DIRECTIONS: Please write your answers on the Individual Answer Sheet provided. This part of the contest is 45 minutes long. Questions 1-4 are each worth 1 point. Questions 5-8 are each worth 2 points. Questions 9-11 are each worth 3 points. Calculators and other electronics MAY NOT be used.

1 point each:

1. Find \( k \) so the following system is consistent:
   \[
   \begin{align*}
   x + y &= 1 \\
   kx + y &= 2 \\
   x + ky &= 3
   \end{align*}
   \]

2. Simplify \((63! - 61!) \mod 71\)

3. A square 1 cm on a side has the corners cut off resulting in a regular octagon. What is the length of a side of the octagon?

4. Convert \(89\frac{1}{8}\) into binary form.

2 points each:

5. Find the prime factors of \(1,000,027\).

6. Compute the value of the continued fraction.

\[
\frac{1}{5 + \frac{1}{5 - \frac{1}{5 + \ldots}}}
\]
7. For the conic section \( \frac{(y+3)^2}{9} - \frac{(x-7)^2}{25} = 1 \) please describe its asymptotes.

8. Consider the graph of the discrete function \( f(n) = \sum_{k=1}^{n} (\frac{3}{7})^k \).
What will it have for a horizontal asymptote?

3 points:

9. Reduce the fraction \( \frac{116,690,151}{427,863,887} \) to lowest terms.

10. Simplify \( \frac{(4 + \sqrt{15})^{3/2} + (4 - \sqrt{15})^{3/2}}{(6 + \sqrt{35})^{3/2} - (6 - \sqrt{35})^{3/2}} \) to a rational fraction.

11. Find a number system so that the number \( \text{11111} \) in that system is a perfect square of another number in that system. Your answer should be the base for that number system.
## INDIIVIDUAL EXAM ANSWER SHEET

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>ANSWER</th>
<th>SCORE</th>
<th>QUESTION</th>
<th>ANSWER</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>k = 4</td>
<td></td>
<td>5</td>
<td>$7 \times 19 \times 73 \times 103$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td></td>
<td>6</td>
<td>$L = \frac{27 - \sqrt{27^2 - 100}}{10}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$\sqrt{2} - 1$</td>
<td></td>
<td>7</td>
<td>$y = -3 \pm \frac{3}{5}(x-7)$</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>$1011001.001_2$</td>
<td></td>
<td>8</td>
<td>$y = \frac{3}{4}$</td>
<td></td>
</tr>
</tbody>
</table>

# CORRECT $\times 1 =$     # CORRECT $\times 2 =$

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>ANSWER</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>$3/11$</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>$7/13$</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>base = 3 $(102^2_3)$</td>
<td></td>
</tr>
</tbody>
</table>

# CORRECT $\times 3 =$

### Individual Total

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