

Name _____

Date _____

8.1 Polygons — worked answers

Name and classify polygons by their properties, and use the angle sum and the exterior-angle rule. · 68 questions

A · Fluency — Names, sides and angles.

- 1 How many sides does a **triangle** have?

Answer: 3

A triangle has 3 sides — and therefore 3 angles too.

- 2 How many sides does a **quadrilateral** have?

Answer: 4

A quadrilateral has 4 sides — and therefore 4 angles too.

- 3 How many sides does a **pentagon** have?

Answer: 5

A pentagon has 5 sides — and therefore 5 angles too.

- 4 How many sides does a **hexagon** have?

Answer: 6

A hexagon has 6 sides — and therefore 6 angles too.

- 5 How many sides does a **heptagon** have?

Answer: 7

A heptagon has 7 sides — and therefore 7 angles too.

- 6 How many sides does a **octagon** have?

Answer: 8

A octagon has 8 sides — and therefore 8 angles too.

- 7 How many sides does a **nonagon** have?

Answer: 9

A nonagon has 9 sides — and therefore 9 angles too.

- 8 How many sides does a **decagon** have?

Answer: 10

A decagon has 10 sides — and therefore 10 angles too.

- 9 How many sides does a **hendecagon** have?

Answer: 11

A hendecagon has 11 sides — and therefore 11 angles too.

- 10 How many sides does a **dodecagon** have?

Answer: 12

A dodecagon has 12 sides — and therefore 12 angles too.

- 11** What is the name of a polygon with 3 sides?
Answer: triangle
3 sides makes a **triangle**.
- 12** What is the name of a polygon with 4 sides?
Answer: quadrilateral
4 sides makes a **quadrilateral**.
- 13** What is the name of a polygon with 5 sides?
Answer: pentagon
5 sides makes a **pentagon**.
- 14** What is the name of a polygon with 6 sides?
Answer: hexagon
6 sides makes a **hexagon**.
- 15** What is the name of a polygon with 7 sides?
Answer: heptagon
7 sides makes a **heptagon**.
- 16** What is the name of a polygon with 8 sides?
Answer: octagon
8 sides makes a **octagon**.
- 17** What is the name of a polygon with 9 sides?
Answer: nonagon
9 sides makes a **nonagon**.
- 18** What is the name of a polygon with 10 sides?
Answer: decagon
10 sides makes a **decagon**.
- 19** What is the name of a polygon with 11 sides?
Answer: hendecagon
11 sides makes a **hendecagon**.
- 20** What is the name of a polygon with 12 sides?
Answer: dodecagon
12 sides makes a **dodecagon**.
- 21** What do the interior angles of a **quadrilateral** add up to, in degrees?
Answer: 360
Split it into 2 triangles from one vertex: $2 \times 180^\circ = 360^\circ$.
- 22** What do the interior angles of a **pentagon** add up to, in degrees?
Answer: 540
Split it into 3 triangles from one vertex: $3 \times 180^\circ = 540^\circ$.
- 23** What do the interior angles of a **hexagon** add up to, in degrees?
Answer: 720
Split it into 4 triangles from one vertex: $4 \times 180^\circ = 720^\circ$.

- 24** What do the interior angles of a **heptagon** add up to, in degrees?

Answer: 900

Split it into 5 triangles from one vertex: $5 \times 180^\circ = 900^\circ$.

- 25** What do the interior angles of a **octagon** add up to, in degrees?

Answer: 1080

Split it into 6 triangles from one vertex: $6 \times 180^\circ = 1080^\circ$.

- 26** What do the interior angles of a **nonagon** add up to, in degrees?

Answer: 1260

Split it into 7 triangles from one vertex: $7 \times 180^\circ = 1260^\circ$.

- 27** What do the interior angles of a **decagon** add up to, in degrees?

Answer: 1440

Split it into 8 triangles from one vertex: $8 \times 180^\circ = 1440^\circ$.

- 28** What do the interior angles of a **hendecagon** add up to, in degrees?

