
 f(x) = \begin{cases} 
 1 - x^2 & \text{if } x \leq 0 \\
 2x + 1 & \text{if } x > 0 
\end{cases}
\]
Evaluate \( f(-2) \) and \( f(1) \).
\[
 f(-2) = \boxed{-3} \\
 f(1) = \boxed{3}
\]
7) If \( f(x) = x^2 + 2x - 1 \) and \( g(x) = 2x - 3 \), find the following functions.
(a) \( f \circ g = \)
\[
 \boxed{4x^2 - 8x + 2}
\]
(b) \( g \circ f = \)
\[
 \boxed{2x^2 + 4x - 5}
\]
(c) \( g \circ g \circ g = \)
\[
 \boxed{8x - 21}
\]
If you have had difficulty with these problems, you may wish to consult the Review of Functions on the website StewartCalculus.com.

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30. **Question Details**

If \( f(x) = x^3 \), evaluate the difference quotient \( \frac{f(7 + h) - f(7)}{h} \) and simplify your answer.
\[
 h^2 + 21h + 147
\]
If you have had difficulty with these problems, you should look at Sections 1.1 - 1.3 of your text or YouBook.
### 31. Question Details

**SCalc7 0.Diagnostic.Functions.003a.**  
Find the domain of the function. (Enter your answer using interval notation.)  
\[ f(x) = \frac{2x + 1}{x^2 + x - 42} \]

\[ \left( -\infty, -7 \right) \cup \left( -7, 6 \right) \cup \left( 6, \infty \right) \]

If you have had difficulty with these problems, you should look at Sections 1.1 - 1.3 of your text or YouBook.

### 32. Question Details

**SCalc7 0.Diagnostic.Functions.003c.**  
Find the domain of the function. (Enter your answer using interval notation.)  
\[ h(x) = \sqrt{5 - x} + \sqrt{x^2 - 1} \]

\[ \left( -\infty, -1 \right] \cup \left[ 1, 5 \right] \]

If you have had difficulty with these problems, you should look at Sections 1.1 - 1.3 of your text or YouBook.

### 33. Question Details

**SCalc7 0.Diagnostic.Functions.004c.**  
How is the graph of the function obtained from the graph of \( f \)?

\[ y = f(x - 5) + 6 \]

- shifted 6 units to the left and 5 units upward
- shifted 5 units to the left and 6 units upward
- shifted 6 units to the right and 5 units upward
- shifted 5 units to the right and 6 units upward
- shifted 6 units to the right and 6 units downward

If you have had difficulty with these problems, you should look at Sections 1.1 - 1.3 of your text or YouBook.

### 34. Question Details

**SCalc7 0.Diagnostic.Functions.007a.**  
If \( f(x) = x^2 + 3x - 4 \) and \( g(x) = 3x - 8 \), find the following function.  
\[ f \circ g \]

\[ 9x^2 - 39x + 36 \]

If you have had difficulty with these problems, you should look at Sections 1.1 - 1.3 of your text or YouBook.
35. Question Details

If \( g(x) = 3x - 4 \), find the following function.

\[ g \circ g \circ g \]

\[ 27x - 52 \]

If you have had difficulty with these problems, you should look at Sections 1.1 - 1.3 of your text or YouBook.

36. Question Details

1) Convert from degrees to radians.

(a) \( 300^\circ = \frac{5\pi}{3} \) rad

(b) \( -18^\circ = -\frac{\pi}{10} \) rad

2) Convert from radians to degrees.

(a) \( \frac{5\pi}{6} \) rad = \( 150^\circ \)

(b) \( 2 \) rad = \( \frac{360}{\pi} \)°

3) Find the length of an arc of a circle with radius 12 cm if the arc subtends a central angle of 30°.

\[ 2\pi \text{ cm} \]

4) Find the exact values.

