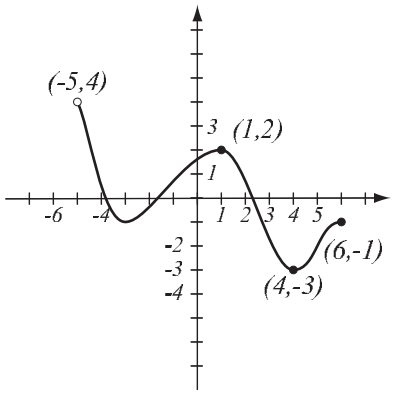
College Algebra — Exam 1
MAT 140C, Spring 2026 — D. Ivanšić

Name: _____

Show all your work!

1. (8pts) Use the graph of the function f at right to answer the following questions.



a) Find: $f(4) =$ $f(1) =$

b) What is the domain of f?

c) What is the range of f?

d) What are the solutions of the equation $f(x) = -2$?

2. (10pts) Use your calculator to accurately sketch the graph of $y = x^3 - 8x^2 + 5x - 3$.

a) Draw the graph on paper and indicate units on the axes.

b) Find all the $x-$ and $y-$intercepts (accuracy: 6 decimal points).

3. (5pts) Draw the line that passes through points $(-1, 1)$ and $(-1, 6)$. Then write the equation of the line.

4. (10pts) Find the equation of the line (in form $y = mx + b$) that is perpendicular to the line $2x - 4y = 5$ and passes through the point $(4, 1)$. Draw both lines.

5. (8pts) Draw the quadrangle with vertices $A = (4, 0)$, $B = (2, 4)$, $C = (-4, 0)$ and $D = (-2, -3)$. Use slopes to determine if any two of its sides are perpendicular.

6. (9pts) Let $f(x) = x^2 - \sqrt{2x - 7}$. Find the following (simplify where appropriate).

$f(1) =$ $f(8) =$

$f(4u) =$ $f(x + 3) =$

7. (9pts) Find the domains of the functions below and write them using interval notation.

$f(x) = \dfrac{1}{x^2 - 5x - 36}$ $g(x) = \sqrt{2x + 7}$

8. (5pts) Solve and write the solution in interval notation.

$4 \leq 7 - 2x < 11$

9. (10pts) The diameter of a circle has endpoints $(-2, -3)$ and $(4, 1)$.
a) Find the equation of the circle.
b) Draw the circle in the coordinate plane.

10. (12pts) An electric company offers two plans to pay for electricity usage:
A) \$60 flat fee that includes 200 kWh, then 12 cents per kWh for usage beyond 200 kWh.
B) \$10 flat fee plus 16 cents per kWh.
Assuming a customer always uses at least 200 kWh of electricity, for which amounts of electricity is plan A better?

11. (14pts) Because she was afraid to be late, Fiona rushed to a concert and got there in 2 hours. On the way back, she drove 9mph slower, so it took her a quarter of an hour longer.
a) How fast did Fiona drive to and from the concert?
b) How far did she drive to the concert?

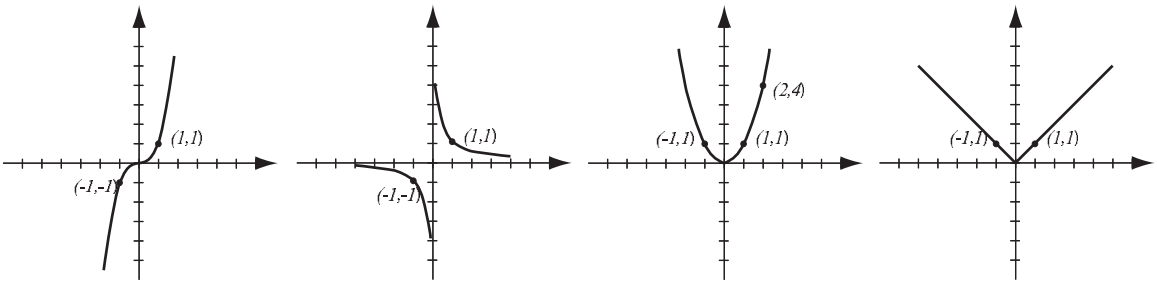
Bonus (10pts) Madison will invest some money into accounts bearing 2.5% and 3% simple interest. She plans to invest $600 more into the account bearing 3% interest than the account bearing 2.5% interest. If she wishes to have at least $106 in total interest after 1 year, what is the least she can invest in the account bearing 2.5% interest? Solve as an inequality.

