Chapter 12 Angles

Practice 1 Angles on a Line

In each figure, \( \overrightarrow{AC} \) is a line. Use a protractor to find the unknown angle measures.

1.

\[
\begin{align*}
\angle DBC &= \underline{\phantom{000}} \\
\angle DBA &= \underline{\phantom{000}} \\
\angle DBC + \angle DBA &= \underline{\phantom{000}} + \underline{\phantom{000}} \\
&= \underline{\phantom{000}} 
\end{align*}
\]

2.

\[
\begin{align*}
\angle x &= \underline{\phantom{000}} \\
\angle y &= \underline{\phantom{000}} \\
\angle x + \angle y &= \underline{\phantom{000}} + \underline{\phantom{000}} \\
&= \underline{\phantom{000}}
\end{align*}
\]
\( \overrightarrow{AC} \) is a line. Use a protractor to find the unknown angle measures.

3. 

\[ \begin{align*} 
\text{m} \angle p &= \underline{\phantom{000}} \\
\text{m} \angle q &= \underline{\phantom{000}} \\
\text{m} \angle r &= \underline{\phantom{000}} \\
\text{m} \angle p + \text{m} \angle q + \text{m} \angle r &= \underline{\phantom{000}} + \underline{\phantom{000}} + \underline{\phantom{000}} \\
&= \underline{\phantom{000}} 
\end{align*} \]

Name the angles on each line.

4. \( \overrightarrow{XZ} \) is a line.

\[ \begin{align*} 
\text{W}, \text{Y}, \text{Z} 
\end{align*} \]

5. \( \overrightarrow{PR} \) is a line.

\[ \begin{align*} 
\text{P}, \text{Q}, \text{R}, \text{S}, \text{T} 
\end{align*} \]
Lesson 12.1  Angles on a Line

Name each set of angles on a line.
6. \( \overrightarrow{AC} \) is a line.
7. \( \overrightarrow{AB} \) and \( \overrightarrow{CD} \) are lines.

Find the unknown angle measures.
8. \( \overrightarrow{AC} \) is a line. Find the measure of \( \angle DBC \).

\[
m\angle DBC + 125^\circ = 180^\circ
\]
\[
m\angle DBC = 180^\circ - 125^\circ
\]
\[
= 55^\circ
\]

9. \( \overrightarrow{EG} \) is a line. Find the measure of \( \angle HFE \).

\[m\angle HFE = \phantom{0}\]
Find the unknown angle measures.

10. \( \overrightarrow{OQ} \) is a line. Find the measure of \( \angle SPT \).

\[
\begin{align*}
\text{m} \angle SPT &= \square \\
\end{align*}
\]

11. \( \overrightarrow{AC} \) is a line. Find the measure of \( \angle EBF \).

\[
\begin{align*}
\text{m} \angle EBF &= \square \\
\end{align*}
\]

12. \( \overrightarrow{JK} \) is a line. Find the measures of \( \angle y \) and \( \angle z \).

\[
\begin{align*}
\text{m} \angle y &= \square \\
\text{m} \angle z &= \square \\
\end{align*}
\]

13. \( \overrightarrow{EF} \) and \( \overrightarrow{GH} \) are lines. Find the measures of \( \angle a \) and \( \angle b \).

\[
\begin{align*}
\text{m} \angle a &= \square \\
\text{m} \angle b &= \square \\
\end{align*}
\]
Practice 2  Angles at a Point

In each figure, the rays meet at a point. Use a protractor to find unknown angle measures.

1. 
\[ \text{m} \angle a = \underline{\hspace{2cm}} \]
\[ \text{m} \angle b = \underline{\hspace{2cm}} \]
\[ \text{m} \angle c = \underline{\hspace{2cm}} \]
\[ \text{m} \angle a + \text{m} \angle b + \text{m} \angle c = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \]

2. 
\[ \text{m} \angle AOB = \underline{\hspace{2cm}} \]
\[ \text{m} \angle BOC = \underline{\hspace{2cm}} \]
\[ \text{m} \angle COD = \underline{\hspace{2cm}} \]
\[ \text{m} \angle DOE = \underline{\hspace{2cm}} \]
\[ \text{m} \angle AOE = \underline{\hspace{2cm}} \]
\[ \text{m} \angle AOB + \text{m} \angle BOC + \text{m} \angle COD + \text{m} \angle DOE + \text{m} \angle AOE = \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} + \underline{\hspace{2cm}} = \underline{\hspace{2cm}} \]
Name the angles at a point.

