Dear Student,

I look forward to teaching you in Honors Precalculus in the upcoming school year. The problems in this packet represent important skills from Algebra 1 and 2 and Geometry that are basic to your success in the course. Please print out the packet, and then place your name on each page. Work each problem in both parts carefully, spreading this assignment throughout the summer instead of cramming it in right before school starts. Show your work where possible, using a separate sheet if necessary, and clearly mark your answer to each question. If you recognize a topic, but have forgotten how to do it, you may want to consult notes or a web site to review the skill. However, if you are totally unsure of how to do a problem, or have never learned that skill, it is best to leave it blank. This will not penalize your grade. Your summer work will be collected on the first day of class in the fall, and will be graded on effort and completion. Your packet will then be used to diagnose your individual strengths and needs, so that we can review topics quickly that you have mastered, and then spend more time on the areas which need review or need to be taught from the beginning. The goal is to develop an accurate profile of the skills you know and must learn so that I can adjust our work at the beginning to meet your needs. That way, you will be ready for success as we move into the major new areas of precalculus.

If you have any general questions about the assignment or the process described above, you may e-mail me using the new e-mail address that becomes effective after June 10, 2019: icohen@spaulsmd.org. Please be aware that I will be out of town at various times over the summer without access to e-mail, so I may not always be able to respond quickly to your questions. In that case, use your good common sense and do the best you can so that you don’t fall behind in completing the work by the end of summer. I’m eager to meet and work with you in our class this fall.

Sincerely,

Mr. Cohen
PART I

1) Is the equation $3(2x - 4) = -18$ equivalent to $6x - 12 = -18$?

A Yes, because of the Associative Property of Multiplication.
B Yes, because of the Commutative Property of Multiplication
C Yes, because of the Distributive Property
D No, they are not equivalent.

2) Simplify: $\sqrt{16} + \sqrt{8} =$

A 4  C 9
B 6  D 10

3) Which of the following is equivalent to $x^4x^2$?

A $x^4x^3$  C $x^7x^3$
B $x^5x^3$  D $x^6x^3$

4) Which number has no reciprocal?

A -1  C 3
B 0  D .001

5) What is the multiplicative inverse of $\frac{1}{2}$?

A $\frac{1}{2}$  C $\frac{1}{2}$
B -2  D 2

6) Solve for $x$: $|2x - 3| = 5$

A {-4, 4}  C {-1, 4}
B {-4, 3}  D {-1, 3}

7) Solve: $5 - |x + 4| \leq -3$

A $-2 \leq x \leq 6$  C $-12 \leq x \leq 4$
B $x \leq -2$ or $x \geq 6$  D $x \leq -12$ or $x \geq 4$

8) Which equation is equivalent to:

$5x - 2(7x + 1) = 14x$?

A $-9x - 2 = 14x$  C $-9x + 2 = 14x$
B $-9x + 1 = 14x$  D $12x - 1 = 14x$

9) Which equation is a step in solving

$4(2 - 5x) = 6 - 3(1 - 3x)$?

A $8x = 5$  C $29x = 5$
B $8x = 17$  D $29x = 17$

10) The total cost ($c$) in dollars of renting a sailboat for $n$ days is given by the equation:

$c = 120 + 60n$.

If the total cost was $360, for how many days was the sailboat rented?

A 2  C 6
B 4  D 8

11) To solve: $3(x + 5) = 2x + 35$

Step 1: $3x + 15 = 2x + 35$
Step 2: $5x + 15 = 35$
Step 3: $5x = 20$
Step 4: $x = 4$

Which is the first incorrect step in the solution shown above?

A Step 1  B Step 2
C Step 3  D Step 4
12) A 120-foot long rope is cut into 3 pieces. The first piece of rope is twice as long as the second. The third piece is three times as long as the second piece. What is the length of the longest piece of rope?

A 20 ft  \quad C 60 ft  
B 40 ft  \quad D 80 ft

13) The rental cost of a construction crane is $750 per day plus $250 per hour of use. What is the maximum number of hours the crane can be used each day if the rental cost may not exceed $2500 per day?

A 2.5 hr  \quad C 7.0 hr  
B 3.7 hr  \quad D 13.0 hr

14) Solve: \( x - 5 > 14 \).

A \( x > 9 \)  \quad C \( x < 9 \)  
B \( x > 19 \)  \quad D \( x < 19 \)

15) The lengths of the sides of a triangle are \( y, y + 1 \), and 7 cm. If its perimeter is 56 cm, what is the value of \( y \) ?

A 24  \quad C 31  
B 25  \quad D 32

16) Which number below serves as a counterexample to the following statement?

"All positive integers are divisible by 2 or 3."

A 100  \quad C 30  
B 57  \quad D 25

17) What is the conclusion of the following statement?

"If \( x^2 = 4 \), then \( x = -2 \) or \( x = 2 \)."

A \( x^2 = 4 \)  \quad C \( x = -2 \)  
B \( x = 2 \)  \quad D \( x = -2 \) or \( x = 2 \)

18) Which of the following is a valid conclusion to the statement "If a student is a high school band member, then the student is a good musician."

A All good musicians are high school band members.
B A student is a high school band member.
C All students are good musicians.
D All high school band members are good musicians.

