Part I

Answer all 27 questions in this part. Each correct answer will receive 2 credits. For each statement or question, choose the word or expression that, of those given, best completes the statement or answers the question. Record your answers on your separate answer sheet. [54]

1. The expression $\frac{3}{4}\sqrt{-80}$ is equivalent to
   (1) $3i\sqrt{5}$
   (2) $2i\sqrt{15}$
   (3) $-3\sqrt{5}$
   (4) $-2\sqrt{15}$

2. In $\triangle RST$, $m\angle S = 135$, $r = 27$, and $t = 19$. What is the area of $\triangle RST$ to the nearest tenth of a square unit?
   (1) 90.7
   (2) 181.4
   (3) 256.5
   (4) 362.7

3. The expression $\frac{\sqrt{5}}{7 - \sqrt{5}}$ is equivalent to
   (1) $\frac{7\sqrt{5} + 5}{54}$
   (2) $\frac{7\sqrt{5} - 5}{54}$
   (3) $\frac{7\sqrt{5} + 5}{44}$
   (4) $\frac{7\sqrt{5} - 5}{44}$
4 A multiple-choice test has 4 possible choices for each question. A person guesses on 10 questions. What is the probability the person gets exactly 8 questions correct?

(1) \(10C_8\left(\frac{1}{4}\right)^8\left(\frac{3}{4}\right)^2\)  
(2) \(10C_8\left(\frac{1}{4}\right)^8\left(\frac{3}{4}\right)^2\)

(3) \(10C_8\left(\frac{1}{10}\right)^8\left(\frac{9}{10}\right)^2\)  
(4) \(10C_8\left(\frac{1}{10}\right)^8\left(\frac{9}{10}\right)^2\)

5 The summation \(2 \sum_{n=3}^{6} \cos\left(\frac{\pi}{n-2}\right)\) equals

(1) \(-\frac{2 + \sqrt{2}}{2}\)  
(2) \(-2 + \sqrt{2}\)

(3) \(-\frac{1 + \sqrt{2}}{2}\)  
(4) \(-1 + \sqrt{2}\)

6 The graph of a relation is shown below.

![Graph of a relation](image)

What is the domain of this relation?

(1) \{-2, -1, 0, 1\}  
(2) \{-\frac{1}{2}, 0, \frac{1}{2}, 1\}

(3) \{x \mid -2 \leq x < 2\}  
(4) \{x \mid -2 \leq x \leq 2\}
7 The Mathematics Club will select a president, a vice president, and a treasurer for the club. If there are 15 members in the club, how many different selections of a president, a vice president, and a treasurer are possible if each club member can be selected to only one position?

(1) 42  (3) 2730
(2) 455  (4) 3375

8 For which equation will \( f(-2) = -6 \)?

(1) \( f(x) = x^3 + x \)  (3) \( f(x) = 4x^3 + 6x^2 - x \)
(2) \( f(x) = x^4 - 5x \)  (4) \( f(x) = -3x^3 - 4x^2 + 4x \)

9 What is the product of \( x^2 - 2x + 3 \) and \( x + 1 \)?

(1) \( x^3 - x^2 + x + 3 \)  (3) \( x^2 - 3x + 2 \)
(2) \( x^3 - 2x^2 + 3x \)  (4) \( x^2 - x + 4 \)

10 A principal is concerned about the decline in the number of students who purchase food from the cafeteria. A survey was developed to assist the principal. The most appropriate method would be for the principal to randomly select 100 students from

(1) the junior class
(2) the student directory
(3) the Algebra 2/Trigonometry classes
(4) the students who are eating during fourth period lunch in the cafeteria
11 The solution of $8^{1-p} = 16^{2p-1}$ is

(1) $\frac{7}{11}$  
(2) $\frac{3}{5}$  
(3) $\frac{4}{9}$  
(4) $\frac{2}{5}$

12 Which relation is not a function?

(1) \(\{(x,y): y = |x|\}\)  
(2) \(\{(x,y): y = -x^2\}\)  
(3) \(\{(x,y): y = x\}\)  
(4) \(\{(x,y): y = \pm \sqrt{x}\}\)

13 What does the correlation coefficient of -0.975 on a linear regression indicate?

(1) The slope is positive.  
(2) One variable causes the other.  
(3) The scatterplot shows no association of the variables.  
(4) One variable has a strong relationship with the other.

