1. In the diagram of \( \triangle AEB \), \( \overline{EB} \) is extended to \( R \) and \( K \), and \( m \angle 3 = m \angle 4 = 135 \). Triangle \( AEB \) must be

(1) equilateral
(2) acute and isosceles
(3) obtuse and isosceles
(4) right and isosceles

2. In the diagram, \( m \angle BDC = 100^\circ \), \( m \angle A = 50^\circ \), and \( m \angle DBC = 30^\circ \). Which statement is true?

(1) \( \triangle ABD \) is obtuse.
(2) \( \triangle ABC \) is isosceles.
(3) \( m \angle ABD = 80^\circ \)
(4) \( \triangle ABD \) is scalene.

3. In the diagram of quadrilateral \( NAVY \), \( m \angle YNA = 30^\circ \), \( m \angle YAN = 38^\circ \), \( m \angle AVY = 94^\circ \), and \( m \angle VAY = 46^\circ \).

Which segment has the shortest length?

(1) \( \overline{AY} \)
(2) \( \overline{NY} \)
(3) \( \overline{VA} \)
(4) \( \overline{YY} \)
4. Using the diagram on the right, label each statement as TRUE or FALSE.

   I. $m \angle 1 + m \angle 2 + m \angle 3 = 180$ \hspace{1cm} \text{TRUE}
   II. $m \angle 2 = m \angle 3$ \hspace{1cm} \text{FALSE}
   III. $m \angle 3 + m \angle 4 = 180$ \hspace{1cm} \text{TRUE}
   IV. $m \angle 2 + m \angle 3 = m \angle 4$ \hspace{1cm} \text{FALSE}
   V. $m \angle 1 + m \angle 2 = m \angle 4$ \hspace{1cm} \text{TRUE}

5. Lines $l$ and $m$ are cut by transversal $n$.
Which statement would prove $l \parallel m$?

   (1) $m \angle 2 = m \angle 6$ \hspace{1cm} \text{corresponding } \angle \text{s}
   (2) $m \angle 2 = m \angle 3$ \hspace{1cm} \text{vertical } \angle \text{s}
   (3) $m \angle 7 + m \angle 8 = 180^\circ$ \hspace{1cm} \text{supplementary } \angle \text{s}
   (4) $m \angle 3 + m \angle 5 = 90^\circ$

6. In this figure, transversal $e$ intersects lines $a$, $b$, $c$, and $d$.

   Which lines must be parallel?

   (1) $a$ and $c$ \hspace{1cm} (3) $b$ and $d$
   (2) $b$ and $c$ \hspace{1cm} (4) $a$ and $d$

7. In the diagram, $AEBF \parallel CGD$, and $\overline{GE}$ and $\overline{GF}$ are drawn.
If $m \angle EFG = 32^\circ$ and $m \angle AEG = 137^\circ$, what is $m \angle EGF$?

   (1) $11^\circ$ \hspace{1cm} (3) $75^\circ$
   (2) $43^\circ$ \hspace{1cm} (4) $105^\circ$
8. The four diagrams below each illustrate a geometry construction. Label each one as either perpendicular bisector, altitude, median, or angle bisector.

9. Based on the construction shown, which conclusion is not always true?

(1) $AB \perp CD$  
(2) $AB = CD$  
(3) $AE = EB$  
(4) $CE = DE$

10. Based on the construction shown, which statement must be true?

(1) $m \angle ABD = \frac{1}{2} m \angle CBD$  
(2) $m \angle ABD = m \angle CBD$  
(3) $m \angle ABD = m \angle ABC$  
(4) $m \angle CBD = \frac{1}{2} m \angle ABD$
Construct each of the following. Show all construction marks.

11. perpendicular bisector of $\overline{XY}$

**Step 1**
- "more than halfway" from $X$ and $Y$

**Step 2**
- Connect both points of intersect

12. perpendicular to $\overline{AB}$ through point $M$

**Step 1**
- 2 points same distance from $M$

**Step 2**
- "more than halfway"

**Step 3**
- Connect both points of intersect

13. altitude to $\overline{BC}$ from point $A$

**Step 1**
- 2 points same distance from $A$

**Step 2**
- "more than halfway"

**Step 3**
- Connect both points of intersect with $A$

14. median to $\overline{AC}$ from point $B$

**Step 1**
- "more than halfway" from $A$ and $C$

**Step 2**
- Connect both points of intersect to get midpt

**Step 3**
- Connect midpoint with $B$

15. inscribed square

**Step 1**
- Draw diameter

**Step 2**
- Construct $\perp$ bisector using diameter endpts so that the bisector intersects the circle at 2 more pts

**Step 3**
- Connect all 4 pts

16. inscribed equilateral triangle

**Step 1**
- Measure radius

**Step 2**
- Start on point on circle using radius measured

**Step 3**
- Connect every other point

4 = sections

3 = sections (from $b = \text{sections}$)
17. Using the grid shown, find the coordinates of each point after the given transformation.