19) The chart at right shows an expression evaluated for four different values of \( x \).

\[
x | x^2 + x + 5 \\
1 | 7 \\
2 | 11 \\
6 | 47 \\
7 | 61 \\
\]

Josie concluded that for all positive values of \( x \), \( x^2 + x + 5 \) gives a prime number. Which value of \( x \) would be a counterexample to prove Josie was wrong?

A 5  \quad C 16  
B 11  \quad D 21

20) Here is Rita’s solution to an equation:

Given: \( x^2 + 5x + 6 = 0 \)
Step 1: \((x + 2)(x + 3) = 0 \)
Step 2: \( x + 2 = 0 \) or \( x + 3 = 0 \)
Step 3: \( x = -2 \) or \( x = -3 \)

Which property of real numbers did Rita use to justify Step 2?

A Multiplication property of equality
B Zero product property of multiplication
C Commutative property of multiplication
D Distributive property

21) Here is Sally’s solution to an equation:

Given: \( n + 8(n + 20) = 110 \)
Step 1: \( n + 8n + 20 = 110 \)
Step 2: \( 9n + 20 = 110 \)
Step 3: \( 9n = 110 - 20 \)
Step 4: \( 9n = 90 \)
Step 5: \( n = 10 \)
Step 6: \( n = 10 \)
21) [continued]
Which statement about Sally’s solution is accurate?

A Sally’s solution is correct.
B Sally made a mistake in Step 1.
C Sally made a mistake in Step 3.
D Sally made a mistake in Step 5.

22) When is the following statement true?

"The opposite of a number is less than the original number."

A The statement is NEVER true.
B The statement is ALWAYS true.
C It is true for positive numbers.
D It is true for negative numbers.

23) What is the y-intercept of the graph of 4x + 2y = 12?

A −4
B −2
C 6
D 12

24) Which inequality is graphed below?

A $y < \frac{1}{2}x - 1$
B $y \leq \frac{1}{2}x - 1$
C $y > \frac{1}{2}x - 1$
D $y \geq \frac{1}{2}x - 1$

25) Which graph below represents $y = 2x - 2$?

26) Which of the inequalities below represents the shaded region of the graph?

A $3x + y \leq 2$
B $3x + y \geq 2$
C $3x + y \leq -2$
D $3x + y \geq -2$
27) Which equation below represents the following graph?

A) \( y = x \)  
B) \( y = 2x \)  
C) \( y = x + 2 \)  
D) \( y = 2x + 2 \)

28) Which of the following points lies on the graph of \( 3x + 6y = 2 \)?

A) \( (0, 2) \)  
B) \( (0, 6) \)  
C) \( (1, -\frac{1}{2}) \)  
D) \( (1, -\frac{1}{3}) \)

29) What is the equation of the line that has a slope of 4 and contains the point \( (3, -10) \)?

A) \( y = 4x - 22 \)  
B) \( y = 4x + 22 \)  
C) \( y = 4x - 43 \)  
D) \( y = 4x + 43 \)

30) The following table shows the cost of renting a bicycle by the hour, including a deposit.

<table>
<thead>
<tr>
<th>Hours ((h))</th>
<th>Cost in dollars ((c))</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>45</td>
</tr>
</tbody>
</table>

If you graph hours \((h)\) on the horizontal axis and cost \((c)\) on the vertical axis, what would be the equation of the line that models the data?

31) The table shows the value of some points on the graph of a linear function.

<table>
<thead>
<tr>
<th>( x )</th>
<th>1</th>
<th>3</th>
<th>5</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>1</td>
<td>7</td>
<td>13</td>
<td>19</td>
</tr>
</tbody>
</table>

Which of the following equations models the linear function in the table?

A) \( y = 2x + 1 \)  
B) \( y = 2x - 1 \)  
C) \( y = 3x - 2 \)  
D) \( y = 4x - 3 \)

32) The equation of line \( l \) is \( 6x + 5y = 3 \), and the equation of line \( m \) is \( 5x - 6y = 0 \). Which statement below is true about these lines?

A) Lines \( l \) and \( m \) have the same \( y \)-intercept.  
B) Lines \( l \) and \( m \) are parallel.  
C) Lines \( l \) and \( m \) have the same \( x \)-intercept.  
D) Lines \( l \) and \( m \) are perpendicular.

33) Which of the following equations represents a line parallel to \( y = \frac{5}{4}x + 2 \)?

A) \( y = -\frac{5}{4}x + 1 \)  
B) \( y = -\frac{4}{5}x + 2 \)  
C) \( y = \frac{4}{5}x + 3 \)  
D) \( y = \frac{5}{4}x + 4 \)

34) Which of the following graphs would you use to correctly represent the solution to this system of inequalities?

\[
\begin{align*}
2x &\geq y - 1 \\
2x - 5y &\geq 10
\end{align*}
\]

[look on the next page]
35) What is the solution to this system of equations?
\[
\begin{align*}
    y &= -3x - 2 \\
    6x + 2y &= -4
\end{align*}
\]
A (6, 2)  C no solution
B (1, -5)  D infinitely many solutions

36) What is the solution to this system of equations?
\[
\begin{align*}
    x + 3y &= 7 \\
    x + 2y &= 10
\end{align*}
\]
A \( \left( \frac{7}{2}, \frac{13}{4} \right) \)  C \( \left( \frac{7}{2}, \frac{17}{5} \right) \)
B \( (-2, 17) \)  D \( (16, -3) \)

