Write interval notation and sketch on the number line.

1. (3pts) $\{x | x > 4\}$

2. (3pts) $\{x | -4 \leq x < 3\}$

Solve the equations.

3. (3pts) $2x + 11 = 4x - 9$

4. (4pts) $6(3x + 1) - 4x = 4 - 5(x - 2)$

Simplify and write in standard form:

5. (4pts) $3x^2(x + 1) - (2x^2 - 1)(x + 6) =$

6. (4pts) $(5x + 1)(3x^2 - 7x - 9) =$

Simplify and write the answer so all exponents are positive:

7. (2pts) $(5x)^2 x^5 =$

8. (2pts) $\dfrac{(7y)^2}{y^5} =$

9. (3pts) $(4x^2 y)^2 x^5 y^2 =$

10. (5pts) $(4x^{-2} y^4)^3 (x^3 y^{-2})^4 =$

11. (7pts) $\dfrac{(3u^7 v^{-3})^3}{(6u^3 v^{-4})^2} =$

Factor the following.

12. (4pts) $x^2 + 13x + 40 =$

13. (4pts) $x^2 - 3x - 54 =$

Solve the equations.

14. (6pts) $x^2 - 13 = -13x + 1$

15. (6pts) $x^2 + 2x - 1 = 20 - 2x$

1. (10pts) Let $A = (-1, -1)$, $B = (5, 1)$ and $C = (0, 6)$.
a) Plot the points in the coordinate system and show algebraically that C has the same distance from A and B.
b) If M is the midpoint of A and B, outline the triangle AMC and determine algebraically if it is a right triangle.

2. (8pts) Write the equation of the circle with center $(-2, 3)$ that passes through the origin. Sketch the circle.

3. (8pts) Use the graph of the function f at right to answer the following questions.

a) Find $f(3)$ and $f(1)$.

b) What is the domain of f?

c) What is the range of f?

d) What are the solutions
   of the equation $f(x) = 1$?
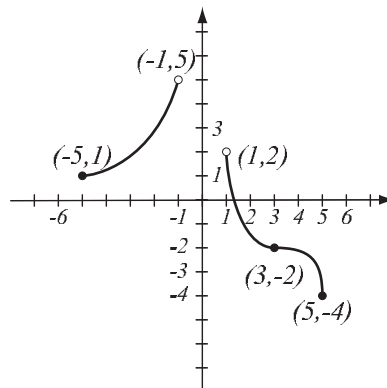
4. (12pts) The function
$f(x) = x^3 - 7x^2 + 5x - 3$ is given.

a) Use your calculator to accurately its graph. Draw the graph here, and indicate units on the axes.

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

c) State the domain and range.

5. (12pts) Find the domain of each function and write it using interval notation.

$$g(x) = \frac{x - 7}{x^2 + 3x - 10}$$

$$f(x) = \frac{\sqrt{-x}}{3x + 19}$$

6. (10pts) Let $g(x) = \dfrac{x^2 - 5}{x^2 + 3x - 28}$. Find the following (simplify where appropriate).

$g(4) =$

$g(-2) =$

$g(\sqrt{u}) =$

$g(x + 3) =$

1. (10pts) Find the equation of the line (in form $y = mx + b$) passing through $(-1, -3)$ and is perpendicular to the line $4x - 3y = 1$. Draw both lines.

2. (6pts) Find the linear function f if $f(-2) = 4$ and $f(3) = 7$. Draw the graph of the function.

3. (8pts) Draw the triangle with vertices $A = (1, 0)$, $B = (8, 8)$ and $C = (-1, 3)$. Use slopes to algebraically determine if this triangle is right.

4. (4pts) According to the census, the population of Calloway county was 34,177 in 2000, and 37,191 in 2010. What is the average rate of change of the population from 2000 to 2010? What are the units for the average rate of change?

5. (12pts) The electric bill for a family was \$117.52 in a month when it used 849 kWh (kilowatt-hours) of power. In another month, it used 1174 kWh and was billed \$156.52.
a) Assuming that the electricity cost $C(x)$ is a linear function of the amount of power x used (in kWh), write a formula for $C(x)$.
b) What is the cost if no electricity is used during a month? What is the meaning of this number?
c) What is the meaning of the slope in this example?