(a) \( \tan(\pi/3) = \sqrt{3} \)

(b) \( \sin(7\pi/6) = -\frac{1}{2} \)

(c) \( \sec(5\pi/3) = 2 \)

5) Express the lengths \( a \) and \( b \) in the figure in terms of \( \theta \).

\[ a = 24 \sin(\theta) \]

\[ b = 24 \cos(\theta) \]

6) If \( \sin(x) = 1/3 \) and \( \sec(y) = 5/4 \), where \( x \) and \( y \) lie between 0 and \( \pi/2 \), evaluate \( \sin(x + y) \).

\[ \frac{4 + 6\sqrt{2}}{15} \]

7) Find all values of \( x \) such that \( \sin(2x) = \sin(x) \) and \( 0 \leq x \leq 2\pi \). (List the answers in increasing order.)
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If you have had difficulty with these problems, you may wish to consult the Review of Trigonometry on the website StewartCalculus.com.

37. Question Details

Find the length of an arc of a circle with radius 36 cm if the arc subtends a central angle of 20°.

\[ x = \frac{4\pi}{3} \text{ cm} \]

If you have had difficulty with these problems, you should look at Appendix D of your text or YouBook.

38. Question Details

Find the exact value.

\[ \tan\left(\frac{\pi}{3}\right) = \sqrt{3} \]

If you have had difficulty with these problems, you should look at Appendix D of your text or YouBook.

39. Question Details

Find the exact value.

\[ \sec\left(\frac{5\pi}{3}\right) = 2 \]

If you have had difficulty with these problems, you should look at Appendix D of your text or YouBook.

40. Question Details

If \( \sin x = \frac{1}{3} \) and \( \sec y = \frac{\sqrt{5}}{4} \), where \( x \) and \( y \) lie between 0 and \( \pi/2 \), evaluate \( \sin(x + y) \).

\[ \frac{4}{15} + \frac{2\sqrt{2}}{5} \]

If you have had difficulty with these problems, you should look at Appendix D of your text or YouBook.
41. Question Details

Find all values of \( x \) such that \( \sin 2x = \sin x \) and \( 0 \leq x \leq 2\pi \). (Enter your answers as a comma-separated list.)

\[ x = 0, \frac{\pi}{3}, \frac{5\pi}{3}, \frac{2\pi}{3} \]

If you have had difficulty with these problems, you should look at Appendix D of your text or YouBook.

42. Question Details

Sketch the graph of the function by first making a table of values.

\[ H(x) = |5x| \]

| \( x \) | \( H(x) = |5x| \) |
|-------|-----------------|
| 5     | 25              |
| 4     | 20              |
| 3     | 15              |
| 2     | 10              |
| 1     | 5               |
| 0     | 0               |
Read more about Topic 21: Special Functions
Sketch the graph of the function by first making a table of values.

\[ f(x) = \frac{5x}{|5x|} \]

| x   | \( f(x) = \frac{5x}{|5x|} \) |
|-----|--------------------------------|
| -3  | undefined                     |
| -2  | undefined                     |
| -1  | undefined                     |
| 0   | undefined                     |
| 1   | 1                              |
| 2   | 1                              |
| 3   | 1                              |

Read more about Topic 21: Special Functions
Sketch the graph of the piecewise defined function.

\[ f(x) = \begin{cases} 
-1 & \text{if } x < -1 \\
2 & \text{if } -1 \leq x \leq 1 \\
-1 & \text{if } x > 1
\end{cases} \]
Sketch the graph of the piecewise-defined function.

\[ f(x) = \begin{cases} 
1 - (x - 3)^2, & x \leq 4 \\
\sqrt{x - 4}, & x > 4 
\end{cases} \]
Graph the function.

\[ k(x) = \begin{cases} 
4x + 2, & x \leq -1 \\
4x^2 - 1, & -1 < x \leq 1 \\
1 - x^2, & x > 1 
\end{cases} \]
47. Question Details

Find expressions for the quadratic functions whose graphs are shown.

\[ f(x) = \frac{2}{3} (x - 8)^2 \]

\[ g(x) = -x^2 - 2.5x + 1 \]

(b) Draw the graph of the equation in part (a).

48. Question Details

Jason leaves Detroit at 1:00 PM and drives at a constant speed west along I-96. He passes Ann Arbor, 40 mi from Detroit, at 1:48 PM.

(a) Express the distance \( d \) traveled in terms of the time \( t \) (in hours) elapsed.

\[ d(t) = 50t \]

(b) Draw the graph of the equation in part (a).
(c) What is the slope of this line?

What does it represent?
The monthly cost of driving a car depends on the number of miles driven. Lynn found that in May it cost her $582 to drive 480 mi and in June it cost her $742 to drive 880 mi.