37) Marcy has a total of 100 coins, some dimes and the rest quarters. The total value of her coins is $14.05. How many quarters does she have?
A 27  C 56
B 40  D 73

38) Which of the following best describes the graph of this system of equations?
\[
\begin{align*}
    y &= -2x + 3 \\
    5y &= -10x + 15
\end{align*}
\]
A two identical lines  B two parallel lines  C two lines intersecting in only one point  D two lines intersecting in only two points

39) Simplify: \( \frac{5x^3}{10x^7} \)
A \( 2x^4 \)  C \( \frac{1}{5x^4} \)
B \( \frac{1}{2x^4} \)  D \( \frac{x^4}{5} \)

40) \( (4x^2 - 2x + 8) - (x^2 + 3x - 2) = \)
A \( 3x^2 + x + 6 \)  C \( 3x^2 - 5x + 6 \)
B \( 3x^2 + x + 10 \)  D \( 3x^2 - 5x + 10 \)

41) The sum of two binomials is \( 5x^2 - 6x \). If one of the binomials is \( 3x^2 - 2x \), what is the other?
A \( 2x^2 - 4x \)  C \( 8x^2 + 4x \)
B \( 2x^2 - 8x \)  D \( 8x^2 - 8x \)

42) Simplify \( (x + 2) + (x - 2)(2x + 1) \):
A \( 2x^2 - 2x \)  C \( 2x^2 + x \)
B \( 2x^2 - 4x \)  D \( 4x^2 + 2x \)

43) A rectangular volleyball court has a width of \( x \) meters and a length of \( 2x \) meters. How would you express its area in square meters?
A \( 3x \)  C \( 3x^2 \)
B \( 2x^2 \)  D \( 2x^3 \)

44) Factor: \( 3a^2 - 24ab + 48b^2 \)
A \( (3a-8b)(a-6b) \)  C \( 3(a-4b)(a-4b) \)
B \( (3a-16b)(a-3b) \)  D \( 3(a-8b)(a-8b) \)
45) Which is a factor of \(x^2 - 11x + 24\) ?
- **A** \(x + 3\)
- **B** \(x - 3\)
- **C** \(x + 4\)
- **D** \(x - 4\)

46) Factor completely: \(9t^2 + 12t + 4\).
- **A** \((3t + 2)^2\)
- **B** \((3t + 4)(3t + 1)\)
- **C** \((9t + 4)(t + 1)\)
- **D** \(9t^2 + 12t + 4\)

47) Factor completely: \(32 - 8z^2\)
- **A** \(-8(2 + z)(2 - z)\)
- **B** \(8(2 + z)(2 - z)\)
- **C** \(-8(2 + z)^2\)
- **D** \(8(2 - z)^2\)

48) If \(x^2\) is added to \(x\), the sum is 42. Which of the following could be a value of \(x\) ?
- **A** \(-7\)
- **B** \(-6\)
- **C** \(14\)
- **D** \(42\)

49) What should be added to both sides of this equation in order to complete the square?
\[x^2 - 8x = 5\]
- **A** \(4\)
- **B** \(-4\)
- **C** \(16\)
- **D** \(-16\)

50) What are the solutions of the quadratic equation \(x^2 + 6x = 16\)?
- **A** \(-2, -8\)
- **B** \(-2, 8\)
- **C** \(2, -8\)
- **D** \(2, 8\)

51) Liza correctly solved the equation \(x^2 + 4x = 6\) by completing the square. Which step below is part of her solution?
- **A** \((x + 2)^2 = 8\)
- **B** \((x + 2)^2 = 10\)
- **C** \((x + 4)^2 = 10\)
- **D** \((x + 4)^2 = 22\)

52) Cassie is solving this equation by factoring:
\[10x^2 - 25x + 15 = 0\]
Which of the following was one of her correct factors?
- **A** \(x + 3\)
- **B** \(x - 3\)
- **C** \(2x + 3\)
- **D** \(2x - 3\)

53) Toni is solving this equation by completing the square:
\[ax^2 + bx + c = 0\ (a > 0)\]
Step 1: \[ax^2 + bx = -c\]
Step 2: \[x^2 + \frac{b}{a}x = -\frac{c}{a}\]
Step 3: ??

What is the correct Step 3 in the solution?
- **A** \[x^2 = -\frac{c}{b} \cdot \frac{b}{a}\]
- **B** \[x + \frac{b}{a} = -\frac{c}{ax}\]
- **C** \[x^2 + \frac{b}{a}x + \frac{b}{2a} = -\frac{c}{a} + \frac{b}{2a}\]
- **D** \[x^2 + \frac{b}{a}x + \left(\frac{b}{2a}\right)^2 = -\frac{c}{a} + \left(\frac{b}{2a}\right)^2\]

54) Which is one of the solutions to the equation \(2x^2 - x - 4 = 0\)?
- **A** \(\frac{1}{4} - \sqrt{33}\)
- **B** \(\frac{1}{4} + \sqrt{33}\)
- **C** \(\frac{1 + \sqrt{33}}{4}\)
- **D** \(-\frac{1}{4} - \sqrt{33}\)

55) What statement best explains why there is no real solution to the quadratic equation \(2x^2 + x + 7 = 0\)?
- **A** The value of \(1^2 - 4 \cdot 2 \cdot 7\) is positive.
- **B** The value of \(1^2 - 4 \cdot 2 \cdot 7\) is equal to 0.
- **C** The value of \(1^2 - 4 \cdot 2 \cdot 7\) is negative.
- **D** The value of \(1^2 - 4 \cdot 2 \cdot 7\) is not a perfect square.
56) Find the solution set of 
\[8x^2 + 2x = -1\]

A \(\left\{-\frac{1}{2}, \frac{1}{4}\right\}\)  
C \(\left\{-\frac{1 + \sqrt{7}}{8}, -\frac{1 - \sqrt{7}}{8}\right\}\)

B \(\{-1 + \sqrt{2}, -1 - \sqrt{2}\}\)  
D no real solution

57) The graph of \(y = x^2 - 3x - 4\) is below.

