INSTRUCTIONS: **Simplify** and **box** all your answers. Write neatly and **justify all answers**. A correct answer with incorrect work or no justification may receive no credit. Books, notes, and electronic devices are not permitted while taking the exam. The exam is worth 100 points.

Potentially useful formulas:

(i) $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$

(ii) $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

(iii) Equation of a circle: $(x - h)^2 + (y - k)^2 = r^2$

NOTE: YOU MAY TEAR OFF THIS FIRST PAGE AND USE (FRONT AND BACK) AS SCRATCH PAPER.

i. DO NOT START UNTIL INSTRUCTED BY A PROCTOR.

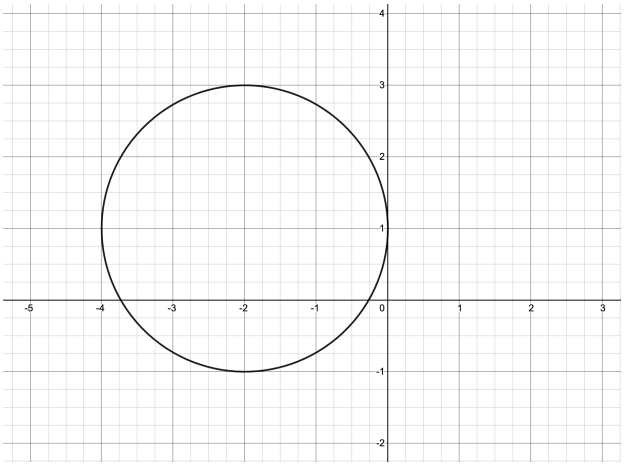
ii. THE EXAM IS ON BOTH SIDES OF EACH FOLLOWING EXAM PAGE

iii. WRITE YOUR NAME ON THE NEXT PAGE. JUST BEFORE YOU UPLOAD TO GRADESCOPE WRITE DOWN YOUR UPLOAD TIME ON THE NEXT PAGE.

iv. WHEN YOU FINISH (IF BEFORE THE EXAM END TIME) PLEASE QUIETLY COLLECT YOUR THINGS AND MOVE TO THE SUBMISSION AREA TO UPLOAD YOUR ANSWERS WITH SUPPORTING WORK TO GRADESCOPE.

Name: _____ Upload time: _____

1. For the graph of the circle, answer the following: (7 pts)



(a) Identify the radius and the coordinates of the center of the circle.

(b) Write down the equation of the circle.

2. Find the domain of the following functions. Express your answers in interval notation. (15 pts)

(a) $s(x) = \dfrac{x^2 - 4x + 3}{x^2 - 3x}$

(b) $h(x) = \dfrac{\sqrt{x-3}}{2x-8}$

(c) $n(t) = 4t + \sqrt[3]{t-1}$

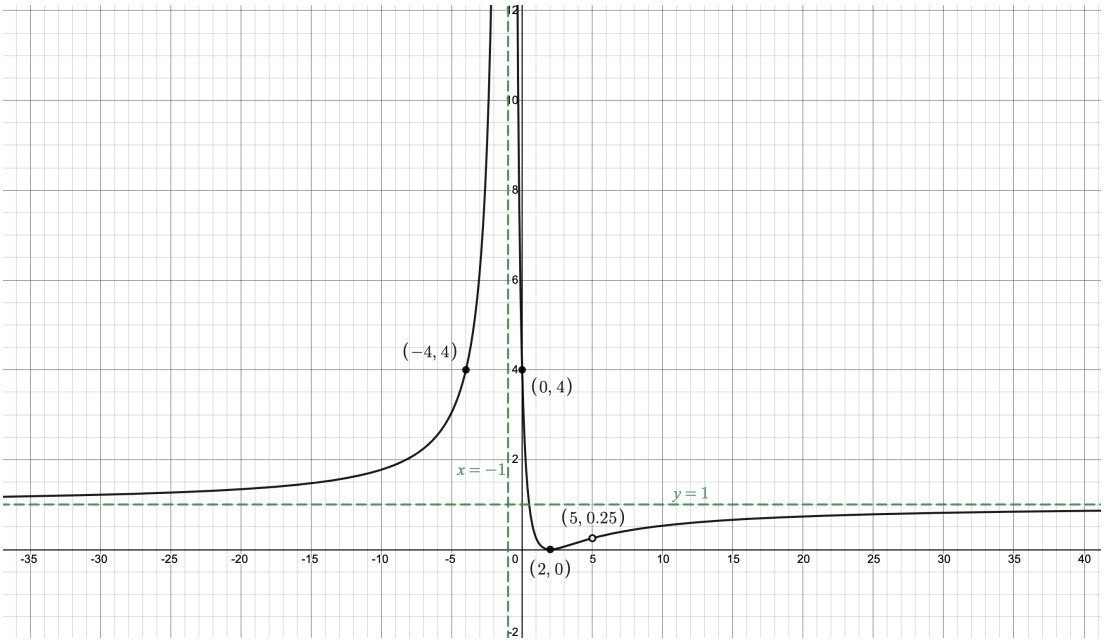
3. For $f(x) = 2x^2 - x$ answer the following: (10 pts)