6. (20pts) A university is trying to establish the relationship between the year t and the enrollment of students E during year t. In the table, E is the number of students enrolled and t is the year. Solve the problems below with accuracy 6 decimal points.
a) Draw the scatterplot of the data. Does the relationship look linear?
b) Use two points in the scatterplot to get an equation of a line that models the relationship between E and t. Draw the line on the graph.
c) Use your calculator to find the "line of best fit" for the data. Draw the line on the graph.
d) Find the coefficient of correlation r. How strong is the linear relationship between E and t?
e) What enrollment can the university expect in year 2021?

P	S
1999	8,097
2002	8,120
2004	8,166
2008	8,914
2011	9,920
2015	10,304
2018	10,078

Solve the inequalities. Write your solution in interval notation.

1. (5pts) $7 \leq 2x + 3 < 15$

2. (7pts) $5 - 4x < -2$ or $1 - 2x > 9$

3. (6pts) Find the domain of the function in interval notation: $f(x) = \dfrac{\sqrt{2x - 5}}{x - 4}$.

4. (14pts) Joe, a furniture store employee, can be paid on one of two plans:
A) Salary of \$1050 per month, plus a commission of 10% of sales, or
B) Salary of \$1370 per month, plus a commission of 5% of sales over \$2,000.
Assuming Joe can always sell more than \$2,000, for what level of sales is plan A better?
Solve as an inequality.

5. (14pts) On a drive to Paducah you take the scenic route and drive at average speed 45 mph. On your return, you take a road that is 10 miles longer, but since you drive at average speed 55 mph, it takes you 3 minutes shorter than the trip to Paducah.
a) How long did you drive to Paducah?
b) How far did you travel to Paducah?

6. (14pts) How many liters of a 4% solution of hydrochloric acid must be mixed with 7 liters of a 17% solution of hydrochloric acid in order to get a 12% solution of hydrochloric acid?

1. (10pts) Use your calculator to accurately sketch the graph of the function
$f(x) = \dfrac{5x^2 + 1}{x^4 + 3}$. Draw the graph here, indicate units on the axes, and solve the problems
below with accuracy 6 decimal points.
a) Find the local maxima and minima for this function.
b) State the intervals where the function is increasing and where it is decreasing.

2. (20pts) Let $f(x) = \dfrac{x^2}{\sqrt{3x + 9}}$, $g(x) = \sqrt{17 - 2x}$. Find the following (simplify where possible):

$(f + g)(-1) =$ $\qquad\qquad\qquad\qquad\qquad\qquad (fg)(4) =$

$\dfrac{g}{f}(x) =$ $\qquad\qquad\qquad\qquad\qquad\qquad (g \circ f)(9) =$

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

The domain of $(fg)(x)$ in interval notation

3. (8pts) Consider the function $h(x) = \dfrac{8}{x^2 - 3}$ 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. (8pts) Sketch the graph of the piecewise-defined function:

$$f(x) = \begin{cases} 2x + 1, & \text{if } -2 \le x < 3 \\ x - 5, & \text{if } x \ge 3. \end{cases}$$

5. (14pts) Rodrigo is building a stable with area 1100 square feet and eight stalls with a gap between them of 10 feet. He wishes to minimize the building cost, which is the same as minimizing the total length of the walls.

a) Express the total length of the walls of the building 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 stable for which the total length of the walls is minimal? What is the minimal wall length?
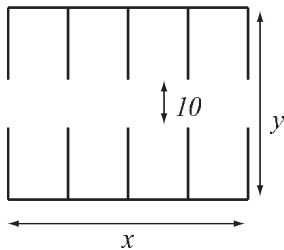
1. (21pts) For the following functions:
a) determine algebraically whether they are odd, even, or neither
b) use the calculator to draw their graphs here and verify your conclusions by stating symmetry.

$$f(x) = x^3 - 8x \qquad\qquad g(x) = -x^2 + 7|x| + 3 \qquad\qquad h(x) = x^4 + 2x^2 - 5x$$

2. (16pts) Draw the graphs of $f(x) = \frac{1}{2}(x+4)^2$ and $g(x) = 3 - \sqrt{x-4}$ using transformations. Explain how you transform graphs of basic functions in order to get the graphs of f and g. Indicate at least two points on each graph.

3. (10pts) Write the equation for the function whose graph has the following characteristics:
a) shape of $y = \frac{1}{x}$, shifted right 5 units
b) shape of $y = x^2$ stretched horizontally by factor 2, then shifted down 1 unit
c) shape of $y = \sqrt[3]{x}$, reflected about the y-axis, then stretched vertically by factor 4, then shifted left 2 units.