a. Find $A'$ the image of $A$ after $r_{y=x}$ reflect over $y=x$
   $A(-5, 3) \rightarrow A'(3, -5)$

b. Find $B'$ the image of $B$ after $r_{x-axis}$ reflect over $x-axis$
   $B(-4, -4) \rightarrow B'(-4, 4)$

c. Find $C'$ the image of $C$ after $R_{90°}$ counter clockwise
   $C(4, -2) \rightarrow C'(2, 4)$

d. Find $D'$ the image of $D$ after $D_2$ dilate from origin centered about the origin
   $D(2, 1) \rightarrow D'(4, 2)$

18. Using the grid shown, find the coordinates of each point after the given transformation.

a. Find $A'$ the image of $A$ after $r_{(0,0)}$ reflect through origin
   $A(-5, 3) \rightarrow A'(5, -3)$

b. Find $B'$ the image of $B$ after $r_{y-axis}$ reflect over $y-axis$
   $B(-4, -4) \rightarrow B'(4, -4)$

c. Find $C'$ the image of $C$ after $r_{x-axis}$ reflect over $x-axis$
   $C(4, -2) \rightarrow C'(-2, -2)$

d. Find $D'$ the image of $D$ after $T_{-2,3}$ translate left 2 up 3
   $D(2, 1) \rightarrow D'(0, 4)$

19. On the set of axes shown, rectangle $ABCD$ can be proven congruent to rectangle $KLMN$ using which transformation?

(1) rotation
(2) translation
(3) reflection over $x = 0$
(4) reflection over $y = 0$

20. Which coordinate rule represents a reflection of the $x$-axis?

(1) $(x, y) \rightarrow (y, x)$  (3) $(x, y) \rightarrow (-x, y)$
(2) $(x, y) \rightarrow (-y, x)$  (4) $(x, y) \rightarrow (x, -y)$
21. On the graph shown, point \( A(3, 4) \) and \( \overline{BC} \) with coordinates \( B(4, 3) \) and \( C(2, 1) \) are graphed. What are the coordinates of \( B' \) and \( C' \) after \( \overline{BC} \) undergoes a dilation centered at point \( A \) with a scale factor of 2?

\[ \begin{align*}
(1) \ & B'(5, 2) \text{ and } C'(1, -2) \\
(2) \ & B'(6, 1) \text{ and } C'(0, -1) \\
(3) \ & B'(5, 0) \text{ and } C'(1, -2) \\
(4) \ & B'(5, 2) \text{ and } C'(3, 0)
\end{align*} \]

22. On the set of axes below, \( \triangle ABC \cong \triangle DEF \). Describe a sequence of rigid motions that maps \( \triangle ABC \) onto \( \triangle DEF \).

One of many possible answers:

- Reflect over y-axis
- Then
- Reflect over \( y = 2 \)

23. Which rotation about its center will \textit{not} carry a regular decagon onto itself?

\[ \begin{align*}
(1) \ & 36^\circ \\
(2) \ & 180^\circ \\
(3) \ & 216^\circ \\
(4) \ & 270^\circ
\end{align*} \]

24. In regular hexagon \( ABCDEF \) shown, \( \overline{AD}, \overline{BE}, \) and \( \overline{CF} \) all intersect at \( G \).

When \( \triangle ABG \) is reflected over \( BG \) and then rotated \( 180^\circ \) about point \( G \), \( \triangle ABG \) is mapped onto

\[ \begin{align*}
(1) \ & \triangle FEG \\
(2) \ & \triangle AFG \\
(3) \ & \triangle CBG \\
(4) \ & \triangle DEG
\end{align*} \]
Properties of Congruent Triangles and Definitions/Theorems

25. State the most efficient method of proving each pair of triangles congruent.

- a. **ASA**
- b. **AAS**
- c. **SAS**
- d. **SAS**
- e. **SSS**
- f. **HL**
- g. **SSS**
- h. **ASA**

26. Mark each set of diagrams with the given information. Determine the most efficient method that will prove these triangles are congruent.

