The following handout is review the Algebra needed for this class. It should be familiar to you from previous classes such as M110, M111. Do your best to refresh these materials if you already had it, or to learn it if you have not.

**Important**: This handout is for you to keep, **DO Not** turn it in as part of the homework. Use separate papers and show all your work not just final answers.

### Part A: Simplifying

Simplify and write your answers with positive exponents:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>((9(7 - 4) + 19) - (25 - (7 + 3)))</td>
<td>((-b^{15})) 27a^6</td>
</tr>
<tr>
<td>2.</td>
<td>(4^3 + (20)(10) + 7^2 - 23)</td>
<td>((-24y)) x^12</td>
</tr>
<tr>
<td>3.</td>
<td>(16 ÷ (19 - 15)^2 - 7)</td>
<td>((-18x^7y))</td>
</tr>
<tr>
<td>4.</td>
<td>(-32 - 8 ÷ 4 - (-2))</td>
<td>(\frac{7a^{16}b^5}{8})</td>
</tr>
<tr>
<td>5.</td>
<td>([6(x + 4) - 12] - [5(x - 8) + 11])</td>
<td>(-32)</td>
</tr>
<tr>
<td>6.</td>
<td>(4{[8(x - 3) + 9] - [4(3x - 7) + 2]})</td>
<td>(-\frac{7b^2}{a^4})</td>
</tr>
<tr>
<td>7.</td>
<td>(6x^4y^3 - 4x^8y^2 - x^{-8}y^2)</td>
<td>(-6)</td>
</tr>
<tr>
<td>8.</td>
<td>(6x^5y^{-2} - 3x^y^3)</td>
<td>(290)</td>
</tr>
</tbody>
</table>
| 9. | \(
\begin{array}{c}
14a^4b^{-3} \\
-2a^8b^{-5}
\end{array}
\) | \(x + 41\) |
| 10. | \(
\begin{array}{c}
-14a^{14}b^{-5} \\
-16a^{-2}b^{-10}
\end{array}
\) | \(-16x + 44\) |
| 11. | \((-3a^2b^{-5})^{-3}\) | \(31\) |
| 12. | \((-8a^{-4}b^5c^2)^{-4}\) | \(\frac{k^{24}}{2^8a^{20}}\) |
| 13. | \(\left(\frac{-4a^4b^{-2}}{a^{-1}b^4}\right)^{-4}\) | \(\frac{-b^{28}}{3^7a^{35}}\) |
| 14. | \(\left(\frac{-3a^{-2}b}{a^{-7}b^5}\right)^{-7}\) | \(\frac{a^{16}}{2^{12}b^{20}c^8}\) |
15. \[ \left( \frac{3}{2} \right)^{\frac{3}{2}} \left( \frac{1}{2} \right)^{\frac{1}{2}} \]

16. \[ \left( \frac{5}{6} \right)^{\frac{2}{3}} \left( 8x \right)^{\frac{2}{3}} \]

17. \[ \left( \frac{x^6}{9y^4} \right)^{-\frac{1}{2}} \]

18. \[ \left( \frac{-8x^3}{y^6} \right)^{\frac{2}{3}} \]

19. Multiply: \((3x^{-3}y^2)(-5x^3y)\):

   [A] \(-15xy^3\)  
   [B] \(15xy^3\)  
   [C] \(\frac{-15y^2}{x^9}\)  
   [D] \(-15y^3\)

20. Multiply: \((3x + 4y)(x^2 - y)\):

   [A] \(3x^3 + 3xy - 4yx^2 - 4y^2\)  
   [B] \(3x^3 - 3xy + 4yx^2 - 4y^2\)  
   [C] \(3x^3 - 3xy + 4yx^2 - 4y^2\)  
   [D] \(3x^3 - 3xy + 4yx^2 + 4y^2\)

Convert to exponential form:

21. \(7^\sqrt{7}\)

