The final exam for Algebra 1 will take place on June 5 and 6. The following study guide will help you prepare for the exam.

**Tips for doing well on the final exam:**

- Answer EVERY QUESTION on this study guide, even if you think you already know it.
- Use your notes and other resources to find the answer to questions you do not know. Make an effort to find the answer yourself before asking for help.
- If you still cannot figure out how to do a problem, flag it to discuss with your teacher. Ask specific questions, such as "I know how to do the first two steps, but then I get stuck on step 3," as opposed to "I don’t get it."
- SHOW ALL WORK. You may lose points on the exam if you do not do this!! Showing work means making appropriate substitutions and writing down all steps when solving a problem.
- CHECK YOUR WORK. Some questions will deduct points if you do not do this! Checking work will help you find the “silly” mistakes. Check work whenever you:
  - solve an equation (plug solution(s) back into equation)
  - solve a linear system of equations (plug solution back into all equations in the system)
  - solve a system of linear inequalities (pick a point from shaded solution and plug back in to all inequalities in the system)
  - factor a polynomial (multiply the factored form to get the original polynomial)
- Use your time wisely. Answer all questions you know first, then go back and work on the ones you do not.
- Use your scratch paper wisely. When the test begins, write down formulas you have memorized that are not on the SOL formula sheet. Important formulas to know:
  - Slope: \( m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} \)
  - Slope-intercept form of a line: \( y = mx + b \)
  - Standard form of a line: \( Ax + By = C \)
  - Point-slope form of a line: \( y - y_1 = m(x - x_1) \)
  - Standard form of a parabola: \( y = ax^2 + bx + c \)
  - Direct variation: \( y = kx \)
  - Inverse variation: \( y = \frac{k}{x} \)
- Breathe! If you’ve prepared, feel confident!
Practice questions:

1) What is the value of \( \left( \frac{bc}{4} - (7 - a) + 2 \right) \div (b-1) \) when \( a = 4 \), \( b = 8 \), and \( c = 5 \)?

2) Evaluate \( \frac{2a}{5} + d(n-1) \) when \( a = -20 \), \( n = 10 \), \( d = 3 \)

3) Evaluate the following expressions when \( a = 8 \), \( b = -6 \), \( d = 3 \), \( x = -4 \), \( y = 5 \)
   a) \( \frac{3bd}{9} - bx + xy - a \)
   b) \( 5x - 2y + \frac{ab}{x} - x^2y \)
   c) \( \frac{1}{4}x^2y + x(y-2) + (ay)^3 \)

4) Translate the English phrase to math:
   a number cubed decreased by 2 less than the same number

5) Translate the English phrase to math:
   the quotient of 3 less than twice a number and another number

6) Translate the English phrase to math:
   the product of twice the difference of \( p \) and \( q \) and the sum of \( p \) and \( q \)

7) Translate the English sentence to math, then solve the equation:
   When a number is multiplied by 5 and increased by 7, the result is 62.

8) Evaluate the following expressions in scientific notation:
   a) \( (7.3 \times 10^{-8})\times (6.5 \times 10^{14}) \)
   b) \( (4.3 \times 10^{-2})^3 \)
   c) \( \frac{4.8 \times 10^{-3}}{1.2 \times 10^{-11}} \)

9) Add or subtract the polynomials:
   a) \( (10x^{12} - 4x^5 + 7) + (-3x^{12} - 8x^6 - 12) \)
   b) \(-9y^2 - 8x)\times (-2xy - 2x^2 + y^2)\times (-y^2 + 4xy) \)
   c) \( (8x^3 - 6 + 3x^4) - (x^4 - 7x^3 - 3) \)
   d) \( (4x^2 + 7x^3 y^2)\times (6x^2 - 7x^3 y^2 - 4x)\times (10x + 9x^2) \)

10) Simplify the expressions (divide):
   a) \( \frac{10x^8 - 4x^6 + 12x^5}{2x^3} \)
   b) \( \frac{15x^8 y^2 - 25x^2 y^{10} + 100x^3 y^8}{5x^3 y^{-2}} \)
11) Multiply the polynomials:
   a) $3xy(4x^2yz - 11x^5y^4)$  
   b) $(2x - 1)(8x - 5)$  
   c) $(8x + 1)(6x - 3)$  
   d) $(4x+2)(6x^2 - x + 2)$  
   e) $(2x - 1)^2$  
   f) $(3x + 4)(3x - 4)$  

