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 formula:

(i) 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.

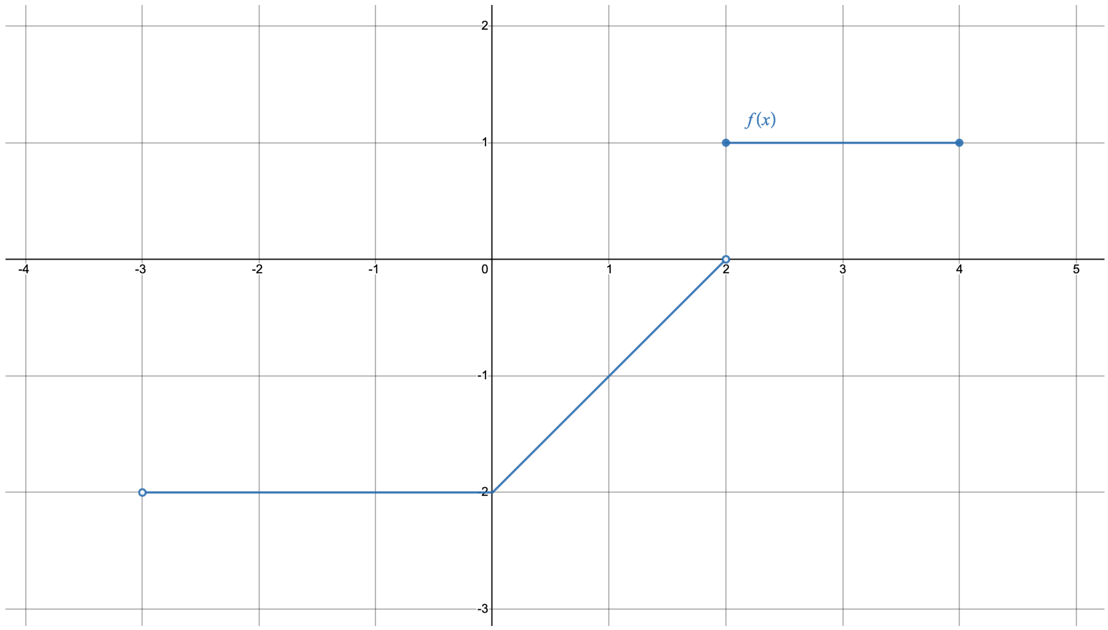
ii. THE EXAM IS ON BOTH SIDES OF EACH FOLLOWING EXAM PAGE

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. Answer the following for the given graph of a function $f(x)$ Give answers in interval notation where relevant (12 pts):



   (a) Identify the domain of f.

   (b) Identify the the range of f.

   (c) Find $(f + f)(-1)$.

   (d) Find $f(-3)$ if it exists. If the value does not exist write "DNE."

   (e) Solve $f(x) = -1$.

   (f) Find $(f \circ f)(1)$.

   (g) f is not one-to-one. Briefly explain why this function is not one-to-one.

   (h) Find the x-values where $f(x) \geq 0$. Give your answer in interval notation.

   (i) Find the net change of $f(x)$ from $x = 0$ to $x = 3$.

   (j) Write down a piecewise-defined function that gives the same graph as $f(x)$.

2. The following are unrelated. (7 pts)

   (a) Find the center and radius of the circle that has equation: $x^2 + y^2 - 4y = 3$.

   (b) Find the equation of the line that crosses through the points $(2, -3)$ and $(1, -1)$.

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

   (a) $v(t) = 16t^2 + 64$

   (b) $f(x) = \dfrac{\sqrt{x+2}}{x-4}$

   (c) $g(x) = \dfrac{x}{x^2 - 7x + 12}$

4. For $f(x) = 2x^2 - 4$ compute the following for real number constant a and nonzero constant h: (6 pts)

(a) $f(a)$

(b) $f(a+h)$

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

5. For $k(x) = \dfrac{1}{\sqrt{x}}$ and $j(x) = x^2 + 4$, find the following: (5 pts)

(a) Find $f(x) = (j \circ k)(x)$.