22. \(5\sqrt[3]{a^2}\)

23. \(3\sqrt[3]{x^2 + y}\)

24. \(4\sqrt{b^2}\)

   Answers, not in order: \(b^{1/2}; (x^2 + y)^{1/3}; a^{3/5}; 1^{1/7}\)

Convert to radical form:

25. \(x^{\frac{2}{5}}\)

26. \(x^{-2/3}\)

27. \((x^2 - y)^{-2/3}\)

28. \((x^2 + y)^{2/5}\)

   Answers, not in order: \(\frac{1}{\sqrt[3]{(x^2 - y)^2}}; (x^2 + y)^{1/3}; \sqrt[3]{x^2}; \frac{1}{\sqrt[3]{(x^2)^2}}\)

page (2)
**Part B: Factoring**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Answers, not in order</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (x^2 + 3x - 54)</td>
<td>((x + 10)(x - 9))</td>
</tr>
<tr>
<td>2. (10x + x^2 + 24)</td>
<td>((3x - 2)(2x + 1))</td>
</tr>
<tr>
<td>3. (x + x^2 - 90)</td>
<td>((x^2 - 5)(x^2 - 2))</td>
</tr>
<tr>
<td>4. (x^4 + 80x^2 + 79)</td>
<td>((4x + 3)(2x - 3))</td>
</tr>
<tr>
<td>5. (x^6 - x^3 - 42)</td>
<td>((3x + 2)(3x + 4))</td>
</tr>
<tr>
<td>6. (x^8 - 7x^4 + 10)</td>
<td>((x + 9)(x - 6))</td>
</tr>
<tr>
<td>7. (8x^2 - 6x - 9)</td>
<td>((x + 6)(x + 4))</td>
</tr>
<tr>
<td>8. (3x^2 - 20x + 32)</td>
<td>((x^2 + 79)(x^2 + 1))</td>
</tr>
<tr>
<td>9. (9x^2 + 8 + 18x)</td>
<td>((x^3 + 6)(x^3 - 7))</td>
</tr>
<tr>
<td>10. (6x^2 - x - 2)</td>
<td>((3x - 8)(x - 4))</td>
</tr>
<tr>
<td>11. (x^2 - 64)</td>
<td>((4x^2 + 11y)(4x^2 - 11y))</td>
</tr>
<tr>
<td>12. (x^2 y^2 - 81)</td>
<td>((x + 8)(x - 8))</td>
</tr>
<tr>
<td>13. (16x^4 - 121y^2)</td>
<td>((xy + 9)(xy - 9))</td>
</tr>
</tbody>
</table>

14. In simplifying: \(\frac{(x^2 - 2x - 15)}{(x^2 - 25)} \cdot \frac{(x^2 + 3x - 10)}{(x^2 + 3x)} \div \frac{(x^2 - 6x + 8)}{(2x^2 - 8x)}\); the final answer is:

   \[\text{[A]} \, 2 \quad \text{[B]} \, -2 \quad \text{[C]} \, \frac{x - 1}{x + 3} \quad \text{[D]} \, \frac{1 - x}{x + 3}\]
Part C: Solving Equations:

Solve for $x$:

<table>
<thead>
<tr>
<th></th>
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</tr>
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<tbody>
<tr>
<td>1.</td>
<td>$9(2x + 8) = 20 - (x + 5)$</td>
</tr>
<tr>
<td>2.</td>
<td>$6[4(8 - x) - 5(9 + 3x)] - 21 = -7[3(7 + 4x) - 4]$</td>
</tr>
<tr>
<td>3.</td>
<td>$\frac{4}{x - 1} = \frac{3}{x + 2}$</td>
</tr>
<tr>
<td>4.</td>
<td>$\frac{x - 2}{x - 4} = \frac{2}{x - 4}$</td>
</tr>
<tr>
<td>5.</td>
<td>$\frac{3}{x - 2} + \frac{2x}{4 - x^2} = \frac{5}{x + 2}$</td>
</tr>
<tr>
<td>6.</td>
<td>$\frac{1}{2x + 10} = \frac{8}{x^2 - 25} - \frac{2}{x - 5}$</td>
</tr>
<tr>
<td>7.</td>
<td>$\frac{1}{x - 2} = \frac{2}{x + 4} + \frac{2x - 1}{x^2 + 2x - 8}$</td>
</tr>
<tr>
<td>8.</td>
<td>$\frac{5x}{x - 7} - \frac{35}{x + 7} = \frac{490}{x^2 - 49}$</td>
</tr>
</tbody>
</table>