College Algebra — Exam 2
MAT 140C, Spring 2026 — D. Ivanšić

Name: _____

Show all your work!

1. (8pts) The following are graphs of basic functions. Write the equation of the graph under each one.



2. (20pts) Let $f(x) = \dfrac{1}{x^2 - 9}$, $g(x) = x + 5$.

Find the following (simplify where possible):

$(f + g)(0) =$ $(fg)(5) =$

$\dfrac{g}{f}(x) =$ $(g \circ f)(4) =$

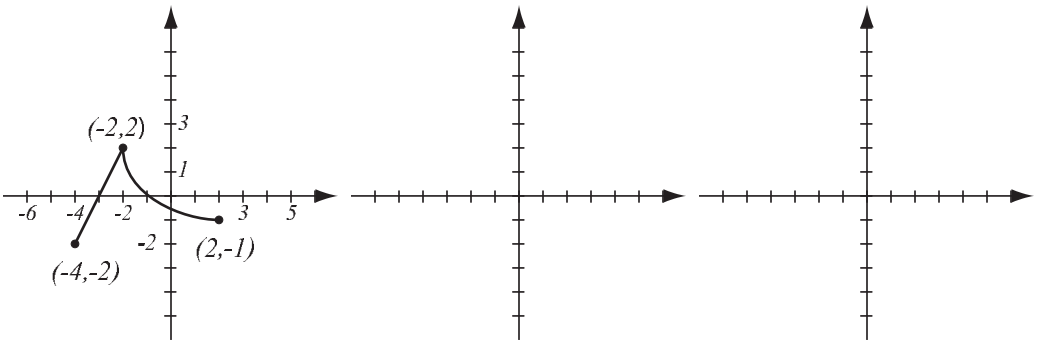
$(f \circ g)(x) =$

The domain of fg in interval notation

3. (6pts) Consider the function $h(x) = 3 + \sqrt{x+5}$ and find **two** different solutions to the following problem: find functions f and g so that $h(x) = f(g(x))$, where neither f nor g are the identity function.

4. (6pts) Write the equation for the function whose graph has the following characteristics:
a) shape of $y = x^2$, stretched vertically by factor 3.
b) shape of $y = x^3$, shifted left by 4, then reflected over the y-axis.

5. (10pts) The graph of $f(x)$ is drawn below. Find the graphs of $-f(x+2)$ and $f(2x) - 3$ and label all the relevant points.



6. (8pts) Sketch the graph of the piecewise-defined function:

$$f(x) = \begin{cases} 2x - 5, & \text{if } x < 1 \\ 5 - 2x, & \text{if } x \geq 1 \end{cases}$$

7. (5pts) Find the values of the piecewise-defined function.

$$f(x) = \begin{cases} x^2 - 3x, & \text{if } -1 \leq x < 3 \\ \dfrac{4}{x^2+1}, & \text{if } x \geq 3 \end{cases}$$

$f(7) =$

$f(3) =$

$f(0) =$

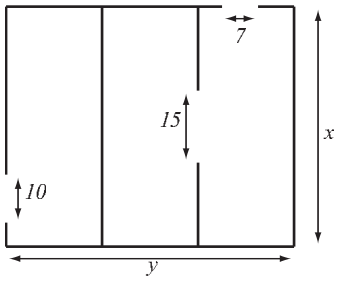
8. (3pts) Sketch a graph of an even function with the property $f(0) = 2$. You can draw any curve you like, as long as it has the property requested.

9. (20pts) Let $f(x) = x^5 - 7x^3$ (answer with 6 decimal points accuracy).
a) Use your graphing calculator to accurately draw the graph of f (on paper!). Indicate units on the axes.
b) Determine algebraically whether the function is odd, even, or neither.
c) Verify your conclusion from b) by stating symmetry.
d) Find the local maxima and minima for this function.
e) State the intervals where the function is increasing and where it is decreasing.

10. (14pts) Landscape architect Zuri is designing a walled garden with area 4,000 square feet. Its plan is shown below, where the lines indicate walls. There are also three gaps in the walls to allow for entry into sections of the garden. Zuri's goal is to minimize construction cost, same as minimizing the total length of the walls.

a) Express the total wall length as a function of the length of one of the sides x. What is the domain of this function?

b) Graph the function in order to find the minimum. What are the dimensions of the enclosure that has the smallest total wall length and what is the smallest total wall length?