12) Factor the polynomials. **Verify your answer by multiplying back to get original polynomial.**
   a) $4x^3y^2 - 12x^4y$  
   b) $16x^2 - 25$  
   c) $x^2 + 4x - 21$  
   d) $2x^2 - 16x + 30$  
   e) $6x^2 - 4x - 2$  
   f) $24x^2 - 42x + 9$  

13) Simplify the expressions using positive exponents:
   a) $x^5x^{10}x^{-6}$  
   b) $\frac{10z^{-1}z^5}{2z^3} \cdot 3z^{-9}$  
   c) $-\frac{16x^5y^9z^{-2}}{4x^3y^7z^4}$  
   d) $(-2a^3b^5c^{-2})^3$  
   e) $0^{-10}$  
   f) $\left(-\frac{1}{x^3y^4z^{-2}}\right)^{-2}$  

14) Express the radicals in simplest form, rationalizing denominators if necessary.
   a) $\sqrt{28}$  
   b) $\sqrt{50x^4y^7z^5}$  
   c) $\sqrt{\frac{72x^5y^6}{25}}$  
   d) $\frac{\sqrt{5}}{49x^6y^8}$  
   e) $\frac{3}{\sqrt{6}}$  
   f) $\frac{\sqrt{164x^3y^6}}{6}$  

15) Determine which of the following are functions. More than one answer is possible. Select all that apply.
   a) $\{(8, 8), (2, 5), (-2, 5)\}$  
   b) $\begin{array}{c|c}
   x & y \\
   \hline
   1 & 5 \\
   8 & -7 \\
   0 & 1 \\
   8 & 4
   \end{array}$  
   c)   
   d)   
   e) $f(x) = 2x + 3$  
   f) $\{(3, 8), (10, 0), (3, 7)\}$
16) Find the zero(s) for each function:
   a) 
   
   b) \( f(x) = x^2 - 5x + 6 \)
   
   c) 
   
   d) Find the roots:
   \( 2x^2 + 8x = -6 \)

17) What are the range values of the function \( g(x) = 2x^2 - 3x + 5 \) for the domain values \{-3, 5, 10\}? 

18) Graph the functions, determining whether it is concave up or down, and finding the y-intercept, the axis of symmetry, the vertex, and the zeros.
   a) \( y = x^2 - 2x - 8 \)
   concave up or down __________
   y-intercept ________
   axis of symmetry ________
   vertex ________
   zeros ________
   
   b) \( f(x) = x^2 - 4x + 4 \)
   concave up or down __________
   y-intercept ________
   axis of symmetry ________
   vertex ________
   zeros ________
19) A used car from Ted’s Car Lot can travel 120 miles using 5 gallons of gas. How many miles would the same car be able to travel on 8 gallons of gas?

20) As the temperature rises, the number of bigfoot sightings in North Dakota decreases in an inverse relationship. If there were 12 bigfoot sightings when the temperature was 80 degrees, how many bigfoot sightings would you expect when the temperature drops to 60 degrees?

21) The White House needs a new coat of paint. If 20 painters would take 45 hours to paint the White House, how many painters would be needed to paint the house in 30 hours?

22) Determine the mean, MAD, and standard deviation for each set. **Round to the nearest tenth if necessary.**
   a)  { 10, 4, 9, 9, 3 }
   b)  { -5, 1, 6, 2 }

23) The z-score of an element in a dataset is given by the formula
   \[ z = \frac{x - \mu}{\sigma} \]
   In Data Set A, a specific element has a z-score of -1. If Data Set A has a mean of 20 and standard deviation of 4, find the value of the element.

24) Using the box-and-whisker plot below, determine the following:

   A) Range=_____
   B) Mean=_____
   C) Median=_____

25) Approximate the slope of the line of best fit for this scatter plot:
26) What is the domain of the function shown? What is the range? **Write your responses in set builder notation.**

![Graph of a function with labeled axes x and y.]

27) If \( f(x) = x^2 + 2x + 3 \), what is \( f(6) \)? Find the zeros of the function.

28) What is the solution to the inequality \(-2x - 7 \geq 15\)? Write the solution in set builder notation.

29) Find the x and y intercepts of the line \(-5x - 3y = 30\).

30) Find the slope of the line represented by \(4x - 3y + 2 = 0\).