Solve by any method (substitution or elimination):

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>9.</td>
<td>$4x + y = -1$ ; and $x - 2y = 11$</td>
</tr>
<tr>
<td>10.</td>
<td>$-5x + y = -23$ ; and $6x + 7y = 3$</td>
</tr>
<tr>
<td>11.</td>
<td>$5x - 7y = -16$ ; and $2x + 8y = 26$</td>
</tr>
<tr>
<td>12.</td>
<td>$0.7x - 0.3y = 0.5$ ; and $-0.4x + 0.7y = 1.3$</td>
</tr>
<tr>
<td>13.</td>
<td>$\frac{1}{3}x + \frac{1}{5}y = 7$ ; and $\frac{1}{6}x - \frac{2}{5}y = -4$</td>
</tr>
<tr>
<td>14.</td>
<td>$x - 2y = 16$ ; and $y + 3 = 3x$</td>
</tr>
</tbody>
</table>
### Solve:

15. \( R = \frac{ax}{a+x} \) for \( x \)

16. \( R = \frac{2x}{x+2a} \) for \( x \)

17. \( \frac{t}{a} + \frac{t}{b} = 1 \) for \( b \)

18. \( A = P(1 + rt) \) for \( r \)

19. \( \frac{2}{x} + \frac{4}{y} = \frac{3}{z} \) for \( y \)

20. \( A = P(1 + rt) \) for \( t \)

### Solve for \( x \) (use the quadratic formula):

21. \( 3x^2 = 18x - 6 \)

22. \( x^2 + 3x = 8 \)

23. \( x^2 + 4 = 6x \)

24. \( 7x^2 + 8x = -2 \)

25. \( 3x(x + 1) - 7x(x + 2) = 6 \)

26. \( x + \frac{1}{x - 1} = 1 \)

27. \( \frac{x}{4} - \frac{8}{x} = 1 \)

28. \( 3x^2 - 4x - 1 = 0 \)

29. \( \sqrt[3]{x} + 5 = 2 \)

30. \( \sqrt[4]{x} - 3 = 2 \)

### Answers, not in order

- \( x = 2Ra / (2 - R) \)
- \( x = Ra / (a - R) \)
- \( r = (A - P) / Pt \)
- \( t = (A - P) / Pr \)
- \( y = \frac{4xz}{3x - 2z} \)
- \( b = at / (a - t) \)
- \( \pm \sqrt{2} \)
- \(-2, -3/4 \)
- \(3 \pm \sqrt{7} \)
- \(8, -4 \)
- \(3 \pm \sqrt{5} \)
- \(-\frac{3 \pm \sqrt{41}}{2} \)
- \(-\frac{4 \pm \sqrt{2}}{7} \)
- \(3 \)
- \(19 \)
- \(x = \frac{2 \pm \sqrt{7}}{3} \)

**Quadratic Formula:** \( x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \) when \( ax^2 + bx + c = 0 \)
Part D: Percentage Applications

1. What percent of 180 is 36?  6. 20.4 is 24% of what number?
2. What percent of 76 is 19?  7. 0.3 is 12% of what number?
3. What percent of 125 is 30?  8. 7 is 175% of what number?
4. What percent of 300 is 57?  9. What number is 65% of 840?
5. 45 is 30% of what number? 10. What number is 1% of one million?