For what value or values of \(x\) is \(y = 0\) ?

A -1 only  
B -4 only  
C -1 and 4  
D 1 and -4

59) Which quadratic function, when graphed, has \(x\)-intercepts of 4 and -3?

A \(y = (x - 3)(x + 4)\)  
C \(y = (3x - 1)(4x + 1)\)

B \(y = (x + 3)(2x - 8)\)  
D \(y = (3x + 1)(8x - 2)\)

60) How many times does the graph of \(y = 2x^2 - 2x + 3\) intersect the \(x\)-axis?

A none  
B one  
C two  
D three

61) An object projected straight downward with initial velocity \(v\) feet per second travels a distance \(s = vt + 16t^2\), where \(t\) = time in seconds. If Rachel is standing on a balcony 84 feet above the ground and throws a penny straight down with an initial velocity of 10 feet per second, in how many seconds will it reach the ground?

A 2 seconds  
B 3 seconds  
C 6 seconds  
D 8 seconds

62) The height of a triangle is 4 inches greater than twice its base. The area of the triangle is 168 in\(^2\). How long is the base of the triangle?

A 7 in  
B 8 in  
C 12 in  
D 14 in

63) Simplify \(\frac{x^2 - 4xy + 4y^2}{3xy - 6y^2}\):

A \(\frac{x - 2y}{3}\)  
B \(\frac{x - 2y}{3y}\)

C \(\frac{x + 2y}{3}\)  
D \(\frac{x + 2y}{3y}\)
64) Simplify \( \frac{6x^2 + 21x + 9}{4x^2 - 1} \):

A \( \frac{3(x+1)}{2x-1} \)  
B \( \frac{3(x+3)}{2x-1} \)

65) Find the product of the following:

\( \frac{7z^2 + 7z}{4z+8} \cdot \frac{z^2 - 4}{z^2 + 2z^2 + z} \)

A \( \frac{7(z-2)}{4(z+1)} \)  
B \( \frac{7(z+2)}{4(z-1)} \)

66) Divide \( \frac{x^2 + 8x + 16}{x+3} + \frac{2x+8}{x^2 - 9} \):

A \( \frac{2(x+4)^2}{(x-3)(x+3)^2} \)  
B \( \frac{2(x+3)(x-3)}{x+4} \)

67) Simplify \( \frac{3x}{x + \frac{x}{4}} \):

A \( \frac{x^2}{5} \)  
B \( \frac{9x^2}{20} \)

68) A pharmacist mixed some 10% saline solution with some 15% saline solution to obtain 100 ml of a 12% saline solution. How much of the 10% solution did she use in the mixture?

A 60 ml  B 45 ml  C 40 ml  D 25 ml

69) Annie’s average driving speed for a 4-hr trip was 45 mph. During the first 3 hours she drove at 40 mph. What was her average speed for the last hour of her trip?

A 50 mph  B 60 mph  C 65 mph  D 70 mph

70) One pipe can fill a tank in 20 minutes, while a smaller pipe takes 30 minutes to fill the tank. How long would it take the two pipes together to fill the tank?

A 50 min  B 25 min  C 15 min  D 12 min

71) Two airplanes left the same airport flying in opposite directions. If one plane averages 400 mph and the other plane averages 250 mph, how long will it take for the planes to be 1625 miles apart?

A 2.5 hr  B 4 hr  C 5 hr  D 10.8 hr

72) Lisa makes a punch that is 25% fruit juice by adding pure fruit juice to a 2-liter mixture that has 10% fruit juice. How many liters of pure fruit juice does she need to use?

A 0.4 L  B 0.5 L  C 2 L  D 8 L

73) Which of the following relations is a function?

A \( \{ (-1, 3), (-2, 6), (0, 0), (-2, -2) \} \)
B \( \{ (-2, -2), (0, 0), (1, 1), (2, 2) \} \)
C \( \{ (4, 0), (4, 1), (4, 2), (4, 3) \} \)
D \( \{ (7, 4), (8, 8), (10, 8), (10, 10) \} \)
74) Which relation graphed below has a range that is completely negative?

A

B

C

D

75) Which of the following graphs does NOT represent a function?

