INSTRUCTIONS

1. DO NOT OPEN THIS EXAM UNTIL YOU ARE TOLD TO DO SO.

2. CAREFULLY MARK YOUR STUDENT ID ON YOUR SCANTRON.

3. This exam has 7 pages, including the cover sheet. There are 18 multiple-choice questions, each worth 5 points, and 2 workout questions, worth a total of 10 points. No partial credit will be given on the multiple choice questions.

4. You will have 60 minutes to complete the exam. No notes or books are allowed.

5. TI-30Xa and TI-30XIIS scientific calculators are allowed. NO other calculators are allowed.

6. When you are finished, check your work carefully. Then, slide your scantron inside the exam packet before returning the exam to YOUR instructor.

USEFUL FORMULAS

- \( y = mx + b \)
- \( y = y_1 = m(x - x_1) \)
- \( A^2 - B^2 = (A + B)(A - B) \)
- \( A^3 + B^3 = (A + B)(A^2 - AB + B^2) \)
- \( A^3 - B^3 = (A - B)(A^2 + AB + B^2) \)
- \( d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} \)
- \( \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right) \)
- \( (x - h)^2 + (y - k)^2 = r^2 \)
- \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \)
- \( A = P + Prt \)
- \( a^2 + b^2 = c^2 \)
- \( \frac{f(x + h) - f(x)}{h} \)
- \( d = rt \)
- \( f(x) = a(x - h)^2 + k \)
- \( \left(\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right) \)
Multiple Choice Section:

1. Solve and write your answer in interval notation: \( |10 - 5x| \geq 20 \).

   (a) \((-\infty, -2]\)
   \[
   \begin{align*}
   10 - 5x & \geq 20 \\
   -5x & \geq 10 \\
   x & \leq -2 \\
   \end{align*}
   \]
   \[
   \begin{array}{c}
   \text{\(x \leq -2\)}
   \end{array}
   \]

   (b) \((-\infty, -2] \cup [6, \infty)\)
   \[
   \begin{align*}
   10 - 5x & \leq -20 \\
   -5x & \leq -30 \\
   x & \geq 6 \\
   \end{align*}
   \]
   \[
   \begin{array}{c}
   \text{\(x \geq 6\)}
   \end{array}
   \]

   (c) \([-2, 6]\)

   (d) \((-\infty, \infty)\)

   (e) \((-\infty, -6] \cup [2, \infty)\)

2. Describe how the function \( y = (x - 4)^2 + 8 \) can be obtained from one of the basic graphs.

   (a) Start with the graph of \( y = x^2 \) and shift the graph left 8 units and up 4 units.

   (b) Start with the graph of \( y = x^2 \) and shift the graph right 4 units and down 8 units.

   (c) Start with the graph of \( y = x^2 \) and shift the graph left 4 units and up 8 units.

   (d) Start with the graph of \( y = x^2 \) and shift the graph right 4 units and up 8 units.

   (e) Start with the graph of \( y = x^2 \) and shift the graph right 8 units and down 4 units.

3. Given that \( f(x) = -3x + 3 \) and \( g(x) = -2x^3 + 2 \), find \((f \circ g)(-5)\).

   (a) \(-81\)
   \[
   f(g(-5)) = -2(-5)^3 + 2 = -2(125) + 2 = -250 + 2 = -248
   \]

   (b) \(-750\)

   (c) \(-3003\)
   \[
   f(g(-5)) = -2(\frac{8}{5}) + 3 = -\frac{16}{5} + 3 = -3\frac{1}{5} + 3 = \frac{1}{5}
   \]

   (d) \(-756\)

   (e) \(-753\)

4. Determine whether the function \( f(x) = x^3 - 2x + 7 \) is even, odd, or neither.

   (a) Even
   \[
   f(-x) = (-x)^3 - 2(-x) + 7 = -x^3 + 2x + 7
   \]

   (b) Odd
   \[
   f(-x) \neq f(x) \quad \text{thus even}
   \]

   (c) Neither
   \[
   f(-x) = -(x^3 - 2x + 7) = -x^3 + 2x - 7
   \]

   \[
   -f(x) \neq f(-x) \quad \text{thus odd}
   \]
5. Determine the interval(s) on which the function is decreasing.