Answers, not in order: (85), (2.5), (150), (19%), (10,000), (4), (20%), (546), (25%), (24%)

11. What percent of 80 is 100?  14. What is 2% of 40?
12. What percent of 10 is 205?  15. 2 is what percent of 40?
13. What is 40% of 2?  16. 40 is 2% of what number?

17. On a test of 88 items, a student got 76 correct. What percent were correct?
18. One season a basketball player made 36 out of 75 three-point shots. What percent did he make?
19. The sales tax rate in New York City is 8%. How much is charged on a purchase of $428.86? How much is the total cost of the purchase?
20. Due to inflation, the price of an item increased 12 cents. This was an 8% increase. What was the old price? the new price?

Answers, not in order: (86.36%), (48%), (2000), (0.8), (5%), (125%), (2050%), (0.8),
(34.31, 463.17), (1.5, 1.62)

21. After a 40% price reduction, a shirt is on sale at $19.20. What was the original price (that is, the price before reduction)?
22. A family spent $224 one month for food. This was 28% of its income. What was its monthly income?
23. An investment is made at 4% simple interest for 1 year. It grows to $8112. How much was originally invested?
24. Money is borrowed at 6.2% simple interest. After 1 year, $6945.48 pays off the loan. How much was originally borrowed?
25. After a 34% price reduction, a blouse is on sale at $29.04. What was the original price?
26. The price of a refrigerator selling at $600 is to be reduced by 20%. What is the sale price?
27. The price of an automobile selling at $6800 will be increased by 4%. What is the new price?
28. An $800 stereo system will be sold at a 25% reduction. What will be the new price?
29. In order to cope with rising costs, an oil producer plans to raise prices by 15%. If a barrel of oil now sells for $28.00, what will be the new price?
30. A boat that originally sold for $600 is now on sale for $540. What is the percentage of discount?

Answers, not in order: (44), (800), (7800), (32), (6540), (480), (7072), (10%), (600), (32.20)
## Part E: Slope, Equations of a Line and Inequalities

### Find the slope of the containing the given pair of points:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Answers, not in order</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>(-6, -4) and (-7, -9)</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>(-4, 7.2) and (4.7, 7.2)</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>(-1, -1) and (2, -4)</td>
<td>3/4</td>
</tr>
<tr>
<td>4.</td>
<td>(-10, 2) and (2, 11)</td>
<td>-1</td>
</tr>
</tbody>
</table>

### Find the slope of the line:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Answers, not in order</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td>$5y - 12 = 3x$</td>
<td>$3/5$</td>
</tr>
<tr>
<td>6.</td>
<td>$-12 = 4x - 7$</td>
<td>undefined</td>
</tr>
<tr>
<td>7.</td>
<td>$18 = -3y$</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>$2y - 3 = 5$</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>$17y + 4x + 3 = 7 + 4x$</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>$4 - 5y + 7x = -10$</td>
<td>$7/5$</td>
</tr>
</tbody>
</table>

### Find the slope $m$ and the $y$-intercept $b$ of the line:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Answers, not in order</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>$2x + 3y = 8$</td>
<td>$m = 0, b = -19$</td>
</tr>
<tr>
<td>12.</td>
<td>$-2x - 9y = 18$</td>
<td>$m = -8/7, b = -24/7$</td>
</tr>
<tr>
<td>13.</td>
<td>$y = -19$</td>
<td>$m = -2/9, b = -2$</td>
</tr>
<tr>
<td>14.</td>
<td>$-8x - 7y = 24$</td>
<td>$m = -2/3, b = 8/3$</td>
</tr>
</tbody>
</table>

