Welcome to Algebra 2 Honors! Here is a packet of pre-algebra and algebra topics that you are expected to know before you start class in the fall.

Most problems are **no calculator**. To prepare yourself for the year ahead, make sure you do not use a calculator on these questions. If a calculator may be used the problem will clearly be marked **CALC**.

This packet contains notes, worked out examples, and practice problems. Be sure to read the examples in each section before starting. You can show your work directly in this packet.

**This packet should be completed before the first day of school.**
We will go over the answers and questions from this packet during the first few classes. If you have any questions, don't worry, we will answer them.

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**Topic 1: Number Hierarchy**

![Number Hierarchy Diagram]

- **Complex Numbers**
  - **Real Numbers**
    - **Rational Numbers**
    - **Integers**
    - **Whole Numbers**
    - **Natural Numbers**
  - **Imaginary Numbers**
    - **Irrational Numbers**
**Description of Numbers:**

**Complex:** A number $a + bi$ where $a$ and $b$ are real numbers and $i$ is the imaginary number. All numbers are complex.

**Real Numbers:** Numbers that can be graphed on a number line.

**Imaginary Numbers:** Numbers that contain the $\sqrt{-1} = i$

**Rational Numbers:** Numbers that can be written as the ratio of two integers.

**Irrational Numbers:** Numbers that cannot be written as the ratio of two integers.

**Integers:** Positive and negative whole numbers.

**Whole Numbers:** The set of the natural numbers and zero.

**Natural Numbers:** The set of the counting numbers {1,2,3,4,5…}

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1. Check the box if the value belongs to the given number set.

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<th>Integers</th>
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<th>Odd Numbers</th>
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<th>Negative Numbers</th>
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### Topic 2: Operations on Fractions

**Adding/Subtracting Fractions:**
Rewrite fractions so that they have a common denominator. Then add the numerators together.

Examples:
\[
\frac{5}{6} + \frac{2}{3} = \frac{5}{6} + \frac{4}{6} = \frac{9}{6} = \frac{3}{2}
\]
\[
\frac{4}{4} \cdot \frac{1}{3} - \frac{3}{4} \cdot \frac{3}{3} = \frac{4}{12} - \frac{9}{12} = \frac{-5}{12}
\]

**Multiplying Fractions:**
No common denominator is needed. Multiply straight across the numerator and straight across the denominator. You can also simplify before you multiply.

Examples:
\[
\frac{5}{6} \cdot \frac{2}{3} = \frac{10}{18} = \frac{5}{9}
\]
\[
\frac{10}{26} \cdot \frac{5}{7} = \frac{50}{21}
\]

**Dividing Fractions:**
Multiply the first fraction by the reciprocal of the second fraction. Order matters!

Examples:
\[
\frac{5}{6} \div \frac{2}{3} = \frac{5}{6} \cdot \frac{3}{2} = \frac{15}{12} = \frac{5}{4}
\]
\[
\frac{5}{28} \div \frac{30}{7} = \frac{5}{28} \cdot \frac{7}{30} = \frac{1}{24}
\]

Perform the following operations on the fractions below.

2. \(\frac{7}{8} + \frac{3}{4}\)
3. \(\frac{3}{20} \cdot \frac{7}{4}\)
4. \(\frac{6}{35} \div \frac{48}{7}\)

5. \(\frac{2}{3} - \frac{5}{9}\)
6. \(\frac{2}{9} - \frac{1}{6}\)
7. \(\frac{4}{7} \div \frac{14}{3}\)
Topic 3: Solving Linear Equations by Clearing the Fractions

Example 1:

Solve for \( x \):
\[
\frac{1}{2}x + \frac{1}{3}x = 10
\]

\( \left( \frac{1}{2}x + \frac{1}{3}x = 10 \right) \)
\[
3x + 2x = 10
\]
\[
5x = 10
\]
\[
x = 2
\]

Steps:
1. Multiply by least common multiple of denominator
2. Solve for variable

Example 2:

Solve for \( x \):
\[
5 \left( \frac{1}{4}x + \frac{3}{5} \right) = \frac{2}{3}
\]

\( \left( \frac{5}{4}x + 3 = \frac{2}{3} \right) \)

Distribute first
\[
15x + 3(6) = 8
\]
\[
-3(6) - 3(6)
\]
\[
15x = -28
\]
\[
x = -\frac{28}{15}
\]

Solve the following equations by clearing the fractions.

8. \[
\frac{2}{3}m - \frac{3}{5}m = 4
\]

9. \[
\frac{1}{2}w + 4 = -\frac{2}{3}w + \frac{1}{2}
\]

10. \[
6 \left( \frac{2}{3}x - \frac{1}{12} \right) = x + \frac{1}{8}
\]
Topic 4: Rewriting Formulas

A **formula** is an equation that relates two or more variables.

