I pledge that I have neither given nor received unauthorized assistance during this examination.

Signature:

- DON’T PANIC! If you get stuck, take a deep breath and go on to the next question.
- Unless the problem says otherwise you must show your work sufficiently much that it’s clear to me how you arrived at your answer.
- You may use a graphing or scientific calculator on this exam. You may not use a phone.
- You may bring a two-sided sheet of notes on letter-sized paper in your own handwriting.
- There are 11 problems on 3 pages.

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Good luck!
1. For the following equations, find all solutions (if any exist).
   
   (a) $3\sqrt{x} + 2 = 0$
   
   Solution: No solutions

   (b) $2 - \frac{30}{x} = 0$
   
   Solution: $x = 15$

   (c) $3x - 7 = 4x + 3$
   
   Solution: $x = -10$

   (d) $x^2 - 5x - 14 = 0$
   
   Solution: $x = 7$ and $x = -2$

   (e) $36x^3 + 18x^2 = 0$
   
   Solution: $x = 0, x = -\frac{1}{2}$

   (f) $x^2 - 1 = x$
   
   Solution: $x = \frac{1\pm\sqrt{5}}{2}$

2. Consider the following graph:

   (a) Is this the graph of a function?
   
   Solution: Yes.
(b) If the answer to part (a) is yes, what is the domain of the function?

**Solution:** [1, 7]

(c) If the answer to part (b) is yes, what is the range of the function?

**Solution:** [2, 6]

3. A rectangular building lot is 10 feet longer than it is wide and has a total area of 875 square feet. What are its dimensions?

**Solution:** 25 feet by 35 feet.

4. Simplify the following expressions as much as you can.
   (a) \(x^2x^3\)

   **Solution:** \(x^5\)

   (b) \(\frac{x^2y^3}{\sqrt{xy^2}}\)

   **Solution:** \(x^{3/2}y\)

   (c) \(\frac{1}{x+5} - \frac{x}{x+3}\)

   **Solution:** \(\frac{3 - 4x - x^2}{(x + 3)(x + 5)}\)

5. Factor these expressions as much as you can:
   (a) \(x^4 - 3x^3\)

   **Solution:** \(x^3(x - 3)\)

   (b) \(x^2 + 2x - 8\)

   **Solution:** \((x + 4)(x - 2)\)

6. Expand these expressions and simplify them as much as you can:
(a) \((x + 1)^2 - (x - 3)^2\)

\[ \text{Solution: } 8(x - 1) \]

(b) \((x - 2y)(x + 2y)\)

\[ \text{Solution: } x^2 - 4y^2 \]

7. For which values of \(x\) does the inequality \((x - 1)(2x + 1) < 0\) hold? Give your answer in interval notation.

\[ \text{Solution: } \left(-\frac{1}{2}, 1\right) \]

8. Give an equation for a line that goes through the point \((0, 0)\) and is parallel to the line defined by \(2x - 6y = 3\).

\[ \text{Solution: } y = \frac{1}{3}x \]

9. The graph of \(y = f(x)\) is as shown.

\[ \text{Sketch the graphs of the following functions:} \]

(1) \(y = f(x) + 3\) \quad (2) \(y = f(x + 3)\) \quad (3) \(y = -f(x)\) \quad (4) \(y = 2 - f(x)\).
Solution: (1) is shifted upward by 3, (2) is shifted leftward by 3, (3) is flipped vertically across the $y$-axis, and (4) is like (3) but shifted upward by 2 after flipping.

10. Put the following quadratic equations into standard form. For each one, give the vertex of the parabola and state whether it is a minimum or a maximum.

(a) $2x^2 - 10x + 14$

Solution: $2(x - \frac{5}{2})^2 + \frac{3}{2}$. Vertex is $(5/2, 3/2)$, and it is a minimum.

(b) $6 - x^2 - 5x$

Solution: $-(x + \frac{5}{2})^2 + \frac{49}{4}$. Vertex is $(-5/2, 49/4)$, and it is a maximum.

(c) $-2x^2 + 2x + 1$

Solution: $-2(x - \frac{1}{2})^2 + \frac{3}{2}$. Vertex is $(1/2, 3/2)$ and it is a maximum.
11. The number of apples produced per tree in an orchard depends on how densely the trees are planted. If 40 trees are planted per acre of land, then each tree produces 540 apples. It is estimated that each tree’s apple production decreases by 90 apples for every extra 10 trees planted per acre (i.e., if 50 trees are planted per acre, then each tree would produce 450 apples).

(a) Give a function $A(n)$ modeling the total number of apples produced on one acre of land if $n$ trees are planted on that land.

Solution: $A(n) = 9n(100 - n) = -9n^2 + 900n$

(b) How many trees should be planted per acre to maximize yield?

Solution: 50 trees per acre