(a) $(-6, -4)$ and $(0, 4)$
(b) $(2, 2)$
(c) $(-6, -6)$
(d) $(4, -6)$ and $(2, -4)$
(e) $(-4, 0)$

6. Given that $f(x) = 5x - 1$ and $g(x) = -6x^2 + 7x - 9$, find $(f \circ f)(-1)$.

(a) $-1$
(b) $-6$
(c) $-7$
(d) $-31$
(e) $-30$

\[ f(-1) = 5(-1) - 1 = -5 - 1 = -6 \]
\[ g(-6) = -6(-6)^2 + 7(-6) - 9 = -30 - 1 = -31 \]

7. Solve: $9 - |x + 5| = 1$.

(a) $x = -13, 3$
(b) $x = -13$
(c) $x = -3, 13$
(d) $x = 3$
(e) $x = -8, 8$

\[ 9 - 1 = |x + 5| \]
\[ 8 = |x + 5| \]
\[ x + 5 = 8 \] or \[ x + 5 = -8 \]
\[ x = 3 \] or \[ x = -13 \]

8. Solve: $x^3 - 16x = 0$.

(a) $x = -16, 16$
(b) $x = -4, 4$
(c) $x = 0, 4$
(d) $x = 0, 16$
(e) $x = -4, 0, 4$

\[ x(x^2 - 16) = 0 \]
\[ x(x + 4)(x - 4) = 0 \]
\[ x = -4 \] or \[ x + 4 = 0 \] or \[ x - 4 = 0 \]
\[ x = -4 \] or \[ x = -4 \] or \[ x = 4 \]
9. Find $h(-7) + h(-5) + h(4)$, given the function $h(x) = \begin{cases} -3x - 9 & \text{for } x < -5 \\ 3 & \text{for } -5 \leq x < 1, \\ 2x + 5 & \text{for } x \geq 1 \end{cases}$

(a) 28
(b) -8
(c) 31
(d) 4
(e) -28

\[ h(-7) = 3(-7) - 9 = 21 - 9 = 12 \]
\[ h(-5) = 3 \]
\[ h(4) = 2(4) + 5 = 3 + 5 = 13 \]
\[ 12 + 3 + 13 = 28 \]

10. (3.4) Solve: $x - \sqrt{x + 49} = -7$.

(a) $x = -13$
(b) $x = -13, 0$
(c) $x = 0$
(d) $x = -13$
(e) $x = 7$

\[
\begin{aligned}
(x + \sqrt{x + 49})^2 &= (x + 49) \\
\frac{1}{2}(x + 49) &= \sqrt{x + 49} \\
\sqrt{x + 49} &= \frac{1}{2}(x + 49) \\
12 &\geq x + 13 = 0 \\
-13 &\geq x + 13 = 0 \\
\text{Check:}
\end{aligned}
\]

11. Determine whether the graph of $5 = 3x^4 + y$ is symmetric with respect to the $x$-axis, $y$-axis, or the origin.

(a) $x$-axis
(b) $y$-axis
(c) $x$-axis and $y$-axis
(d) Origin
(e) $x$-axis, $y$-axis, and origin

12. Find the vertex of the function $g(x) = -x^2 - 6x + 3$

(a) Maximum: $(-3, 12)$
(b) Minimum: $(-3, 12)$
(c) Maximum: $(3, -24)$
(d) Minimum: $(3, -24)$
(e) Maximum: $(0, 0)$

\[ \frac{-b}{2a} : \frac{-(-6)}{2(-1)} = \frac{6}{2} = -3 \]
\[ g(-3) = -(-3)^2 - 6(-3) + 3 \]
\[ = -9 + 18 + 3 = 12 \]
\[ (-3, 12) \text{ since } a = -1 < 0 \]
\[ \text{it has a max} \]
13. Solve: \( \left( \frac{x + 4}{2} + \frac{x - 9}{3} \right) = 1 \)

