

1. (4pts) Evaluate.

$$\frac{\sqrt{36} + 4 \cdot (-3)}{7 - 4/\sqrt{4}} =$$

2. (8pts) Simplify and write in standard form:

a) $(x - 7)(2x + 1) - 2x(x - 4) =$

b) $(x^2 + 1)(3x^2 - 5x + 1) =$

3. (3pts) Write a polynomial of degree 4 whose leading coefficient is -7, constant term is 3, and has at least three terms.

4. (10pts) The Hacks Company makes axes. Its fixed costs are \$56,000, and the variable cost of producing x thousand axes are $-2x^2 + 4580x$. Suppose the company can sell the axes for \$10.98 a piece.

a) Find the expressions for revenue, cost and profit when selling x thousand axes.

b) Fill out the profit table for the indicated values of x .

x	P
5	
10	
30	
50	
110	

5. (6pts) Draw the sets described by the inequality on the real line and write them in interval notation.

$$-3 \leq x < 7$$

$$x \geq 4$$

Factor the following. Use either a known formula or a factoring method.

6. (2pts) $4x^4 - 10x^2 =$

7. (4pts) $x^2 - x - 20 =$

8. (5pts) $6x^2 + 7x - 10 =$

9. (5pts) $4x^2 - 28xy + 49y^2 =$

10. (3pts) $64u^2 - 9w^2 =$

11. (6pts) $125u^3 - 8v^3 =$

12. (4pts) Write the absolute value expressions without absolute value:

$|2u - 4v|$, if we know that $2u - 4v \geq 0$

$|3x - 5y|$, if we know that $3x - 5y < 0$

Simplify and write the answer so all exponents are positive:

1. (4pts) $(4x^2y^{-2})^3(2x^{-3}y^2)^4 =$

2. (5pts) $\frac{(6u^3v^{-4})^2}{(3u^2z^{-3})^4} =$

Simplify, showing intermediate steps.

3. (2pts) $\sqrt{96} =$

4. (3pts) $\sqrt[3]{16} - \sqrt[3]{54} =$

Solve the equations.

5. (3pts) $7 - 3(2 + x) = 5(x + 3) - 2$

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

7. (6pts) $\frac{3}{x+1} + \frac{9}{x^2 - x - 2} = \frac{4}{x-2}$

8. (5pts) $xy + yz + zx = 4$ (solve for z)

Simplify.

9. (8pts) $\frac{x-3}{x^2-4x-5} - \frac{2x+3}{x^2-25} =$

10. (7pts) $\frac{1 - \frac{2}{x+3}}{1 + \frac{2}{x-3}} =$

11. (7pts) Simplify and write the answer so all exponents are positive:

$$\frac{\left(8x^3y^{\frac{5}{2}}\right)^{\frac{4}{3}}}{\left(100x^4y^{-\frac{4}{3}}\right)^{\frac{1}{2}}} =$$

12. (5pts) Rationalize the denominator.

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

1. (10pts) Last month Jane was paid \$413.07. If her hourly pay is \$8.43 and she gets time-and-a-half for working overtime (that is, her hourly wage is 50% higher for hours worked beyond 40), how many hours did Jane work? Write the meaning of your variable.

2. (10pts) The revenue of a company (in thousands) can be approximated by the formula $R = -.13t^2 + 7.4t + 15.68$, where $3 < t < 15$ and $t = 3$ corresponds to year 2003.
a) What is the revenue in 2010?
b) When will revenue be \$89,500?

3. (12pts) How many liters of pure antifreeze must be mixed with 4 liters of a 12% solution of antifreeze in order to get an 20% solution? Write the meaning of your variable.

