**Mathematics**  
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(Chapter - 3) (Understanding Quadrilaterals)  
(Class - VIII)  

**Exercise 3.1**

**Question 1:**  
Given here are some figures:

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  

Classify each of them on the basis of the following:  
(a) Simple curve  
(b) Simple closed curve  
(c) Polygon  
(d) Convex polygon  
(e) Concave polygon

**Answer 1:**  
(a) Simple curve

1.  
2.  
5.  
6.  
7.  

(b) Simple closed curve

1.  
2.  
5.  
6.  
7.  

(c) Polygons

1.  
2.  
4.  

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(d) Convex polygons

(e) Concave polygon

Question 2:
How many diagonals does each of the following have?
(a) A convex quadrilateral
(b) A regular hexagon
(c) A triangle

Answer 2:
(a) A convex quadrilateral has two diagonals.
   Here, AC and BD are two diagonals.

(b) A regular hexagon has 9 diagonals.
   Here, diagonals are AD, AE, BD, BE, FC, FB, AC, EC and FD.

(c) A triangle has no diagonal.

Question 3:
What is the sum of the measures of the angles of a convex quadrilateral? Will this property hold if the quadrilateral is not convex? (Make a non-convex quadrilateral and try)

Answer 3:
Let ABCD is a convex quadrilateral, then we draw a diagonal AC which divides the quadrilateral in two triangles.

\[ \angle A + \angle B + \angle C + \angle D = \angle 1 + \angle 6 + \angle 5 + \angle 4 + \angle 3 + \angle 2 \]
\[ = (\angle 1 + \angle 2 + \angle 3) + (\angle 4 + \angle 5 + \angle 6) \]
\[ = 180^\circ + 180^\circ \ [\text{By Angle sum property of triangle}] \]
\[ = 360^\circ \]

Hence, the sum of measures of the triangles of a convex quadrilateral is 360°.

Yes, if quadrilateral is not convex then, this property will also be applied.

Let ABCD is a non-convex quadrilateral and join BD, which also divides the quadrilateral in two triangles.

Using angle sum property of triangle,
In \( \triangle ABD \), \[ \angle 1 + \angle 2 + \angle 3 = 180^\circ \] \[ ..........(i) \]
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In \( \triangle BDC \), \( \angle 4 + \angle 5 + \angle 6 = 180^\circ \) ..........(ii)

Adding equation (i) and (ii),
\[ \angle 1 + \angle 2 + \angle 3 + \angle 4 + \angle 5 + \angle 6 = 360^\circ \]
\[ \Rightarrow \angle 1 + \angle 2 + (\angle 3 + \angle 4) + \angle 5 + \angle 6 = 360^\circ \]
\[ \Rightarrow \angle A + \angle B + \angle C + \angle D = 360^\circ \]

Hence proved.

**Question 4:**
Examine the table. (Each figure is divided into triangles and the sum of the angles deduced from that.)

<table>
<thead>
<tr>
<th>Figure</th>
<th>Side</th>
<th>Angle sum</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Triangle" /></td>
<td>3</td>
<td>( 1\times180^\circ = (3-2)\times180^\circ )</td>
</tr>
<tr>
<td><img src="image" alt="Triangle" /></td>
<td>4</td>
<td>( 2\times180^\circ = (4-2)\times180^\circ )</td>
</tr>
<tr>
<td><img src="image" alt="Triangle" /></td>
<td>5</td>
<td>( 3\times180^\circ = (5-2)\times180^\circ )</td>
</tr>
<tr>
<td><img src="image" alt="Triangle" /></td>
<td>6</td>
<td>( 4\times180^\circ = (6-2)\times180^\circ )</td>
</tr>
</tbody>
</table>

What can you say about the angle sum of a convex polygon with number of sides?

**Answer 4:**
(a) When \( n = 7 \), then
\[ \text{Angle sum of a polygon} = (n-2)\times180^\circ = (7-2)\times180^\circ = 5\times180^\circ = 900^\circ \]
(b) When \( n = 8 \), then
\[ \text{Angle sum of a polygon} = (n-2)\times180^\circ = (8-2)\times180^\circ = 6\times180^\circ = 1080^\circ \]
(c) When \( n = 10 \), then
\[ \text{Angle sum of a polygon} = (n-2)\times180^\circ = (10-2)\times180^\circ = 8\times180^\circ = 1440^\circ \]
(d) When \( n = n \), then, angle sum of a polygon = \( (n-2)\times180^\circ \)

**Question 5:**
What is a regular polygon? State the name of a regular polygon of:
(a) 3 sides
(b) 4 sides
(c) 6 sides

**Answer 5:**
A regular polygon: A polygon having all sides of equal length and the interior angles of equal size is known as regular polygon.
(i) 3 sides. Polygon having three sides is called a triangle.
(ii) 4 sides. Polygon having four sides is called a quadrilateral.
(iii) 6 sides. Polygon having six sides is called a hexagon.