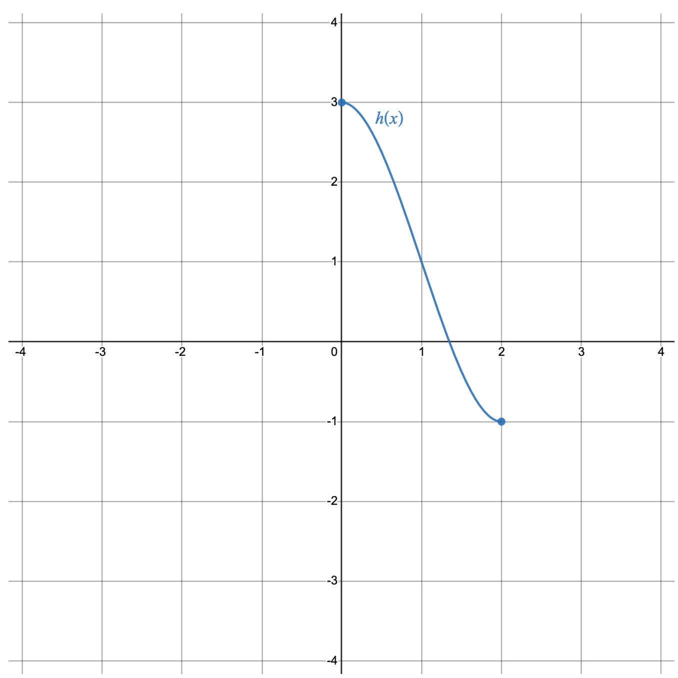
(b) Find the domain of $f(x)$.

6. Answer the following for the one-to-one function $h(x)$ whose graph is given below with domain $[0, 2]$. (6 pts)

(a) On the graph to the right, graph the line $y = x$.

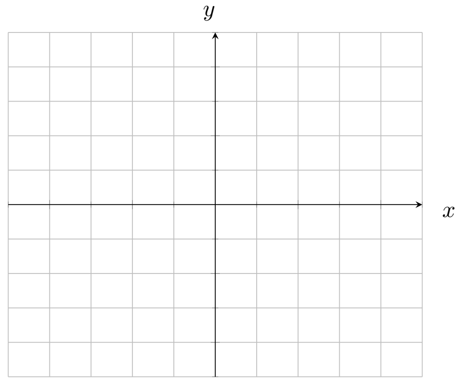
(b) On the same graph sketch the graph of $h^{-1}(x)$ (label at least two points on the graph of $h^{-1}(x)$).

(c) What is the range of $h^{-1}(x)$ in interval notation?

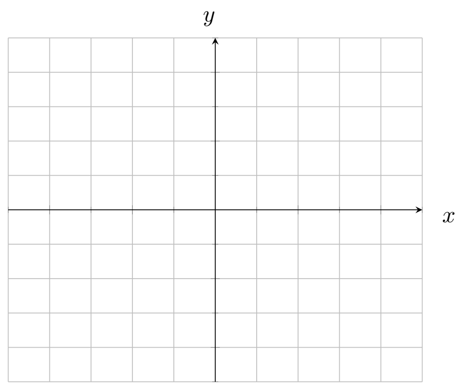


7. Sketch the shape of the graph of each of the following on the provided axes. Make sure to label relevant value(s) on your axe(s) (19 pts)