(a) Express the monthly cost $C$ as a function of the distance driven $d$, assuming that a linear relationship gives a suitable model.

$C(d) = 0.4d + 390$

(b) Use part (a) to predict the cost of driving 1800 miles per month.

$\$1110$

(c) Draw the graph of the linear function.

What does the slope represent?

- It represents the cost (in dollars) per mile.
- It represents the fixed cost (amount she pays even if she does not drive).
- It represents the distance (in miles) traveled.
- It represents the cost (in dollars) of driving.
(d) What does the \( C \)-intercept represent?

- It represents the distance (in miles) traveled.
- It represents the cost (in dollars) of driving.
- \[ \square \text{ It represents the fixed cost (amount she pays even if she does not drive).} \]
- It represents the cost (in dollars) per mile.

(e) Why does a linear function give a suitable model in this situation?

- A linear function is suitable because the monthly cost is fixed despite the fact that the miles driven may vary.
- \[ \square \text{ A linear function is suitable because the monthly cost increases as the number of miles driven increases.} \]
- A linear function is suitable because the monthly cost increases as the number of miles driven decreases.
- A linear function is suitable because the monthly cost increases even if the miles driven is constant.
50. Question Details

For each scatter plot, decide what type of function you might choose as a model for the data.

(a) The data appear to be periodic and a sine or cosine function would make the best model. A model of the form

\[ f(x) = a \cos(bx) + c \]

seems appropriate.

(b) The data appear to be decreasing in a linear fashion. A model of the form

\[ f(x) = mx + b \]

seems appropriate.

51. Question Details

Solve the equation for the indicated variable.

\[ a - 5(b - 6(c - x)) = 6; \quad \text{for } x \]

\[ x = \frac{a - 5b + 30c - 6}{30} \]
Match the exponential function with its graph.

(a) $f(x) = 2^x - 2$
(b) $f(x) = 2^{-x}$
(c) $f(x) = 2^x + 1$
(d) $f(x) = 2^x$
(d) 

- $f(x) = 2^x - 2$
- $f(x) = 2^{-x}$
- $f(x) = 2^x + 1$
- $f(x) = 2^x$
53. Question Details

Find the exponential function \( f(x) = a^x \) whose graph is given.

\[
f(x) = \]

54. Question Details

Find the exponential function \( f(x) = a^x \) whose graph is given.

\[
f(x) = \]

55. Question Details

Explain how each graph is obtained from the graph of \( y = f(x) \).

(a) \( y = f(x) + 3 \)

- Stretch the graph horizontally and vertically by a factor of 3.
- Shift the graph 3 units to the right.
- Shift the graph 3 units to the left.
- Shift the graph 3 units upward.
- Shift the graph 3 units downward.

(b) \( y = f(x + 3) \)
Strengthen the graph horizontally and vertically by a factor of 3.
Shift the graph 3 units downward.
Shift the graph 3 units to the left.
Shift the graph 3 units to the right.
Shift the graph 3 units upward.

(c) \( y = 3f(x) \)
- Shrink the graph horizontally by a factor of 3.
- Shift the graph 3 units to the left.
- Shift the graph 3 units upward.
- Stretch the graph horizontally and vertically by a factor of 3.
- Stretch the graph vertically by a factor of 3.

(d) \( y = f(3x) \)
- Shift the graph 3 units to the left.
- Shrink the graph horizontally by a factor of 3.
- Shift the graph 3 units upward.
- Stretch the graph horizontally and vertically by a factor of 3.
- Stretch the graph vertically by a factor of 3.

(e) \( y = -f(x) - 1 \)
- First reflect the graph about the \( x \)-axis, and then shift it 1 unit downward.
- First reflect the graph about the \( x \)-axis, and then shift it 1 unit left.
- First reflect the graph about the \( x \)-axis, and then shift it 1 unit upward.
- First reflect the graph about the \( y \)-axis, and then shift it 1 unit upward.
- First reflect the graph about the \( y \)-axis, and then shift it 1 unit downward.

(f) \( y = 3f\left(\frac{1}{3}x\right) \)
- Shrink the graph horizontally by a factor of 3.
- Shrink the graph horizontally and vertically by a factor of 3.
- Stretch the graph horizontally and vertically by a factor of 3.
- Stretch the graph vertically by a factor of 3.
- Stretch the graph horizontally by a factor of 3.

