Suggested Problems for Math 112

Note: This file may change as the semester evolves.

CCA = Contemporary College Algebra, SIA = Shaum’s Intermediate Algebra

CCA( 2.1) Displaying Data page 12 - 14 Problems 1, 2, 3, 4, 5, 6, 7, 8, 11, 12

SIA(1.5) Order of Operations Pages 21 - 23

(1) \(72 - 15.2 \times 12 + 6\)  \hspace{1cm} (2) \((72 - 15.2) \times 12 + 6\)  \hspace{1cm} (3) \(72 - (15.2 \times 12 + 6)\)

(4) \(\frac{83 + (-4) \times 8}{-17 - 95}\)  \hspace{1cm} (5) \(542.8 - 86 \times 12 / 16.1\)  \hspace{1cm} (6) \(-14.7 - \frac{-41.09}{33.8} - \frac{-12.90}{12.90}\)

(7) \(-3.47^2\)  \hspace{1cm} (8) \((-8.7)^2 - 14.1^3\)  \hspace{1cm} (9) \((32.87 - 7.3^2)^3\)

(10) \(4^3 - 7[(-1)^5 - 8.2^4]\)  \hspace{1cm} (11) \(12[(-13.4(-1.4 + 7.8) + 3.6]\)

SIA(2.1) Definitions (Polynomials) Pages 47 - 49 See the problems in the text. No additional problems are offered.

SIA(2.2) Polynomial Sums and Differences Pages 49 - 51

Perform the indicated operations. Express your answer as a polynomial in simplest terms (that is to say, a polynomial in standard form).

(1) \(7 - 5x + 3x - 12x + 2\)  \hspace{1cm} (2) \(x^2 + x - 6x^2 + 12x + 2x^2\)

(3) \(x - 5x^2 + 3 + 4x^2 + 9x - 18\)  \hspace{1cm} (4) \(8 - (2x^2 - 7x + 9) + x + (x^2 - 13)\)

(5) \(4z^2 - 8z - z^2 - (z - 2z^2 + 2)\)  \hspace{1cm} (6) \((13b - 5ab + 7b^2) - (2a + ab + b^2)\)

(7) \((2x^2 + 4x + 9) - [8x^2 + (2x - x^2)]\)  \hspace{1cm} (8) \(8 - x^2 - [3x - 4x^2 - (2 + x^2)]\)
SIA(2.3) Polynomial Products Pages 52 - 56

Simplify the following expressions. Your answer should be free of parentheses.

1. \(2b^3 3b^4\)
2. \(5x^3 - (3x)^3\)
3. \((2x^4)^2\)
4. \(5(3a + 5b - 8)\)
5. \(3xy^7(2x^2 + 5y)\)
6. \((x + 7)(x - 9)\)
7. \((2x + 3)(x + 4)\)
8. \((y - 7)(y + 7)\)
9. \((x^2 + 5x - 3)(2x + 1)\)

SIA(4.1) Solving First-Degree Equations Pages 99 - 104

Determine whether each of the following equations is an identity, a contradiction, or a conditional. Your answer should include algebraic evidence to support your answer.

1. \(2 + (2x + 3)^2 = 4x^2 + 12x + 11\)
2. \(a^2 + b^2 = (a + b)^2\)
3. \(2[4(x - 1) + 5] = 8x + 4\)
4. \((x - y)(x + 2y) = x^2 + xy - 2y^2\)

Solve the following equations for the unknown letter.

5. \(8 - 5x + 2 + x = 0\)
6. \(2y + 5 + 3(4 - y) = 0\)
7. \(4.7x + 8 - x + 2.9 = 0\)
8. \(8 - 2(5 + 3b) + 6b = 2\)
9. \(y - 4 + 2(y - 6) = 17y + 2\)
10. \(\frac{3x + 7}{3} = 2x + 1\)

CCA 2.2 Average (Mean) pages 15 - 19 Problems 1, 2, 3, 4, 5, 6, 7, 8, 11, 17, 19

CCA 2.3 Median and Mode Pages 20 - 25 Problems 1 - 14 (all), Problems 15, 21, 22, 23
CCA 2.4 Variable Representation  Pages 26 - 33. Problems 1, 2, 3, 4,  Problems 6 - 11

A   Translate the first statement into a mathematical statement and then answer the question.

