1. Which of the following is a factor of $x^4 - x$? Circle all those that apply.

(A) $x$   (B) $x - 1$   (C) $x + 1$   (D) $x^2 + x + 1$   (E) $x^2 - x + 1$

2. How many roots does the equation below have?

$x(x^2 - 3) - 4(x^2 - 3) = 0$

(A) 0   (B) 1   (C) 2   (D) 3   (E) 4

3. \[ \frac{1 + \frac{1}{x}}{1 - \frac{1}{x}} = \]

(A) $\frac{x + 1}{x - 1}$   (B) $\frac{x - 1}{x + 1}$   (C) $x - 1$   (D) $1 - x$   (E) $x$

4. What is the radius of the circle whose equation is given by $x^2 - 8x + y^2 + 6y = 24$?

(A) $4$   (B) $\sqrt{24}$   (C) $5$   (D) $6$   (E) $7$

5. Which of the following is a solution to $2(5 - 3x) - 2 \cdot 5 - 3x = 108$? Circle all that apply.

(A) none   (B) $-12$   (C) $-9$   (D) $-2$   (E) $0$

6. Which of the following is not a solution to $3(x - 2)^3(x + 1)^2 - 2(x - 2)^2(x + 1)^3 = 0$? Circle all that apply.

(A) $-2$   (B) $-1$   (C) $0$   (D) $2$   (E) $8$
On all the following questions, show your work.

7. (7 points) Find all roots of the equation

\[(x - 1)(x + 1) + (x - 2)(x + 1) = 0.\]

8. (7 points) Rationalize the numerator of the expression \(\frac{\sqrt{4 + h - 2}}{h}\), and express your answer in simplified form.

9. (7 points) Find a complete factorization of \(x^6 - 64\).

10. (7 points) Find a symbolic representation of \(f \circ g(x)\) in the case where \(f(x) = \sqrt{2x - 5}\) and \(g(x) = 7 - x\). Then find the implied domain of \(f \circ g(x)\).
11. (7 points) The points $A = (0, 0), B = (8, 0)$, and $C = (3, 6)$ are the vertices of triangle. Find the length of the longest side.

12. (7 points) What is the slope of the line joining the points $(-2, f(-2))$ and $(4, f(4))$, where $f$ is the function defined by

$$f(x) = \begin{cases} x^2 - |x| & \text{if } x \leq 2 \\ 3x - 2 & \text{if } x > 2 \end{cases}$$

13. (7 points) Find the (implied) domain of the function $f(x) = \frac{\sqrt{x}}{x-3}$.

14. (12 points) Suppose the functions $f$ and $g$ are given by the table of values shown. Complete the table by calculating the values of $f \circ g(x)$ and $g \circ f(x)$ for each of the values of $x$ in the table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
<th>$g(x)$</th>
<th>$f \circ g(x)$</th>
<th>$g \circ f(x)$</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
15. (40 points) Evaluate each of the limits, or state that it does not exist.

(a) \( \lim_{x \to \infty} \frac{x^2 + 9x - 11}{2x^2 - 4x + 23} \)

(b) \( \lim_{z \to 2} \frac{z^3 - 8}{z - 2} \)

(c) \( \lim_{h \to 3} \frac{(2 - h)^2 + (2 + h)^2}{h^2 - 3h + 6} \)

(d) \( \lim_{x \to 3} \frac{x - 3}{x^2 - 9} \)

(e) \( \lim_{x \to 2} f(x) \)

where

\[ f(x) = \begin{cases} 
(x - 4)^2 & \text{if } x < 2 \\
7 & \text{if } x = 2 \\
5x - 6 & \text{if } x > 2 
\end{cases} \]