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, electronic devices, other unauthorized devices, and help from another person 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.

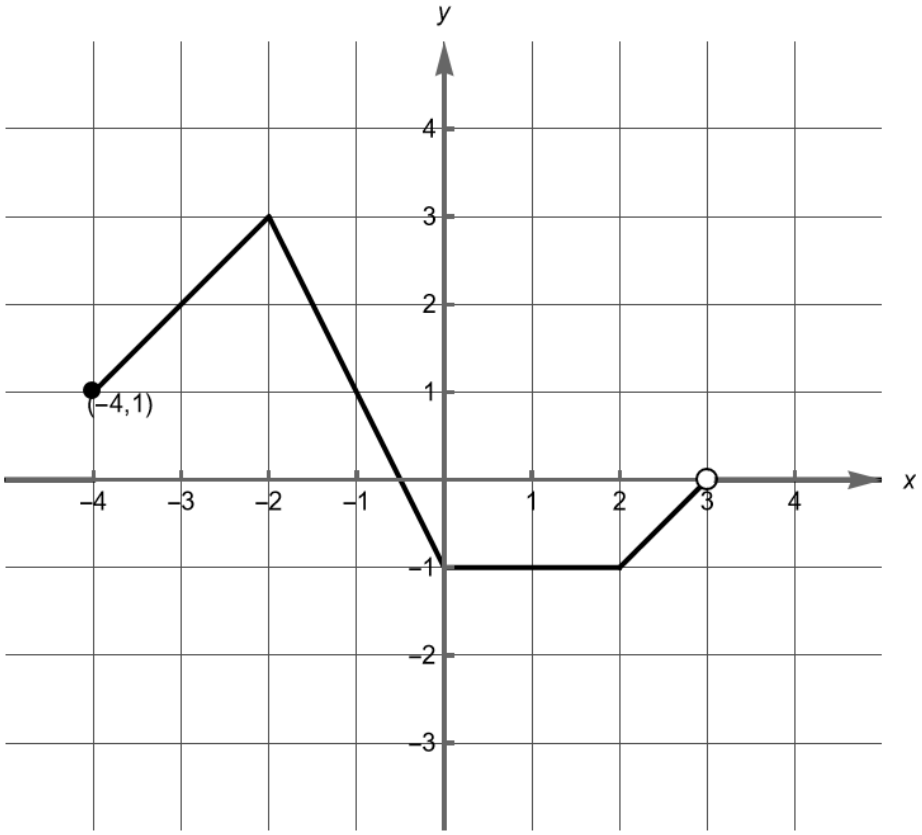
ii. THE EXAM IS ON BOTH SIDES OF EACH FOLLOWING EXAM PAGE

iii. WRITE YOUR NAME ON THE NEXT PAGE.

iv. WHEN YOU FINISH (IF BEFORE THE EXAM END TIME) PLEASE QUIETLY COLLECT YOUR THINGS AND FOLLOW PROCTOR INSTRUCTIONS IN UPLOADING YOUR EXAM WITH SUPPORTING WORK TO GRADESCOPE. ONLY WORK THAT'S SUBMITTED TO GRADESCOPE WILL BE GRADED.

Name: _____

1. Refer to the given graph of $g(x)$ to answer the following: (10 pts)



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

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

(c) Find $(g \circ g)(0)$

(d) Find $(g + g)(0)$

(e) Find x-value(s) for which $g(x) = 3$.

(f) Find x-values for which $g(x) \leq -1$. Give your answer in interval notation.

(g) Find the net change of $g(x)$ from $x = -3$ to $x = 2$

(h) Is $g(x)$ odd, even, or neither?

(i) Identify a restriction of the domain so that g is one-to-one and has the same range as in part (b). Give your answer in interval notation.

(j) Use your domain restriction to calculate $g^{-1}(1)$.

2. For the function $f(t) = \dfrac{t-1}{3}$: (7 pts)

   (a) Find $(f \circ f)(t)$

   (b) Find the domain of $(f \circ f)(t)$

3. For $f(x) = -x^2 + 1$ find the following: (7 pts)

   (a) $f(a)$

   (b) $f(a+h)$

   (c) $\dfrac{f(a+h) - f(a)}{h}$

4. A chemist starts heating some liquid in a test tube. The temperature of the liquid depends on time and grows linearly from 35° Celsius at time $t = 3$ seconds to 42° Celsius at time $t = 16$ seconds. Answer the following questions (7 pts):

   (a) Find the linear equation that relates the temperature T and the time t.