4. (13pts) The graph of $f(x)$ is drawn below. On three separate graphs, sketch the graphs of the functions $f(x) - 3$, $-f(\frac{1}{2}x)$ and $2f(x+1)$ and label all the relevant points.
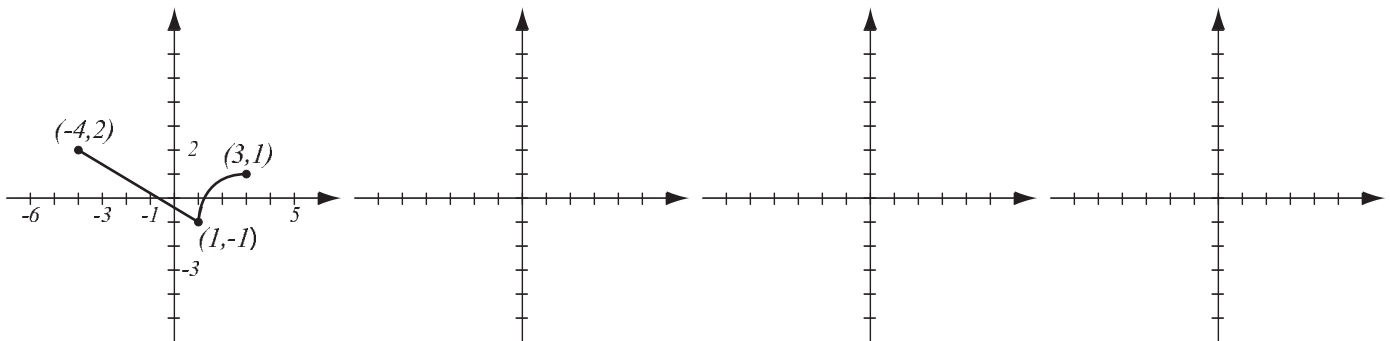
Use formulas to expand:

1. (4pts) $(x - 9)^2 =$

2. (5pts) $(4u + 5v)^2 =$

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

Use the *ac*-method or another method to factor. Show how you got your answer.

4. (5pts) $2x^2 - 13x - 7 =$

5. (6pts) $6x^2 - 31x + 18 =$

6. (8pts) Compute expressions with fractions by hand.

$\dfrac{2}{5} \cdot \dfrac{15}{8} =$

$\dfrac{12}{7} \div \dfrac{18}{49} =$

$\dfrac{3}{10} - \dfrac{8}{15} =$

$\dfrac{13}{18} + \dfrac{7}{30} =$

Multiply or divide the rational expressions.

7. (7pts) $\dfrac{6x + 12}{x^2 - 16} \cdot \dfrac{2x^2 - 3x - 20}{2x + 4} =$

8. (7pts) $\dfrac{x^2 - 3x}{x^2} \div \dfrac{x^2 - 9}{2x^2 + 7x + 3} =$

Add or subtract the rational expressions.

9. (6pts) $\dfrac{5x - 2}{x^2 + 4x} - \dfrac{7}{x} =$

10. (8pts) $\dfrac{2x - 1}{3x^2 - 13x - 10} + \dfrac{x}{x^2 - 25} =$

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

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

2. (6pts) $\dfrac{4 + i}{2 - 3i} =$

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

$i^{85} =$

4. (8pts) The water level of a river above normal (in feet) is given by $H(x) = -x^2 + 14x - 9$, where x is the number of days after October 28th.
a) On what dates was the water level 24 feet above normal?
b) On what date did the water level peak?

5. (8pts) Solve the equation: $x^6 - 3x^3 - 40 = 0$

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

$x^2 - 12x + 8 = 0$

7. (12pts) The quadratic function $f(x) = -x^2 + 2x - 7$ is given. Do the following without using the calculator.

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

b) Find the vertex of the graph.

c) Sketch the graph of the function.

8. (12pts) In a rectangle, one side is twice as long as another side, and the diagonal is 11 meters longer than the shorter side. What are the dimensions of the rectangle?

1. (4pts) Solve the equation.

$|3x + 11| = 7$

2. (12pts) Solve the inequalities. Draw your solution and write it in interval form.

$|x - 2| \geq 8$ $|2x + 5| < 3$

Solve the equations:

3. (8pts) $1 + \dfrac{7}{x - 3} = \dfrac{x + 25}{x^2 - 2x - 3}$ **4.** (8pts) $x + 3 + \sqrt{4x + 17} = 0$

5. (14pts) A toy rocket is launched from height 15 feet upwards with initial velocity 48 feet per second. Its height in meters after t seconds is given by $s(t) = -16t^2 + 48t + 15$.
a) Sketch the graph of the height function.
b) When does the rocket reach its greatest height, and what is that height?
c) When is the rocket at height 35 feet?