A

B

C

D
PART II

1) Solve $|3 - 6x| = 15$.
   A) $\{2,3\}$  C) $\{-2, -3\}$
   B) $\{-2, 3\}$  D) $\{-2, -3\}$

2) What are the possible values for $x$ in the equation $|12 - 4x| = 2$?
   A) $x = -2.50$ or $x = -3.50$
   B) $-3.50 < x < -2.50$
   C) $3.5 > x > 2.5$
   D) $x = 2.50$ or $x = 3.50$

3) For a wedding, Sharon bought several dozen roses and several dozen carnations. The roses cost $15 per dozen, and the carnations cost $8 per dozen. Sharon bought a total of 17 dozen flowers and paid a total of $192. How many roses did she buy?
   A) 6 dozen  C) 8 dozen
   B) 7 dozen  D) 9 dozen

4) What is the solution to this system?
   \[
   \begin{align*}
   2x - y + 3z &= 8 \\
   x - 6y - z &= 0 \\
   -6x + 3y - 9z &= 24
   \end{align*}
   \]
   A) $(0, 4, 4)$  C) no solution
   B) $(1, 4, -\frac{10}{3})$  D) infinite solutions

5) A restaurant manager bought 20 packages of bagels. Some packages contained 6 bagels each, and the rest contained 12 bagels each. There were 168 bagels in all. How many packages of 12 bagels did she buy?
   A) 6  C) 9
   B) 8  D) 12

6) What system of inequalities is graphed?
   A) $y > -2$ and $y > x + 1$
   B) $y > -2$ and $y < x + 1$
   C) $y < -2$ and $y > x + 1$
   D) $y < -2$ and $y < x + 1$

7) Which point lies in the solution set of the system
   \[
   \begin{align*}
   2y - x &\geq -6 \\
   2y - 3x &< -6
   \end{align*}
   \]
   A) $(-4, -1)$  C) $(0, -3)$
   B) $(3, 1)$  D) $(4, 3)$

8) Which system of inequalities is shown in the following graph? [Answer choices are at the top of the next page.]
8) [continued]
A) \[ \begin{align*}
    y &\geq \frac{1}{2}x + 3 \\
    y &\geq x - 2
\end{align*} \]
B) \[ \begin{align*}
    y &\geq 2x + 3 \\
    y &\leq x - 2
\end{align*} \]
C) \[ \begin{align*}
    2x - y &\geq 3 \\
    x + y &\leq 2
\end{align*} \]
D) \[ \begin{align*}
    2x + y &\geq 3 \\
    x - y &\geq 2
\end{align*} \]

9) Solve: \[ \begin{align*}
    2x - 3y &= 4 \\
    4x + y &= -6
\end{align*} \]
A) (5, -2)  
B) (-2, 5)  
C) (-1, -2)  
D) (-2, -1)

10) Use long division to simplify:
\[ \frac{2x^4 + 21x^3 + 35x^2 - 37x + 46}{2x + 7} \]
A) \[ x^3 + 7x^2 - 7x + 6 - \frac{4}{2x + 7} \]
B) \[ 2x^3 + 14x^2 - 14x + 12 - \frac{4}{2x + 7} \]
C) \[ x^3 - 7x^2 + 7x - 6 + \frac{4}{2x + 7} \]
D) \[ x^3 + 7x^2 - 7x + 6 + \frac{4}{2x + 7} \]

11) Multiply \((3x^2 + x - 4)\) \((2x - 5)\):
A) \[ 6x^3 - 13x^2 - 13x - 20 \]
B) \[ 6x^3 - 13x^2 - 13x + 20 \]
C) \[ 6x^3 + 13x^2 + 3x - 20 \]
D) \[ 6x^3 + 13x^2 + 3x + 20 \]

12) \((-2x^2 + 6x + 1) - 2(4x^2 - 3x + 1) = \)
A) \[ 6x^2 - 1 \]
B) \[-10x^2 - 1 \]
C) \[ 6x^2 + 12x - 1 \]
D) \[-10x^2 + 12x - 1 \]

13) Multiply \((6y^2 - 2)\) \((6y + 2)\):
A) \[ 36y^2 - 4 \]
B) \[ 36y^3 - 4 \]
C) \[ 36y^3 + 12y^2 + 12y - 4 \]
D) \[ 36y^3 + 12y^2 - 12y - 4 \]

14) Find the volume of the figure below:
A) \(x^3 + 10x^2 + 34x + 24\)
B) \(x^3 + 11x^2 + 34x + 24\)
C) \(x^3 + 10x^2 + 24x + 24\)
D) \(x^3 + 11x^2 + 24x + 24\)

15) Find the product: \((5x^3 - 2x)(3x^2 + x - 8)\)
A) \(5x^3 + 3x^2 - x - 8\)
B) \(15x^5 - 42x^3 + 16x\)
C) \(15x^5 + 5x^4 - 46x^3 - 2x^2 + 16x\)
D) \(15x^6 - 35x^3 - 6x^2 + 14x\)

16) Factor \(8a^3 + c^3\):
A) \((2a + c)(2a + c)(2a + c)\)
B) \((2a - c)(4a^2 + 2ac + c^2)\)
C) \((2a - c)(4a^2 + 4ac + c^2)\)
D) \((2a + c)(4a^2 - 2ac + c^2)\)

17) The total area of a rectangle is \(4x^4 - 9y^2\). Which factors could represent its dimensions?
A) \((2x^2 - 3y)(2x^2 + 3y)\)
B) \((2x^2 + 3y)(2x^2 - 3y)\)
C) \((2x - 3y)(2x + 3y)\)
D) \((2x + 3y)(2x - 3y)\)

18) Which product below is equivalent to \((x + 1)^2 - y^2\)?
A) \((x + 1 + y)^2\)
B) \((x + 1 - y)^2\)
C) \((x - 1 + y)(x - 1 - y)\)
D) \((x + 1 + y)(x + 1 - y)\)