(a) Find $f(a)$

(b) Find $f(a + h)$

(c) Find $\dfrac{f(a + h) - f(a)}{h}$ and simplify.

4. Answer the following for the given graph of a rational function $R(x)$ with labeled asymptotes. (15 pts)



(a) Find the domain of $R(x)$. Express your answer in interval notation.

(b) Find the range of $R(x)$. Express your answer in interval notation.

(c) Find the x-intercept(s) of $R(x)$.

(d) Find $(R \cdot R)(-4)$.

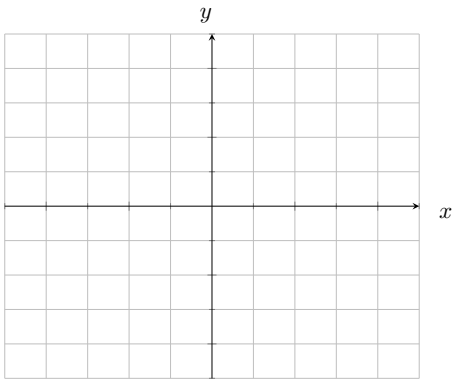
(e) Find $(R \circ R)(2)$.

(f) $R(x)$ is **not** one-to-one. Give a brief explanation as to why $R(x)$ is not one-to-one.

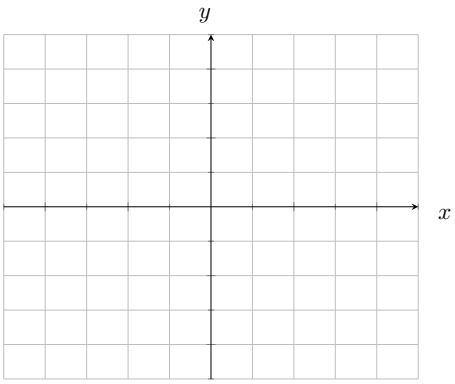
(g) Write down a restriction of the domain of $R(x)$ so that the range stays the same and the function on the restricted domain is one-to-one.