(1) The sum of a number and three times that number is twenty.  What is the number?

(2) Determine the length of the sides of a rectangular picture whose area is 100 square centimeters and one side is twice as long as the other side.

(3) The average Fortune 500 company spends $13 million annually for local and domestic long-distance fax service. The amount spent for local faxes is about one third the amount spend for domestic long-distance faxes.  Find the amount spent for each type of fax service.

(4) A flower seed company has a rectangular test plot with a perimeter of 322 m.  The length is 25 m more than the width.  Find the dimensions of the plot.

(5) The average cost of moving a distance of 1255 mi is $1035 if you handle the move yourself.  This is about 52% of the cost of hiring a professional moving firm.  What is the cost of the professionally handled move?

(6) The frame of a picture is 28 cm by 32 cm outside and is of uniform width. What is the width of the frame if 192 square cm of the picture shows?  Try to solve this (more difficult) equation algebraically.  Otherwise solve the equation graphically using your graphing calculator.  (We will review the algebraic solution later in the course.)

(7) On September 1st you made a $500 payment on a bank loan that charges 1.5 % interest per month.  After adding a month's interest charge based on the ``old balance'' and then deducting the payment, the bank told me that my new balance was $15,450.  What was the ``old balance''?
B. Use algebraic techniques to determine the missing elements of the following addition sequences.

(1) 1, 2, _____, _____, _____
(2) 1, __, __, 3, __, __, __
(3) 2, __, __, __, 7, __, __, __
(4) __, 3, __, __, __, 14, __, __
(5) __, __, __, __, 1, 2, __, __, ___

C. Use algebraic techniques to determine the missing elements of the following multiplication sequences.

(1) 1, 2, _____, _____, _____
(2) 2, __, __, 8, __, __, ___
(3) __, __, 2, __, __, 6, __, __, ___

CCA 2.6 Discovering Relations Between Variables Pages 44 - 57

Problems 1 - 12, 14 - 18. Do Prob 15 a second time using a linear regression on your calculator.

19. The following table gives the population of a community from 1970 to 2000.

<table>
<thead>
<tr>
<th>Year</th>
<th>Population in thousands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>89</td>
</tr>
<tr>
<td>1975</td>
<td>94</td>
</tr>
<tr>
<td>1980</td>
<td>100</td>
</tr>
<tr>
<td>1985</td>
<td>106</td>
</tr>
<tr>
<td>1990</td>
<td>124</td>
</tr>
<tr>
<td>1995</td>
<td>129</td>
</tr>
<tr>
<td>2000</td>
<td>141</td>
</tr>
</tbody>
</table>

(a) Use your calculator to determine the linear regression model for this table. Use it again to graph a scatter plot which contains the table entries along with the linear regression line. Carefully reproduce the graph screen on paper. If the line appears to be a good fit, we can use it to predict values.

(b) Use the graph to estimate the population in the year 2006. Do it again using algebra and the linear regression model.

(c) Use algebra to determine when the population will be 158,000.
20. The annual amount of office paper in pounds used by a company during its transition to a “paperless” workplace is given below.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pounds</td>
<td>1040</td>
<td>980</td>
<td>840</td>
<td>820</td>
<td>760</td>
<td>750</td>
<td>730</td>
</tr>
</tbody>
</table>

(a) Use your calculator to determine the linear regression model for this table. Use it again to graph a scatter plot which contains the table entries along with the linear regression line. Carefully reproduce the graph screen on paper. If the line appears to be a good fit, we can use it to predict values.

(b) Use the graph to estimate the paper consumption in the year 2007. Do it again using algebra and the linear regression model.