Solution or Explanation
(a) To obtain the graph of \( y = f(x) + 3 \) from the graph of \( y = f(x) \), shift the graph 3 units upward.
(b) To obtain the graph of \( y = f(x + 3) \) from the graph of \( y = f(x) \), shift the graph 3 units to the left.
(c) To obtain the graph of \( y = 3f(x) \) from the graph of \( y = f(x) \), stretch the graph vertically by a factor of 3.
(d) To obtain the graph of \( y = f(3x) \) from the graph of \( y = f(x) \), shrink the graph horizontally by a factor of 3.

(e) To obtain the graph of \( y = -f(x) - 1 \) from the graph of \( y = f(x) \), first reflect the graph about the \( x \)-axis, and then shift it 1 unit downward.

(f) To obtain the graph of \( y = 3f\left(\frac{1}{3}x\right) \) from the graph of \( y = f(x) \), stretch the graph horizontally and vertically by a factor of 3.

56. Question Details

The graph of \( y = \sqrt{2x - x^2} \) is given. Use transformations to create a function whose graph is as shown.

\[
y = 2\sqrt{2(x - 7) - (x - 7)^2}
\]

![Graph of \( y = \sqrt{2x - x^2} \)]

57. Question Details

Graph the function by hand, not by plotting points, but by starting with the graph of one of the standard functions given in Section 1.2, and then applying the appropriate transformations.

\[
y = -\sqrt[7]{x}
\]
Solution or Explanation

\( y = -\sqrt[4]{x} \): Start with the graph of \( y = \sqrt[4]{x} \) and reflect about the \( x \)-axis.
\[ y = \sqrt[3]{x} \]

\[ y = -\sqrt[3]{x} \]
Solution or Explanation

\[ y = \frac{1}{2} (1 - \cos x) \]

Start with the graph of \( y = \cos x \), reflect about the \( x \)-axis, shift 1 unit upward, and then shrink vertically by a factor of 2.
Find each of the following functions and state their domains. (Enter the domains in interval notation.)

\( f(x) = x^3 + 4x^2 \), \( g(x) = 6x^2 - 1 \)

(a) \( f + g \)
\[
\begin{align*}
\quad \quad f + g &= x^3 + 10x^2 - 1 \\
\text{domain} &= (-\infty, \infty)
\end{align*}
\]

(b) \( f - g \)
\[
\begin{align*}
\quad \quad f - g &= x^3 - 2x^2 + 1 \\
\text{domain} &= (-\infty, \infty)
\end{align*}
\]

(c) \( fg \)
\[
\begin{align*}
\quad \quad fg &= (x^3 + 4x^2)(6x^2 - 1) \\
\text{domain} &= (-\infty, \infty)
\end{align*}
\]

(d) \( f/g \)
\[
\begin{align*}
\quad \quad f/g &= \frac{x^3 + 4x^2}{6x^2 - 1} \\
\text{domain} &= \left(-\infty, -\sqrt{\frac{1}{6}}\right) \cup \left(-\sqrt{\frac{1}{6}}, \sqrt{\frac{1}{6}}\right) \cup \left(\sqrt{\frac{1}{6}}, \infty\right)
\end{align*}
\]
Find each of the following functions.

\[ f(x) = x^2 - 1, \quad g(x) = 2x + 2 \]

(a) \( f \circ g \)

\[ (2x + 2)^2 - 1 \]

State the domain of the function. (Enter your answer using interval notation.)

\[ (-\infty, \infty) \]

(b) \( g \circ f \)

\[ 2(x^2 - 1) + 2 \]

State the domain of the function. (Enter your answer using interval notation.)

\[ (-\infty, \infty) \]

(c) \( f \circ f \)

\[ (x^2 - 1)^2 - 1 \]

State the domain of the function. (Enter your answer using interval notation.)

\[ (-\infty, \infty) \]

(d) \( g \circ g \)

\[ 2(2x + 2) + 2 \]

State the domain of the function. (Enter your answer using interval notation.)

\[ (-\infty, \infty) \]
Find each of the following functions.

