

College Algebra w.B.A.— Exam 1
MAT 120, Spring 2014 — D. Ivanšić

Name: _____
Show all your work!

Factor the expressions:

1. (3pts) $4x^2 - 25y^2 =$

2. (5pts) $12x^2 + 4x - 5 =$

3. (5pts) $9u^2 - 24uv + 16v^2 =$

Simplify, showing intermediate steps.

4. (3pts) $\sqrt{48} + \sqrt{12} =$

5. (2pts) $\sqrt[3]{72} =$

6. (8pts) Simplify.

$$\frac{2x + 3}{x^2 + x - 6} - \frac{5}{x^2 + 6x + 9} =$$

7. (8pts) Simplify. Express answers first in terms of positive exponents.

$$\frac{\left(125x^6y^{-\frac{1}{2}}\right)^{\frac{1}{3}}}{\left(10x^3y^{\frac{3}{4}}\right)^2} =$$

8. (5pts) Rationalize the denominator.

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

Solve the equations.

9. (3pts) $3(x - 5) + 2 = 5(x + 4)$

10. (5pts) $a + b + abc = ab + ac$ (solve for b)

11. (5pts) $|x - 3| = |2x + 1|$

12. (6pts) $x^2 + 20x + 7 = 5x - x^2$

13. (14pts) A company makes large pots for plants. Its cost to make x thousand pots, $0 \leq x \leq 30$, is $0.25x^2 + 11x + 34$ (also in thousands). Suppose the company can sell the pots for \$23 a piece.

- a) Find the expressions for revenue and profit (in thousands) when selling x thousand pots.
- b) Find the profit when 23,800 pots are produced.
- c) How many pots are produced in order to make a profit of \$75,000?

14. (14pts) You have 8% and 15% solutions of muriatic acid. How many liters of each solution is needed to get 10 liters of an 11% solution of muriatic acid? Write the meaning of your variable.

15. (14pts) A plot of land is 20 meters long and 7 meters wide. If we increase the width and decrease the length by the same amount we get a plot of area 180m^2 . Find this amount. Write the meaning of your variable.

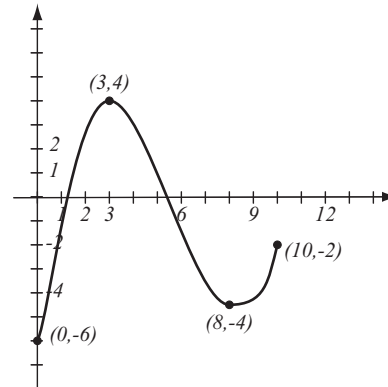
Bonus (10pts) Joe's tractor can travel 10mph faster than Jake's. Starting at the same time, Joe completed an entire journey when Jake completed $\frac{2}{3}$ of this same journey. What are the speeds of Joe's and Jake's tractors? Write the meaning of your variable.

College Algebra w.B.A.— Exam 2
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1. (8pts) Use the graph of the profits (in billions) of an airline to answer the questions below. Negative profits mean losses and $x = 0$ corresponds to year 2009.

- a) Find the profits in 2006 and 2011.
- b) At what times was profit 2 billion?
- c) When was profit highest? What was the highest profit?
- d) At what times was the loss more than 3 billion?



2. (14pts) The equation $y = x^3 + 7x^2 + 8x + 4$ 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) Find the peaks and valleys of the graph (accuracy: 6 decimal points).

Solve the inequalities. Write your solution in interval notation.

3. (5pts) $-3 < 2x + 5 < 4$

4. (7pts) $|x - 5| < 2$

5. (8pts) The scores of a group of people who took an intelligence quotient test were more than 12 units away from 100.

a) If x is the IQ score, write an inequality involving absolute value that stands for the above statement.

b) Solve the inequality to get the scores of this group.

6. (10pts) Find the equation of the line (in form $y = mx + b$) that is perpendicular to the line $4x + 3y = 7$, and passes through point $(-1, -2)$. Draw both lines.

7. (12pts) The electricity bill for a household was \$57.72 when it used 352 kilowatt-hours (kWh) of electricity and it was \$79.17 when it used 547 kWh.

a) The bill for electric power y depends on the amount of power used x (in kWh) in a linear fashion. Write the equation that expresses this relationship.

b) How much will the household pay if it uses 0 kWh? What does this number mean?

c) How many kWh did the household use if it paid \$63.22?