Bonus. (10pts) Among all right triangles whose hypothenuse has length 5, find the one that has the greatest area. You can use the two sides as base and height, because they are perpendicular. (Solve it like you did the optimization problem above.)

College Algebra — Exam 3
MAT 140C, Spring 2026 — D. Ivanšić

Name: _____

Show all your work!

Simplify, so that the answer is in form $a + bi$.

1. (5pts) $2i(3i - 2) + 3i(5 + i) =$

2. (5pts) $\dfrac{4 + i}{3 - 2i} =$

3. (4pts) Simplify and justify your answer.

$i^{62} =$

4. (6pts) Solve the equation by completing the square.

$x^2 - 12x + 4 = 0$

5. (6pts) Solve the inequality. Write the solution in interval form.

$|x + 5| \geq 6$

6. (6pts) Let $P(x)$ be a polynomial of degree 4.
a) Draw a graph of P that has three x-intercepts.
b) Draw a graph of P that has the minimal number of turning points.

7. (12pts) The quadratic function $f(x) = -x^2 + 2x + 15$ is given. Do the following without using the calculator.
a) Find the x- and y-intercepts of its graph, if any.
b) Find the vertex of the graph.
c) Sketch the graph of the function.

Solve the equations:

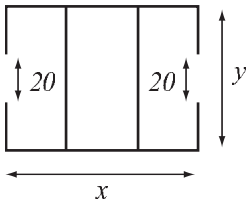
8. (8pts) $\dfrac{x}{x+4} - \dfrac{2}{x+1} = \dfrac{5x-1}{x^2+5x+4}$

9. (8pts) $\sqrt{4x+17} - x = 3$

10. (14pts) The polynomial $f(x) = (x-1)^2(x-4)(x+3)$ is given.
a) What is the end behavior of the polynomial?
b) List all the zeros and their multiplicities. Find the y-intercept.
c) Use the graphing calculator along with a) and b) to accurately sketch the graph of f (yes, on paper!).
d) Find all the turning points (i.e., local maxima and minima) with accuracy 6 decimal points.

11. (12pts) In a rectangle whose area is $5\,\text{ft}^2$, the length is $2\,\text{ft}$ more than the width. What are the dimensions of the rectangle?

12. (14pts) A logistics company is building a warehouse whose floorplan is below. It has two entrances of width 20 feet. It has budgeted enough money to build 540 feet of walls, and its goal is to maximize the total area of the warehouse.
a) Express the total area of the warehouse as a function of the length of one of the sides. What is the domain of this function?
b) Graph the function in order to find the maximum (no need for the graphing calculator — you should already know what the graph looks like). What are the dimensions of the warehouse that has the biggest possible total area, and what is the biggest possible total area?



Bonus. (10pts) This is an identity: $x^3+1=(x+1)(x^2-x+1)$. Use it to solve the equation $x^3=-1$ by factoring . You should get three solutions, two of which are complex. Then draw (with some precision) the solutions in the plane where a point with coordinates (a,b) corresponds to the complex number $a+bi$. Connect the solutions with line segments. What do you notice?

College Algebra — Exam 4
MAT 140C, Spring 2026 — D. Ivanšić

Name: _____

Show all your work!

1. (8pts) Evaluate without using the calculator. For each problem, write the question you should ask yourself in order to find the logarithms.

$\log_3 27 =$ $\log_2 \frac{1}{16} =$ $\log_a \sqrt[3]{a^5} =$ $\log_{a^3} a^{12} =$

2. (4pts) Use the change-of-base formula and your calculator to find $\log_{12} 24$ with accuracy 6 decimal places. Show how you obtained your number.

3. (5pts) If $\log_a 3 = 0.5283$ and $\log_a 11 = 1.1531$, calculate the following values:

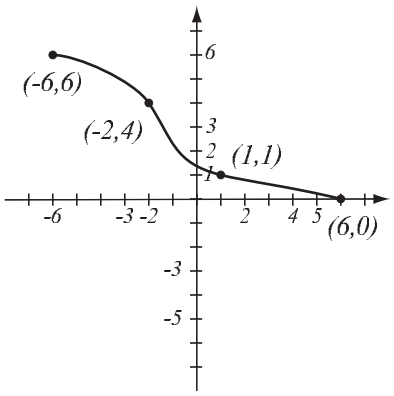
$\log_a \dfrac{3}{11} =$ $\log_a 99 =$

4. (4pts) Simplify.