6. (14pts) Jacinda is building a stable with six stalls with a gap between them of 10 feet. She has budgeted for 1200 ft of walls and wishes to maximize the area of the stable.
a) Express the total area of the stable as a function of one of the sides of the rectangle. What is the domain of this function?
b) Sketch the graph of the area 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 stable that has the greatest total area? What is the greatest total area possible?
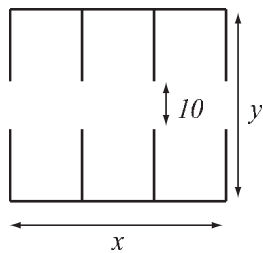
1. (6pts) The graph of a function f is given.
a) Is this function one-to-one? Justify.
b) If the function is one-to-one, find the graph
of f^{-1}, labeling the relevant points.
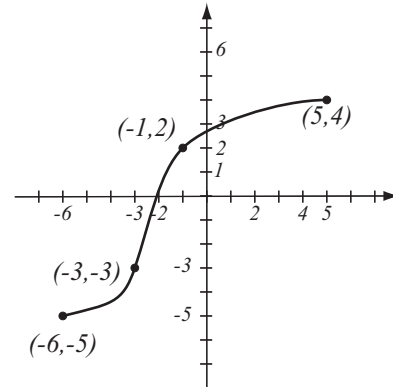
2. (12pts) Let $f(x) = \dfrac{4x-1}{6x+3}$. Find the formula for f^{-1}. Find the ranges of f and f^{-1}.

3. (8pts) Evaluate without using the calculator:

$\log_3 9 =$ $\log_4 \frac{1}{64} =$ $\log_{25} 5 =$ $\log_{b^2} b^3 =$

4. (4pts) Use the change-of-base formula
and your calculator to find $\log_5 67$ with ac-
curacy 6 decimal places. Show how you
obtained your number.

5. (12pts) Investigate the effect of increased frequency of compounding: for a deposit of $8,000 and annual interest rate of 3.72%, calculate the amount in the account after 1 year for the frequencies of compounding below.
a) Write the general formula for the amount, replacing the variables by numbers, if known.
b) Use the table feature on your calculator to quickly compute amounts after 1 year.
c) Does compounding more often make a big difference?

Frequency: every	n	Amount after 1 year
year		
quarter		
month		
day		
hour		
second		

6. (3pts) Find the domain of $f(x) = \ln(4 - 5x)$.

7. (8pts) Temperature in degrees Fahrenheit (F) can be computed from temperature in degrees Celsius (C) using the formula $F(C) = \frac{9}{5}C + 32$.
a) Convert $13°C$ and $25°C$ into degrees Fahrenheit.
b) Find a formula for the inverse function and explain what it represents.
c) Convert $40°F$ and $81°F$ into degrees Celsius.

8. (7pts) Using transformations, draw the graph of $f(x) = 2\ln(x + 4)$. Explain how you transform the graph of a basic function in order to get the graph of f. Show at least one point on the graph, and asymptotes to the graph, if any.

1. (5pts) If $\log_a 4 = u$ and $\log_a 5 = v$, express in terms of u and v:

$\log_a 20 =$

$\log_a \dfrac{25}{4} =$

2. (11pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$\log_5 \left(25x^{-7}y^3\right) =$

$\log_2 \dfrac{x^{\frac{5}{2}}y^3}{32\sqrt{xy^5}} =$

3. (12pts) Write as a single logarithm. Simplify if possible.

$2\log(3x^4) - \frac{1}{3}\log(27y^6) + 5\log x =$

$2\ln(x^2 - 4x - 5) - 3\ln(x - 5) - 2\ln(x + 1) =$

Solve the equations.

4. (5pts) $6^{2x-3} = \left(\dfrac{1}{36}\right)^{x+1}$

5. (7pts) $7^{x-4} = 4^{2x+1}$

6. (8pts) $e^{2x} + 11 \cdot e^{x} - 26 = 0$

7. (12pts) A car repair shop bought a car-lift for \$2000. Its value after t years is given by the function $V(t) = 2000 \cdot 0.92^{t}$.
a) Graph the value function.
b) What is the value after 3, 5 and 7 years?
c) When will the value of the car-lift be \$400?