\( f(x) = 2 - 4x \), \( g(x) = \cos x \)

(a) \( f \circ g \)

\[ 2 - 4 \cos(x) \]

State the domain of the function. (Enter your answer using interval notation.)

\([-\infty, \infty]\)

(b) \( g \circ f \)

\[ \cos(2 - 4x) \]

State the domain of the function. (Enter your answer using interval notation.)

\([-\infty, \infty]\)

(c) \( f \circ f \)

\[ 2 + 16x^2 \]

State the domain of the function. (Enter your answer using interval notation.)

\([-\infty, \infty]\)

(d) \( g \circ g \)

\[ \cos(\cos(x)) \]

State the domain of the function. (Enter your answer using interval notation.)

\([-\infty, \infty]\)

Solution or Explanation

Click to View Solution
Find each of the following functions.  
\( f(x) = \sqrt[3]{x}, \quad g(x) = \frac{2}{\sqrt[3]{8 - x}} \)

(a) \( f \circ g \)

\( \frac{\sqrt[3]{8 - x}}{\sqrt[3]{8 - x}} \)

State the domain of the function. (Enter your answer using interval notation.)

\( (-\infty, 8] \)

(b) \( g \circ f \)

\( \frac{3}{\sqrt[3]{8 - x}} \)

State the domain of the function. (Enter your answer using interval notation.)

\( [0, \infty) \)

(c) \( f \circ f \)

\( \sqrt[3]{x} \)

State the domain of the function. (Enter your answer using interval notation.)

\( [0, \infty) \)

(d) \( g \circ g \)

\( \frac{3}{\sqrt[3]{8 - \sqrt[3]{8 - x}}} \)

State the domain of the function. (Enter your answer using interval notation.)

\( (-\infty, \infty) \)
Find the functions and their domains. (Enter the domains in interval notation.)

\[ f(x) = x + \frac{1}{x}, \quad g(x) = \frac{x + 17}{x + 2} \]

(a) \( f \circ g \)
\[
(f \circ g)(x) = \frac{x + 2}{x + 17} + \frac{x + 17}{x + 2}
\]
\( \text{domain} \quad (-\infty, -17) \cup (-17, -2) \cup (-2, \infty) \)

(b) \( g \circ f \)
\[
(g \circ f)(x) = \frac{x^3 + 17x + 1}{x^2 + 2x + 1}
\]
\( \text{domain} \quad (-\infty, -1) \cup (-1, 0) \cup (0, \infty) \)

(c) \( f \circ f \)
\[
(f \circ f)(x) = \frac{x + 1}{x} + \frac{x}{x^2 + 1}
\]
\( \text{domain} \quad (-\infty, 0) \cup (0, \infty) \)

(d) \( g \circ g \)
\[
(g \circ g)(x) = \frac{6x + 17}{x + 7}
\]
\( \text{domain} \quad (-\infty, -7) \cup (-7, -2) \cup (-2, \infty) \)

Solution or Explanation

Click to View Solution
Find each of the following functions.

\[ f(x) = \frac{x}{1 + x}, \quad g(x) = \sin 3x \]

(a) \( f \circ g \)

\[
\frac{\sin(3x)}{1 + \sin(3x)}
\]

State the domain of the function.

- \( x \neq \frac{\pi}{4} + \frac{2}{3}\pi n \) [where \( n \) is any integer]
- \( x \neq \frac{\pi}{2} + \frac{2}{3}\pi n \) [where \( n \) is any integer]
- \( x \neq \frac{\pi}{7} + \frac{2}{3}\pi n \) [where \( n \) is any integer]
- \( x \neq \frac{7\pi}{2} + 7\pi n \) [where \( n \) is any integer]
- \( x \neq \frac{\pi}{2} + 7\pi n \) [where \( n \) is any integer]

(b) \( g \circ f \)

\[
\sin\left(\frac{3x}{1 + x}\right)
\]

State the domain of the function. (Enter your answer using interval notation.)

\( (-\infty, -1) \cup (-1, \infty) \)

(c) \( f \circ f \)

\[
\frac{x}{1 + x^2}
\]

State the domain of the function. (Enter your answer using interval notation.)

\( (-\infty, -1) \cup \left(-1, -\frac{1}{2}\right) \cup \left(-\frac{1}{2}, \infty\right) \)

(d) \( g \circ g \)

\[
\sin(3\sin(3x))
\]

State the domain of the function. (Enter your answer using interval notation.)