   (b) What does the slope of the line from part (a) represent physically?

   (c) What does the T-intercept of the line from part (a) represent physically?

5. Find the center and radius for: $x^2 + y^2 - 4y = 3$. (5 pts)

6. The following are unrelated: (10 pts)

(a) Find the equation of the line that is parallel to the x-axis and passes through the point $(-2, 5)$.

(b) $g(x)$ is an even function with domain $(-\infty, \infty)$. The point $(3, 5)$ lies on its graph. Which of the following points also lies on its graph?
(i) $(-3, 5)$ (ii) $(-3, -5)$ (iii) $(3, -5)$ (iv) None of these

(c) Find all value(s) of b such that the distance between the two points, $(0, 2)$ and $(1, b)$, is 2.

(d) If $h(x) = \sqrt{2 - x}$ and $k(x) = \sqrt{x - 2}$ then what is the domain of $g(x) = (h + k)(x)$?

7. For $h(x) = \dfrac{2}{2x+5}$ answer the following (7 pts):

   (a) Find the inverse function for $h(x)$

   (b) What is the range of $h(x)$?

8. If the equation of a parabola in standard form is given by $y = a(x-3)^2 + 2$ and the parabola passes through the point $(-3, 1)$ find the value of a. (4 pts)

9. Find the domain of the following functions. Express your answers in interval notation. (12 pts)

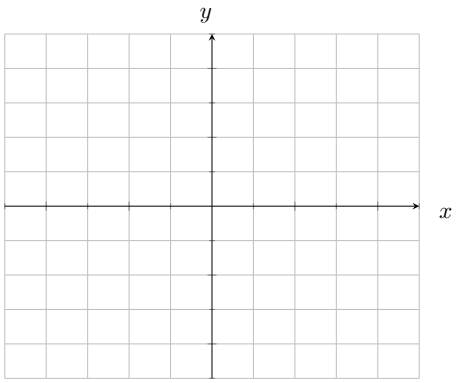
(a) $n(x) = \dfrac{x^2 - 1}{x^2 - 2x - 3}$

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

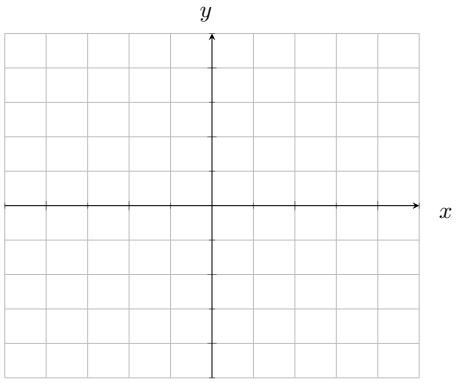
(c) $s(x) = 2x^2 + \sqrt[3]{-x}$

10. Sketch the shape of the graph of each of the following on the provided axes. **Label** at least one value on the x-axis and y-axis for each part. (14 pts)

