1. (5 points) \( \lim_{x \to 3} \frac{x^2 - 3x}{\sqrt{x} + 1 - 2} = \)
   - a) 3
   - b) 4
   - c) 9
   - d) 12
   - e) d.n.e.

3. (5 points) \( \lim_{m \to 1} \frac{m^4 - 1}{2m^2 - 5m + 3} = \)
   - a) -4
   - b) -2
   - c) 2
   - d) 4
   - e) d.n.e.

2. (5 points) \( \lim_{h \to 0} \frac{(x + h)^4 - x^4}{h} = \)
   - a) 0
   - b) \( h^4 \)
   - c) \( 4x^3 \)
   - d) \( 4x^3 + 6x^2h + 4xh^2 + h^3 \)
   - e) d.n.e.

4. (5 points) \( \lim_{x \to 5} \frac{\sqrt{x} - 3}{(x - 5)^2} = \)
   - a) \(-\infty\)
   - b) 0
   - c) \( \sqrt{5} \)
   - d) \( \infty \)
   - e) 1
5. (5 points) The average rate of change of the function \( f(x) = x^3 + x + 1 \) on the interval \([1, 3]\) is

a) 0
b) \( \frac{1}{14} \)
c) \( \frac{1}{28} \)
d) 14
e) 28

6. (5 points) The slope of the tangent line to the curve \( y = \frac{1}{\sqrt{x}} \) at the point \( \left( \frac{1}{4}, 2 \right) \) is

a) -4
b) -2
c) -1
d) 0
e) \( \frac{1}{2} \)
7. (5 points) If the function

\[ f(x) = \begin{cases} 
3x^2 + 5x + 1 & x < 2 \\
x + 5 & x \geq 2 
\end{cases} \]

is to be continuous everywhere, then \( c = \)

a) 2  
b) 9  
c) 18  
d) 23  
e) 28

10. (5 points) Compute the slope between \((x, x^2)\) and \((x + h, (x + h)^2)\).

a) 2x  
b) 2x + h  
c) 2x + h^2  
d) 2x^2 + h^2  
e) 2x^2 + 2x + h^2
11. (5 points) Find the radius and center of the circle given by the equation

\[ 2x^2 + 8x + 2y^2 - 12y - 102 = 0 \]

a) Radius: 8  Center: (2, 3)  
b) Radius: 64  Center: (2, -3)  
c) Radius: 8  Center: (2, -3)  
d) Radius: 64  Center: (-2, 3)  
e) Radius: 8  Center: (-2, 3) 

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12. (5 points) It can be shown that

\[ 1 - \frac{x^2}{6} < \frac{x \sin x}{2 - 2 \cos x} < 1 \]

holds for all values of x close to 0. Since both \( \lim_{x \to 0} \left(1 - \frac{x^2}{6}\right) = 1 \) and \( \lim_{x \to 0} (1) = 1 \), we can conclude that

\[ \lim_{x \to 0} \frac{x \sin x}{2 - 2 \cos x} = 1 \]

by the

a) Intermediate Value Theorem.  
b) Squeeze (Sandwich) Theorem.  
c) Mean Value Theorem.  
d) Fundamental Theorem of Calculus.  
e) Extreme Value Theorem.
13. (10 points) Use the graph provided to answer the following 10 true/false questions.

a) \( \lim_{x \to 0} f(x) = 1 \) \quad T \quad F

b) \( \lim_{x \to 1} f(x) = 2 \) \quad T \quad F

c) \( \lim_{x \to 2} f(x) = 0 \) \quad T \quad F

d) \( \lim_{x \to 3^+} f(x) = 2 \) \quad T \quad F

e) \( \lim_{x \to 3^-} f(x) = 2 \) \quad T \quad F

f) \( \lim_{x \to 3} f(x) = 1 \) \quad T \quad F

g) \( \lim_{x \to 6} f(x) = \infty \) \quad T \quad F

h) \( f(1) = 2 \) \quad T \quad F

i) \( f(3) = 1 \) \quad T \quad F

j) \( f(6) = \infty \) \quad T \quad F
14. (12 points) (Show all work and reduce as much as possible.)

a) (4 pts.) State the limit definition of the derivative.

\[ f'(x) = \]

b) (8 pts.) Use the limit definition of the derivative to compute the derivative of

\[ f(x) = \frac{1}{ax + b} \]

where \( a \) and \( b \) are positive constants.
(No credit will be given if the definition is not used.)
15. (12 points) For the function

\[
f(x) = \begin{cases} 
  \frac{x^2 - 2x}{(x - 2)(x - 5)} & x < 3 \\
  \frac{1}{x - 4} & x > 3 
\end{cases}
\]

find the points at which \( f \) is discontinuous and for each point of discontinuity, determine whether it is a removable, infinite, or jump discontinuity and verify the type. (To get full credit, you must show all work including verifying the type of discontinuity.)

Record answers below: (You may not need all the lines...)

_________ discontinuity at \( x = \) ____, since ________________________________.

_________ discontinuity at \( x = \) ____, since ________________________________.

_________ discontinuity at \( x = \) ____, since ________________________________.

_________ discontinuity at \( x = \) ____, since ________________________________.

_________ discontinuity at \( x = \) ____, since ________________________________.
16. (6 points) Find values for $a$, $b$, and $c$ so that the function

$$f(x) = \frac{ax + b}{cx + 3}$$

has the following:

1) a $y$-intercept of 4.

2) a domain of all reals except 3.

3) an $x$-intercept of $\frac{-12}{5}$.

$$a = \underline{\hspace{2cm}} \quad b = \underline{\hspace{2cm}} \quad c = \underline{\hspace{2cm}}$$