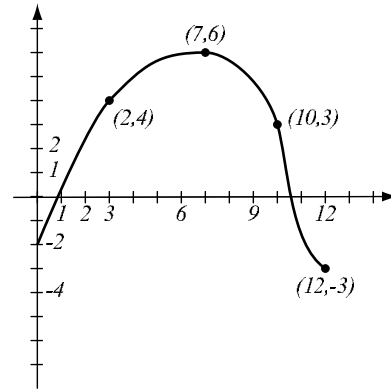
4. (14pts) Runners Fernando and Maria live 5 miles apart. One day, they decide to exercise by running toward each other. Maria runs 1mph faster than Fernando, and they meet in 18 minutes. Write the meaning of your variables as you solve:

- a) How fast does each of them run?
- b) How far from Maria's house do they meet?

5. (14pts) Harry has a plot of land 13 meters wide and 25 meters long. He wants to extend it to get a plot of area 500 square meters by increasing the width and length. If the increase in width has to be twice the increase in length, by how much is he increasing each to achieve the desired area? Write the meaning of your variable.

1. (8pts) Use the graph for the water level of a lake over 12 months (in feet above or below a certain mark) to answer the following questions.

- Find the water level at 0 and 8 months.
- At what times was the water level 4 ft?
- When was the water at its highest level? What was the highest water level?
- At what times was the water below 1 ft?



2. (14pts) The equation $y = x^3 - 5x^2 + 2x + 6$ is given.

- Use your calculator to accurately its graph. Draw the graph here, and indicate units on the axes.
- Find all the x - and y -intercepts (accuracy: 6 decimal points).
- Find the peaks and valleys of the graph (accuracy: 6 decimal points).

3. (8pts) Find the x and y intercepts of the graph of the equation $x^2 + y^2 - 4x - 2y + 1 = 0$

4. (10pts) Find the equation of the line (in form $y = mx + b$) that is parallel to the line $3x - 2y = 4$, and passes through point $(2, -1)$. Draw both lines.

5. (8pts) Use slopes of lines to find out whether the triangle with vertices $A = (-6, -2)$, $B = (-2, 3)$ and $C = (1, 0)$ is a right triangle.

6. (12pts) The number of students enrolled at MSU increased from 10,025 in 2008 to 10,832 in 2013.

a) Assuming the number of students grows in a linear fashion, write the equation expressing the number of students y in terms of number of years x since 2008.

b) What number of students does your equation predict for 2016?

c) When does the equation predict MSU will have 12,000 students?

1. (18pts) The manager of a large clothing store wishes to find a function that relates the daily demand D for men's jeans to the price p of the jeans. The data below were obtained based on a price history of jeans sales.
- Draw the scatterplot of the data (put p on the x -axis). Does the relationship look linear?
 - Use two points in the scatterplot to get an equation of a line that models the relationship between p and D . Draw the line on the graph.
 - Use your calculator to find the "line of best fit" for the data. Draw the line on the graph.
 - Find the coefficient of correlation r . How strong is the linear relationship between p and D ?
 - How many jeans would the store expect to sell daily if the price is \$25?

p (\$/pair)	D (pairs of jeans sold per day)
20	60
22	57
23	56
23	53
27	52
29	49
30	44

2. (8pts) Net weights of a sample of coffee packages were within 13 grams of the declared net weight of 500 grams.
- If w is the net weight of a sample package, write an inequality involving absolute value that stands for the above statement.
 - Solve the inequality to get a range for the weight of the sample packages.

Solve the inequalities. Write your solution in interval notation.

3. (5pts) $7 < 4 - 3x < 11$

4. (7pts) $|x + 4| \geq 3$

5. (7pts) Find the domain of the function $f(x) = \frac{\sqrt{3x - 5}}{x^2 - 3x - 4}$ in interval notation.

6. (7pts) Let $f(x) = \frac{x + 4}{5 - 2x}$. Find the following and simplify where appropriate:

a) $f(2) =$

b) $f(-2x) =$

c) $f(5x - 1) =$

7. (8pts) In a certain state, the tax on taxable income is as follows:

If taxable income is	tax is
between 0 and \$5,000	2% of the taxable income
more than \$5,000, up to \$20,000	\$100 plus 4% of taxable income over \$5,000
more than \$20,000	\$700 plus 6% of taxable income over \$20,000.

