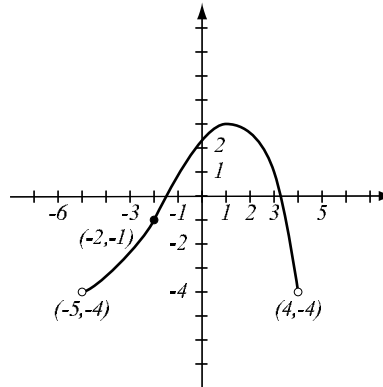


1. (8pts) Use the graph of the function  $f$  at right to answer the following questions.

- Find  $f(-2)$  and  $f(0)$ .
- What is the domain of  $f$ ?
- What is the range of  $f$ ?
- What are the solutions of the equation  $f(x) = 1$ ?



2. (10pts) Use your calculator to accurately sketch the graph of  $y = x^4 - 8x^2 - 11$ . Draw the graph here, and indicate units on the axes. Find all the  $x$ - and  $y$ -intercepts (accuracy: 6 decimal points).

3. (4pts) Convert to scientific notation or a decimal number:

$$27,110 =$$

$$3.159 \times 10^{-5} =$$

Use formulas to expand:

4. (4pts)  $(3x - 2)^2 =$

5. (4pts)  $(x^2 - y)(x^2 + y) =$

6. (6pts)  $(x + 5)^3 =$

Simplify, showing intermediate steps.

7. (2pts)  $\sqrt{63} =$

8. (5pts)  $\sqrt[3]{40x^4} =$

9. (7pts)  $\frac{\sqrt[4]{324x^5y^{11}}}{\sqrt[4]{2xy^2}} =$

10. (8pts) Simplify.

$$\frac{2x - 1}{x^2 - 49} - \frac{4}{x^2 + 4x - 21} =$$

11. (8pts) Simplify. Express answers first in terms of positive exponents, then convert to root notation.

$$\frac{(64x^{-2}y^6)^{\frac{2}{3}}}{\left(2x^{-\frac{3}{5}}y^5\right)^4} =$$

12. (6pts) Rationalize the denominator.

$$\frac{4\sqrt{2} - 5}{3 - \sqrt{2}}$$

13. (4pts) Solve the equation for  $y$ .

$$2x + 3y = c$$

14. (8pts) Solve the equation.

$$3x^2 + 5x = 6 - x^2$$

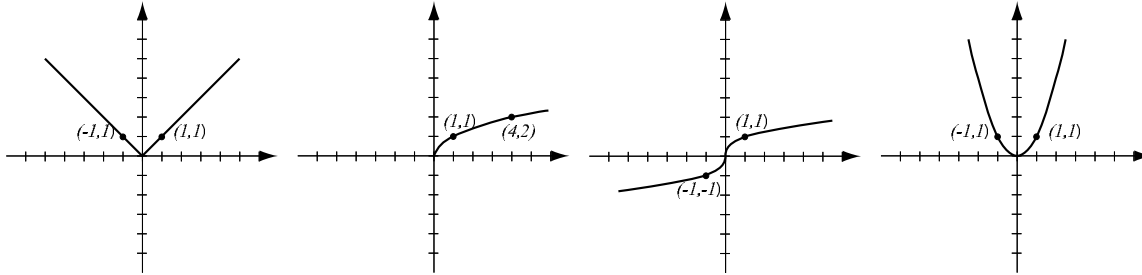
15. (4pts) Find the domain of the function  $f(x) = \frac{|x - 7|}{x + 4}$ .

- 16.** (12pts) The circle whose diameter has endpoints  $(5, 1)$  and  $(-1, -1)$  is given.
- Find the equation of the circle.
  - Draw the circle in the coordinate plane.
  - Is this circle the graph of a function? Why or why not?