3. 

4. 

5. 

6. 

___

___

___

___
Find the unknown angle measures.

7. Find the measure of \( \angle AOB \).

\[
m\angle AOB = \underline{\phantom{100}}
\]

8. Find the measure of \( \angle a \).

\[
m\angle a = \underline{\phantom{100}}
\]

9. Find the measure of \( \angle b \).

\[
m\angle b = \underline{\phantom{100}}
\]

10. Find the measure of \( \angle c \).

\[
m\angle c = \underline{\phantom{100}}
\]
Find the unknown angle measures.

11. Find the measure of $\angle q$.

12. Find the measure of $\angle r$.

$$m\angle q = \boxed{} \quad m\angle r = \boxed{}$$

13. Find the measure of $\angle a$.

$$m\angle a = \boxed{}$$

14. $\overrightarrow{PR}$ and $\overrightarrow{TU}$ meet at $Q$. Find the measures of $\angle PQS$ and $\angle TQR$.

$$m\angle PQS = \boxed{} \quad m\angle TQR = \boxed{}$$
Practice 3  Vertical Angles

Complete.

1. $\overrightarrow{AB}$ and $\overrightarrow{CD}$ meet at $O$. Use a protractor to find unknown angle measures.

$$m\angle w = \underline{\quad}$$

$$m\angle x = \underline{\quad}$$

$$m\angle y = \underline{\quad}$$

$$m\angle z = \underline{\quad}$$

$m\angle \underline{\quad} = m\angle \underline{\quad}$

$\angle \underline{\quad}$ and $\angle \underline{\quad}$ are vertical angles.

$m\angle \underline{\quad} = m\angle \underline{\quad}$

$\angle \underline{\quad}$ and $\angle \underline{\quad}$ are vertical angles.

2. $\overrightarrow{XZ}$ and $\overrightarrow{VW}$ meet at $Y$. Use a protractor to find unknown angle measures.

$$m\angle XYW = \underline{\quad}$$

$$m\angle WYU = \underline{\quad}$$

$$m\angle UYZ = \underline{\quad}$$

$$m\angle ZYV = \underline{\quad}$$

$$m\angle VYX = \underline{\quad}$$

$\angle \underline{\quad}$ and $\angle \underline{\quad}$ are vertical angles.

$\angle \underline{\quad}$ and $\angle \underline{\quad}$ are vertical angles.
Complete.

3. Look at the star and its marked angles. In the table below, write three sets of
   a. angles on a line,
   b. angles at a point,
   c. vertical angles.

<table>
<thead>
<tr>
<th>Angles on a Line</th>
<th>Angles at a Point</th>
<th>Vertical Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \angle b ) and ( \angle c )</td>
<td>( \angle a, \angle b, \angle c, ) and ( \angle d )</td>
<td>( \angle a ) and ( \angle c )</td>
</tr>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Draw.

4. Draw rays at $P$ to form
   a. an angle whose measure forms a sum of $180^\circ$ with the measure of $\angle x$,
   b. an angle whose measure is equal to the measure of $\angle x$.
(Do not use a protractor to draw the angles.)

a. 

b. 

Find the unknown angle measures.

5. $\overrightarrow{AB}$ and $\overrightarrow{CD}$ meet at $O$. Find the measure of $\angle COB$.

$$\text{m} \angle COB = \underline{\hspace{2cm}}$$

6. $\overrightarrow{EF}$ and $\overrightarrow{GH}$ meet at $O$. Find the measures of $\angle GOF$ and $\angle EOH$.

$$\text{m} \angle GOF = \underline{\hspace{2cm}}$$

$$\text{m} \angle EOH = \underline{\hspace{2cm}}$$

7. $\overrightarrow{RS}$ and $\overrightarrow{PQ}$ meet at $N$. Find the measures of $\angle PNR$, $\angle RNQ$, and $\angle QNS$.

$$\text{m} \angle PNR = \underline{\hspace{2cm}}$$

$$\text{m} \angle RNQ = \underline{\hspace{2cm}}$$

$$\text{m} \angle QNS = \underline{\hspace{2cm}}$$
Find the unknown angle measures.