(c) Use algebra to determine when the annual paper consumption will be 500 pounds.

21. A therapeutic drug has the side effect of raising a patient's heart rate.

<table>
<thead>
<tr>
<th>Drug level (in mg)</th>
<th>0</th>
<th>50</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart Rate (beats per minute)</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>110</td>
</tr>
</tbody>
</table>

(a). Use your calculator to create a scatter plot which contains the table entries. Then use your calculator to determine the linear regression model for this table. Enter this linear equation into your calculator so the line appears on the scatter plot. Carefully reproduce the graph screen on graph paper. If the line appears to be a good fit, we can use it to predict values.

(b) Use the graph to estimate the heart rate of a person who has taken 375 mg. Do it again using algebra and the linear regression model.

(c) Use algebra to determine when the heart rate will be 150.

22. The following table gives the population of Botswana from 1975 to 1990.

<table>
<thead>
<tr>
<th>Year</th>
<th>1975</th>
<th>1980</th>
<th>1985</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in millions)</td>
<td>0.7555</td>
<td>0.901</td>
<td>1.078</td>
<td>1.285</td>
</tr>
</tbody>
</table>
23. The table below gives the percentage of school with interactive videodisc players from 1992 to 1996.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage</td>
<td>8</td>
<td>14</td>
<td>21</td>
<td>29.1</td>
<td>29.3</td>
</tr>
</tbody>
</table>

(a) Use your calculator to create a scatter plot which contains the table entries. Then use your calculator to determine the linear regression model for this table. Enter this linear equation into your calculator so the line appears on the scatter plot. Carefully reproduce the graph screen on graph paper. If the line appears to be a good fit, we can use it to predict values.

(b) Use the graph to estimate the percentage in 2006. Do it again using algebra and the linear regression model.

(c) Use algebra to determine when the percentage will be (or was) 75%.

24. The table below gives the number of Military Personnel on active duty.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Military Personnel (in thousands)</td>
<td>2044</td>
<td>1996</td>
<td>1807</td>
<td>1705</td>
<td>1611</td>
<td>1518</td>
<td>1472</td>
</tr>
</tbody>
</table>

(a) Use your calculator to create a scatter plot which contains the table entries. Then use your calculator to determine the linear regression model for this table. Enter this linear equation into your calculator so the line appears on the scatter plot. Carefully reproduce the graph screen on graph paper. If the line appears to be a good fit, we can use it to predict values.

(b) Use the graph to estimate the number of military personnel in 2007. Do it again using algebra and the linear regression model.
(c) Use algebra to determine when the number of military personnel will be 1,000,000 people.

25. The table below gives the total revenue the NFL received from network television.

<table>
<thead>
<tr>
<th>Year (since 1975)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue (in millions of dollar)</td>
<td>210</td>
<td>364</td>
<td>651</td>
<td>1075</td>
<td>1159</td>
<td>2200</td>
<td>2200</td>
</tr>
</tbody>
</table>

(a) Use your calculator to create a scatter plot which contains the table entries. Then use your calculator to determine the linear regression model for this table. Enter this linear equation into your calculator so the line appears on the scatter plot. Carefully reproduce the graph screen on graph paper. If the line appears to be a good fit, we can use it to predict values.

(b) Use the graph to estimate the revenue in 2010. Do it again using algebra and the linear regression model.

(c) Use algebra to determine when the revenue will be $3,084,000,000.

CCA 2.7 Applications of Linear Equations Pages 58 - 65 Problems 1 - 10, Problems 15 - 19, Problem 23.

24. You rent a booth at an art and craft fair for $100 to sell hats. You make $3.75 on each hat that you sell.

a. Write a linear equation that shows your total profit at the end of the fair.

b. What is your profit if you sell 62 hats?

c. How many hats will you have to sell in order to cover the cost of the booth rental?

d. How many hats will you have to sell in order to make $300?