5. Sketch the shape of the graph of each of the following on the given set of axes. Label x-intercepts if any: (19 pts)

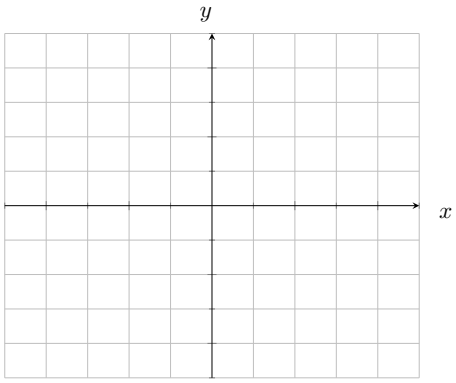
(a) $f(x) = \sqrt{x} + 2$



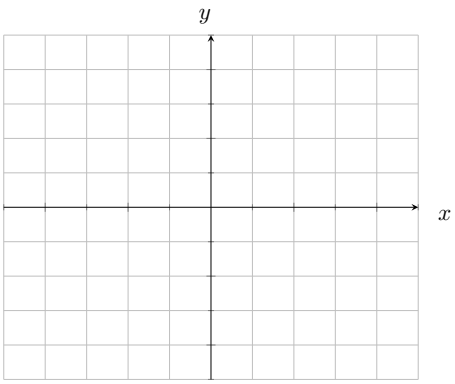
(d) $g(x) = -x^3$



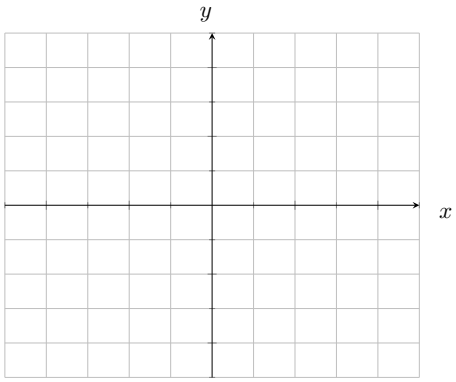
(b) $k(x) = x^8$



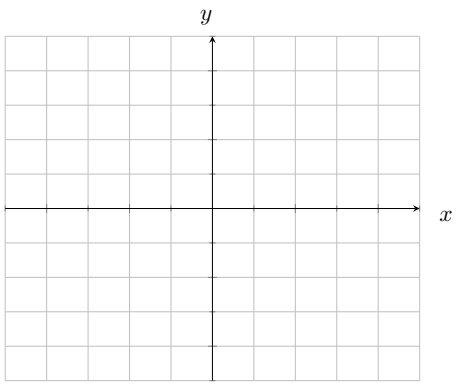
(e) $m(x) = |x - 1|$



(c) $x^2 + y^2 = 1$



(f) $q(x) = \begin{cases} x^2 - 1 & \text{if } x \leq 1 \\ \frac{1}{x} & \text{if } x > 1 \end{cases}$



6. Find the inverse function of $g(x) = 1 - 3x^3$ (you may assume the inverse function exists). (5 pts)

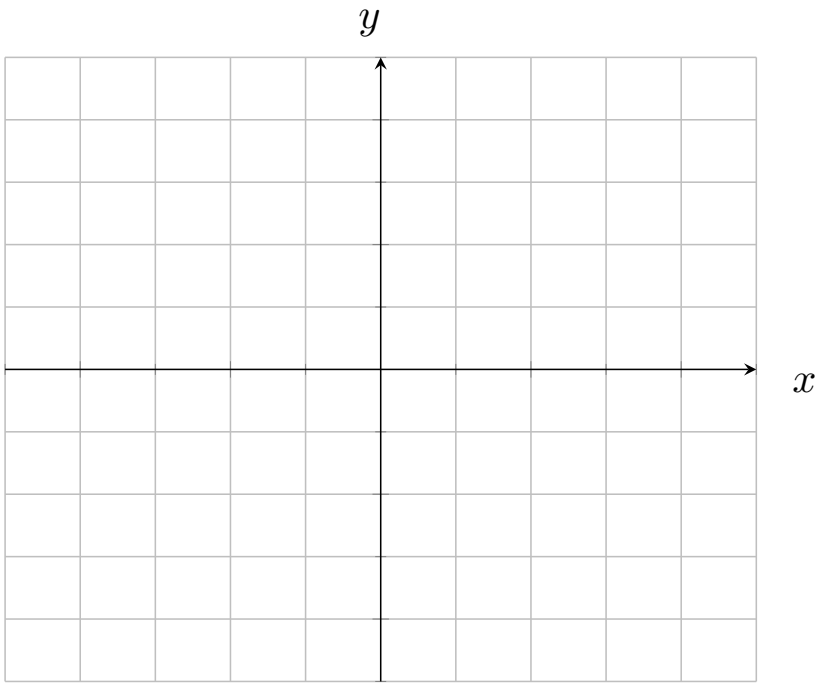
7. (a) Sketch the shape of the graph of a polynomial function, $P(x)$, that satisfies **all** of the information. **Label** all intercepts on the graph. (6 pts)

   i. The graph has y-intercept $(0, 0)$.

   ii. The graph has end behavior consistent with $y = -x^4$

   iii. The graph bounces (touches but does not cross) at x-intercept $(3, 0)$

   iv. The graph has no other x-intercepts.