Rewriting a formula means that you are **solving for another variable** and writing an equation that is equivalent to the original formula.

To solve for a variable, you work through the same steps as you would to solve an equation.

**Example 1:**
Solve the distance formula for the rate: $d = rt$

\[
\frac{d}{t} = r
\]

**Example 2:**
Solve the formula for the sum of all interior angles of a polygon for $n$: $S = 180(n - 2)$

Method 1:

\[
\frac{S}{180} = n - 2
\]

\[
n = \frac{S}{180} + 2
\]

Method 2:

\[
S = 180(n - 2)
\]

\[
S + 360 = 180n
\]

\[
n = \frac{S + 360}{180}
\]

**Example 3:**
Solve $7x - 4xy = 5$ for $x$.

\[
x(7 - 4y) = 5
\]

\[
x = \frac{5}{7 - 4y}
\]

**Hint:** If you see the same variable more than once, but need to solve for that variable, you must factor out the variable. Do not divide by the variable.
Rewrite the following formulas for the requested variable.

11. $F = \frac{9}{5}C + 32$, solve for $C$
12. $A = \frac{1}{2}(b_1 + b_2)h$, solve for $b_1$

13. $P = 2\pi r + 2x$, solve for $r$.
14. $8y - x = 9$, solve for $x$.

15. $4x - 2xy = 7$, solve for $x$.
16. $2xy + x = 3$, solve for $x$. 
17. Graph each inequality on the number line and simplify the inequality if possible.
  a. \(-2 < x \leq 3\)  
  b. \(x < -1 \text{ or } x \geq 2\)  
  c. \(x > -2 \text{ or } x \geq 1\)  
  d. \(x < 5 \text{ or } x > -2\)
Topic 6: Solving Linear Inequalities

Solving linear inequalities is the same as solving linear equations with one exception – when you multiply or divide BOTH sides of an inequality by a negative number, you must reverse, or “flip” the inequality sign. A solution of an inequality in one variable is a value that, when substituted for the variable, results in a true statement. When checking your solution, test to make sure that the boundary point makes the equation true and that the values in the shaded region make the inequality true.

Example 1:
\[ x - 2 \leq 4x - 8 \]
\[ -4x + x \leq -8 \]
\[ -3x \leq -8 \]
\[ x \geq \frac{8}{3} \]

Example 3:
\[ -7 < 5x - 2 \leq 8 \]
\[ +2 +2 +2 \]
\[ \frac{5}{5} < \frac{10}{5} \]
\[ -1 \leq x \leq 2 \]

Example 4:
\[ 4x - 7 \leq 5 \quad \text{or} \quad 3x + 2 \geq 23 \]
\[ +7 +7 -2 -2 \]
\[ \frac{4x}{4} \leq \frac{12}{4} \quad \frac{3x}{3} \geq \frac{21}{3} \]
\[ x \leq 3 \quad \text{or} \quad x \geq 7 \]

Solve the following inequalities:

18. \( 3x + 5 \leq 8x - 25 \)  
19. \( 14x - 9 > 20x + 33 \)

20. \( -5 \leq 3 - 2x < 7 \)  
21. \( 3x + 1 > 10 \) or \( 3 - 4x \geq 11 \)
Topic 7: Finding the Slope of a Line/Rate of Change

Slope is a constant rate of change. Formula: \( m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1} = \text{rise} \div \text{run} \)

Example 1:
Find the slope of the line connecting \((3,5)\) and \((7,2)\).
\[
m = \frac{2-5}{7-3} = \frac{-3}{4}
\]

Example 2:
Find the slope of the line connecting \((2,4)\) and \((7,2)\).
\[
m = \frac{4-2}{7-2} = \frac{2}{5}
\]

Example 3:
Find the slope of the line connecting \((2,5)\) and \((2,-8)\).
\[
m = \frac{-8-5}{2-2} = \text{undefined}
\]

Example 4:
Find the value of \(k\) given that the line connecting \((2,4)\) and \((3k,k+1)\) has a slope of \(\frac{1}{6}\).
\[
\frac{(k+1)-4}{3k-2} = \frac{1}{6} \quad \text{use slope formula}
\]
\[
\frac{k-3}{3k-2} = \frac{1}{6} \quad \ast \text{cross multi*}
\]
\[
6(k-3) = 3k-2
\]
\[
6k-18 = 3k-2
\]
\[
3k-18 = -2
\]
\[
3k = 16
\]
\[
k = \frac{16}{3}
\]

Given the following coordinates, find the slope & identify if the line is vertical, horizontal, or oblique.