$\ln e^{\sqrt{8}} =$ $7^{\log_7(2u+5v)} =$

5. (8pts) If you deposit \$8,000 in an account bearing 3.24% interest, compounded monthly, how much is in the account after 4 years?

6. (6pts) The graph of a function f is given.
a) Is this function one-to-one? Justify.
b) If the function is one-to-one, find the graph of f^{-1}, labeling the relevant points, and showing any asymptotes.



7. (9pts) Let $f(x) = \dfrac{2x-3}{x-5}$.
a) Find the formula for f^{-1}.
b) Find the range of f.

8. (6pts) Using transformations, draw the graph of $f(x) = 3 + 2^{-x}$. Explain how you transform the graph of a basic function in order to get the graph of f. Indicate at least one point on the graph and any asymptotes.

9. (12pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$\log_4\left(16x^2\sqrt[4]{y^7}\right) =$

$\log_5 \dfrac{125y^6}{x^4y^2} =$

10. (12pts) Write as a single logarithm. Simplify if possible.

$3\log(u^{-2}v^4) + 5\log(uv^2) =$

$3\log_2(x^2 - 7x + 12) - 2\log_2(x-4) - \log_2(x-3) =$

Solve the equations.

11. (6pts) $5^{2x-1} = 25^{4-3x}$

12. (8pts) $4^{x+1} = 5^{2-x}$

13. (12pts) According to census data, the population of Lexington, KY, was 296,000 in 2010 and 323,000 in 2020. Assume that it has grown according to the formula $P(t) = P_0 e^{kt}$.
a) Find k and write the function that describes the population at time t years since 2010. Graph it on paper.
b) Find the predicted population in the year 2030.

Bonus (10pts) Solve the equation.

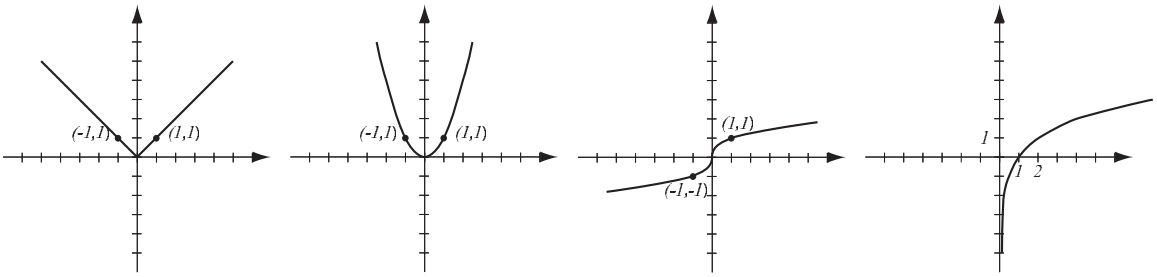
$3 \cdot 3^{2x} - 28 \cdot 3^x + 9 = 0$

College Algebra — Final Exam
MAT 140C, Spring 2026 — D. Ivanšić

Name: _____

Show all your work!

1. (8pts) The following are graphs of basic functions. Write the equation of the graph under each one.



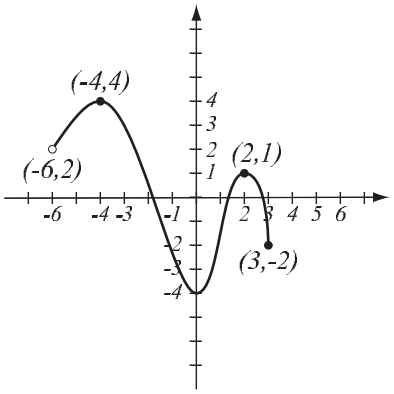
2. (8pts) Use the graph of the function f at right to answer the following questions.

a) Find: $f(0) =$ $f(4) =$

b) What is the domain of f?

c) What is the range of f?

d) What are the solutions of the equation $f(x) = 3$?



3. (10pts)

a) Find the equation of the line that passes through $(-3, 2)$ and has y-intercept 4.

b) Find the equation of the line (in form $y = mx + b$) that is perpendicular to the line in a) and also passes through the point $(2, -3)$.