Answer: 1620

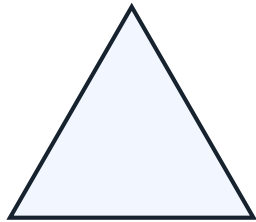
Split it into 9 triangles from one vertex: $9 \times 180^\circ = 1620^\circ$.

- 29** What do the interior angles of a **dodecagon** add up to, in degrees?

Answer: 1800

Split it into 10 triangles from one vertex: $10 \times 180^\circ = 1800^\circ$.

- 30** Each interior angle of a **regular triangle** is how many degrees?

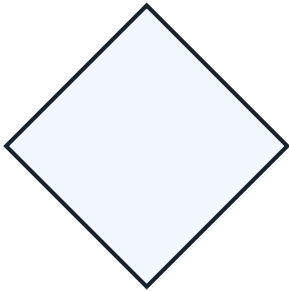


regular triangle

Answer: 60

The angles total 180° and all 3 are equal, so each is $180 \div 3 = 60^\circ$.

- 31** Each interior angle of a **regular quadrilateral** is how many degrees?

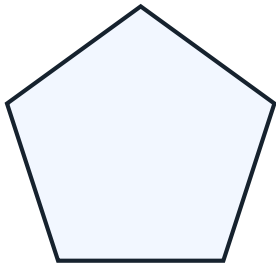


regular quadrilateral

Answer: 90

The angles total 360° and all 4 are equal, so each is $360 \div 4 = 90^\circ$.

- 32** Each interior angle of a **regular pentagon** is how many degrees?

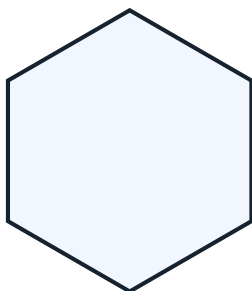


regular pentagon

Answer: 108

The angles total 540° and all 5 are equal, so each is $540 \div 5 = 108^\circ$.

- 33** Each interior angle of a **regular hexagon** is how many degrees?

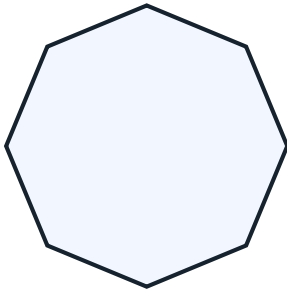


regular hexagon

Answer: 120

The angles total 720° and all 6 are equal, so each is $720 \div 6 = 120^\circ$.

- 34** Each interior angle of a **regular octagon** is how many degrees?

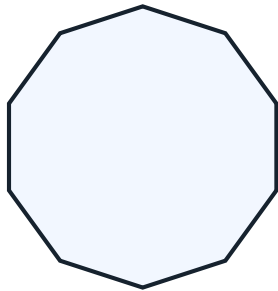


regular octagon

Answer: 135

The angles total 1080° and all 8 are equal, so each is $1080 \div 8 = 135^\circ$.

- 35** Each interior angle of a **regular decagon** is how many degrees?

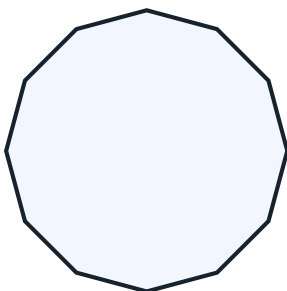


regular decagon

Answer: 144

The angles total 1440° and all 10 are equal, so each is $1440 \div 10 = 144^\circ$.

- 36** Each interior angle of a **regular dodecagon** is how many degrees?



regular dodecagon

Answer: 150

The angles total 1800° and all 12 are equal, so each is $1800 \div 12 = 150^\circ$.

- 37** Each exterior angle of a **regular pentagon** is how many degrees?

Answer: 72

The exterior angles of any polygon total 360° , and a regular pentagon has 5 equal ones: $360 \div 5 = 72^\circ$.

- 38** Each exterior angle of a **regular hexagon** is how many degrees?

Answer: 60

The exterior angles of any polygon total 360° , and a regular hexagon has 6 equal ones: $360 \div 6 = 60^\circ$.