Write the multi-part formula for the function $T(x)$ which represents the tax on taxable income of x dollars.

1. (8pts) Sketch the graph of the piecewise-defined function:

$$f(x) = \begin{cases} 3x - 7, & \text{if } 0 \leq x < 3 \\ x - 6, & \text{if } x \geq 3. \end{cases}$$

2. (24pts) Suppose the cost to produce 1,000 compressors (used in heat pumps) is \$1,242,000 and the cost to produce 5,000 compressors is \$5,042,000. Assume the manufacturer can sell the compressors for \$1,200.

- Find the cost function, assuming it is linear.
- What is the marginal cost of producing the 6001st compressor?
- What is the average cost of producing 2,000 compressors? 4,000 compressors?
- Write the revenue function for selling x compressors.
- Write the profit function for selling x compressors.
- What is the revenue of selling 3,000 compressors? The profit?
- What is the break-even point in this example?

3. (14pts) Suppose the supply and demand functions for a toaster oven are:
supply: $p = 1.4q$; demand: $p = 80 - 2.3q$; p in dollars, q in some units.

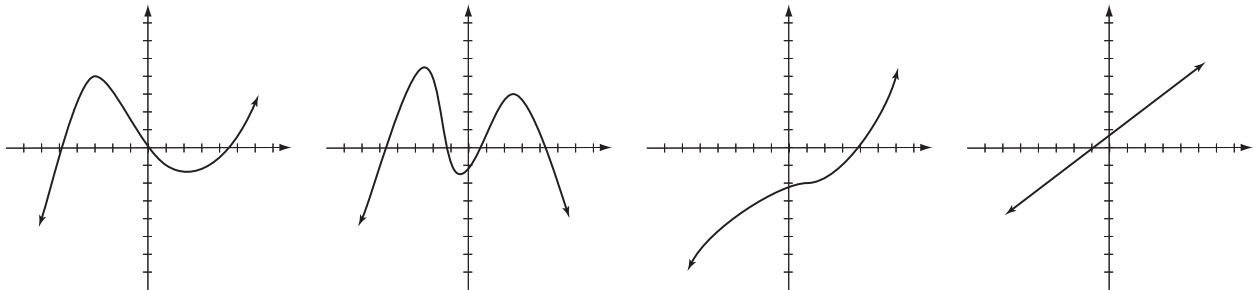
- a) Find the price if demand is 12 units.
- b) Find the demand at price \$50. Find the supply at that price.
- c) Graph the supply and demand curves on the same axes.
- d) Find the equilibrium price and equilibrium quantity for our example.

4. (14pts) The quadratic function $f(x) = -x^2 - x + 20$ 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.
- d) Write the function in standard form.

1. (12pts) Graph the function $P(x) = 2(x + 3)^2(x - 1)x$ by following the guidelines.
- Find the x -intercepts of the graph and the y -intercept.
 - What is the graph like for large $|x|$?
 - Find the turning points of P .
 - Sketch the graph of the function on paper. Make sure scale is marked and all features you found in a)-c) are indicated.

2. (8pts) Under each graph below, write 2, 3, 4 or 5 if it could be the graph of a polynomial of degree 2, 3, 4 or 5. More than one number per graph is possible.



3. (10pts) The cost of producing x fruit baskets is $C(x) = -0.5x^2 + 15x + 550$. Suppose the manufacturer can sell the fruit baskets to a grocery chain for \$25 apiece.
- Write the revenue and profit function for selling x baskets of fruit.
 - How many fruit baskets should be sold in order to maximize the manufacturer's profit? What is the maximal profit?