**Bonus** (10pts) Simplify.

$$\frac{3 + \frac{18x^2 - 4x}{x^3 - 8}}{1 + \frac{10x + 44}{x^2 + 2x - 8}} =$$

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



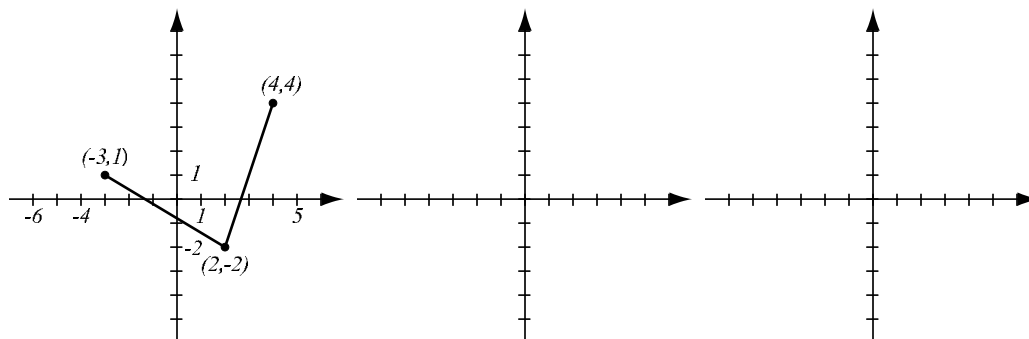
2. (10pts) Find the equation of the line  $L$  (in form  $y = mx + b$ ) that passes through points  $(-3, 2)$  and  $(2, 7)$ . Then find the equation of line that passes through  $(1, 1)$  and is perpendicular to  $L$ .

Solve the inequalities. Write your solution in interval notation.

3. (6pts)  $8 \leq 5x - 2 < 16$

4. (7pts)  $3x + 4 < 5$  or  $3x - 2 \geq 7$

5. (10pts) The graph of  $f(x)$  is drawn below. Find the graphs of  $-f(x+1)$  and  $f(2x)-3$  and label all the relevant points.



6. (20pts) Let  $f(x) = \frac{2}{\sqrt{x+6}}$ ,  $g(x) = \sqrt{4-3x}$ .

Find the following (simplify where possible):

$$(f - g)(1)$$

$$\frac{f}{g}(x) =$$

$$(g \circ f)(0)$$

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

The domain of  $f$

The domain of  $g$

The domain of  $(f + g)(x)$

**7.** (17pts) Let  $f(x) = x^3 - 4x$  (answer with 6 decimal points accuracy).

a) Use your graphing calculator to accurately draw the graph of  $f$  (on paper!). Indicate scale on the graph.

b) Determine algebraically whether  $f$  is even, odd, or neither. Verify your answer further by examining the graph.

c) Find the local maxima and minima for this function.

d) State the intervals where the function is increasing and where it is decreasing.

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

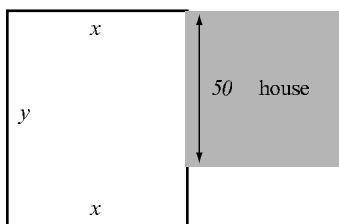
$$f(x) = \begin{cases} -2x + 1, & \text{if } x \leq -1 \\ x + 2, & \text{if } -1 < x \leq 5. \end{cases}$$

9. (14pts) A 393-mile-long road joins cities Hamsterton and Gerbilville. At the same time, one car leaves Hamsterton and drives toward Gerbilville, and another car, driving 15mph faster than the first car, leaves Gerbilville and drives toward Hamsterton. After 3 hours they meet on the road.

- What are the speeds of the cars?
- How far from Hamsterton did they meet?

**Bonus.** (10pts) Manuel has 400ft of fencing that he will use to enclose a rectangular pen for his rabbit. The pen will use the entire 50ft wall of his house as part of a side of the pen (see the picture). Follow the steps below to find the dimensions of the pen that has the greatest area.

- Write the area  $A(x)$  as a function of  $x$ . What is the domain of  $A$ ?
- Graph  $A(x)$  in order to find the maximum. What are the dimensions of the enclosure that has the greatest area?