14 Which angle has the same terminal side as an angle of 155°?

(1) -205°  
(2) -155°  
(3) 25°  
(4) 335°
15 For any power of $i$, the imaginary unit, where $b$ is a whole number, $i^{4b+3}$ equals

(1) 1  
(2) $i$  
(3) $-1$  
(4) $-i$

16 What is the solution set of $x - \frac{10}{x} + 3 = 0$?

(1) $\{-5, 2\}$  
(2) $\{-2, 5\}$  
(3) $\{-1, 10\}$  
(4) $\{-10, 1\}$

17 In triangle $ABC$, if $\angle A = 40, BC = 10,$ and $AB = 12$, then $\angle C$ can be

(1) an acute angle, only  
(2) a right angle, only  
(3) an obtuse angle, only  
(4) either an acute or an obtuse angle

18 To the nearest thousandth, what is $23^\circ 50'$, in radian measure?

(1) 0.416  
(2) 0.415  
(3) 0.410  
(4) 0.409

Use this space for computations.
19 When \( f(x) = \frac{x - 7}{2} \), what is the value of \( (f \circ f^{-1})(3) \)?

(1) \(2x + 7\)    (3) \(3\)
(2) \(-2\)      (4) \(x\)

20 What is the equation of the circle passing through the point \((-5, -2)\) whose center is at \((-2, 3)\)?

(1) \((x + 5)^2 + (y + 2)^2 = 34\)
(2) \((x + 5)^2 + (y + 2)^2 = 50\)
(3) \((x + 2)^2 + (y - 3)^2 = 34\)
(4) \((x + 2)^2 + (y - 3)^2 = 50\)

21 If \(a = -2\) and \(b = -3\), what is the value of the expression \(\frac{c^a}{c^b} - \frac{c^b}{c^a}\), when \(c \neq 0\)?

(1) \(0\)     (3) \(2c\)
(2) \(\frac{c^2 + 1}{c}\)     (4) \(\frac{c^2 - 1}{c}\)

22 What is the fourth term in the expansion of \((2x - 1)^6\)?

(1) \(-160x^3\)   (3) \(16x^4\)
(2) \(-40x^3\)   (4) \(240x^4\)
23 If the roots of a quadratic equation are real, irrational, and unequal, the discriminant could have a value of

(1) 1  (3) 8
(2) 0  (4) -6

24 What is the \( n \)th term of the sequence \(-1, 3, 7, 11, \ldots\)?

(1) \( a_n = -1 - 4(n - 1) \)
(2) \( a_n = -1 + 4(n - 1) \)
(3) \( a_n = 4 - (n - 1) \)
(4) \( a_n = 4 + (n - 1) \)

25 What is the sample standard deviation of the data in the table below, rounded to the \textit{nearest tenth}?

<table>
<thead>
<tr>
<th>Scores</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>60</td>
<td>2</td>
</tr>
<tr>
<td>70</td>
<td>7</td>
</tr>
<tr>
<td>80</td>
<td>6</td>
</tr>
<tr>
<td>90</td>
<td>3</td>
</tr>
<tr>
<td>100</td>
<td>2</td>
</tr>
</tbody>
</table>

(1) 12.5  (3) 17.1
(2) 12.8  (4) 18.7
26 Which equation is not true?

(1) \( \cot^2 \theta = 1 - \sec^2 \theta \)  
(2) \( \sin^2 \theta = 1 - \cos^2 \theta \)  
(3) \( \sec^2 \theta = \tan^2 \theta + 1 \)  
(4) \( \csc^2 \theta = 1 + \cot^2 \theta \)

27 Which quadratic equation has roots whose sum is \(-\frac{9}{4}\) and product is \(\frac{2}{3}\)?

(1) \( 12x^2 + 8x + 27 = 0 \)  
(2) \( 12x^2 - 27x + 8 = 0 \)  
(3) \( 12x^2 - 8x - 27 = 0 \)  
(4) \( 12x^2 + 27x + 8 = 0 \)
Part II

Answer all 8 questions in this part. Each correct answer will receive 2 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil. [16]

28 Factor $6x^3 + 33x^2 - 63x$ completely.
29 Five thousand dollars is invested at an interest rate of 3.5% compounded quarterly. No money is deposited or withdrawn from the account. Using the formula below, determine, to the nearest cent, how much this investment will be worth in 18 years.

\[ A = P \left(1 + \frac{r}{n}\right)^{nt} \]

\( A \) = amount  
\( P \) = principal  
\( r \) = interest rate  
\( n \) = number of times the interest rate compounded annually  
\( t \) = time in years
30 A colony of bacteria grows exponentially. The table below shows the data collected daily.