\( (-\infty, \infty) \)
65. Find \( f \circ g \circ h \).

\[
\begin{align*}
  f(x) &= 9x - 2, \\
  g(x) &= \sin x, \\
  h(x) &= x^2 \\
  (f \circ g \circ h)(x) &= 9 \sin(x^2) - 2
\end{align*}
\]

Solution or Explanation

\[
(f \circ g \circ h)(x) = f(g(h(x))) = f(g(x^2)) = f(\sin(x^2)) = 9 \sin(x^2) - 2
\]

66. Express the function in the form \( f \circ g \). (Use only non-identity functions.)

\[
F(x) = (7x + x^2)^4
\]

\[
\begin{align*}
  \{f(x), g(x)\} &= \left\{ x^4, x^2 + 7x \right\}
\end{align*}
\]

Solution or Explanation

Let \( g(x) = 7x + x^2 \) and \( f(x) = x^4 \). Then \((f \circ g)(x) = f(g(x)) = f(7x + x^2) = (7x + x^2)^4 = F(x)\).

67. Express the function in the form \( f \circ g \). (Use non-identity functions for \( f \) and \( g \).)

\[
G(x) = \sqrt[3]{\frac{x}{9 + x}}
\]

\[
\begin{align*}
  \{f(x), g(x)\} &= \left\{ \sqrt[3]{x}, \frac{x}{9 + x} \right\}
\end{align*}
\]

Solution or Explanation

Click to View Solution

68. Express the function in the form \( f \circ g \). (Use non-identity functions for \( f \) and \( g \).)

\[
u(t) = \frac{\csc t}{3 + \csc t}
\]

\[
\begin{align*}
  \{f(t), g(t)\} &= \left\{ \frac{t}{3 + t}, \csc t \right\}
\end{align*}
\]

Solution or Explanation

Click to View Solution
Use the table to evaluate each expression.

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>f(x)</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>g(x)</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

(a) \( f(g(1)) \) 

(b) \( g(f(1)) \) 

(c) \( f(f(1)) \) 

(d) \( g(g(1)) \) 

(e) \( (g \circ f)(3) \) 

(f) \( (f \circ g)(6) \)
Use the given graphs of $f$ and $g$ to evaluate each expression, or if the expression is undefined, enter UNDEFINED.

(a) $f(g(2))$ 
(b) $g(f(0))$ 
(c) $(f \circ g)(0)$ 
(d) $(g \circ f)(6)$ 
(e) $(g \circ g)(-2)$ 
(f) $(f \circ f)(4)$
A spherical balloon is being inflated and the radius of the balloon is increasing at a rate of 8 cm/s.

(a) Express the radius $r$ of the balloon as a function of the time $t$ (in seconds).

$$r(t) = \frac{8t}{3}$$

(b) If $V$ is the volume of the balloon as a function of the radius, find $V \circ r$.

$$(V \circ r)(t) = \frac{4}{3} \pi (8t)^3$$

Interpret the answer found in part (b).

- This formula gives the amount of time (in seconds) the balloon has been inflating as a function of $V$.
- This formula gives the volume of the balloon (in cm$^3$) as a function of time (in seconds).

---

A ship is moving at a speed of 35 km/h parallel to a straight shoreline. The ship is 9 km from shore and it passes a lighthouse at noon.

(a) Express the distance $s$ between the lighthouse and the ship as a function of $d$, the distance the ship has traveled since noon; that is, find $f$ so that $s = f(d)$.

$$s = f(d) = \sqrt{81 + d^2}$$

(b) Express $d$ as a function of $t$, the time elapsed since noon; that is, find $g$ so that $d = g(t)$.

$$d = g(t) = \frac{35t}{2}$$

(c) Find $f \circ g$.

$$(f \circ g)(t) = \sqrt{81 + (35t)^2}$$

What does this function represent?

- This function represents time elapsed since noon as a function of the distance between the lighthouse and the ship.
- This function represents the distance between the lighthouse and the ship as a function of the time elapsed since noon.
73. Question Details

An airplane is flying at a speed of 350 mi/h at an altitude of one mile and passes directly over a radar station at time $t = 0$.