College Algebra — Exam 3  
MAT 140, Fall 2012 — D. Ivanišić

Name: \_\_\_\_\_  
*Show all your work!*

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

1. (4pts)  $(3 - 2i)(5 - i) =$

2. (6pts)  $\frac{1 - i}{-2 + i} =$

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

$i^{1115} =$

Solve the equations:

4. (6pts) By completing the square:

$x^2 + 8x = -2$

5. (4pts)  $|3x - 1| = 4$

6. (6pts) Solve the inequality. Draw the solution and write it in interval form.

$|x - 4| \geq 6$

**7.** (14pts) The quadratic function  $f(x) = x^2 - 4x - 5$  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.
- d) What is the range of the function?

Solve the equations:

**8.** (8pts)  $3x^4 + 2x^2 - 8 = 0$

**9.** (8pts)  $\sqrt{3x + 4} = \sqrt{2x - 5} - 2$

**10.** (14pts) The polynomial  $f(x) = (x - 3)^2(x + 4)^2$  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 what you learned in a) and b) to sketch the graph of  $f$  (yes, on paper!).

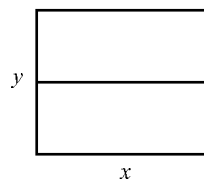
d) Find all the turning points (i.e., local maxima and minima).

**11.** (12pts) In a right triangle, one side of the triangle is 3cm shorter than the hypotenuse and the other side is 1cm shorter than the hypotenuse. What is the length of the hypotenuse?

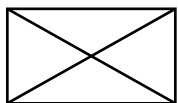
**12.** (14pts) Truck mechanic Rodrigo wishes to build two side-by-side repair bays for trucks separated by a wall (see picture). One side of the repair bays does not need a wall (doors come there). Rodrigo has enough money to build 600 feet of walls, and he wants to build a bay with maximal area.

a) Express the area of the enclosure as a function of the length of one of the sides. What is the domain of this function?

b) Sketch the graph the function in order to find the maximum (no need for the graphing calculator — you should already know what the graph looks like). How should the repair bay be sized so that its area is maximal?



**Bonus.** (10pts) 40 meters of fencing were used to enclose a rectangular area and divide it into four parts by fencing the diagonals of the rectangle. If one side of the rectangle is five meters longer than the other side, what are the dimensions of the rectangle?



College Algebra — Exam 4  
MAT 140, Fall 2012 — D. Ivanišić

Name: \_\_\_\_\_  
*Show all your work!*

1. (8pts) Evaluate without using the calculator:

$$\log_9 81 = \qquad \log_{49} \frac{1}{7} = \qquad \log_a \sqrt[3]{a^4} = \qquad \log_{16} 64 = \qquad \text{(think root)}$$

2. (4pts) Use your calculator to find  $\log_4 65$  with accuracy 6 decimal places. Show how you obtained your number.

3. (5pts) If  $\log_a 7 = 1.180299$  and  $\log_a 2 = 0.420431$ , find (show how you obtained your numbers):

$$\log_a \frac{7}{2} = \qquad \log_a 56 =$$

4. (6pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$$\log_3 \frac{x^4}{9^4 \sqrt{y^5}} =$$

5. (13pts) Write as a single logarithm. Simplify if possible.

$$3 \log(x^4 y^3) - 2 \log(x^3 y^4) =$$

$$2 \log_7(x^2 + 2x - 15) + \log_7(x + 5) - 3 \log_7(x - 3) =$$

6. (8pts) How much should you invest in an account bearing 3.32%, compounded monthly, if you wish to have \$9,000 in three years?

7. (9pts) Let  $f(x) = b^x$ ,  $b > 1$ .

a) Draw the graph of the exponential function. Indicate three points on this graph.

b) Use the graph of  $f$  to draw the graph of its inverse  $f^{-1}(x) = \log_b x$ . Indicate three points on this graph.

c) What is the range of  $f^{-1}(x)$ ?