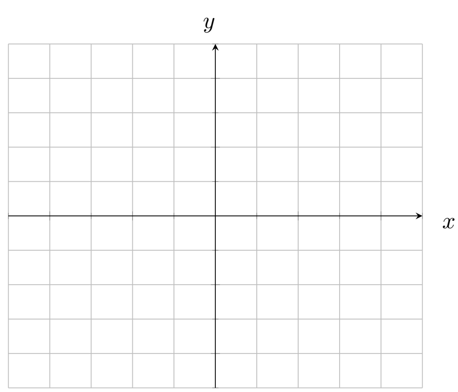
(a) $f(x) = -\frac{1}{2}x + 1$



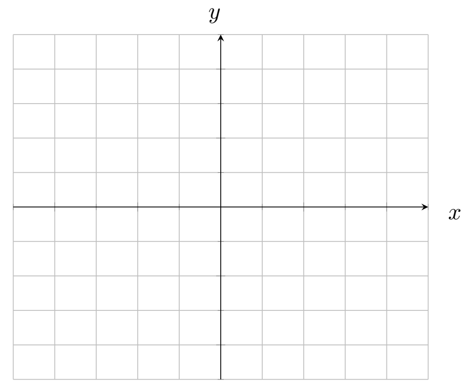
(b) $k(x) = (x-1)^3$



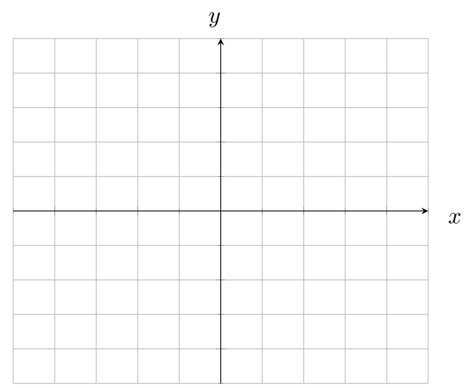
(c) $(x-2)^2 + (y+1)^2 = 4$



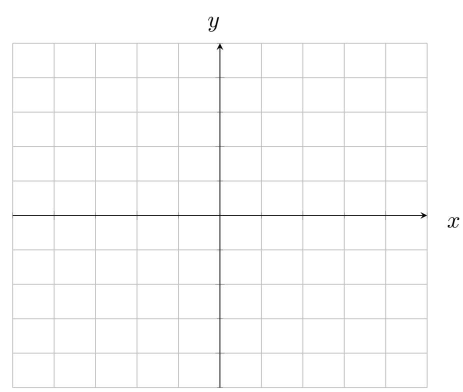
(d) $g(x) = \sqrt[3]{x} + 2$



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



(f) $q(x) = \begin{cases} 1 & \text{if} \quad x < 1 \\ x^2 - 1 & \text{if} \quad x \geq 1 \end{cases}$



8. For $P(x) = -x^4 - 5x^3 - 4x^2$ answer the following. (7 pts)

(a) Indicate on a graph or use arrow notation to indicate the end behavior of $P(x)$.

(b) Find the y-intercept of $P(x)$.

(c) Find all zeros and identify the multiplicity of each zero.

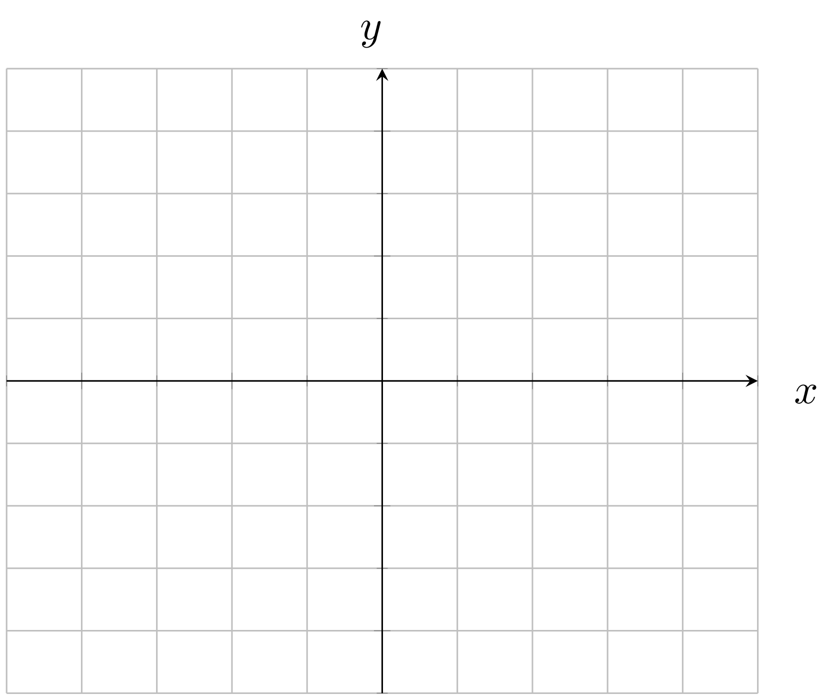
9. Sketch the shape of the graph of a polynomial function, $g(x)$, that satisfies **all** of the information. **Label** all intercepts on the graph. (5 pts)

i. The graph has y-intercept $(0, 2)$.

ii. The graph has end behavior consistent with $y = 2x^5$.

iii. The graph crosses at $(-2, 0)$ and bounces (touches but does not cross) at $(1, 0)$ and $(2, 0)$.

iv. The graph has no other x-intercepts.