(a) Express the horizontal distance $d$ (in miles) that the plane has flown as a function of $t$.

$$d(t) = 350t$$

(b) Express the distance $s$ between the plane and the radar station as a function of $d$.

$$s(d) = \sqrt{1 + d^2}$$

(c) Use composition to express $s$ as a function of $t$.

$$(s \circ d)(t) = \sqrt{1 + (350t)^2}$$

Solution or Explanation

Click to View Solution

74. Question Details

The Heaviside function $H$ is defined by

$$H(t) = \begin{cases} 
0 & \text{if } t < 0 \\
1 & \text{if } t \geq 0
\end{cases}$$

It is used in the study of electric circuits to represent the sudden surge of electric current, or voltage, when a switch is instantaneously turned on.

(a) Sketch the graph of the Heaviside function.

(b) Sketch the graph of the voltage $V(t)$ in a circuit if the switch is turned on at time $t = 0$ and 180 volts are applied instantaneously to the circuit.
Write a formula for \( V(t) \) in terms of \( H(t) \).

- \( V(t) = H(t) - 180 \)
- \( V(t) = 180 \)
- \( V(t) = 180H(t) \)
- \( V(t) = \frac{H(t)}{180} \)
- \( V(t) = H(t) + 180 \)

(c) Sketch the graph of the voltage \( V(t) \) in a circuit if the switch is turned on at time \( t = 7 \) seconds and 230 volts are applied instantaneously to the circuit.

Write a formula for \( V(t) \) in terms of \( H(t) \). (Note that starting at \( t = 7 \) corresponds to a translation.)

- \( V(t) = 7H(t + 230) \)
- \( V(t) = 230H(t) - 7 \)
- \( V(t) = 7H(t - 230) \)
- \( V(t) = 230H(t + 7) \)
- \( V(t) = 230H(t - 7) \)
75. Question Details

If you invest \( x \) dollars at 7% interest compounded annually, then the amount \( A(x) \) of the investment after one year is \( A(x) = 1.07x \). Find \( A \circ A, A \circ A \circ A, A \circ A \circ A \circ A \).

\[
\begin{align*}
A \circ A &= 1.07^2 x \\
A \circ A \circ A &= 1.07^3 x \\
A \circ A \circ A \circ A &= 1.07^4 x
\end{align*}
\]

What do these compositions represent?

- They represent the amount of interest gained on the investment after 2, 3, and 4 years.
- They represent the total amount of the investment after 2, 3, and 4 years.

Find a formula for the composition of \( n \) copies of \( A \).

\[ 1.07^n x \]

Solution or Explanation

Click to View Solution

76. Question Details

Suppose \( g \) is an even function and let \( h = f \circ g \). Is \( h \) always an even function?

- Yes
- No

Solution or Explanation

Click to View Solution
77. Suppose $g$ is an odd function and let $h = f \circ g$. Is $h$ always an odd function?
- Yes
- No

What if $f$ is odd?
- $h$ is even.
- $h$ is odd.
- There is not enough information to determine what $h$ is.

What if $f$ is even?
- $h$ is even.
- $h$ is odd.
- There is not enough information to determine what $h$ is.

78. Explain how the following graphs are obtained from the graph of $y = f(x)$. (Select all that apply.)
(a) $y = 9f(x)$
- Shift 9 units upward.
- Shift 9 units downward.
- Shift 9 units to the right.
- Shift 9 units to the left.
- Stretch the graph vertically by a factor of 9.
- Shrink the graph vertically by a factor of 9.
- Stretch the graph horizontally by a factor of 9.
- Shrink the graph horizontally by a factor of 9.
- Reflect about the $x$-axis.
- Reflect about the origin.

(b) $y = f(x - 4)$
\( y = -f(x) \)
- Shift 1 unit upward.
- Shift 1 unit downward.
- Shift 1 unit to the right.
- Shift 1 unit to the left.
- Stretch the graph vertically by a factor of 1.
- Shrink the graph vertically by a factor of 1.
- Stretch the graph horizontally by a factor of 1.
- Shrink the graph horizontally by a factor of 1.
- Reflect about the \( x \)-axis.
- Reflect about the origin.