8. (8pts) Let  $f(x) = 2 \log_3(x - 4)$ .

a) What is the domain of  $f$ ?

b) Explain how you transform the graph of  $\log_3 x$  in order to get the graph of  $f$ . Indicate the  $x$ -intercept and any asymptotes.

- 9.** (9pts) Let  $f(x) = \frac{2x}{x-3}$ ,  $x \geq 0$ .
- a) Find the formula for  $f^{-1}$ .
  - b) Find the range of  $f$ .

Solve the equations.

**10.** (8pts)  $\left(\frac{1}{6}\right)^{3x-1} = 36^{3-5x}$

**11.** (10pts)  $\log_8(x-2) + \log_8(x+6) = 2\log_8(x+4)$

**12.** (12pts) In 1994, the population of Chinchilla City was 32,000 and has since then grown according to the formula  $P(t) = P_0e^{kt}$ , with a 2.5% exponential growth rate.

a) Write the function that describes the population at time  $t$  years since 1994. Graph it on paper.

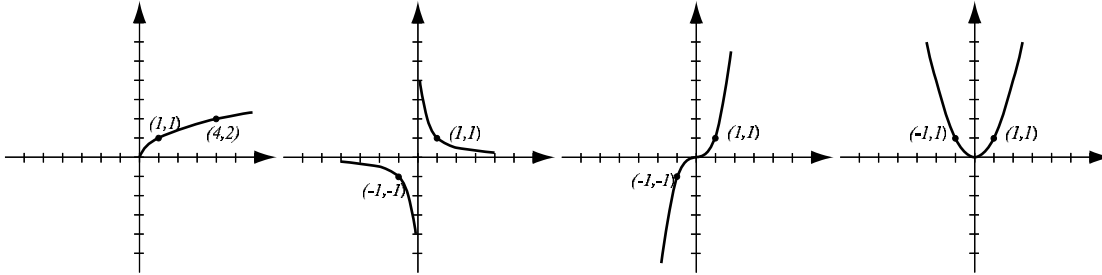
b) Find the population in the year 2005.

c) When will Chinchilla City reach population 50,000?

**Bonus** (10pts) If you invest in an account bearing 7% interest, compounded weekly, how long will it take until your money doubles? (*Hint: the deposit amount doesn't matter.*)

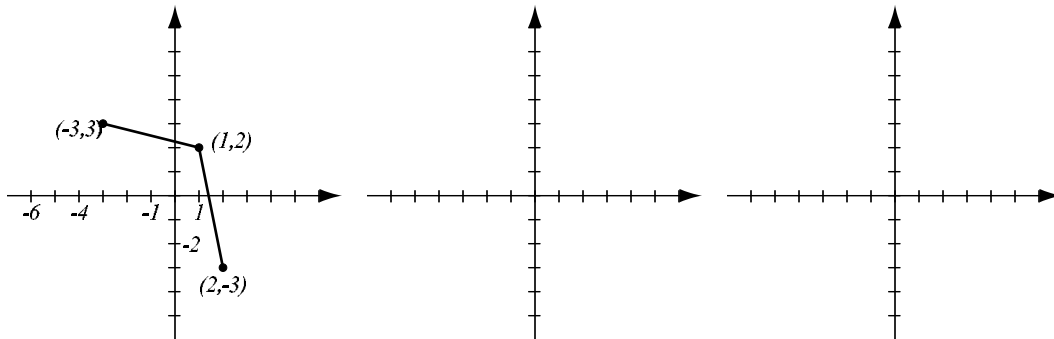


1. (8pts) The following are graphs of basic functions. Write the equation of the graph under each one.



2. (8pts) Find the equation of the line that passes through  $(3, -2)$  and is perpendicular to the line  $3x + 2y = 7$ . Draw both lines in the same coordinate system.

3. (8pts) The graph of the function  $f$  is given below. On separate graphs, sketch the graphs of the functions  $f(x) + 1$  and  $f(2x)$ . Label all the relevant points.



4. (10pts) Use the graph of the function  $f$  at right to answer the following questions.