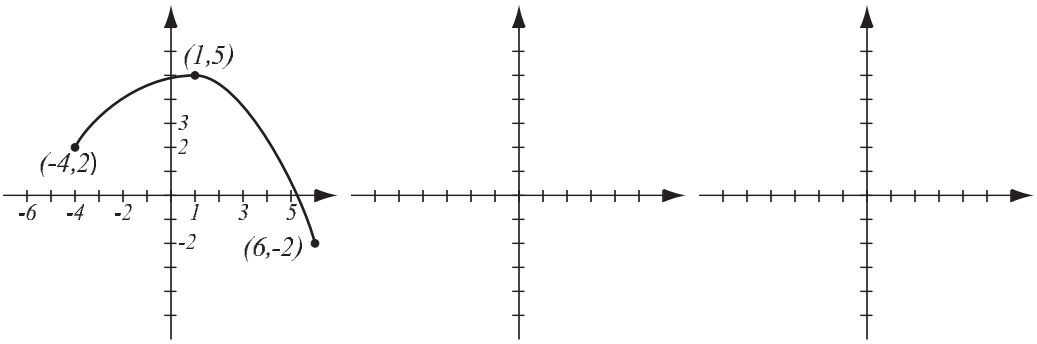
c) Draw both lines in the same coordinate system

4. (3pts) Find the domain of the function $f(x) = \sqrt{4 - 3x}$ and write it in interval notation.

5. (6pts) Solve and write the solution in interval notation.

$|3x - 5| < 5$

6. (10pts) The graph of $f(x)$ is drawn below. Find the graphs of $-f(x + 2)$ and $f(2x) - 3$ and label all the relevant points.



7. (6pts) Let $f(x) = 2x^3 - 5$. Find the formula for $f^{-1}(x)$.

8. (12pts) The quadratic function $f(x) = -x^2 + 4x + 21$ is given. Do the following without using the calculator.
a) Find the x- and y-intercepts of its graph, if any.
b) Find the vertex of the graph.
c) Sketch the graph of the function.

9. (5pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$\log_7 \left(49x^5 \sqrt[3]{y^4}\right) =$

10. (6pts) Write as a single logarithm. Simplify if possible.

$2\log(3u^5) + 4\log v^3 - 3\log(6u^2v^3) =$

11. (8pts) Let $f(x) = \dfrac{2x-7}{2-x}$, $g(x) = x + 4$. Find the following (simplify where possible):

$\dfrac{f}{g}(x) =$ $(f \circ g)(x) =$

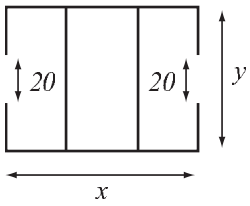
12. (20pts) The polynomial $P(x) = (x-4)^2(x+4)^2$ is given (answer with 6 decimals accuracy).
a) What is the end behavior of the polynomial?
b) Factor the polynomial to find all the zeros and their multiplicities. Find the y-intercept.
c) Determine algebraically whether the function is odd, even, or neither. (Multiply out the factors if you need to.)
d) Use the graphing calculator along with a) and b) to sketch the graph of P (yes, on paper!).
e) Verify your conclusion from c) by stating symmetry.
f) Find all the turning points (i.e., local maxima and minima).

13. (8pts) Solve the equation.

$2 - \sqrt{24 - 3x} = x$

14. (14pts) Because she was afraid to be late, Fiona rushed to a concert and got there in 2 hours. On the way back, she drove 8mph slower, so it took her a quarter of an hour longer.
a) How fast did Fiona drive to and from the concert?
b) How far did she drive to the concert?

15. (14pts) A logistics company is building a warehouse whose floorplan is below. It has two entrances of width 20 feet. It has budgeted enough money to build 620 feet of walls, and its goal is to maximize the total area of the warehouse.
a) Express the total area of the warehouse as a function of the length of one of the sides. What is the domain of this function?
b) Graph the function in order to find the maximum (no need for the graphing calculator — you should already know what the graph looks like). What are the dimensions of the warehouse that has the biggest possible total area, and what is the biggest possible total area?



16. (12pts) According to census data, the population of Lexington, KY, was 225,000 in 1990 and 261,000 in 2000. Assume that it has grown according to the formula $P(t) = P_0 e^{kt}$.
a) Find k and write the function that describes the population at time t years since 1990. Graph it on paper.
b) Find the predicted population in the year 2020.

Bonus (10pts) This is an identity: $x^3 + 1 = (x+1)(x^2 - x + 1)$. Use it to solve the equation $x^3 = -1$ by factoring . You should get three solutions, two of which are complex. Then draw (with some precision) the solutions in the plane where a point with coordinates (a, b) corresponds to the complex number $a + bi$. Connect the solutions with line segments. What do you notice?