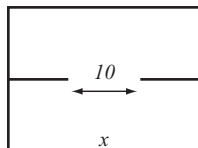
Bonus. (2pts) Use the grade computer on the website to find out your current grade based on exams 1&2 and joysheets 1–6. Assume no points for attendance and a 3 for your participation grade, and enter exam scores with bonus points included. Write the current overall percentage here and the score you need to increase this percentage to the next letter grade.

4. (15pts) You are building a simple rectangular building with two rooms and a 10-ft opening between them and have enough money to build 200 feet of walls (see picture). Your goal is to maximize the enclosed area.

a) Let x be the length of the building. Find the width in terms of x .

b) Express the area of the building as a function of the x .

c) 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 building that has the greatest area and what is the greatest area possible?



5. (15pts) The revenue of a charter boat company depends on the number of unsold seats x . The boat has 150 seats: if 30 are unsold, the ride costs \$160 per seat. Every additional unsold seat increases the price of the ride by \$2.

a) For several values of x , write the price of the ride. Then write an expression for the price of a seat as a function of x .

b) Write an expression for revenue as a function of x .

c) Sketch the graph of the revenue function in order to find the number of unsold seats giving maximum revenue. What is the maximal revenue?

1. (6pts) Let $f(x) = \left(\frac{3}{2}\right)^x$ and $g(x) = \left(\frac{2}{3}\right)^x$.
- Sketch the graphs of the functions on the same coordinate system.
 - What do you notice about the two graphs?
 - Indicate two related points, one on each graph, that verify your observation in b).

2. (8pts) Evaluate without using the calculator:

$$\log_2 16 = \qquad \log_3 \frac{1}{243} = \qquad \log_{49} 7 = \qquad \ln \sqrt[5]{e^9} =$$

3. (4pts) Use your calculator to find $\log_7 33$ with accuracy 6 decimal places. Show how you obtained your number.

4. (8pts) If $\log_a 5 = 0.859833$ and $\log_a 8 = 1.11093$, find (show how you obtained your numbers):

$$\log_a \frac{5}{8} = \qquad \log_a 200 = \qquad a =$$

5. (11pts) Write as a sum and/or difference of logarithms. Express powers as factors. Simplify if possible.

$$\log_7 (49x^3y^4) =$$

$$\log_3 \frac{9\sqrt[4]{x^7}}{y^3} =$$

6. (11pts) Write as a single logarithm. Simplify if possible.

$$2\log(7x^4) - \frac{1}{2}\log(25y^6) - 2\log x =$$

$$\log_a(x^2 - 3x - 10) - \log_a(x - 5) - 2\log_a(x + 2) =$$

7. (12pts) In 2005, a restaurant purchased a pizza oven for \$4,000. In 2011, its value was estimated to be \$1900. Suppose the value of the oven is described by the function $V(t) = y_0b^t$.

a) Find the function $V(t)$ describing the value of the oven t years after 2005.

b) Sketch the graph of $V(t)$.

c) What is the value of the oven in 2014?

d) What is the rate of depreciation on the oven? (That is the annual rate at which the oven loses value.)

Solve the equations.

1. (8pts) $\log_2(x + 1) = 3 + \log_2(x - 4)$

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

3. (7pts) $4^{3x-2} = 7^{2-x}$

4. (14pts) The number of students enrolled at our fine school increased from 10,025 in 2008 to 10,832 in 2013. Assume the number of students follows the model $P(t) = y_0b^t$.
- Write the function describing the number $P(t)$ of students t years after 2008. What is the growth rate of MSU's student population?
 - Graph the function.
 - According to this model, when will Murray State have 14,000 students?

5. (8pts) Radiocarbon dating found that 80% of the original amount of carbon-14 is still present in a mummy sample. Assume half-life of carbon-14 is 5600 years. How old is the mummy?

6. (10pts) How much money should you deposit in a simple-interest account bearing 2.35% if you would like to have \$4000 in fifteen months? How much of the final \$4000 is from interest?

7. (8pts) You can deposit \$1,000 into an account bearing 3.7% simple interest. How long will it take until you have \$1,500 in the account?