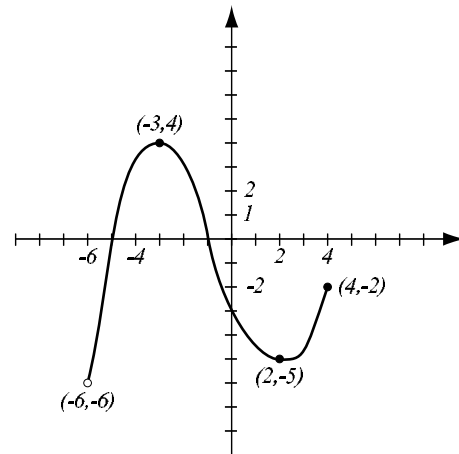
a) Find  $f(-3)$ .

b) What is the range of  $f$ ?

c) List the  $x$ -intercepts of the graph.

d) Where does  $f$  have a local minimum? What is its value?

e) What are the solutions of the equation  $f(x) = 1$ ?



5. (6pts) Solve the inequality. Draw the solution and write it in interval form.

$$|x - 2| \geq 7$$

6. (12pts) The quadratic function  $f(x) = x^2 - 2x - 6$  is given. Do the following without using the calculator.

a) Find the  $x$ -intercepts of its graph, if any.

b) Find the vertex of the graph.

c) Sketch the graph of the function.

7. (14pts) Consider the polynomial  $P(x) = 4(x - 3)^2(x + 1)$ . Answer the following (decimal answers should have accuracy to two decimal places).

a) Find the  $x$ -intercepts of the graph and the  $y$ -intercept.

b) What is the end behavior of the polynomial?

c) Find the turning points of  $P$ .

d) Sketch the graph of the function on paper. Make sure scale is marked and all features you found in a)-c) are indicated.

8. (8pts) Simplify and write the answer so all exponents are positive:

$$\frac{(2x)^4(x^{-3}y^5)^3}{(xy)^{-4}(10y)^2} =$$

9. (8pts) Simplify.

$$\frac{x + 1}{x^2 + 4x - 5} + \frac{2x - 1}{x^2 + 10x + 25} =$$

10. (9pts) Let  $f(x) = \frac{2x}{5x-1}$ .

a) Find  $f^{-1}(x)$ .

b) Find the range of  $f$ .

11. (8pts) Solve the equation.  $e^{x+3} = 4^{2x-1}$

12. (5pts) If  $\log_a 9 = 1.662353$  and  $\log_a 2 = 0.831176$ , find (show how you obtained your numbers):

$$\log_a 18 =$$

$$\log_a \frac{8}{9} =$$

13. (6pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$$\log_5 \frac{x^3}{25y^4} =$$

**14.** (14pts) A 393-mile-long road joins cities Hamsterton and Gerbilville. At the same time, one car leaves Hamsterton and drives toward Gerbilville, and another car, driving 15mph faster than the first car, leaves Gerbilville and drives toward Hamsterton. After 3 hours they meet on the road.

- a) What are the speeds of the cars?
- b) How far from Hamsterton did they meet?

**15.** (14pts) Sharon has 4000m of fencing and wishes to enclose a rectangular field that borders a river, where she does not fence the side along the river.

- a) Express the area of the enclosure as a function of the length of one of the sides. What is the domain of this function?
- b) Sketch the graph the function in order to find the maximum (no need for the graphing calculator — you should already know what the graph looks like). How should the field be sized so that its area is maximal?

**16.** (12pts) In 1994, the population of Chinchilla City was 32,000 and has since then grown according to the formula  $P(t) = P_0e^{kt}$ , with a 2.5% exponential growth rate.

a) Write the function that describes the population at time  $t$  years since 1994. Graph it on paper.

b) Find the population in the year 2005.

c) When will Chinchilla City reach population 50,000?

**Bonus.** (15pts) 40 meters of fencing were used to enclose a rectangular area and divide it into four parts by fencing the diagonals of the rectangle. If one side of the rectangle is five meters longer than the other side, what are the dimensions of the rectangle?