### Find an equation of the line if the slope $m$ is given and one point:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Answers, not in order</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.</td>
<td>$m = -3 , (-2,0)$</td>
<td>$y = -4/5x + 23/5$</td>
</tr>
<tr>
<td>16.</td>
<td>$m = 3 , (-2,-2)$</td>
<td>$y = 3x + 4$</td>
</tr>
<tr>
<td>17.</td>
<td>$m = -4/5 , (2,3)$</td>
<td>$y = -3x - 6$</td>
</tr>
</tbody>
</table>

### Find an equation of the line containing the two points:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Answers, not in order</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.</td>
<td>(-1, -1) and (9, 9)</td>
<td>$y = 5/3x - 5$</td>
</tr>
<tr>
<td>19.</td>
<td>(0, -5) and (3, 0)</td>
<td>$y = 3x + 5$</td>
</tr>
<tr>
<td>20.</td>
<td>(-4, -7) and (-2, -1)</td>
<td>$y = x$</td>
</tr>
</tbody>
</table>

General Equation of a straight line: $y = mx + b$; $m$ is the slope and $b$ is the $y$-intercept
21. In a certain city, the cost for a taxi ride for 20 miles is $13. For 30 miles, the cost is $18. Assuming the number of miles is \( x \), find the linear equation for the cost.

22. The college bookstore sells a textbook costing $10 for $13.50 and a textbook costing $12 for $15.90. If the markup policy of the bookstore is linear, write an equation that relates sales price \( S \) and cost \( C \). What is the cost of a textbook that sells for $22?

23. An appliance manufacturer finds that it had sales of $200,000 five years ago and sales of $600,000 this year. If the growth in sales is assumed to be linear, what will the sales be five years from now?

24. A product that sold for $250 three years ago sells for $325 this year. If price increases are assumed to be linear, how much will the product sell for six years from now?

25. In 1950, the life expectancy of females was 72 years. In 1970, it was 75 years. Let \( E \) = the life expectancy and \( t \) = the number of years since 1950. Find the linear equation.

26. The average weekly for durable goods in the United States economy in 1967 was $25 billion. By 1982 this average had increased to $70 billion. Use these data to find the linear equation and find the level of average weekly orders in 1987?

**Answers, not in order:** \((c = 0.5x + 3)\), \((s = 1.20c + 1.5 ; 17.08)\), \((s = 80,000t + 600,000 ; 1,000,000)\)
\((E = 0.15t + 72)\), \((p = 25t + 325 ; 475)\), \((y = 3t + 25 ; 85)\), \((c = 0.3x + 5)\).

<table>
<thead>
<tr>
<th>Solve for ( x ):</th>
<th>( -1 &lt; x &lt; 14/5 )</th>
<th>( 3/2 \leq x \leq 11/2 )</th>
<th>( x \geq -4/5 )</th>
<th>( 2 &lt; x &lt; 4 )</th>
<th>( x &lt; -2/5 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. ( 3 - x \leq 4x + 7 )</td>
<td>( 8x - 9 &lt; 3x -11 )</td>
<td>( 8 &lt; 3x + 2 &lt; 14 )</td>
<td>( 3 \leq 4x - 3 \leq 19 )</td>
<td>( -7 &lt; 5x - 2 \leq 12 )</td>
<td></td>
</tr>
</tbody>
</table>

27. By renting a car for $40 a day and 20 cents per mile, or for $60 per day with unlimited mileage. Find the number of miles per day that makes the limited mileage cheaper.

28. If you have two jobs:
   Job A: You make $30,000 per year.
   Job B: You make $2000 per month plus 5% commission on gross sale.
   What is the amount of sale per year that makes job B better than A.

29. If you have two jobs:
   Job A: You make $2,000 per month plus 5% commission on gross sale.
   Job B: You make $1,000 per month plus 10% commission on gross sale over $10,000.
   What is the amount of sale per month that makes job B better than A.

30. A car can be rented for $30 per day with unlimited mileage, or for $24 per day, plus 10 cents per mile. For what daily mileages would the unlimited plan save you money?

