1 If $\sqrt{x - 4} = 7$, what is the value of $x$?
   1) 11  
   2) 18  
   3) 45  
   4) 53

2 The coordinates of $\Delta ABC$ are $A(1, 1)$, $B(2, 3)$, and $C(3, 1)$. If $\Delta A'B'C'$ is the result of the transformation $D_2 \circ r_{y-axis}$, then $\Delta A'B'C'$ is
   1) similar to $\Delta ABC$  
   2) congruent to $\Delta ABC$  
   3) a right triangle  
   4) an equilateral triangle

3 What is the value of $3 \sum_{n=2}^{6} \frac{n^2}{2}$?
   1) 10  
   2) 13  
   3) 30  
   4) 60

4 An equation of a parabola that has $x = 2$ as its axis of symmetry is
   1) $y = x^2 - 4x + 1$  
   2) $y = x^2 - 2x + 3$  
   3) $y = 2x^2 + 8x - 3$  
   4) $y = 2x^2 + 4x - 7$

5 What is the solution set for the equation $|3 - 2x| = 5$?
   1) $\{-1, 4\}$  
   2) $\{1, -4\}$  
   3) $\{-1\}$  
   4) $\{4\}$

6 A central angle of $\frac{4\pi}{15}$ radians intercepts an arc whose degree measure is
   1) 48  
   2) 72  
   3) 96  
   4) $\frac{4\pi}{15}$

7 If $\cos 2\theta = 1$, a value of $\theta$ is
   1) $45^\circ$  
   2) $90^\circ$  
   3) $180^\circ$  
   4) $270^\circ$

8 If $\cos x = -0.7$ and $\csc x > 0$, the terminal side of angle $x$ is located in Quadrant
   1) I  
   2) II  
   3) III  
   4) IV

9 The graph of the equation $xy = 12$ is best described as
   1) a circle  
   2) two lines  
   3) an ellipse  
   4) a hyperbola
10 The image of function \( f(x) \) is found by mapping each point on the function \((x, y)\) to the point \((y, x)\). This image is a reflection of \( f(x) \) in
1) the \( x \)-axis
2) the \( y \)-axis
3) the line whose equation is \( y = x \)
4) the line whose equation is \( y = -x \)

11 What is the inverse of the function \( y = 3x - 2 \)?
1) \( y = -3x + 2 \)
2) \( y = \frac{x + 2}{3} \)
3) \( y = \frac{x - 2}{3} \)
4) \( 3y = 2x \)

12 Which equation represents the circle whose center is \((3, -1)\) and whose radius is \( \sqrt{6} \)?
1) \((x + 3)^2 + (y - 1)^2 = 36 \)
2) \((x - 3)^2 + (y + 1)^2 = 36 \)
3) \((x + 3)^2 + (y - 1)^2 = 6 \)
4) \((x - 3)^2 + (y + 1)^2 = 6 \)

13 Which expression is equivalent to \( \frac{y - x}{x^2 - y^2} \)?
1) \( \frac{1}{x - y} \)
2) \( -\frac{1}{x - y} \)
3) \( \frac{1}{x + y} \)
4) \( -\frac{1}{x + y} \)

14 If \( \log x = 3 \log a - \log b \), then \( x \) is equal to
1) \( \frac{3a}{b} \)
2) \( \frac{a^3}{b} \)
3) \( 3a - b \)
4) \( a^3 - b \)

15 Which expression is equivalent to \( b \) in the equation \( V = \sqrt[\frac{1}{3}]{a^4 b^\frac{1}{3}} \)?
1) \( \frac{V^6}{a^{12}} \)
2) \( \frac{V^5}{a^7} \)
3) \( \frac{V^2}{a^4} \)
4) \( \frac{V}{a^2} \)

16 In the binomial expansion of \((x + y)^8\), what is the coefficient of the term containing \(x^3y^5\)?
1) 15
2) 28
3) 56
4) 70

17 If \( R \) is inversely proportional to \( A \), and \( R = 4 \) when \( A = 100 \), what is the value of \( R \) when \( A = 250 \)?
1) 0.625
2) 1.6
3) 10
4) 6.250
18 If $m \angle A = 35\degree$, $b = 3$, and $a = 4$, how many different triangles can be constructed?
1) No triangles can be constructed.
2) two triangles
3) one right triangle, only
4) one obtuse triangle, only

19 In a right triangle where one of the angles measures $30\degree$, what is the ratio of the length of the side opposite the $30\degree$ angle to the length of the side opposite the $90\degree$ angle?
1) $1: \sqrt{2}$
2) $1:2$
3) $1:3$
4) $1: \sqrt{3}$

20 If zero is the value of the discriminant of the equation $ax^2 + bx + c = 0$, which graph best represents $y = ax^2 + bx + c$?

21 If $f(x) = 3x + 1$ and $g(x) = x^2 - 1$, find $(f \circ g)(2)$.

22 In $\triangle BAT$ and $\triangle CRE$, $\angle A \cong \angle R$ and $\overline{BA} \cong \overline{CR}$. Write one additional statement that could be used to prove that the two triangles are congruent. State the method that would be used to prove that the triangles are congruent.
23. Given the complex numbers $z_1 = 3 + 2i$ and $z_2 = -5 + 5i$. Find $z_1 - z_2$ and graph the result on the accompanying set of axes.

24. The function, $f$, is drawn on the accompanying set of axes. On the same set of axes, sketch the graph of $f^{-1}$, the inverse of $f$.