**Question 6:**
Find the angle measures \( x \) in the following figures:

(a) ![Image](image)
(b) ![Image](image)
(c) ![Image](image)
(d) ![Image](image)
Answer 6:
(a) Using angle sum property of a quadrilateral,
\[ 50^\circ + 130^\circ + 120^\circ + x = 360^\circ \]
\[ \Rightarrow \quad 300^\circ + x = 360^\circ \]
\[ \Rightarrow \quad x = 360^\circ - 300^\circ \quad \Rightarrow \quad x = 60^\circ \]

(b) Using angle sum property of a quadrilateral,
\[ 90^\circ + 60^\circ + 70^\circ + x = 360^\circ \]
\[ \Rightarrow \quad 220^\circ + x = 360^\circ \]
\[ \Rightarrow \quad x = 360^\circ - 220^\circ \quad \Rightarrow \quad x = 140^\circ \]

(c) First base interior angle = \( 180^\circ - 70^\circ = 110^\circ \)
Second base interior angle = \( 180^\circ - 60^\circ = 120^\circ \)
There are 5 sides, \( n = 5 \)
\[ \therefore \quad \text{Angle sum of a polygon} = (n - 2) \times 180^\circ \]
\[ = (5 - 2) \times 180^\circ = 3 \times 180^\circ = 540^\circ \]
\[ \therefore \quad 30^\circ + x + 110^\circ + 120^\circ + x = 540^\circ \]
\[ \Rightarrow \quad 260^\circ + 2x = 540^\circ \quad \Rightarrow \quad 2x = 540^\circ - 260^\circ \]
\[ \Rightarrow \quad 2x = 280^\circ \quad \Rightarrow \quad x = 140^\circ \]

(d) Angle sum of a polygon = \( (n - 2) \times 180^\circ \)
\[ = (5 - 2) \times 180^\circ = 3 \times 180^\circ = 540^\circ \]
\[ \therefore \quad x + x + x + x + x = 540^\circ \]
\[ \Rightarrow \quad 5x = 540^\circ \quad \Rightarrow \quad x = 108^\circ \]
Hence each interior angle is \( 108^\circ \).

Question 7:
(a) Find \( x + y + z \)

Answer 7:
(a) Since sum of linear pair angles is \( 180^\circ \).
\[ \therefore \quad 90^\circ + x = 180^\circ \]
\[ \Rightarrow \quad x = 180^\circ - 90^\circ = 90^\circ \]
And \( z + 30^\circ = 180^\circ \)
\[ \Rightarrow \quad z = 180^\circ - 30^\circ = 150^\circ \]
Also \( y = 90^\circ + 30^\circ = 120^\circ \)

[Exterior angle property]
\[ \therefore \quad x + y + z = 90^\circ + 120^\circ + 150^\circ = 360^\circ \]
(b) Using angle sum property of a quadrilateral,
\[ 60^\circ + 80^\circ + 120^\circ + n = 360^\circ \]
\[ \Rightarrow \quad 260^\circ + n = 360^\circ \]
\[ \Rightarrow \quad n = 360^\circ - 260^\circ \]
\[ \Rightarrow \quad n = 100^\circ \]

Since sum of linear pair angles is 180°.
\[ \therefore \quad w + 100^\circ = 180^\circ \quad \ldots \ldots \text{(i)} \]
\[ x + 120^\circ = 180^\circ \quad \ldots \ldots \text{(ii)} \]
\[ y + 80^\circ = 180^\circ \quad \ldots \ldots \text{(iii)} \]
\[ z + 60^\circ = 180^\circ \quad \ldots \ldots \text{(iv)} \]

Adding eq. (i), (ii), (iii) and (iv),
\[ \Rightarrow \quad x + y + z + w + 100^\circ + 120^\circ + 80^\circ + 60^\circ = 180^\circ + 180^\circ + 180^\circ + 180^\circ \]
\[ \Rightarrow \quad x + y + z + w + 360^\circ = 720^\circ \]
\[ \Rightarrow \quad x + y + z + w = 720^\circ - 360^\circ \]
\[ \Rightarrow \quad x + y + z + w = 360^\circ \]