1. Find the equation of the line with slope $-3/4$ which passes through the point $(5, -6)$. Provide the exact answer in the standard form.

2. Find the exact value: \[ \lim_{x \to 2} \frac{2x^2 - x - 6}{x^2 - 4} \]

3. Find the exact value: \[ \lim_{x \to 3} \frac{3}{x - 1} - \frac{3}{2x^2 - 18} \]

4. Given $f(x) = 16 - x^2$, find the average rate of change of $f(x)$ from $x = -1$ to $x = 3$. Draw a BIG and CLEAR graph to illustrate your answer.

5. Given $f(x) = \frac{-3}{\sqrt{2-x}}$, find and completely simplify the difference quotient of $f(x)$.

6. Find the exact value: \[ \lim_{x \to \infty} \frac{2x^2 + x - 6}{4 - 12x^2} \]

7. Simplify the following into a single fraction, and leave the answer in the radical notation:

\[ x \cdot \frac{3}{2} \left(4 - x^2\right)^{1/2} \cdot (-3x) = 2 \left(4 - x^2\right)^{1/2} \]

8. Find the exact and simplified solutions: $x^2(x^2 + 2) = 4$

9. State the formal mathematical definition of the continuity of a given function $f(x)$ at a point $x = a$ in precise terms.
1. \[ m = \frac{-3}{4} \]  
   \[ p1 = (x_1, y_1) = (\frac{3}{4}, -6) \]

   Use point-slope form: \[ y - y_1 = m(x - x_1) \]
   \[ y + 6 = -\frac{3}{4}(x - \frac{3}{4}) \]
   \[ y + 6 = -\frac{3}{4}x + \frac{9}{4} \]
   \[ y = -\frac{3}{4}x + \frac{15}{4} - 6 \]
   \[ y = -\frac{3}{4}x - \frac{9}{4} \]
   \[ y + \frac{3}{4}x = -\frac{9}{4} \]

   or just \[ 3x + 4y = -9 \] is the standard form.

2. \[ \lim_{x \to 2} \frac{2x^2 - x - 6}{x^2 - 4} \]
   Form: \( \frac{0}{0} \) Indeterminate Form

   \[ = \lim_{x \to 2} \frac{(2x + 3)(x - 2)}{(x - 2)(x + 2)} \]
   \[ = \lim_{x \to 2} \frac{2x + 3}{x + 2} = \frac{7}{4} \]

3. \[ \lim_{x \to 3} \frac{\frac{3}{x - 1} - \frac{3}{2}}{2x^2 - 18} \]
   Form: \( \frac{0}{0} \) Indeterminate Form

   \[ = \lim_{x \to 3} \frac{\left(\frac{3}{x - 1} - \frac{3}{2}\right) \cdot 2(x - 1)}{(2x^2 - 18) \cdot 2(x - 1)} \]
   \[ = \lim_{x \to 3} \frac{6 - 3(x - 1)}{2(x - 1)(x - 3)(x + 3)} \]
   \[ = \lim_{x \to 3} \frac{3(3 - x)}{4(x - 1)(x - 3)(x + 3)} \]
   \[ = \frac{-9}{4(2)(6)} = \frac{-3}{48} = \frac{-1}{16} \]
4. \( f(x) = 16 - x^2 \), \( x_1 = -1 \) and \( x_2 = 3 \)

The average rate of change of \( f(x) \) from \( x_1 \) to \( x_2 \)

\[
\frac{f(x_2) - f(x_1)}{x_2 - x_1} = \frac{f(3) - f(-1)}{3 - (-1)} = \frac{[16 - (3)^2] - [16 - (-1)^2]}{4} = \frac{7 - 15}{4} = -2
\]

**DRAW A BIG & CLEAR diagram to illustrate your answer.**

( Diagram must include ALL FEATURES! )

**Slope of this secant line is equal to -2**

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5. Given: \( f(x) = \frac{-3}{\sqrt{2-x}} \)