8. \( \overrightarrow{JK} \) and \( \overrightarrow{LM} \) meet at \( O \). Find the measure of \( \angle NOK \).

\[
\begin{align*}
\text{m} \angle NOK &= \underline{\hspace{2cm}}
\end{align*}
\]

9. \( \overrightarrow{AB} \), \( \overrightarrow{CD} \), and \( \overrightarrow{EF} \) meet at \( O \). Find the measure of \( \angle x \).

\[
\begin{align*}
\text{m} \angle x &= \underline{\hspace{2cm}}
\end{align*}
\]

10. \( \overrightarrow{AB} \) and \( \overrightarrow{CD} \) meet at \( O \). Find the measure of \( \angle w \).

\[
\begin{align*}
\text{m} \angle w &= \underline{\hspace{2cm}}
\end{align*}
\]
Find the unknown angle measures.

11. $\overrightarrow{QR}$ and $\overrightarrow{ST}$ meet at $O$. Find the measures of $\angle QOS$, $\angle TOR$, and $\angle SOR$.

\[ m\angle QOS = \underline{\phantom{0}} \]
\[ m\angle TOR = \underline{\phantom{0}} \]
\[ m\angle SOR = \underline{\phantom{0}} \]

12. $\overrightarrow{AB}$ and $\overrightarrow{CD}$ meet at $O$. Find the measures of $\angle p$, $\angle q$, and $\angle r$.

\[ m\angle p = \underline{\phantom{0}} \]
\[ m\angle q = \underline{\phantom{0}} \]
\[ m\angle r = \underline{\phantom{0}} \]
13. \( \overrightarrow{UV}, \overrightarrow{WX}, \) and \( \overrightarrow{YZ} \) meet at \( O \). Find the measure of \( \angle UOW \).

\[
m\angle UOW = 
\]

14. \( \overrightarrow{AB}, \overrightarrow{CD}, \) and \( \overrightarrow{EF} \) meet at \( O \). Find the measures of \( \angle x \) and \( \angle y \).

\[
m\angle x = 
\]

\[
m\angle y = 
\]
Check the box for each correct statement. Then explain your answer.

1. \(\overrightarrow{XY}\) is a line.

- \(m\angle a\) is more than 90°.
- If \(m\angle a = m\angle b\), then \(m\angle a = 45°\).

2. \(\overrightarrow{AB}\) and \(\overrightarrow{CD}\) meet at \(O\).

- \(m\angle e = m\angle h\)
- \(m\angle f + m\angle g = m\angle j\)
- \(m\angle e = m\angle g\)
Put On Your Thinking Cap!

Challenging Practice

Find the unknown angle measures. Explain.

1. $\overrightarrow{GJ}$ is a line. $\angle LHK$ is a right angle. Find the measure of $\angle LHJ$.

![Diagram of GJ and HJ with angle 155°]

2. $\overrightarrow{MN}$ and $\overrightarrow{XY}$ meet at $O$ and $m \angle a = m \angle b$. Find the measure of $\angle c$.

![Diagram of MNP and XYP with intersecting lines]
3. $\overrightarrow{AC}$ is a line. $\angle ABE$ and $\angle DBF$ are right angles. Find the measure of $\angle FBC$.

4. $\overrightarrow{AB}$ and $\overrightarrow{WX}$ meet at $O$. $\angle COB$ and $\angle YOX$ are right angles. Find the measures of $\angle AOX$ and $\angle COY$. 
Put On Your Thinking Cap!

Problem Solving

Solve.

1. \( \overrightarrow{JK} \) and \( \overrightarrow{LM} \) are lines.
   Check the box for each correct statement.
   
   a. \( \angle p = \angle r + \angle s \)  
   b. \( \angle s = \angle p - \angle r \)  
   c. \( \angle q = 180^\circ - \angle p \)  
   d. \( \angle r + \angle s = \angle p + \angle q \)

2. \( \overrightarrow{AB} \), \( \overrightarrow{CD} \), and \( \overrightarrow{EF} \) meet at \( O \). Find the sum of the measures of \( \angle AOC \), \( \angle FOD \), and \( \angle BOE \).
   \( \angle AOC + \angle FOD + \angle BOE = \) ________
3. \(ABCD\) is a square. \(\overrightarrow{BE}\) is a ray. Find the measure of \(\angle x\).

4. How many degrees does the hour hand of a clock turn between 3 P.M. and 7:30 P.M.?

5. \(\overrightarrow{AB}\) is a line. The measures of \(\angle a\) and \(\angle b\) are whole numbers.

If the measure of \(\angle b\) is twice that of \(\angle a\), find the measures of \(\angle a\) and \(\angle b\).