22. \((4,4)\) and \((4,8)\)  23. \((2,-2)\) and \((8,-2)\)  24. \((0,8)\) and \((9,0)\)

25. Find the value of \(k\) so that the line through the given points has the given slope.
\((-2,3)\) and \((k,7)\), \(m = -2\)
Topic 8: Finding $x$- and $y$-intercepts

**Example 1:**
The $x$-intercept(s) occur when $y = 0$.
To find the $x$-intercept, set the $y$-value equal to zero and solve for $x$.

Find the $x$-intercept of $y = 2x - 24$

\[0 = 2x - 24\]
\[24 = 2x\]
\[x = 12\]

**Example 2:**
The $y$-intercept occurs when $x = 0$.
To find the $y$-intercept, set the $x$-value equal to zero and solve for $y$.

Find the $y$-intercept of $3y - 4y = 10$

\[3(0) - 4y = 10\]
\[-4y = 10\]
\[y = -\frac{5}{2}\]

26. $y = \frac{3}{2}x - 3$

27. $y = 2x + 4$

slope:  
$y$-intercept:  
x-intercept: 

28. $4x + 2y = 8$

29. $5x + 2y = 10$

slope:  
$y$-intercept:  
x-intercept: 
Topic 9: Equations of Linear Functions

**Point-slope form of a line:** \( y - y_1 = m(x - x_1) \), where \( m \) is the slope and \((x_1, y_1)\) is a point on the line.

**Slope-intercept form of a line:** \( y = mx + b \), where \( m \) is the slope and \( b \) is the \( y \)-intercept.

**Standard form of a line:** \( Ax + By = C \), where \( A \), \( B \), and \( C \) are integers and \( A \) is positive.

**Example 1:**
Write the equation of a line in all forms connecting: \((-2, 5)\) and \((3,1)\)

\[
m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{1 - 5}{3 - (-2)} = \frac{-4}{5}
\]

**Point-slope form:**
\[
y - 5 = \frac{-4}{5}(x - 3)
\]

**Slope-intercept form:**
\[
y = \frac{-4}{5}x + \frac{17}{5}
\]

**Standard form:**
\[
4x + 5y = 17
\]

**Example 2:**
Write the equation of a line in all forms with a slope of \(\frac{1}{3}\) through the point \((2,1)\)

**Point-slope form:**
\[
y - 1 = \frac{1}{3}(x - 2)
\]

**Slope-intercept form:**
\[
y = \frac{1}{3}x + \frac{1}{3}
\]

**Standard form:**
\[
-x + 3y = -1
\]

Write each line in all three forms given the information below.

30. Line connecting \((-2,3)\) & \((4,7)\)

31. Line with a slope of -3 through \((7,2)\)
Topic 10: Graphing a Line in Any Form

It is important to know how to graph a line from any form. You should not need to convert forms.

Graphing from point-slope form:
1. Graph the given coordinate
2. Count the slope from that point
3. Draw a line connecting the points

Graphing from slope-intercept form:
1. Plot the y-intercept
2. Count the slope from that point
3. Draw a line connecting the points

Graphing from standard form:
1. Determine the x-intercept
2. Determine the y-intercept
3. Plot each point and connect with a line

Graphing a horizontal or vertical line:
1. Determine two points on the line
2. Draw a line that connects both points
Graph each of the following lines from the given form. Do not convert forms!

32. \( y = -\frac{1}{3}x + 3 \)

33. \( y - 5 = \frac{1}{2}(x - 3) \)

34. \( 2x + 4y = 12 \)

35. \( x = -3 \)

36. \( y = x \)

37. \( 2x - 5y = -10 \)

38. \( y = 4 \)

39. \( y + 1 = -2(x - 3) \)
Topic 11: Solving Systems of Equations

Types of solutions: A system of linear equations has three types of solutions:
- **A coordinate.** This occurs when you have a value for each variable after solving.
- **No solution.** This occurs when you have a false statement such as $5 = 7$ after solving.
- **Infinitely many $(x, y)$ solutions that satisfy the equations.** This occurs when you have a true statement after solving. Note: All real numbers is **not** a solution.

Systems of equation are classified as consistent or inconsistent.
- **A consistent system** has at least one solution.
  - If there is one solution, the consistent system is **independent**.
  - If there are infinitely many solutions, the consistent system is **dependent**.
- **An inconsistent system** has no solutions.