8. (6pts) Find the domain of the function $f(x) = \frac{\sqrt{1-x}}{x+4}$ in interval notation.

9. (10pts) Let $f(x) = x^2 - 7x + 4$. Find the following and simplify where appropriate:

a) $f(4) =$

b) $f(3x) =$

c) $f(x+2) =$

10. (8pts) A wholesaler prices a certain type of coffee according to the rules below.

When buying	cost per pound is
between 0 and 100 pounds	\$ 1.39
more than 100 pounds	\$0.99 for the part over 100 pounds

Write the multi-part formula for the function $C(x)$ which represents the cost of buying x pounds.

11. (12pts) The owners of a stadium would like to find the relationship between the forecast temperature for the day of the game and the number of people attending. The data for several days in the past is below.

a) Draw the scatterplot of the data (put temperature on the x -axis). Does the relationship look linear?

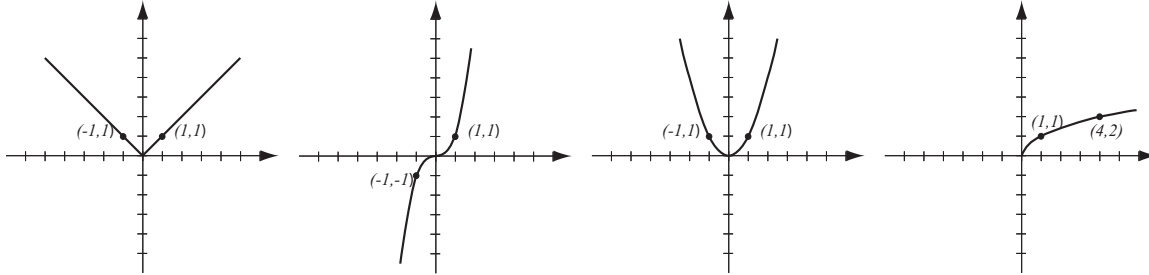
b) Use your calculator to find the “line of best fit” for the data. Draw the line on the graph.

c) How many people would the owners expect to attend if the forecast temperature is 70° ?

Temperature ($^\circ\text{F}$)	Attendance (thousands)
40	15
55	18
64	24
75	29
82	31

Bonus. (10pts) For the function $f(x) = \frac{3}{x}$, find the difference quotient $\frac{f(x+h) - f(x)}{h}$ and simplify.

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



2. (8pts) Sketch the graph of the piecewise-defined function:

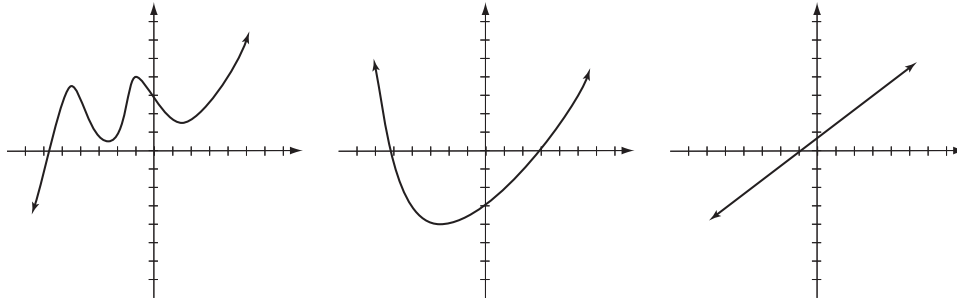
$$f(x) = \begin{cases} x + 4, & \text{if } x \leq -2 \\ 2x + 1, & \text{if } -2 < x \leq 6. \end{cases}$$

3. (14pts) The quadratic function $f(x) = x^2 - 4x + 7$ is given. Do the following without using the calculator.
- Find the x -intercepts of its graph, if any. Find the y -intercept.
 - Find the vertex of the graph.
 - Sketch the graph of the function.
 - Write the function in standard form.

4. (20pts) Suppose the cost to produce 3,000 mixers (used in the kitchen) is \$81,000 and the cost to produce 7,000 mixers is \$129,000. The manufacturer can sell the mixers for \$17.
- Find the cost function, assuming it is linear.
 - What is the average cost of producing 2,000 mixers? 5,000 mixers?
 - Write the revenue function for selling x mixers.
 - Write the profit function for selling x mixers.
 - What is the break-even point in this example?