31) What is the equation of the line that passes through points \((5, 15)\) and \((10, 20)\)?

32) Write the equation of the line whose slope is 3 and passes through the origin.

33) Find the solution to the following equation. **Show all steps when solving.**

\[
5(x + 5) + 9 = -2(1 - 7x)
\]
34) The average life expectancy (in years) of a person based on various years of birth is listed in the following table:

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Life expectancy</td>
<td>44.3</td>
<td>47</td>
<td>51.1</td>
<td>56.7</td>
<td>59.9</td>
<td>71.2</td>
<td>72.7</td>
<td>74</td>
<td>76</td>
<td>80</td>
</tr>
</tbody>
</table>

a) Find the line of best fit for the data (use years since 1900 as your x values). \textbf{Round to the nearest tenth if necessary.}

b) Predict the life expectancy for someone born in 2010. \textbf{Round to the nearest tenth if necessary.}

35) a) What is the slope of the line graphed at right?

b) What is its equation?

36) What is the solution to the system of equations? \textbf{CHECK YOUR WORK BY PLUGGING THE SOLUTION BACK INTO BOTH EQUATIONS.}

\begin{align*}
  x + 2y &= 5 \\
  3x + 2y &= 7
\end{align*}

37) Describe whether the tables represent direct variations, inverse variations, or neither. If it is a direct or inverse variation, write the equation.

\begin{align*}
  \text{a) } & \begin{array}{c|c|c|c}
    x & -2 & -1 & 0 & 1 \\
    y & -10 & -5 & 0 & 5
  \end{array} & \quad \text{b) } \begin{array}{c|c|c|c|c}
    x & 1 & 2 & 3 & 4 \\
    y & 10 & 20 & 30 & 40
  \end{array} \\
  \text{c) } & \begin{array}{c|c|c|c}
    x & 0 & 1 & 2 & 3 \\
    y & 0 & 3 & 6 & 9
  \end{array} & \quad \text{d) } \begin{array}{c|c|c|c|c}
    x & -2 & -1 & 1 & 2 \\
    y & -1 & -2 & 2 & 1
  \end{array}
\end{align*}
38) Sally believes that the more time she spends in the grocery store, the more money she spends. Her recent purchases are recorded in the table at right. Write a linear equation of best fit (round to the nearest tenth).

<table>
<thead>
<tr>
<th>Minutes in Store, $x$</th>
<th>Dollars Spent, $y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>12</td>
<td>29</td>
</tr>
<tr>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>22</td>
<td>73</td>
</tr>
<tr>
<td>26</td>
<td>68</td>
</tr>
</tbody>
</table>

39) What is the equation of the line shown? What is the slope of the line?

40) What is the equation of the line shown? What is the slope of the line?

41) Write the inequality represented by the graph at right:
42) For boys, the mean number of absences in the first grade is 15 with a standard deviation of 7. For girls, the mean number of absences is 10 with a standard deviation of 6. **Round answers to the nearest hundredth.**
   
a) If a boy is absent 10 times, how many standard deviations from the mean is he?

b) If a girl is absent 15 times, how many standard deviations from the mean is she?

43) Solve for the stated variable:
   
a) Solve for h:
   \[ A = \frac{1}{2}bh \]
   
b) Solve for w:
   \[ P = 2l + 2w \]
   
c) Solve for d:
   \[ Q = \frac{c+d}{2} \]
   
d) Solve for a:
   \[ x = 3a + 5ac \]

44) The area of a trapezoid is given by the formula \( A = \frac{1}{2}h(b_1 + b_2) \), where \( h \) is the height, and \( b_1 \) and \( b_2 \) are the lengths of the bases.
   
a) Re-write the formula in terms of height.

b) Find the height of a trapezoid with area 25 and bases 3 and 2.

45) While solving an equation, Lenny wrote the following steps on the board.
   
   \[(2x + 1) + 5 = 9\]
   \[2x + (1 + 5) = 9\]
   
   What property of real numbers guarantees the second equation is equivalent to the first?