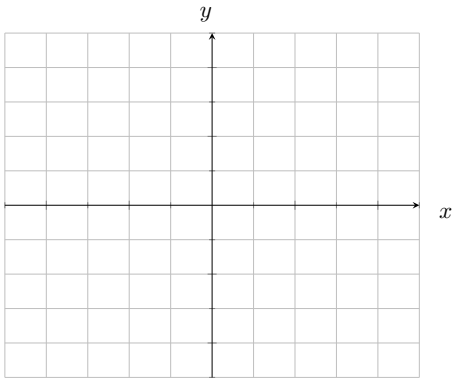
(a) $h(x) = (x+1)^2$



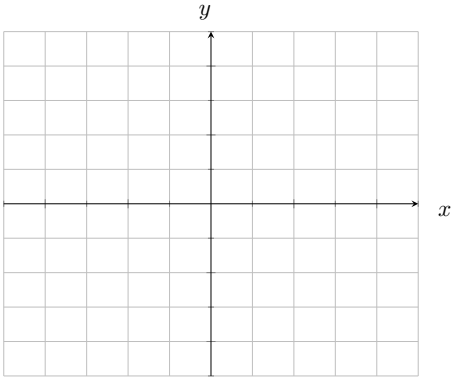
(b) $k(x) = x^3 + 1$



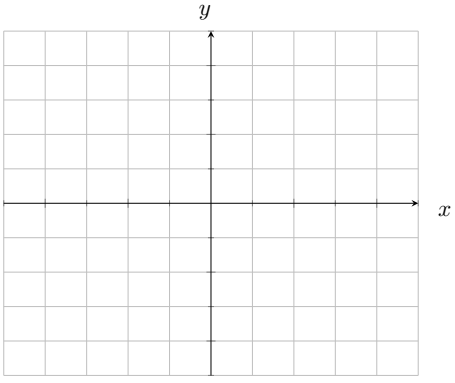
(c) $(x-1)^2 + (y+2)^2 = 4$



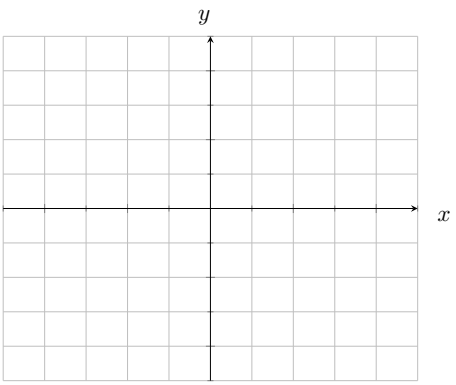
(d) $g(x) = \sqrt[3]{x}$



(e) $m(x) = \sqrt{-x}$



(f) $q(x) = \begin{cases} 2x-1 & \text{if} \quad x \leq 0 \\ |x| & \text{if} \quad x > 0 \end{cases}$



11. For $P(x) = -x^4 + 4x^3 - 3x^2$ answer the following. (11 pts)

(a) i. Identify the term that dominates the end behavior of $P(x)$:

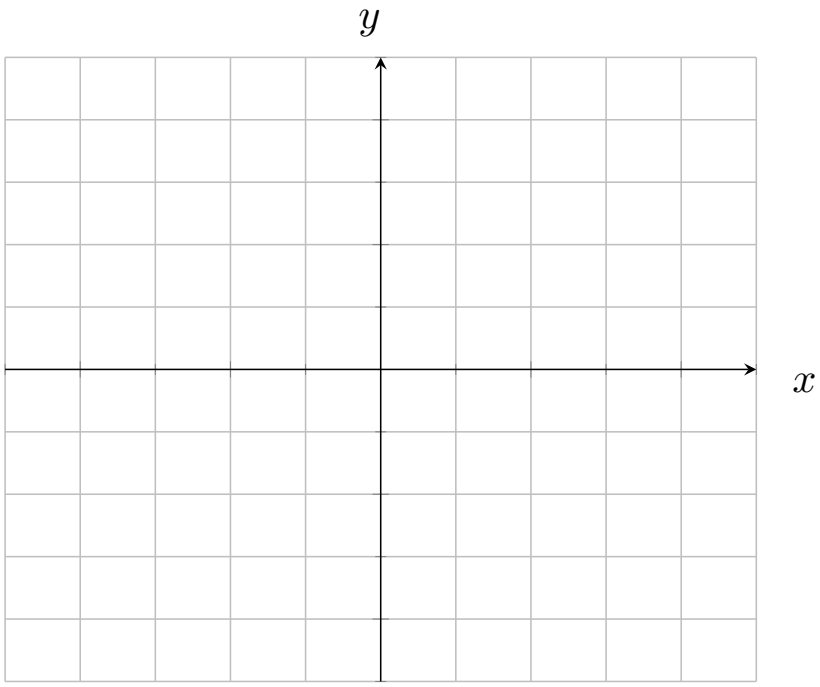
ii. Based on your answer to part (i) fill in the blanks for $P(x)$:

$y \to$ _____ as $x \to -\infty$ and $y \to$ _____ as $x \to \infty$.

(b) Find all zeros of $P(x)$ **and** identify the multiplicity of each zero.

(c) Find the y-intercept.

(d) Sketch the graph of $P(x)$ by using all the above information. **Label** all intercepts on the graph.



12. A wire 10 cm long is cut into two pieces. Each piece is bent into the shape of a square (one square has side length x and the other square has side length y). Express the total area of the two squares as a function of x. (6 pts)

END OF EXAM