(a) \( x = \frac{7}{5} \)

(b) \( x = \frac{5}{7} \)

(c) \( x = \frac{12}{5} \)

(d) \( x = \frac{5}{12} \)

(e) \( x = 3 \)

\[ \frac{3}{2} \cdot \frac{(x + 4)}{2} + 6 \cdot \frac{(x - 9)}{3} = 1 \]

\[ 3(x + 4) + 2(x - 9) = 6 \]

\[ 3x + 12 + 2x - 18 = 6 \]

\[ 5x - 6 = 6 \]

\[ x = \frac{12}{5} \]

14. Describe in words how the graph of \( g(x) = 5(x - 1)^2 \) can be obtained from the graph of \( f(x) = x^2 \).

(a) Shifted right one unit, and stretched vertically by a factor of 5.

(b) Shifted left one unit, and stretched vertically by a factor of 5.

(c) Shifted right one unit, and shrunk vertically by a factor of \( \frac{1}{5} \).

(d) Shifted left one unit, and shrunk vertically by a factor of \( \frac{1}{5} \).

(e) Shifted left five units, and shrunk vertically by a factor of \( \frac{1}{5} \).

15. Determine the relative maxima in the following function.

(a) \( (0,1) \)

(b) \( (1,2) \)

(c) \( (2,0) \)

(d) \( (-1,0) \)

(e) \( (-2,2) \)

16. Given that \( g(x) = x - 3 \) and \( h(x) = x^2 - 1 \), find \( (h - g)(x) \).

(a) \( -x^2 + x - 2 \)

(b) \( x^2 + x + 4 \)

(c) \( x^2 - 2x - 2 \)

(d) \( x^2 - x + 2 \)

(e) \( x^2 - 2x - 4 \)

\[ (h - g)(x) = x^2 - 1 - (x - 3) \]

\[ = x^2 - 1 - x + 3 \]

\[ = x^2 - x + 2 \]
17. Determine if the function \( f(x) = x^2 - 12x + 32 \) has a maximum or a minimum. Indicate its coordinate.

(a) Maximum: \(-4\)

(b) Minimum: \(-4\)

(c) Maximum: \(-6\)

(d) Minimum: \(-6\)

(e) Minimum: \(6\)

18. Find the axis of symmetry of the function \( g(x) = -x^2 - 8x + 5 \)

(a) \(x = 4\)

(b) \(x = -4\)

(c) \(x = -8\)

(d) \(x = 8\)

(e) \(x = 5\)

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**Workout Section:**

19. Solve and write your answer in interval notation: \(|3 - 7x| \leq 4\).

\[-4 \leq 3 - 7x \leq 4\]

\[-7 \leq -7x \leq 1\]

\[x \geq \frac{1}{7}\]

\[x \leq \frac{1}{7}\]

\[x \in [\frac{-1}{7}, 1]\]

\[x \in [-\frac{1}{7}, 1]\]
20. Consider the function \( f(x) = 5 - 3x^2 \).

(a) Find \( f(x + h) \)

\[
\begin{align*}
 f(x + h) &= 5 - 3(x + h)^2 \\
 &= 5 - 3(x^2 + 2xh + h^2) \\
 &= 5 - 3x^2 - 6xh - 3h^2
\end{align*}
\]

(b) Construct and simplify the difference quotient \( \frac{f(x + h) - f(x)}{h} \) for the function \( f(x) = 5 - 3x^2 \).

\[
\begin{align*}
\frac{f(x + h) - f(x)}{h} &= \frac{5 - 3x^2 - 6xh - 3h^2 - (5 - 3x^2)}{h} \\
&= \frac{-6xh - 3h^2}{h} \\
&= -6x - 3h
\end{align*}
\]