D. \( Q = \frac{f(x+h) - f(x)}{h} \)

\[
\frac{-3}{\sqrt{2-(x+h)}} + \frac{3}{\sqrt{2-x}} = \frac{\left( -\frac{3}{\sqrt{2-x+h}} + \frac{3}{\sqrt{2-x}} \right) \sqrt{2-x-h} \sqrt{2-x}}{h \sqrt{2-x-h} \sqrt{2-x}}
\]

\[
= \frac{-3 \sqrt{2-x} + 3 \sqrt{2-x-h}}{h \sqrt{2-x-h} \sqrt{2-x}} = \frac{3 \left( \sqrt{2-x-h} - \sqrt{2-x} \right) \left( \sqrt{2-x-h} + \sqrt{2-x} \right)}{h \sqrt{2-x-h} \sqrt{2-x}}
\]

\[
= \frac{3 \left[ (2-x-h) - (2-x) \right]}{h \sqrt{2-x-h} \sqrt{2-x} \left( \sqrt{2-x-h} + \sqrt{2-x} \right)} = \frac{3 \left[ 2-x-h - 2+x \right]}{h \sqrt{2-x-h} \sqrt{2-x} \left( \sqrt{2-x-h} + \sqrt{2-x} \right)}
\]

\[
= \frac{-3h}{h \sqrt{2-x-h} \sqrt{2-x} \left( \sqrt{2-x-h} + \sqrt{2-x} \right)} = \frac{-3}{\sqrt{2-x-h} \sqrt{2-x} \left( \sqrt{2-x-h} + \sqrt{2-x} \right)}
\]
\[ \lim_{x \to \infty} \frac{2x^2 + x - 6}{4 - 12x^2} \quad \text{Form: } \frac{\infty}{\infty} \quad \text{Indeterminate Form} \]

\[ = \lim_{x \to \infty} \frac{2x^2}{x^2} + \frac{x}{x^2} - \frac{6}{x^2} = \lim_{x \to \infty} \frac{2 + \left( \frac{1}{x} \right)}{\left( \frac{6}{x^2} \right) \left( \frac{4}{x^2} \right) - 12} = \frac{2}{-12} = \frac{-1}{6} \]

7. Simplify:
\[ x \cdot \frac{3}{2} (4-x^2)^{-\frac{1}{2}} \cdot (-3x) = 2 (4-x^2)^{\frac{1}{2}} \]
\[ = \frac{-3x^2}{2} (4-x^2)^{-\frac{1}{2}} - 2 (4-x^2)^{\frac{1}{2}} \]
\[ = \frac{-3x^2}{2 \sqrt{4-x^2}} - \frac{2 \sqrt{4-x^2}}{1} \cdot \frac{2 \sqrt{4-x^2}}{2 \sqrt{4-x^2}} \]
\[ = \frac{-3x^2 - 4 (4-x^2)}{2 \sqrt{4-x^2}} = \frac{-9x^2 - 16 + 4x^2}{2 \sqrt{4-x^2}} = \frac{-5x^2 - 16}{2 \sqrt{4-x^2}} \]

8. Solve for \( x \):
\( x^3(x^2 + 2) = 4 \) \( \therefore \) \( x^2 + 2x^2 = 4 \) \( x^2 + 2x^2 - 4 = 0 \).

Let \( u = x^2 \), so \( u^2 = x^4 \). The eqn is: \( u^2 + 2u - 4 = 0 \). The left-hand side does not factor. Thus, we must use the Quadratic Formula:
\( a = 1 \), \( b = 2 \), \( c = -4 \) \( \therefore u = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-2 \pm \sqrt{4 + 16}}{2} = \frac{-2 \pm 2\sqrt{5}}{2} = -1 \pm \sqrt{5} \).

\( \therefore u = -1 \pm \sqrt{5} \) \( \therefore x^2 = -1 \pm \sqrt{5} \) \( \therefore x = \pm \sqrt{-1 \pm \sqrt{5}} \). These are the four solutions.

9. Defn. (Continuity of a function at a given point):
A function, \( f(x) \), is said to be continuous at \( x = a \) if the following 3 conditions are satisfied:
(a) \( f(a) \) exists (b) \( \lim_{x \to a} f(x) \) exists (c) \( f(x) = \lim_{x \to a} f(x) \).

--- END OF TEST ---