5. (16pts) Suppose the supply and demand functions for some item are:
supply: $p = q^2 + q + 10$; demand: $p = 126 - 10q$; p in dollars, q in some units.
- Find the price if demand is 3 units.
 - Find the demand at price \$30. Find the supply at price \$30.
 - Find the equilibrium price and equilibrium quantity for our example.

6. (6pts) Under the graphs below, write 1, 2, 3, 4 or 5 if it could be the graph of a polynomial of degree 1, 2, 3, 4 or 5. More than one number per graph is possible.



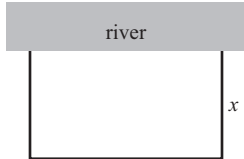
7. (14pts) Graph the polynomial $P(x) = (x+2)^2(x-2)^2(x+4)$ by following the guidelines.
- Find the x -intercepts of the graph and the y -intercept.
 - What is the graph like for large $|x|$?
 - Sketch the graph of the polynomial on paper. Make sure scale is marked and all features you found in a), b) and d) are indicated.
 - Find the peaks and valleys of P .

8. (14pts) Farmer Charles, who has 500 feet of fencing, wishes to enclose a rectangular field with the largest area next to a river. The side along the river does not need fencing.

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

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

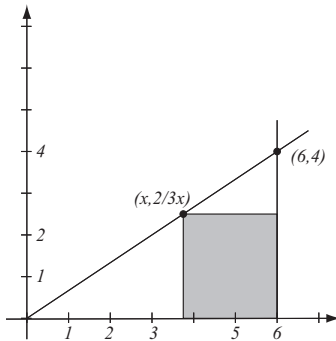
c) Sketch the graph of the area function in order to find the maximum (no need for the graphing calculator — you should already know what the graph looks like). What are the dimensions of the enclosure that has the greatest area and what is the greatest area possible?



Bonus. (10pts) Consider all rectangles whose two sides are on the lines $x = 6$ and the x -axis, and one vertex is on the line $y = \frac{2}{3}x$, as in the picture.

a) Draw two more rectangles that fit this description.

b) Among all such rectangles, find the one with the greatest area. What are its dimensions?



College Algebra w.B.A.— Exam 4
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1. (8pts) Evaluate without using the calculator:

$$\log_3 81 = \quad \log_{25} \frac{1}{625} = \quad \log_a \sqrt[7]{a^2} = \quad \log_{a^4} a^3 = \quad (\text{think root})$$

2. (4pts) Use your calculator to find $\log_3 35$ with accuracy 6 decimal places. Show how you obtained your number.

3. (8pts) If $\log_a 4 = 0.699795$ and $\log_a 5 = 0.812437$, find (show how you obtained your numbers):

$$\log_a 20 = \quad \log_a \frac{16}{25} = \quad a =$$

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

$$\log_4(16x^4 \sqrt[3]{y^7}) =$$

5. (6pts) Write as a single logarithm. Simplify if possible.

$$2 \ln(x^3 y^5) - 3 \ln(x^{-2} y^4) =$$

6. (8pts) Suppose $1 < a < b$. On the same set of axes, sketch $y = a^x$ and $y = b^x$. Indicate three points on each graph. Make sure the position of those two graphs with respect to each other is clear and accurate.

7. (10pts) How much money should you deposit in a simple-interest account bearing 4.5% if you would like to have \$5,000 in a year-and-a-half? How much of the final \$5000 is from interest?

8. (8pts) Paul borrowed \$2,000 and repaid it with \$2,250 after 10 months. What simple annual interest rate did this loan carry?

Solve the equations.

9. (8pts) $27^{2x+1} = 9^{x-7}$

10. (10pts) $\log_4(x + 5) = 2 - \log_4(x - 1)$

11. (10pts) If an investment has a constant growth rate, its value after t years is described by the function $A(t) = y_0b^t$. Suppose an investment has an 8% growth rate. How long until it doubles?

- 12.** (14pts) The population of Growerton increased from 30,000 in 1998 to 45,000 in 2005. Assume the population follows the model $P(t) = y_0 b^t$.
- Write the function describing the the population $P(t)$ of Growerton t years after 1998. What is the city's growth rate?
 - Graph the function.
 - According to this model, when will the city have 60,000 residents?

- Bonus** (10pts) The life expectancy at birth of a person born in year x is approximately $f(x) = 17.6 + 12.8 \ln x$, where $x = 10$ corresponds to 1910.
- What is the life expectancy at birth of a person born in 1960?
 - If life expectancy of a person at birth is 75, when were they born?