25. The temperature F, in Fahrenheit, is a linear function of the temperature C, in Celsius. When the Celsius thermometer reads 30 degrees the Fahrenheit thermometer reads 86 degrees. When the Celsius thermometer reads 40 degrees the Fahrenheit thermometer reads 104 degrees.

a. Write a linear equation that converts Celsius temperatures into Fahrenheit temperatures.

b. The Celsius thermometer is reading 12 degrees. What is the temperature in Fahrenheit?
c. At sea level, water boils at 212 degrees Fahrenheit. What temperature in degrees Celsius makes water boil?

26. Our math class is taking a field trip. It will cost $560 to rent the bus and there is a $15 admission fee per person.
   
a. Write a linear equation that calculates our total costs for \( n \) students.
   
b. How much will it cost if 23 people go on the field trip?
   
c. If our total costs are $1025 how many people will be going on the field trip?

27. The external hard disk on a photographer's computer holds 100 gigabytes of information (which is 100,000 megabytes). The formatting information and applications software take 1,300 megabytes. The photographer wants to store a collection of digitized pictures; each requires 2 megabytes of storage, on the external hard disk.
   
a. Write a linear equation that determines the amount of space available on the external hard disk.
   
b. How much space is available if the photographer has 24,218 pictures stored on the external hard disk?
   
c. How many pictures can the photographer store on the external hard disk?

28. An American tourist in England goes to a bank in London to convert some of his American dollars ($) into British pounds (£). He gives the teller $100. There is a $6.30 processing fee. The remaining was converted into £35 (British pounds).
   
a. Write a linear equation that converts American dollars into British pounds.
   
b. If the tourist gives the teller $175, how many British pounds will he get?
   
c. If the tourist wants £50, how many American dollars will he have to give the teller?

CCA 2.8 Systems of Linear Equations pages 66 -79 Matrix methods will not be covered. Additionally, disregard instructions to do problems using the calculator. Use substitution or elimination techniques.
Problems 1, 2, 3, 4, 7, 8, 9.

Additional resources and problems are available in SIA 7.1 and SIA 7.2 pages 242 - 256. with some practice problems on SIA Pages 279 - 280. Problems 7.1, 7.2, 7.4.
CCA 2.9 Linear Inequalities pages 80 - 87 Problems 1, 2ab, 3, 4ab, 5, 6, 7, 8, 10, 11

CCA 2.10 Linear Programming Pages 88 - 98. Problems 1, 2, 3, 4 (just Query 1), Prob 5, 6, 7, 8.

1. Schroeder Mill can convert logs into lumber and plywood. In a given week, the mill can turn out no more than 400 units of production, of which 100 units of lumber and 150 units of plywood are required by regular customers. The profit is $20 per unit of lumber and $30 per unit of plywood. How many units of each should the mill produce in order to maximize the profit? What is the maximum profit?

2. Suppose it takes 12 units of carbohydrates and 6 units of protein to satisfy Lynette’s minimum weekly requirements. A particular type of meat contains 2 units of carbohydrates and 2 units of protein per pound. A particular cheese contains 3 units of carbohydrates and 1 unit of protein per pound. The meat costs $3.50 per pound and the cheese costs $4.60 per pound. How many pounds of each are needed in order to minimize the cost and still meet the minimum requirements? What is the minimum cost?

3. Handyman Carpentry Shop makes bookcases and desks. Each bookcase requires 5 hr of woodworking and 4 hr of finishing. Each desk requires 10 hr of woodworking and 3 hr of finishing. Each month the shop has 600 hr of labor available for woodworking and 240 hr available for finishing. The profit on each bookcase is $40 and on each desk is $75. How many of each product should be made each month in order to maximize profit? What is the maximum profit?

The following problems are strictly mathematical problems in linear programming given so you can skip the transformation of a story problem into a mathematical problem, and practice just the mathematical computations.