<table>
<thead>
<tr>
<th>Day (x)</th>
<th>Population (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>200</td>
</tr>
<tr>
<td>1</td>
<td>425</td>
</tr>
<tr>
<td>2</td>
<td>570</td>
</tr>
<tr>
<td>3</td>
<td>800</td>
</tr>
<tr>
<td>4</td>
<td>1035</td>
</tr>
<tr>
<td>5</td>
<td>1650</td>
</tr>
<tr>
<td>6</td>
<td>2600</td>
</tr>
</tbody>
</table>

State the exponential regression equation for the data, rounding all values to the nearest hundredth.
31 Express \( \frac{2 + \frac{6}{x-3}}{x} \) in simplest form, when \( x \neq 0 \) and \( x \neq 3 \).
32 A central angle whose measure is \( \frac{2\pi}{3} \) radians intercepts an arc with a length of \( 4\pi \) feet. Find the radius of the circle, in feet.
A sine function is graphed below.

Determine and state the amplitude and period of this function.
On the Algebra 2/Trigonometry midterm at Champion High School, the scores of 210 students were normally distributed with a mean of 82 and a standard deviation of 4.2.

Determine how many students scored between 79.9 and 88.3.
35 Given $\tan \theta = -\frac{5}{12}$ and $\frac{\pi}{2} < \theta < \pi$, determine the exact value of the expression $\sin \theta \cot \theta$. 
Part III

Answer all 3 questions in this part. Each correct answer will receive 4 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. For all questions in this part, a correct numerical answer with no work shown will receive only 1 credit. All answers should be written in pen, except for graphs and drawings, which should be done in pencil.  

36 The lengths of the sides of a triangle are 6 cm, 11 cm, and 7 cm. Determine, to the nearest tenth of a degree, the measure of the largest angle of the triangle.
37 Solve algebraically for $c$:

$$\left| \frac{3}{2}c - 10 \right| - 9 \leq -1$$
38 Solve $2\cos^2 \theta = \cos \theta$ for all values of $\theta$ in the interval $0^\circ \leq \theta < 360^\circ$. 
Part IV

Answer the question in this part. A correct answer will receive 6 credits. Clearly indicate the necessary steps, including appropriate formula substitutions, diagrams, graphs, charts, etc. A correct numerical answer with no work shown will receive only 1 credit. The answer should be written in pen.  

39 Solve for $p$ algebraically: $\log_{16}(p^2 - p + 4) - \log_{16}(2p + 11) = \frac{3}{4}$
Reference Sheet

Area of a Triangle
\[ K = \frac{1}{2} ab \sin C \]

Functions of the Sum of Two Angles
\[
\sin (A + B) = \sin A \cos B + \cos A \sin B \\
\cos (A + B) = \cos A \cos B - \sin A \sin B \\
\tan (A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}
\]

Functions of the Difference of Two Angles
\[
\sin (A - B) = \sin A \cos B - \cos A \sin B \\
\cos (A - B) = \cos A \cos B + \sin A \sin B \\
\tan (A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}
\]

Law of Sines
\[
\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}
\]

Sum of a Finite Arithmetic Series
\[
S_n = \frac{n(a_1 + a_n)}{2}
\]

Binomial Theorem
\[
(a + b)^n = \sum_{r=0}^{n} \binom{n}{r} a^{n-r} b^r
\]

Law of Cosines
\[
a^2 = b^2 + c^2 - 2bc \cos A
\]

Functions of the Double Angle
\[
\sin 2A = 2 \sin A \cos A \\
\cos 2A = \cos^2 A - \sin^2 A \\
\cos 2A = 2 \cos^2 A - 1 \\
\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}
\]

Functions of the Half Angle
\[
\sin \frac{1}{2} A = \pm \sqrt{\frac{1 - \cos A}{2}} \\
\cos \frac{1}{2} A = \pm \sqrt{\frac{1 + \cos A}{2}} \\
\tan \frac{1}{2} A = \pm \sqrt{\frac{1 - \cos A}{1 + \cos A}}
\]

Sum of a Finite Geometric Series
\[
S_n = \frac{a_1 (1 - r^n)}{1 - r}
\]

Normal Curve

Standard Deviation

![Normal Curve Graph]
Scrap Graph Paper — This sheet will *not* be scored.
Scrap Graph Paper — This sheet will *not* be scored.