- a. Given: \( AC \cong BC \)
  \( \overline{CD} \perp \overline{AB} \)

- b. Given: \( \overline{AC} \)
  \( \overline{BC} \)
  \( \angle ABC \cong \angle ADC \)

- c. Given: \( C \) is the midpoint of \( \overline{AE} \)
  \( \angle BAC \cong \angle DEC \)

- d. Given: \( \overline{XS} \) and \( \overline{YR} \) bisect each other
27. State what pair of parts will be congruent based on the given information.

a. $KL$ is an altitude $\perp \rightarrow$ right *

b. $EH$ is an angle bisector $\rightarrow$ cut in half

\[ \angle KLI \cong \angle KLI \]

\[ \angle GEH \cong \angle FEH \]

c. $CD$ is a median $\rightarrow$ midpoint

d. $BD$ is the perpendicular bisector of $AC$

\[ \overline{AB} \cong \overline{CD} \]

28. As shown in the diagram, $AC$ bisects $\angle BAD$ and $\angle B \cong \angle D$.
Which method could be used to prove $\triangle ABC \cong \triangle ADC$?

(1) SSS  (3) SAS

(2) AAA  (4) AAS

29. In the diagram of quadrilateral $ABCD$, $AB \parallel CD$, $\angle ABC \cong \angle CDA$, and diagonal $AC$ is drawn.
Which method could be used to prove $\triangle ABC \cong \triangle CDA$?

(1) AAS  (3) SAS

(2) SSA  (4) SSS
30. Given: $AD \perp DE$
   $CE \perp DE$
   $AC$ bisects $DE$ at $B$.

Prove: $\triangle ADB \cong \triangle CEB$

\[\begin{array}{|c|}
\hline
\text{Statements} & \text{Reasons} \\
\hline
1. $\overline{AD} \perp \overline{DE}, \overline{CE} \perp \overline{DE}$ & 1. Given \\
2. $\angle D \cong \angle E$ & 2. $\perp$ lines form $\cong$ right angles \\
3. $AC$ bisects $\overline{DE}$ at $B$ & 3. Given \\
4. $DB \cong EB$ & 4. a bisector cuts a segment into $2 \cong$ parts \\
5. $\angle DBA \cong \angle EBC$ & 5. intersecting lines form $\cong$ vertical $\angle$'s \\
6. $\triangle ADB \cong \triangle CEB$ & 6. $ASA$ \\
\hline
\end{array}\]

31. Given: $QS$ bisects $\angle PSR$
   $PS \cong SR$

Prove: $\angle P \cong \angle R$

\[\begin{array}{|c|}
\hline
\text{Statements} & \text{Reasons} \\
\hline
1. $QS$ bisects $\angle PSR$ & 1. Given \\
2. $\angle PQS \cong \angle RSQ$ & 2. a bisector cuts an $\angle$ into $2 \cong$ parts \\
3. $PS \cong SR$ & 3. Given \\
4. $QS \cong QS$ & 4. Reflexive \\
5. $\triangle PQS \cong \triangle RQS$ & 5. $SAS$ \\
6. $\angle P \cong \angle R$ & 6. $CPCTC$ \\
\hline
\end{array}\]
32. In the diagram, \( \triangle ABC \sim \triangle DEF \). If \( AB = 36 \), \( BC = 30 \), and \( EF = 15 \), find \( \overline{DE} \).

33. Given right triangle \( ABC \) with a right angle at \( C \), \( m\angle B = 61^\circ \).
Given right triangle \( RST \) with a right angle at \( T \), \( m\angle R = 29^\circ \).

Which proportion in relation to \( \triangle ABC \) and \( \triangle RST \) is not correct?

1. \( \frac{AB}{RS} = \frac{RT}{AC} \)
2. \( \frac{BC}{ST} = \frac{AB}{RS} \)
3. \( \frac{BC}{ST} = \frac{AC}{RT} \)
4. \( \frac{AB}{AC} = \frac{RS}{RT} \)

34. In the diagram below, \( \angle GRS \equiv \angle ART \), \( GR = 36 \), \( SR = 45 \), \( AR = 15 \), and \( RT = 18 \).

Which triangle similarity statement is correct?