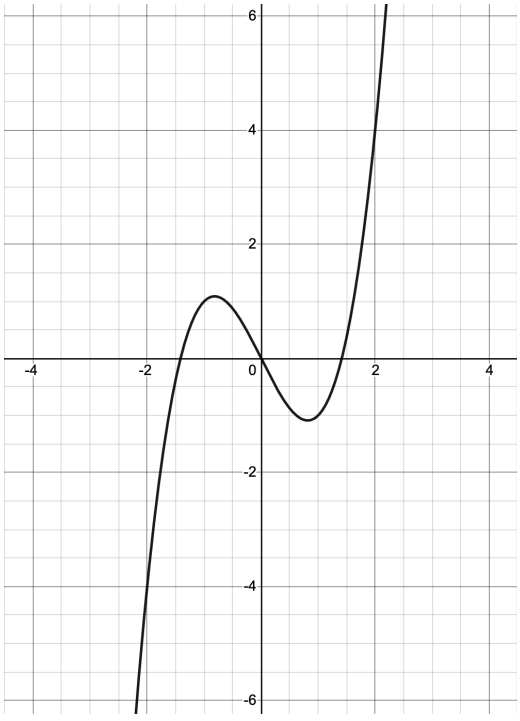
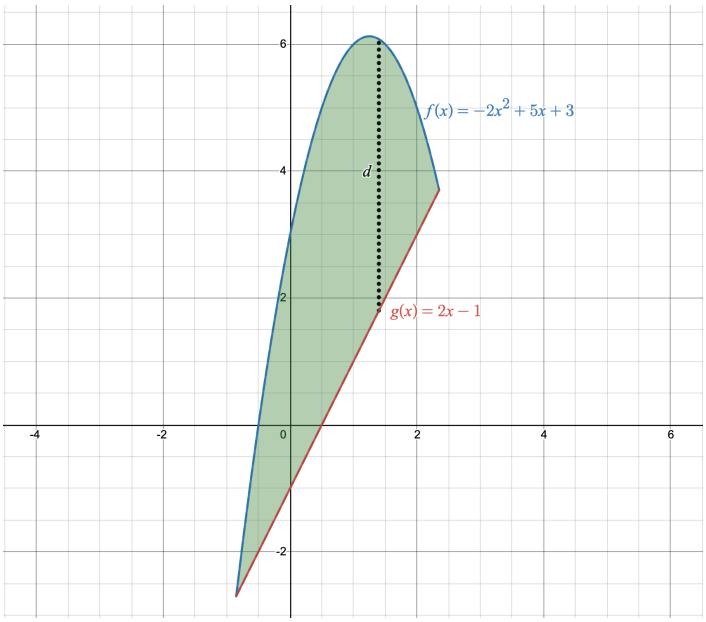


   (b) Write down a polynomial $P(x)$ that satisfies all of the given information. (4 pts)

8. Use long division to find the quotient and remainder when $x^3 - x^2 + 2x + 1$ is divided by $x^2 + 2x$. (6 pts)

9. (a) Is $f(x) = x^5 - \sqrt[3]{x}$ odd, even, or neither? Justify your answer for credit. (4 pts)

(b) Given the graph of a function below, is the function odd, even, or neither? **No justification is needed.** (4 pts)



10. Find the maximum vertical distance d between the parabola, $f(x) = -2x^2 + 5x + 3$, and the line, $g(x) = 2x - 1$, for the green region. (5 pts)