\( y = -6f(x) \)
- Shift 6 units upward.
- Shift 6 units downward.
- Shift 6 units to the right.
- Shift 6 units to the left.
- Stretch the graph vertically by a factor of 6.
- Shrink the graph vertically by a factor of 6.
- Stretch the graph horizontally by a factor of 6.
- Shrink the graph horizontally by a factor of 6.
- Reflect about the \( x \)-axis.
- Reflect about the origin.

\( y = f(4x) \)
Shift 4 units upward.
Shift 4 units downward.
Shift 4 units to the right.
Shift 4 units to the left.
Stretch the graph vertically by a factor of 4.
Shrink the graph vertically by a factor of 4.
Stretch the graph horizontally by a factor of 4.
Shrink the graph horizontally by a factor of 4.
Reflect about the x-axis.
Reflect about the origin.

(f) \( y = 8f(x) - 6 \)
Shift 8 units upward.
Shift 6 units upward.
Shift 8 units downward.
Shift 6 units downward.
Shift 8 units to the right.
Shift 6 units to the right.
Shift 8 units to the left.
Shift 6 units to the left.
Stretch the graph vertically by a factor of 8.
Stretch the graph vertically by a factor of 6.
Shrink the graph vertically by a factor of 8.
Shrink the graph vertically by a factor of 6.
Stretch the graph horizontally by a factor of 8.
Stretch the graph horizontally by a factor of 6.
Shrink the graph horizontally by a factor of 8.
Shrink the graph horizontally by a factor of 6.
Reflect about the x-axis.
Reflect about the origin.

Solution or Explanation

Click to View Solution
79. Question Details

Express the function in the form \( f \circ g \) if \( g(t) = \sec t \).

\[ u(t) = \sqrt{\sec t} \]

\[ f(t) = \sqrt{t} \]

Solution or Explanation
Click to View Solution

80. Question Details

Suppose \( f \) is even and \( g \) is odd. What is \( fg \)?

- even
- odd

Solution or Explanation
Click to View Solution

81. Question Details

Find the domain of the function.

\[ f(x) = \frac{x + 5}{x^2 - 9} \]

- \((-\infty, \infty)\)
- \((-\infty, 9) \cup (9, \infty)\)
- \((-\infty, -3) \cup (-3, 3) \cup (3, \infty)\)
- \((0, 9)\)
- \((-\infty, -3) \cup (3, \infty)\)
82. Question Details

Explain how the graph of \( g \) is obtained from the graph of \( f \). If a graph is not supposed to be stretched or shrunk, enter "1" in the corresponding box on the right. If a graph is not supposed to be shifted in some direction, enter "0" in the corresponding box on the right.

\[
\begin{align*}
(a) & \quad f(x) = |x|, \quad g(x) = |x + 3| - 3 \\
\text{Reflect?} & \quad \downarrow \quad \text{Do not reflect} \\
\text{Stretch/Shrink vertically?} & \quad \downarrow \quad \text{neither stretch nor shrink vertically} \quad \text{by a factor of} \quad \boxed{1} \\
\text{Stretch/Shrink horizontally?} & \quad \downarrow \quad \text{neither stretch nor shrink horizontally} \quad \text{by a factor of} \quad \boxed{1} \\
\text{Shift up/down?} & \quad \downarrow \quad \text{shift down} \quad \boxed{3} \text{ unit(s)} \\
\text{Shift left/right?} & \quad \downarrow \quad \text{shift left} \quad \boxed{3} \text{ unit(s)} \\
(b) & \quad f(x) = |x|, \quad g(x) = |x - 3| + 3 \\
\text{Reflect?} & \quad \downarrow \quad \text{Do not reflect} \\
\text{Stretch/Shrink vertically?} & \quad \downarrow \quad \text{neither stretch nor shrink vertically} \quad \text{by a factor of} \quad \boxed{1} \\
\text{Stretch/Shrink horizontally?} & \quad \downarrow \quad \text{neither stretch nor shrink horizontally} \quad \text{by a factor of} \quad \boxed{1} \\
\text{Shift up/down?} & \quad \downarrow \quad \text{shift up} \quad \boxed{3} \text{ unit(s)} \\
\text{Shift left/right?} & \quad \downarrow \quad \text{shift right} \quad \boxed{3} \text{ unit(s)}
\end{align*}
\]

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