19) Factor completely: \(12x^2 - 147\)
A) \((3x - 7)(4x + 2)\)
B) \((4x - 2)(3x + 7)\)
C) \(12(x - 7)(x + 7)\)
D) \(3(2x - 7)(2x + 7)\)
20) Factor $25x^2 - 40xy + 16y^2$.
   A) $(5x - 4y)^2$  
   B) $(5x + 10 - 4y)^2$  
   C) $5(5x - 4y)^2$  
   D) $5(4xy)^2$

21) \[ \frac{x + 3}{x + 5} + \frac{6}{x^2 + 3x - 10} = \]
   A) \[ \frac{x^2 + x}{x^2 + 3x - 10} \]
   B) \[ \frac{7x - 9}{x^2 + 3x - 10} \]
   C) \[ \frac{x^2 + x + 12}{x^2 + 3x - 10} \]
   D) \[ \frac{x^2 + x + 1}{x^2 + 3x - 10} \]

22) Simplify: \[ \frac{3a^2b^3c^{-2}}{(a^{-1}b^2c)^3} \]
   A) \[ \frac{3a^5}{b^3c^5} \]
   B) \[ \frac{3ab}{c^5} \]
   C) \[ \frac{3}{b^2c^5} \]
   D) \[ \frac{3}{ab^3c^5} \]

23) Find \[ \frac{20x^{-4} + 8x^{-3}}{27y^2 + 15y^{-5}} : \]
   A) \[ \frac{32y^3}{81x} \]
   B) \[ \frac{32}{81xy^7} \]
   C) \[ \frac{25y^3}{18x} \]
   D) \[ \frac{25}{18xy^7} \]

24) Simplify \[ \frac{4x^2 - 16}{2 - x} : \]
   A) \[ 4(x - 2) \]
   B) \[ 4(x + 2) \]
   C) \[ -4(x - 2) \]
   D) \[ -4(x + 2) \]

25) Simplify \[ \frac{x^2 + 4x}{x + 3} - \frac{x^2 - 9}{x^2 + x - 12} : \]
   A) \[ 1 \]
   B) \[ x \]
   C) \[ x + 4 \]
   D) \[ \frac{x + 3}{x - 3} \]

26) Simplify \[ \frac{5x^3y + 20x^2y^2 + 20xy^3}{5xy} : \]
   A) \[ (x + 2)^2 \]
   B) \[ (x + 2y)^2 \]
   C) \[ x^2 + y^2 \]
   D) \[ x^2 + 4y^2 \]

27) Simplify \[ \frac{2x^2 - 10x}{x^2 + 8x + 16} \cdot \frac{4x + 16}{x^2 - 25} : \]
   A) \[ \frac{8x}{(x + 4)(x - 5)} \]
   B) \[ \frac{2x + 4}{(x + 4)(x + 5)} \]
   C) \[ \frac{8x}{(x + 4)(x + 5)} \]
   D) \[ \frac{2x + 4}{x^2 + 20} \]

28) Simplify \[ \frac{4(x + y)}{5x^2y^3} + \frac{-2x - 2y}{10} : \]
   A) \[ -\frac{4}{x^2y^3} \]
   B) \[ \frac{4}{x^2y^3} \]
   C) \[ -\frac{4(x + y)}{x^2y^3(x - y)} \]
   D) \[ \frac{4(x + y)^2}{5x^2y^3} \]

29) Remember that \( i = \sqrt{-1} \). Find \( i^4 \).
   A) \( i \)
   B) \( -i \)
   C) \( 1 \)
   D) \( -1 \)
30) Which of the following complex numbers is represented on the graph below?

A) $4 + 3i$  
B) $4 - 3i$  
C) $3 - 4i$  
D) $3 + 4i$

31) Find the product: $4i(6i) =$
A) 48  
B) 24  
C) −24  
D) −48

32) Find an equivalent to $\frac{2}{3+i}$.
A) $\frac{3-i}{4}$  
B) $\frac{3-i}{5}$  
C) $\frac{4-i}{4}$  
D) $\frac{4-i}{5}$

33) Multiply $(3+i)(3-i)$.
A) 8  
B) 10  
C) $9 - i$  
D) $10 - 6i$

34) If $a$ and $b$ are non-zero real numbers, what is the value of $\frac{1}{a+bi}$?
A) $\frac{a+bi}{a^2+b^2}$  
B) $\frac{a-bi}{a^2+b^2}$  
C) $\frac{a+bi}{a^2-b^2}$  
D) $\frac{a-bi}{a^2-b^2}$

35) Find $(-3 - 2i) - (-5 + i)$:
A) $-8 - 3i$  
B) $-8 - i$  
C) $2 - i$  
D) $2 - 3i$

36) Find the sum of $(12 - 5i)$ and $(-3 + 4i)$.
A) $9 - i$  
B) $15 - 9i$  
C) $-16 + 63i$  
D) $9 - 9i$

37) Solve $x^2 + 2x + 2 = 0$.
A) $\{0, -2\}$  
B) $\{0, -2i\}$  
C) $\{-1 + i, -1 - i\}$  
D) $\{-1 + 2\sqrt{2}, -1 - 2\sqrt{2}\}$