12. Maximize \( P = 30A + 50B \) subject to the constraints

\[(1) \ A \geq 0, \ (2) \ B \geq 0, \ (3) \ 5A + 2B \leq 600, \ (4) \ A + 3B \leq 195\]

13. Find the maximum and minimum values of \( F = 3x - 17y \) subject to the constraints

\[(1) \ x \geq 0, \ (2) \ y \geq 0, \ (3) \ x \leq 350, \ (4) \ y \leq 180, \ (5) \ 2y + x \leq 400\]
**SIA 5.1 Zero and Negative Integer Exponents** Pages 153 - 157. On pages 183 - 84 Problems 5.1 and 5.2.

A. Perform the following operations and simplify. Express your answer as an integer or as a rational number (a quotient of integers).

1. \(18 \cdot 7^{-2}\)  
2. \((-3)^3 4^{-2}\)  
3. \(\frac{3^2}{2^{-3}}\)  
4. \(\left(\frac{3^4}{2^{-5}}\right)^{-2}\)  
5. \((-9)^0 4^{-3}\)  
6. \(\left((-4)^3 7^{-2}\right)^{-3}\)

B. Perform the following operations and simplify. Express your answer without zero or negative integer exponents.

1. \(5(x^4 x^{-5} x^3)^2\)  
2. \(\frac{a^5(ab)^{-2}}{b^3}\)  
3. \(y^5 \left(y^8\right)^{-3}\)  
4. \(\left(\frac{x^3 y^{-2}}{x^{-4} y^3}\right)^2\)  
5. \(\left(\frac{a^3 + b^2}{a^2 b^3}\right)^{-2}\)  
6. \(\left(\frac{x^2 y^3}{5^0 x^3 y^4}\right) \left(\frac{6^2 x^{-4} y^9}{x^7 y^2}\right)^{-1}\)

**SIA 5.3 Rational Exponents and Roots** Pages 160 - 167. On Pages 185-186, Problems 5.7, 5.8, 5.9 5.10#, 5.12#

# on 5.10, 5.12, first convert to exponential notation, then simplify, then return to radical notation. Do not use more than one radical in your final answer.
A. Perform the following operations and simplify.

1. \( x^3 \div x^2 \)
2. \( \frac{y^3 \div y}{y^2} \)
3. \( a^3 \div a^2 \)
4. \( (a^3 b^2)^2 \)
5. \( x^4 \left( \frac{x^4}{x^2} \right)^2 \)
6. \( \left( \frac{y}{x^2} - c^2 \right)^2 \)

B. Express the following in exponential form and simplify.

1. \( \sqrt[3]{x^7} \)
2. \( \frac{18}{\sqrt[5]{x^2}} \)
3. \( \sqrt[5]{(x + 2y)^4} \)

C. Simplify the following radicals. Follow the instructions indicated above by #.

1. \( \left( \frac{4}{\sqrt[3]{y}} \right)^{12} \)
2. \( \left( \frac{4}{\sqrt[3]{x}} \right) \left( \frac{8}{\sqrt[5]{x^3}} \right) \)
3. \( \frac{\sqrt[3]{a^5 b^3}}{4a^7 b^2} \)
4. \( \left( \frac{4}{\sqrt[3]{x^3}} \right)^7 \cdot x^8 \)
5. \( \frac{4}{\sqrt[3]{x^3 y^3}} \cdot \frac{3}{\sqrt[5]{x y^6}} \)
6. \( \frac{3}{\sqrt[7]{y^4}} \)

SIA 2.4 Factoring Pages 56 - 64. On Pages 75 - 77 Problems 2.10, 2.11, 2.12, 2.13, 2.15, 2.16.

A. Factor the following expressions.

1. \( 15x^3 - 3x^2 \)
2. \( 4x^5 y^3 - 16x^2 y^5 \)
3. \( a^4 y^2 + a^2 \)
4. \( x^2 + 2x - 35 \)
5. \( x^2 - 14x + 49 \)
6. \( x^2 - 11x + 24 \)
7. \( 2x^2 + 5x - 3 \)
8. \( 4x^2 - 13x - 3 \)
9. \( 4x^2 + 12x + 9 \)
10. \( 6x^2 + 11x + 3 \)
11. \( x^4 + 8x^2 + 16 \)
12. \( x^2 + 7x - 10 \)
13. \( 4y^2 + 20y + 25 \)
14. \( 9x^2 y^2 - 30xys + 25s^2 \)
15. \( x^2 + 4y^2 \)

SIA 6.1. Solve by Factoring and Square Root Methods. Pages 189 -
A. Solve the following equations by factor or square root method.