1. \( \triangle GRS \sim \triangle ART \) by AA.
2. \( \triangle GRS \sim \triangle ART \) by SAS.
3. \( \triangle GRS \sim \triangle ART \) by SSS.
4. \( \triangle GRS \) is not similar to \( \triangle ART \).
35. What additional piece of information would prove that $\triangle IJK \sim \triangle LMN$?

- $NM = 18$
- $LM = 18$
- $NM = 15$
- $LM = 10$

36. In $\triangle ABC$ and $\triangle DEF$, $\frac{AC}{DF} = \frac{CB}{FE}$. Which additional information would prove $\triangle ABC \sim \triangle DEF$?

- $AC = DF$
- $CB = FE$
- $\angle ACB \equiv \angle DFE$
- $\angle BAC \equiv \angle EDF$

37. In the diagram, $SQ$ and $PR$ intersect at $T$, $PQ$ is drawn, and $PS \parallel QR$.
Prove $\triangle PST \sim \triangle RQT$.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>$PS \parallel QR$</td>
<td>Given</td>
</tr>
<tr>
<td>$\angle PST \equiv \angle RQT$</td>
<td>\parallel lines cut by a transversal form \equiv alt. int. \angle's</td>
</tr>
<tr>
<td>$\angle SPT \equiv \angle QRT$</td>
<td>intersecting lines form \equiv vertical \angle's</td>
</tr>
<tr>
<td>$\angle STP \equiv \angle QTR$</td>
<td>AAA</td>
</tr>
<tr>
<td>$\triangle PST \equiv \triangle RQT$</td>
<td></td>
</tr>
</tbody>
</table>
38. In the diagram of $\triangle ABC$, $D$ is the midpoint of $\overline{AB}$, $E$ is the midpoint of $\overline{BC}$, and $F$ is the midpoint of $\overline{AC}$.

If $AB = 20$, $BC = 12$, and $AC = 16$, what is the perimeter of parallelogram $FEBD$?

$$\overline{10} + \overline{10} + \overline{6} + \overline{6} = \boxed{32}$$

39. As shown in the diagram, $\overline{AB}$ and $\overline{CD}$, and intersect at $E$, and $\overline{AC} \parallel \overline{BD}$.

If $DE = 6$, $BE = 8$, $AE = 12.8$, $BD = 5$, and $AC = 15$, what is the length of $\overline{EC}$?

$$\frac{\triangle ACE}{\triangle BDE} \quad \frac{12.8}{8} = \frac{8}{5} = \frac{x}{6}$$

$$\frac{8}{5} = \frac{x}{6}$$

$$5x = 48$$

$$x = 9.6$$

40. In the diagram of $\triangle ABC$, points $D$ and $E$ are on $\overline{AB}$ and $\overline{CB}$, respectively, such that $\overline{AC} \parallel \overline{DE}$.

If $AD = 24$, $DB = 12$, and $DE = 4$, what is the length of $\overline{AC}$?

$$\frac{\triangle ABC}{\triangle BDE} \quad \frac{x}{4} = \frac{36}{12}$$

$$\frac{12x}{12} = 144$$

$$x = 12$$
41. In the diagram of $\triangle ABC$, $DE \parallel BC$.

If $AB = 10$, $AD = 8$, and $AE = 12$, what is the length of $EC$?

\[
\frac{\triangle ADE}{\triangle AEC} = \frac{8}{10} = \frac{x+12}{12} \\
(8)(x+12) = (10)(12) \\
8x + 96 = 120 \\
8x = 24 \\
x = 3
\]

42. In the diagram of $\triangle ABC$, $\angle ABC$ is a right angle, $AC = 12$, $AD = 8$, and altitude $BD$ is drawn.

What is the length of $BC$?

(1) $4\sqrt{2}$

(2) $4\sqrt{3}$

(3) $4\sqrt{5}$

(4) $4\sqrt{6}$

43. In right triangle $PRT$, $\angle P = 90^\circ$, altitude $PQ$ is drawn to hypotenuse $RT$, $RT = 17$, and $PR = 15$.

Determine and state, to the nearest tenth, the length of $RQ$.

\[
\frac{H}{L} = \frac{L}{S} \\
\frac{17}{L} = \frac{15}{S} \\
17S = 15L \\
S = \frac{15L}{17}
\]

\[
\frac{17}{15} = \frac{15}{x} \\
x = \frac{17 \times 15}{15} = 17 \\
\chi = 13.23529412 \\
RQ = 13.2
\]