38) Solve $1 + \frac{1}{x^2} = \frac{3}{x}$.
A) $\left\{\frac{3 + \sqrt{5}}{2}, \frac{3 - \sqrt{5}}{2}\right\}$  
B) $\left\{\frac{3 + \sqrt{5}}{2}, \frac{3 - \sqrt{5}}{2}\right\}$  
C) $\left\{\frac{3 + \sqrt{13}}{2}, \frac{3 - \sqrt{13}}{2}\right\}$  
D) $\left\{\frac{3 + \sqrt{13}}{2}, \frac{3 - \sqrt{13}}{2}\right\}$

39) Two numbers have the following properties:
- The second is 3 more than the first.
- Their product is 9 more than their sum.
Find the two numbers.
A) $\{-6, -3\}$  
B) $\{-4, -1\}$  
C) $\{-1, 4\}$  
D) $\{-3, 6\}$

40) Jen is solving $x^2 - 8x = 9$ by completing the square. What number should be added to both sides of the equation to complete the square?
A) 2  
B) 4  
C) 8  
D) 16

41) Of two consecutive integers, the first times twice the second equals 612. Find the sum of the two integers.
A) 33  
B) 35  
C) 37  
D) 39
42) Solve this equation for $x$:

$$x^2 - 6x + 5 = -8$$

A) $\{2, 3\}$  
B) $\{2i, 3i\}$  
C) $\{3+2\sqrt{3}, 3-2\sqrt{3}\}$  
D) $\{3+2i, 3-2i\}$

43) Which of the following describes the transformation of $f(x)$ to $g(x)$, given $f(x) = (x+3)^2 - 2$ and $g(x) = (x-2)^2 + 2$?

A) up 4 and 5 to the right  
B) down 2 and 2 to the right  
C) down 2 and 3 to the left  
D) up 4 and 2 to the left

44) Which of the following statements is true about the graphs of $y = 3(x - 5)^2 + 1$ and $y = 3(x + 5)^2 + 1$?

A) Their vertices are minimums.  
B) They have the same shape but with different vertices.  
C) They have different shapes with different vertices.  
D) One has a vertex that is a maximum, the other one’s vertex is a minimum.

45) What are the $x$-intercepts of the function $f(x) = 12x^2 - 5x - 2$?

A) $1$ and $-\frac{1}{6}$  
B) $-1$ and $\frac{1}{6}$  
C) $\frac{2}{3}$ and $-\frac{1}{4}$  
D) $-\frac{2}{3}$ and $\frac{1}{4}$

46) Of the graphs shown in the column at the right, which one shows the function $f(x) = -2(x - 1)^2 + 1$?
47) Which of the following ordered pairs is the vertex of \( f(x) = x^2 + 6x + 5 \)?

A) \((-3, -4)\) \hspace{1cm} C) \((-1, 0)\)
B) \((-2, -3)\) \hspace{1cm} D) \((0, -5)\)

48) Solve for \( x : 5^x = 17 \).

A) 2 \hspace{1cm} C) \(\log_{17} + \log 5\)
B) \(\log 2\) \hspace{1cm} D) \(\frac{\log_{17}}{\log 5}\)

49) If \( \log x = -2 \), what is the value of \( x \)?

A) \(\sqrt[10]{\frac{1}{10}}\) \hspace{1cm} C) \(\frac{1}{100}\)
B) \(-\sqrt[10]{\frac{1}{10}}\) \hspace{1cm} D) 100

50) Which equation is equivalent to \( \log_3 \frac{1}{9} = x \)?

A) \(\frac{1^3}{9} = x^3\) \hspace{1cm} C) \(3^x = \frac{1}{9}\)
B) \(\left(\frac{1}{9}\right)^3 = x\) \hspace{1cm} D) \(3^x = x\)

51) If \( \log_x y = 2 \), which of the following would also be true?

A) \(y = x^2\) \hspace{1cm} C) \(x = y^2\)
B) \(y = 2x\) \hspace{1cm} D) \(x = 2y\)

52) Ann, Bob, Cate, and Dede each worked the same problem at the board. Their work is shown below and in the next column. The teacher said only one had completely correct work and a correct solution.

\[ \begin{align*}
\text{Ann} & : \quad x^3 x^{-7} = x^3 \quad x^3 x^{-7} = x^3 \\
& : \quad = x^{10}, x \neq 0 \quad = \frac{1}{x^4}, x \neq 0
\end{align*} \]

\[ \begin{align*}
\text{Bob} & : \quad x^3 x^{-7} = \frac{x^3}{x^{-7}} \\
& : \quad = x^4, x \neq 0
\end{align*} \]

\[ \begin{align*}
\text{Dede} & : \quad x^3 x^{-7} = \frac{x^3}{x^7} \\
& : \quad = x^4, x \neq 0
\end{align*} \]

Who had the completely correct solution?

A) Ann \hspace{1cm} C) Cate
B) Bob \hspace{1cm} D) Dede

53) Ashleigh graphed the following equation:

\[ \frac{x^2}{16} - \frac{y^2}{9} = 1 \]

What was the shape of her graph?

A) parabola \hspace{1cm} C) ellipse
B) circle \hspace{1cm} D) hyperbola

54) Sam tried to simplify \((x^2)^3 - (x^4)^{-1}\) using the following steps:

\begin{align*}
\text{Step 1:} & \quad (x^2)^3 - (x^4)^{-1} = x^6 - x^{-5} \\
\text{Step 2:} & \quad = x^6 - \frac{1}{x^5} \\
\text{Step 3:} & \quad = \frac{x^6}{x^5} \\
\text{Step 4:} & \quad = x
\end{align*}

Which step contains his first mistake?

