Geometry

Topics Covered in this Unit Include: Angle Theorems and Properties of Figures

Evaluations Given this Unit (Record Your Marks Here)

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Angle Measurement

Labelling Angles

Angles are typically labelled using uppercase letters.

Example:

The angle where the ? is would be identified as LACB or LBCA. The important part is the middle letter which identifies where the angle is. The L symbol is used to specify that it is an angle.

Why do you think that the angle wouldn't be identified as C all by itself (hint: look at the diagram below)?

Practice: In each of the following diagrams, write the letter representation for the angle with the x
Opposite Angles

Consider the following diagram:

Use a protractor to measure the angles ABD, ABC, CBE and DBE. Record your results.

ABD = __________  ABC = __________  CBE = __________  DBE = __________

Draw two lines that cross in your notebook. Label the points and measure the angles the same way that you did for the first diagram. What do you notice about the angles from the two examples?

An important Angle Property
Practice: What is the value of the indicated angle in each of the following diagrams

a) 
\[ \begin{array}{c}
\text{70°} \\
\text{110°}
\end{array} \]

b) 
\[ \begin{array}{c}
\text{123°} \\
\text{57°}
\end{array} \]

**Supplementary Angles**

Supplementary Angles are angles that:

Look at the protractor image to the right:

What does it tell you about the angle of a straight line?

Practice: Find the missing values indicated in each of the following diagrams

a) 
\[ \begin{array}{c}
x \quad 112°
\end{array} \]

b) 
\[ \begin{array}{c}
52° \quad 64°
\end{array} \]
**Triangles**

Define each of the following:

1) Equilateral Triangle

2) Isosceles Triangle

3) Scalene Triangle

Paper cutting exercise.

For any triangle, you can label the corners 1, 2, and 3 as in the image above. If you cut the corners off and put the three together it forms a straight line as shown.

What does this tell you about the angles in a triangle?

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**Angle Sum Theorem**
Practice: Find the value of the missing angles in each of the following.

a) \[
\begin{align*}
\text{a} & \quad 70^\circ \\
\text{b} & \quad 55^\circ
\end{align*}
\]

b) \[
\begin{align*}
\text{m} & \quad 47^\circ \\
\text{a} & \quad 52^\circ
\end{align*}
\]

c) \[
\begin{align*}
\text{x} & \quad 44^\circ
\end{align*}
\]

EQAO Sample Problem

Consider the following diagram.

\[
\begin{align*}
\text{38}^\circ & \quad 103^\circ \\
\text{w} & \quad \text{r}
\end{align*}
\]

Determine the values of r and w.

Justify your answer.

<table>
<thead>
<tr>
<th>Value</th>
<th>Justification</th>
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<tbody>
<tr>
<td>r</td>
<td></td>
</tr>
<tr>
<td>w</td>
<td></td>
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Angle Worksheet #1

Find the missing angle values and give reasons for each of the following:

a) 

\[ \begin{align*}
x &= 33^\circ 
\end{align*} \]

b) 

\[ \begin{align*}
a &= 38^\circ 
b &= \quad \quad 
\end{align*} \]

c) 

\[ \begin{align*}
c &= 34^\circ 
d &= \quad \quad 
\end{align*} \]

d) 

\[ \begin{align*}
y &= 3y 
\end{align*} \]

e) 

\[ \begin{align*}
x &= \quad \quad 
\end{align*} \]

f) 

\[ \begin{align*}
x + 42 &= \quad \
3x - 20 &= \quad \
5x &= \quad 
\end{align*} \]
Parallel Lines

Parallel lines are usually indicated by arrows on the lines.

every example: the arrows on the lines indicate that the two lines are parallel

A Transversal is a line that crosses over two or more parallel lines.

every example: transversal

Whenever there is a transversal and parallel lines there are some angle relationships.

Measure the angles

\[
a = \_\_\_\_\_ \quad b = \_\_\_\_\_ \\
w = \_\_\_\_\_ \quad x = \_\_\_\_\_ \\
y = \_\_\_\_\_ \quad z = \_\_\_\_\_ \\
c = \_\_\_\_\_ \quad d = \_\_\_\_\_
\]

Examine the different measurements that you made. What do you think are the relationships between the angles when a transversal crosses two parallel lines?
Parallel Lines and Angles Practice

Find the values of the missing angles. Give reasons for your answers.

1. 

2. 

3. 

4. 

5. 

6. 

7. 

Angle Worksheet #2

Find the values of the missing angles and give reasons for your answers (the first one is done for you to show you how to receive full marks for this type of question)

1) $x = 25^\circ$  
   $x$ is vertically opposite to $25^\circ$ and vertically opposite angles are equal

   $y = 155^\circ$  
   $y$ is supplementary (straight line) with $x$ so $x + y = 180$

   $z = 155^\circ$  
   $z$ is vertically opposite to $y$ so $y$ and $z$ are equal

2) $x = 45^\circ$

3) $5x = y$

   $3x + 50$

4) $x = y$

   $z = 20^\circ$

5) $y = 85^\circ$

   $x = z$
10) \[ 3x - 20^\circ \]

11) \[ 108^\circ \]

12) \[ 40^\circ \]

105^\circ
Interior and Exterior Angles

The sum of the interior angles in a triangle is ____________

What will the sum of the interior angles be for a figure with 4 sides (a quadrilateral) like a square, rectangle, trapezoid or parallelogram?

What will the sum of the interior angles be for a figure with 5 sides?
What will the sum of the interior angles be for figures with:

a) 6 sides?

b) 7 sides?

c) 8 sides?

Is there a pattern relating the number of sides of a polygon and the sum of the interior angles?

Write a formula to determine the sum of the interior angles for any polygon.

What will the sum of the interior angles be for a polygon with:

a) 30 sides?

b) 50 sides?
Exterior Angles

Exterior Angles are the angles formed by extending the sides of a triangle or quadrilateral.

In the following triangle, a, b, and c are the exterior angles.

Measure angles a, b and c.

Angle a = ______ Angle b = ______ Angle c = ______

What is the sum of the exterior angles of a triangle? ___________________________

For a quadrilateral the exterior angles would look like ....

Measure angles a, b, c and d.

Angle a = ______ Angle b = ______ Angle c = ______ Angle d = ______

What is the sum of the exterior angles of a quadrilateral? ________________________
In general the sum of the exterior angles of any polygon is ____________________

Practice with interior/exterior angles. Find the missing values/angles.

1) 

\[ \begin{array}{c}
106^\circ \\
86^\circ \\
196^\circ \\
67^\circ \\
x \\
\end{array} \]

2) 

\[ \begin{array}{c}
95^\circ \\
\end{array} \]

\[ \begin{array}{c}
x - 20^\circ \\
82^\circ \\
x + 33^\circ \\
\end{array} \]

3) 

\[ \begin{array}{c}
85^\circ \\
z \\
x \\
50^\circ \\
65^\circ \\
y \\
b \\
a \\
\end{array} \]

4) 

\[ \begin{array}{c}
97^\circ \\
2x \\
3x + 23^\circ \\
\end{array} \]
Angle Review Questions

1. Find all of the missing values in each of the following:

   a) 
   
   b) 
   
   c) 
   
   d) 
   
   e) 
   
   f) 
   
   g) 
   
   h)
2. Which line segments in the following diagram are parallel? Give reasons for your answer.

3. Given $\angle A = \angle B + \angle C$
   Show $\angle A = 90^\circ$
   Give reasons for your solution.

4. Find the sum of the interior angles of:
   a) a hexagon
   b) an octagon
   c) a dodecagon (12 sided figure)