Methods and Examples:

**Graphing**
Graph both equations, then find the intersection.

Solve for the variables:
\[
\begin{cases}
2x - y = -10 \\
y + 1 = -\frac{1}{4}(x - 8)
\end{cases}
\]

**Substitution**
Solve one equation for a variable, then substitute the expression in to the variable in the other equation.

Solve for the variables:
\[
\begin{cases}
8x + 2y = 2 \\
x + 3y = 14
\end{cases}
\]

**Elimination**
Add the equations together so that a variable is eliminated. You might need to manipulate the equations first.

Solve for the variables:
\[
\begin{cases}
4x - 2y = -2 \\
12x + 2y = 10
\end{cases}
\]
Solve the following systems by graphing. Then classify the system.

40. \[ \begin{align*}
-3x + 4y &= 8 \\
3 - 2x - 2y &= 6
\end{align*} \]

41. \[ \begin{align*}
y &= -3x - 2 \\
5x + 2y &= -2
\end{align*} \]

Use any method to solve the following systems. Then classify the system.

42. \[ \begin{align*}
3x + 2y &= 1 \\
4x + 6y &= 7
\end{align*} \]

43. \[ \begin{align*}
2x + 3y &= 3 \\
x &= -\frac{3}{2}y + 2
\end{align*} \]

44. \[ \begin{align*}
2x - 5y &= 3 \\
-4x + 10y &= -6
\end{align*} \]
45. If a jet airplane descends at the rate given in the table, what is its height after 27 minutes?

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46. A moving company weighs 22 boxes you have packed that contain either books or clothes. The total weight of these boxes is 445 pounds. If each box of books weighs 35 pounds and each box of clothes weighs 10 pounds, how many boxes of books did you pack?

47. If the perimeter of a rectangle is 120 meters, and the length is 40 meters, find the width of the rectangle.

48. You have two summer jobs. In the first job, you work 25 hours per week and earn $7.75 per hour. In the second job, you earn $6.25 per hour and can work as many hours as you want. You want to earn $250 per week. How many hours must you work at the second job?
49. You want to hang six 2-foot wide posters on the wall. There should be an equal space between the posters and you also want the spaces to the far right and far left of the poster group to be twice the space between any two adjacent posters. The wall is 54 feet long. How far apart should the posters be? (Express your answer in feet and inches).

50. You want to hang six 2-foot wide posters on a cylindrical kiosk that has a diameter of 10 feet. There should be an equal space between the posters. How far apart should the posters be? You may round to the nearest tenth of a foot. (Hint: Draw a diagram. Also, think about how many spaces there are between posters.)

51. Over a 30 day period, the amount of propane in a tank that stores propane for heating a home decreases from 400 gallons to 214 gallons. What is the average rate of change in the amount of propane? (Include units)
Algebra 2 Honors Summer Packet Answers

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<td>j) 1.765</td>
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<td>k) -10000</td>
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<td>l) -1.5</td>
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<td>m) -√6</td>
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2. 13/8
3. 21/80
4. 1/40
5. 1/9
6. 1/18
7. 6/49
8. m = 60
9. w = -3
10. x = 5/24
11. C = 5/9(F - 32)
12. b₂ = 2A/h - b₂
13. r = P - 2x / 2π
14. x = 8y - 9
15. x = 7 / (4 - 2y)
16. x = 3 / (2y - 1)

17. a. 
   b. 
   c. 
   d. all real numbers
18. x ≥ 6
19. x < -7
20. -2 < x ≤ 4
21. x ≤ -2 or x > 3
22. slope: undefined, vertical
23. slope: 0, horizontal
24. slope: -8/9, oblique
25. k = -3
26. slope: 3/2, y-intercept: -3, x-intercept: 2
27. slope: 2, y-intercept: 4, x-intercept: -2
28. slope: -2, y-intercept: 4, x-intercept: 2
29. slope: -5/2, y-intercept: 5, x-intercept: 2
30. point-slope form:
   y - 3 = 2/3(x + 2) or
   y - 7 = 2/3(x - 4)
slope-intercept form:
   y = 2/3x + 13/3
standard form:
   2x - 3y = -13
31. point-slope form:
   y - 2 = -3(x - 7)
slope-intercept form:
   y = -3x + 23
standard form:
   3x + y = 23
32. -39. check your answer using a graphing calculator or desmos.com
33. no solution, inconsistent
34. (-2, 4), consistent and independent
35. (-4, 17 / 5, 10), consistent and independent
36. no solution, inconsistent
37. infinitely many (x, y) solutions that satisfy the equations, consistent and dependent
38. 24,400 feet
39. 9 boxes
40. 20 meters
41. 9 hours
42. 4 feet 8 inches
43. 3.2 feet
44. decreases 6.2 gallons per day