46) Use the quadratic formula to solve the equations (round to the nearest hundredth if necessary):
   
a) \( x^2 + 2x - 15 = 0 \)
   
b) \( 3x^2 - 2x - 4 = 0 \)
   
c) \(-2x^2 + 5x + 5 = 0\)
47) Graph the functions or relations. Are the slopes positive, negative, zero, or undefined? Identify the zero(s) of the functions.

a) \( f(x) = 3x - 6 \)
   
   slope (pos, neg, 0, undef): ____
   
   zero(s): ____

b) \( f(x) = -\frac{2}{3}x + 1 \)
   
   slope (pos, neg, 0, undef): ____
   
   zero(s): ____

c) \( x = 6 \)
   
   slope (pos, neg, 0, undef): ____
   
   x-intercept(s): ____

d) \( f(x) = -4 \)
   
   slope (pos, neg, 0, undef): ____
   
   zero(s): ____
48) Find the solution to the system of equations. Then write an equation of each line shown on the graph.
   a) solution: ________________
      equations: ________________ ________________
   b) solution: ________________
      equations: ________________ ________________

49) Solve the linear systems algebraically. CHECK YOUR WORK BY PLUGGING THE SOLUTION BACK INTO BOTH EQUATIONS.
   a) \( x - y = 11 \)
      \( 2x + y = 19 \)
   b) \( 8x + 14y = 4 \)
      \( 6x + 7y = 10 \)
   c) \( 5x + 4y = -30 \)
      \( 3x - 9y = -18 \)

50) Write the equation of the line that passes through the points (-1, 7) and (3, -1)
   a) in point-slope form
   b) in slope-intercept form
   c) in standard form

51) Solve the inequalities. Write your solutions in set builder notation.
   a) \(-3x - 2x < 5\)
   b) \(-30 + 5x > 4(6 + 8x)\)
   c) \(-3(2x-5) \geq -13 + x\)
52) Graph the inequalities:
   a) \( y < 4x + 4 \)
   b) \( y \geq -2x + 5 \)
   c) \( x - 3y < -9 \)

53) Graph the systems of linear inequalities:
   a) \( y \leq \frac{1}{2}x + 2 \)
   \( y > 3x - 3 \)
   b) \( y < -3 \)
   \( y \geq 4x + 1 \)

54) Write a system of linear inequalities that describe the graph:

55) Solve the equations.
   a) \( x^2 - 10x + 9 = 0 \)
   b) \( x^2 + 16x = -64 \)
   c) \( 3x^2 - 8x + 4 = 0 \)
### Answer Key:

| 1)  | 7     | 13a) $x^9$               | 21) 30 painters                      |
| 2)  | 19    | 13b) $\frac{15}{z^8}$    | 22a) $\mu = 7; \ MAD = 2.8; \ \sigma \approx 2.9$ |
| 3a) | -58   | 13c) $-\frac{4x^9y^2}{z^6}$ | 22b) $\mu = 1; \ MAD = 3; \ \sigma \approx 3.9$ |
| 3b) | -98   | 13d) $-\frac{8a^3b^{15}}{c^6}$ | 23) 16                                 |
| 3c) | 64008 | 13e) undefined            | 24a) range = 20                      |
| 4)  | $x^3-(x-2)$ | 13f) $\frac{x^6y^8}{z^4}$ | 24b) mean cannot be determined on a b&w plot |
| 5)  | $\frac{2x-3}{y}$ | 14a) $2\sqrt{7}$ | 24c) median = 80                      |
| 6)  | 2(p-q)(p+q) | 14b) $5x^2y^3z^2\sqrt{2yz}$ | 25) approximately -1 (answers may vary, but should be close!) |
| 7)  | 5x+7=62; x=11 | 14c) $\frac{6x^2y^3\sqrt{2x}}{5}$ |                                     |
| 8a) | 4.745 x 10$^7$ | 14d) $\frac{\sqrt{5}}{7x^3y^4}$ | 26) domain: $\{x \in \mathbb{R} \mid -5 \leq x \leq 3\}$ range: $\{y \in \mathbb{R} \mid -2 \leq y \leq 6\}$ |
| 8b) | 7.9507 x 10$^{-5}$ | 14e) $\frac{\sqrt{6}}{2}$ |                             |
| 8c) | 4 x 10$^8$ | 14f) $4xy^2$ | 27) 51; no zeros                   |
| 9a) | $7x^{12} - 8x^6 - 4x^5 - 5$ | 15) a, c, d, e |                             |
| 9b) | $-9y^2 + 2xy -2x^2 -8x$ | 16a) -3, -7 | 28) $\{x \in \mathbb{R} \mid x \leq -11\}$ |
| 9c) | $2x^4 + 15x^3 -3$ | 16 b) 2, 3 | 29) x-int: (-6, 0)                      |
| 9d) | $14x^2y^2 + x^2 - 6x$ | 16c) 3 | 30) $m = 4/3$                        |
| 10a) | $5x^5-2x^3+6x^2$ | 16d) -1, -3 | 31) $y = x + 10$                     |
| 10b) | $\frac{3y^4}{x^{11}} - \frac{5y^{12}}{x} + \frac{20y^{10}}{x^{6}}$ | 17) $\{32, 40, 175\}$ | 32) $y = 3x$                          |
| 11a) | $12x^2yz^2 - 33x^6y^5$ | 18a) concave up | 33) $x = 4$                            |
| 11b) | $16x^2 -18x + 5$ | y-int = -8 | 34a) $y = 0.4x + 44.3$               |
| 11c) | $48x^2 -18x - 3$ | axis of sym: $x = 1$ | 34b) 90.8 years                      |
| 11d) | $24x^3 + 8x^2 + 6x + 4$ | vertex: (1, -9) | 35a) $m = -3/2$                      |
| 11e) | $4x^2 - 4x + 1$ | zeros: $x = -2, 4$ | 35b) $y = \frac{3}{2}x -1$         |
| 11f) | $9x^2 - 16$ | 18b) concave up | 36) (1, 2)                           |
| 12a) | $4x^2y(y - 3x)$ | y-int = 4 | 37) a) direct; $y=5x$                 |
| 12b) | $(4x + 5)(4x - 5)$ | axis of sym: $x = 2$ | b) direct; $y=10x$                   |
| 12c) | $(x + 7)(x - 3)$ | vertex: (2, 0) | c) direct; $y=3x$                     |
| 12d) | $2(x - 3)(x - 5)$ | zeros: $x = 2$ | d) inverse; $y = \frac{2}{x}$       |
| 12e) | $2(3x + 1)(x - 1)$ | 19) 192 miles | 38) $y = 3.2x - 10$                    |
| 12f) | $3(4x - 1)(2x - 3)$ | 20) 16 | }
<table>
<thead>
<tr>
<th>39) y = 4; m = 0</th>
<th>48a) (1, 3)</th>
<th>54) y &gt; \frac{1}{3}x - 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>40) x = 4; slope is undefined</td>
<td>y = -x + 4</td>
<td>y ≤ \frac{5}{3}x + 3</td>
</tr>
<tr>
<td>41) y ≥ 3x + 2</td>
<td>y = x + 2</td>
<td></td>
</tr>
<tr>
<td>42a) -0.71</td>
<td>48b) (-3, -4)</td>
<td></td>
</tr>
<tr>
<td>42b) 0.83</td>
<td>y = 2x + 2</td>
<td></td>
</tr>
<tr>
<td>43a) h = \frac{2A}{b}</td>
<td>y = -x - 7</td>
<td></td>
</tr>
<tr>
<td>43b) w = \frac{P - 2l}{2}</td>
<td>49a) (10, -1)</td>
<td></td>
</tr>
<tr>
<td>43c) d = 2Q - c</td>
<td>49b) (4, -2)</td>
<td></td>
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<tr>
<td>43d) a = \frac{x}{3 + 5c}</td>
<td>49c) (-6, 0)</td>
<td></td>
</tr>
<tr>
<td>44a) h = \frac{2A}{b_1 + b_2}</td>
<td>50a) y + 1 = -2(x - 3) OR</td>
<td></td>
</tr>
<tr>
<td>44b) h = 10</td>
<td>50b) y = -2x + 5</td>
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<tr>
<td>45) associative property of addition</td>
<td>50c) 2x + y = 5</td>
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<tr>
<td>46a) x = -5, 3</td>
<td>51a) {x \in \mathbb{R} \mid x &gt; -1}</td>
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<tr>
<td>46b) x ≈ -0.87, 1.54</td>
<td>51b) {x \in \mathbb{R} \mid x &lt; -2}</td>
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<tr>
<td>46c) x ≈ -0.77, 3.27</td>
<td>51c) {x \in \mathbb{R} \mid x ≤ 4}</td>
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47a) slope: positive zero(s): x = 2

47b) slope: negative zero(s): x = 3/2

47c) slope is undefined; x-int at x = 6

47d) slope is zero; no zeros