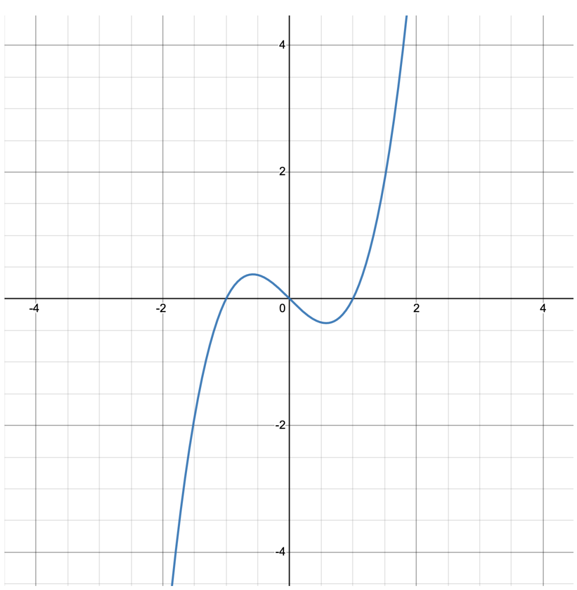


10. Use long division to find the quotient and remainder when $2x^3 + 3x^2 - 6x + 2$ is divided by $x^2 - 3$. (5 pts)

11. The following are unrelated. (6 pts)

(a) Is $f(x) = x^6 - |x| + 1$ odd, even, or neither? Justify your answer to earn credit.

(b) Is the graph below that of an odd function, even function, or neither?



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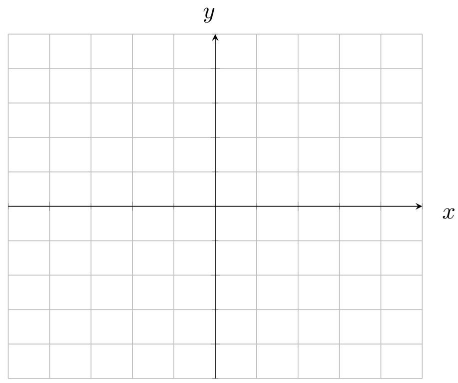
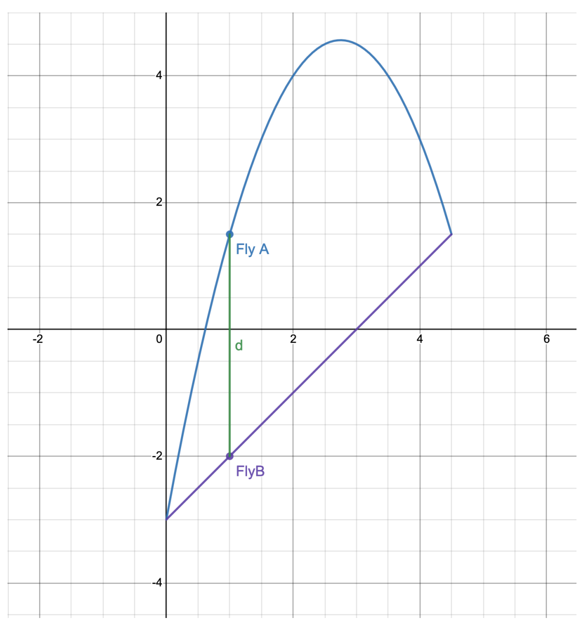
12. (a) Plot the points $C(4, 1)$ and $D\,(4, 3)$ on the graph below. (7 pts)



(b) Find the distance between points C and D.

(c) Two flies, Fly A and Fly B, are crawling along a wall in such a way that Fly A is always directly above Fly B (See picture). Fly A is crawling along the path $f(x) = -x^2 + \frac{11}{2}x - 3$ and fly B is crawling along path $g(x) = x - 3$. Find the maximal distance, d, between the two flies on the interval of x-values: $[0, 4.5]$. As always, show all work in justifying your answer.



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