1. $15x^3 - 3x^2 = 0$
2. $x^2 - 7x + 12 = 0$
3. $y^2 + 4 = 0$
4. $x^2 + 2x - 35 = 0$
5. $x^2 + 49 = 14x$
6. $x^2 - 11x = -24$
7. $2x^2 + 5x = 3$
8. $4x^2 - 3 = 13x$
9. $4x^2 + 12x + 9 = 0$
10. $6x^2 + 11x + 3 = 0$
11. $5y^2 - 16 = 2$
12. $a^2 + 7a - 10 = 0$
13. $4y^2 + 20y + 25 = 0$
14. $(5x - 8)^2 = 17$
15. $3(x - 4)^2 - 8 = 3$

SIA 6.2 Completing the Square and the Quadratic Formula

A. Solve the following equations by completing the square.

1. $x^2 - 7x + 12 = 0$
2. $x^2 + 2x - 35 = 0$
3. $x^2 - 6x + 4 = 0$
4. $x^2 + 49 = 14x$
5. $x^2 + 14x + 46 = 0$
6. $x^2 - 11x + 24 = 0$
7. $4x^2 + 12x + 9 = 0$
8. $4x^2 - 28x + 37 = 0$
9. $9x^2 + 12x - 15 = 0$

B. Solve the following equations by using the Quadratic Formula. Express your answer algebraically.

1. $x^2 - 7x + 12 = 0$
2. $x^2 + 49 = 14x$
3. $x^2 - 11x = -24$
4. $x^2 + 14x + 46 = 0$
5. $x^2 - 11x + 24 = 0$
6. $4x^2 - 28x + 37 = 0$

C. Solve the following equations by using the Quadratic Formula. Use your calculator and express your answer as a decimal to the nearest hundredth.

1. $x^2 + 14x + 46 = 0$
2. $9x^2 + 12x - 15 = 0$
3. $4y^2 + 20y + 25 = 0$
4. $4s^2 - 28s + 37 = 0$
5. $4x^2 - 28x + 37 = 0$
6. $9x^2 + 12x - 15 = 0$

SIA 6.6 Graphs of Second-Degree Equations (and Inequalities)

Pages 221 - 230 Skip Solved Problem 6.14, On pages 239 - 241
Problems 6.11a,b,c,d,h, 6.12, 6.13 a,b,c.
A. Graph the following equations.

1. \( y = x^2 - 8x + 12 \) 
2. \( y = x^2 + 2x + 5 \) 
3. \( y = -x^2 + 6x - 4 \) 
4. \( y = -x^2 + 14x - 49 \) 
5. \( y = x^2 + 14x + 46 \) 
6. \( y = x^2 - 10x + 27 \) 
7. \( y = -4x^2 - 12x - 9 \) 
8. \( y = 4x^2 - 24x + 37 \) 
9. \( y = 9x^2 + 12x + 10 \)

B. Solve the following inequalities

1. \( x^2 - 8x + 12 > 0 \) 
2. \( x^2 + 2x + 5 \leq 0 \) 
3. \( -x^2 + 6x < 4 \) 
4. \( -x^2 + 14x - 49 \geq 0 \) 
5. \( x^2 + 14x + 46 \leq 0 \) 
6. \( x^2 - 10x + 27 \leq 0 \) 
7. \( -4x^2 - 12x - 5 > 0 \) 
8. \( y = 4x^2 - 24x + 37 \geq 0 \) 
9. \( 9x^2 + 12x - 10 > 0 \)