25. Express the sum of $4\sqrt{-12}$ and $3\sqrt{-27}$ in simplest radical form, in terms of $i$.

26. Express the reciprocal of $3 - \sqrt{7}$ in simplest radical form with a rational denominator.

27. In the accompanying diagram of $\triangle RST$, $RS = 30$ centimeters, $m\angle T = 105^\circ$, and $m\angle R = 40^\circ$. Find the area of $\triangle RST$, to the nearest square centimeter.

28. The mid-September statewide average gas prices, in dollars per gallon, $(y)$, for the years since 2000, $(x)$, are given in the table below.

<table>
<thead>
<tr>
<th>Year Since 2000 $(x)$</th>
<th>Price Per Gallon $(y)$</th>
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<tr>
<td>1</td>
<td>1.345</td>
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<td>2</td>
<td>1.408</td>
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<tr>
<td>3</td>
<td>1.537</td>
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<td>4</td>
<td>1.58</td>
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Write a linear regression equation for this set of data. Using this equation, determine how much more the actual 2005 gas price was than the predicted gas price if the actual mid-September gas price for the year 2005 was $2.956$. 
29  Given:  \(J(-4, 1), E(-2, -3), N(2, -1)\)  
Prove:  \(\triangle JEN\) is an isosceles right triangle.  
[The use of the grid is optional.]

30  According to a federal agency, when a lie detector test is given to a truthful person, the probability that the test will show that the person is not telling the truth is 20%.  If a company interviews five truthful candidates for a job and asks about thefts from prior employers, what is the probability a lie detector test will show that at most one candidate is not telling the truth?  

31  Currently, the population of the metropolitan Waterville area is 62,700 and is increasing at an annual rate of 3.25%.  This situation can be modeled by the equation \(P(t) = 62,700(1.0325)^t\), where \(P(t)\) represents the total population and \(t\) represents the number of years from now.  Find the population of the Waterville area, to the nearest hundred, seven years from now.  Determine how many years, to the nearest tenth, it will take for the original population to reach 100,000.  
[Only an algebraic solution can receive full credit.]

32  A tractor stuck in the mud is being pulled out by two trucks.  One truck applies a force of 1,200 pounds, and the other truck applies a force of 1,700 pounds.  The angle between the forces applied by the two trucks is 72°.  Find the magnitude of the resultant force, to the nearest pound.

33  In the accompanying diagram, \(\overline{PA}\) is tangent to circle \(O\) at \(A\), chord \(\overline{AC}\) and secant \(\overline{PCE}\) are drawn, and chords \(\overline{AOB}\) and \(\overline{CD}\) intersect at \(E\).  If \(m\angle AOB = 130^\circ\) and \(m\angle BAC = 50^\circ\), find \(m\angle P\), \(m\angle BEC\), and \(m\angle PCA\).

34  Solve for all values of \(x\), to the nearest tenth:  
\[
\frac{1}{x} + \frac{1}{x+3} = 3
\]
### 0110b

#### Answer Section

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**PTS: 2**  REF: 011021b  STA: A2.A.42  TOP: Compositions of Functions
22 ANS:
\[ \angle B \cong \angle C \text{ and ASA, or } \angle T \cong \angle E \text{ and AAS, or } \overline{AT} \cong \overline{RE} \text{ and SAS} \]

PTS: 2  REF: 011022b  STA: G.G.27  TOP: Congruency Proofs

23 ANS:

\[
8 - 3i
\]

PTS: 2  REF: 011023b  TOP: Graphing Complex Numbers

24 ANS:

\[
3 + \frac{7}{2}
\]

PTS: 2  REF: 011024b  STA: A2.A.44  TOP: Inverse of Functions

25 ANS:

\[ 17i\sqrt{3} \]

PTS: 2  REF: 011025b  STA: A2.N.6  TOP: Square Roots of Negative Numbers

26 ANS:

\[ \frac{3 + \sqrt{7}}{2} \]

PTS: 2  REF: 011026b  STA: A2.N.5  TOP: Rationalizing Denominators

27 ANS:

\[ 172 \]

PTS: 4  REF: 011027b  STA: A2.A.74  TOP: Using Trigonometry to Find Area
28 ANS:
\[ y = 0.0834x + 1.259, 1.28 \]

PTS: 4  REF: 011028b  STA: A2.S.7  TOP: Linear Regression

29 ANS:

To prove that \( \triangle JEN \) is a right triangle, prove that its legs are perpendicular by showing their slopes are opposite reciprocals:
\[
m_{JE} = \frac{1-3}{-4-2} = \frac{4}{-2} = -2
\]
\[
m_{EN} = \frac{-3-1}{-2-2} = \frac{-2}{-4} = \frac{1}{2}
\]

To prove that \( \triangle JEN \) is an isosceles triangle, prove that its legs are congruent by using the distance formula:
\[
d_{JE} = \sqrt{(-4-(-2))^2 + (1-(-3))^2} = \sqrt{20}
\]
\[
d_{EN} = \sqrt{(-2-2)^2 + (-3-1)^2} = \sqrt{20}
\]

PTS: 4  REF: 011029b  STA: G.G.69  TOP: Coordinate Proofs

30 ANS:
2304
3125

KEY: at least or at most

31 ANS:
78,400, 14.6

PTS: 4  REF: 011031b  STA: A2.A.6  TOP: Exponential Growth

32 ANS:

2364


33 ANS:
25, 115, 115

PTS: 6  REF: 011033b  STA: G.G.51  TOP: Chords, Secants and Tangents
34 ANS:
0.4 and -2.7

PTS: 6 REF: 011034b STA: A2.A.23 TOP: Solving Rationals
KEY: irrational and complex solutions