A) Step 1 \hspace{1cm} C) Step 3
B) Step 2 \hspace{1cm} D) Step 4

55) A radioactive element decays over time according to the equation \( y = A \left(\frac{1}{2}\right)^{\frac{t}{300}} \),

where \( A \) = initial number of grams present and \( t \) = the number of years that pass. If 1,000 grams were present initially, how many grams remain after 900 years?

A) 500 grams \hspace{1cm} C) 125 grams
B) 250 grams \hspace{1cm} D) 62.5 grams
56) Bacteria in a culture increase exponentially with time, as shown below:

<table>
<thead>
<tr>
<th>Day</th>
<th># of Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>400</td>
</tr>
</tbody>
</table>

Which of the following equations expresses the number of bacteria, \( y \), present after \( t \) days?

A) \( f(t) = 100 + 2^t \)  
B) \( f(t) = 100(2)^t \)  
C) \( f(t) = 2^t \)  
D) \( f(t) = 200(2)^t \)

57) On the graph of \( y = 2^x \), which of the following values of \( x \) yields a point closest to the \( x \)-axis?

A) \( \frac{1}{4} \)  
B) \( \frac{3}{4} \)  
C) \( \frac{5}{3} \)  
D) \( \frac{8}{3} \)

58) Which table of values contains correct points for the function \( f(x) = 3^{-x} - 2 \)?

A) \[
\begin{array}{c|c|c|c}
 x & -2 & -1 & 0 \\
 f(x) & -18 & -6 & -2 \\
\end{array}
\]

B) \[
\begin{array}{c|c|c|c}
 x & -2 & -1 & 0 \\
 f(x) & -18 & -6 & -2 \\
\end{array}
\]

C) \[
\begin{array}{c|c|c|c}
 x & -2 & -1 & 0 \\
 f(x) & -1.8 & -1.6 & -1 \\
\end{array}
\]

D) \[
\begin{array}{c|c|c|c}
 x & -2 & -1 & 0 \\
 f(x) & 7 & 1 & -1 \\
\end{array}
\]

59) In 2015 the population of a small town was 700. If the annual rate of increase is about 0.8%, which value below expresses the population five years later?

A) \( 5(700)(0.008) \)  
B) \( 5(700)(1.008) \)  
C) \( 700(0.008)^5 \)  
D) \( 700(1.008)^5 \)

60) Find \( \log_6 40 \).

A) \( \log_6 6 + \log_6 40 \)  
B) \( \log_6 6 - \log_6 40 \)  
C) \( (\log_6)(\log_{40}) \)  
D) \( \frac{\log_{40}}{\log_6} \)

61) Given that \( x \) represents a real number, for what values of \( x \) is the following true?

\[ \frac{3x - 9}{3} = x - 3 \]

A) for all real numbers  
B) for certain real numbers only  
C) no values of \( x \) make it true  
D) impossible to determine

62) On a recent test, Jill wrote the following:

\[ \frac{x^2 - 16}{x - 4} = x + 4 \]

Which of the following statements is correct about what Jill wrote?

A) The equation is always true.  
B) The equation is always true, except for the case where \( x = 4 \).  
C) The equation is never true.  
D) The equation is sometimes true when \( x = 4 \)

63) Given the equation \( y = x^n \) where \( x > 0 \) and \( n < 0 \), which of the following is true about \( y \)?

A) \( y > 0 \)  
B) \( y = 0 \)  
C) \( y < 0 \)  
D) \( y \) can’t be determined

64) If \( x \) is a real number, which statement best describes the values of \( x \) for which the inequality \( \sqrt{x} > 0 \) is true?

A) for all \( x > 0 \)  
B) for all \( x \geq 0 \)  
C) for any value of \( x \)  
D) for NO values of \( x \)
65) Which of the following conclusions is true about the statement \( x^2 = \sqrt{x} \)?

A) This is always true.
B) This is true when \( x \) is negative.
C) This is true when \( x = 0 \).
D) This is never true.

66) If \( x \) is a real number, for which values of \( x \) is the equation \( \log_3 5^x = x \) true?

A) all values of \( x \)  
B) some values of \( x \)  
C) no values of \( x \)  
D) can’t be determined

67) Nora wants to create many different passwords of 7 characters by re-arranging the first 3 letters of her name (N,O,R), followed by arrangements of the digits of 2018, the year her brother was born. How many different passwords can she create in this way?

A) 72  
B) 144  
C) 288  
D) 576

68) Which expression represents \((f \circ g)(x)\) if \( f(x) = x^2 - 1 \) and \( g(x) = x + 3 \)?

A) \( x^3 + 3x^2 - x - 3 \)
B) \( x^2 + 6x + 8 \)
C) \( x^2 + x + 2 \)
D) \( x^2 + 8 \)

69) Given that \( f(x) = 3x^2 - 4 \), and that \( g(x) = 2x - 6 \), what is the value of \( g(f(2)) \)?

A) -2  
B) 6  
C) 8  
D) 10

70) If \( f(x) = x^2 + 2x + 1 \) and \( g(x) = 3(x + 1)^2 \), which expression is an equivalent form of \( f(x) + g(x) \)?

A) \( x^2 + 4x + 2 \)
B) \( 4x^2 + 2x + 4 \)
C) \( 4x^2 + 8x + 4 \)
D) \( 10x^2 + 20x + 10 \)