**Answers, not in order:** \( x > 60 \); \( x > 120,000 \); \( x > 40,000 \); \( x < 100 \)
Part F: Graphing Review

Graph the following linear and non linear equations. After you finish, check your answers by using the program Graphmatica. It is very important that you graph them first manually and then use the program to check.

1. \(6x - 2y = 6\)  
2. \(2x + 6y = 12\)
3. \(x = -4\)  
4. \(y = 4\)
5. \(2x - y = 4\); and \(2x + 3y = -4\)  
6. \(3x + y = 5\); and \(x - 2y = 4\)
7. \(y = x^2 - 2x - 3\)  
8. \(y = x^2 + 2x - 5\)
9. \(y = -x^2 - 4x - 2\)  
10. \(y = 5 - x^2\)

Find the \(x\)-intercept for:

11. \(y = x^2 + 2x + 12\)  
12. \(y = -x^2 + 5x + 24\)
13. \(y = -x^2 + x + 20\)
14. \(y = 4x^2 + 12x + 9\)

Answers, not in order

11. \((-4, 0)\) and \((5, 0)\)  
12. \((-3/2, 0)\)
13. \((-3, 0)\) and \((8, 0)\)
14. None

15. The line \(5x + 10y + 2 = 2\)
   [A] passes through the origin    [B] crosses the \(y\)-axis above the origin
   [C] crosses the \(y\)-axes below the origin    [D] is the \(x\)-axis

16. The slope of the line \(y = 5\) is:

17. Match the graphs with the equations:

   a) \(y = -2x + 4\) is best represented by graph: \(\ldots\ldots\)
   b) \(y = -2x - 4\) is best represented by graph: \(\ldots\ldots\)
   c) \(y = 2x + 4\) is best represented by graph: \(\ldots\ldots\)
   d) \(y = 2x - 4\) is best represented by graph: \(\ldots\ldots\)
18. Using Figure 1, and without scaling the graph, the coordinates of point A are:
   [A] (0, 5) [B] (5, 0) [C] (6, 0) [D] (0, 6) [E] None of the above.

19. Using Figure 1, and without scaling the graph, the coordinates of point B are:
   [A] (0, 1) [B] (0, 2) [C] (1, 0) [D] (2, 0) [E] None of the above.

20. Using Figure 1, and without scaling the graph, the coordinates of point C are:
   [A] (2, 3) [B] (15/6, 13/4) [C] (15/7, 12/7) [D] (2, 2) [E] None of the above.

21. Using Figure 1, and without scaling the graph, the coordinates of point D are:
   [A] (3, 0) [B] (5, 0) [C] (0, 3) [D] (0, 5) [E] None of the above.

**Part G: Functions**

1. Find
   a) \( f(-1) \)       \[ f(0), \]          \[ f(1/2) \] for: \( f(x) = x^4 + x^2 \)
   
2. Find
   a) \( f(2x) \)       \[ f(2 + x), \]          \[ f(1/x) \] \[ f(x^2) \] for: \( f(x) = x^2 + 2x \)

   **Answers, not in order:**
   \( (2) ; (5/16) ; (0) \)
   \( (x^2 + 6x + 8) ; (x^4 + 2x^2) ; (4x^2 + 4x) ; (1/x^2 + 2/x) \)

3. Find
   a) \( f(-6) \)       \[ f(k), \]          \[ f(t - 1) \] \[ f(x + h) \] for: \( f(x) = (x + 4)^2 \)
   
4. Find
   a) \( f(-3) \)       \[ f(-1), \]          \[ f(a + h) \] \[ f(1 - t) \] for: \( f(x) = x^2 + 4 \)

   **Answers, not in order:**
   \( (4) ; (t^2 + 6t + 9) ; (k^2 + 8k + 16) ; (x^2 + 2xh + h^2 + 8x + 8h + 16) \)
   \( (13) ; (5 - 2t + t^2) ; (5) ; (a^2 + 2ah + h^2 + 4) \)