- 39** Each exterior angle of a **regular octagon** is how many degrees?

Answer: 45

The exterior angles of any polygon total 360° , and a regular octagon has 8 equal ones: $360 \div 8 = 45^\circ$.

- 40** Each exterior angle of a **regular decagon** is how many degrees?

Answer: 36

The exterior angles of any polygon total 360° , and a regular decagon has 10 equal ones: $360 \div 10 = 36^\circ$.

- 41** Each exterior angle of a **regular dodecagon** is how many degrees?

Answer: 30

The exterior angles of any polygon total 360° , and a regular dodecagon has 12 equal ones: $360 \div 12 = 30^\circ$.

- 42** Each exterior angle of a **regular triangle** is how many degrees?

Answer: 120

The exterior angles of any polygon total 360° , and a regular triangle has 3 equal ones: $360 \div 3 = 120^\circ$.

- 43** Each exterior angle of a **regular quadrilateral** is how many degrees?

Answer: 90

The exterior angles of any polygon total 360° , and a regular quadrilateral has 4 equal ones: $360 \div 4 = 90^\circ$.

B · Reasoning — Where the rules come from.

- 44** What makes a polygon **regular**?

- ☐ All its sides are equal
- ☐ All its angles are equal
- ☐ All its sides are equal and all its angles are equal
- ☐ It has an even number of sides

Answer: All its sides are equal and all its angles are equal

Both conditions are needed. A rhombus has equal sides but unequal angles; a rectangle has equal angles but unequal sides. Neither is regular.

- 45** Why do the interior angles of a pentagon total 540° ?

- ☐ Because $5 \times 108 = 540$
- ☐ Because it splits into 3 triangles, and $3 \times 180 = 540$
- ☐ Because $540 \div 5 = 108$
- ☐ There is no reason

Answer: Because it splits into 3 triangles, and $3 \times 180 = 540$

Drawing all the diagonals from one vertex of an n -gon makes $n - 2$ triangles. That is where the formula $180(n - 2)$ comes from.

46 What do the exterior angles of **any** polygon add up to?

- ☐ 180°
- ☐ 360°
- ☐ 540°
- ☐ It depends on the number of sides

Answer: 360°

Walk right round the outside and you turn through one full turn, whatever the shape.

47 An interior angle and its exterior angle always ...

- ☐ are equal
- ☐ add to 90°
- ☐ add to 180°
- ☐ add to 360°

Answer: add to 180°

They sit on a straight line at each vertex.

48 Is every rectangle a regular polygon?

- ☐ Yes
- ☐ No

Answer: No

Its angles are equal but its sides are not, unless it is a square.

49 Is a square a regular polygon?

- ☐ Yes
- ☐ No

Answer: Yes

Four equal sides and four equal angles.

50 Can a polygon have exactly two sides?

- ☐ Yes
- ☐ No

Answer: No

A polygon needs at least three straight sides to enclose a region.

51 Which of these is **not** a polygon?

- ☐ a triangle
- ☐ a circle
- ☐ a hexagon
- ☐ a square

Answer: a circle

A polygon is made of straight sides; a circle has none.

52 A regular polygon has an exterior angle of 40° . How many sides has it?

- ☐ 6
- ☐ 8
- ☐ 9
- ☐ 10

Answer: 9

$360 \div 40 = 9$. Going through the exterior angle is far quicker than going through the interior one.

- 53 Why is the exterior-angle route usually quicker?
- ☐ The numbers are smaller and the total is always 360°
 - ☐ Because interior angles are hard
 - ☐ It is not quicker
 - ☐ Because polygons are regular

Answer: The numbers are smaller and the total is always 360°

One fixed total and a division, instead of a formula and a rearrangement.

C · Challenge — Working backwards to the shape.

- 54 A regular polygon has an interior angle of 150° . How many sides has it?

Answer: 12

The exterior angle is $180 - 150 = 30^\circ$, and $360 \div 30 = 12$.

- 55 A regular polygon has an interior angle of 140° . How many sides has it?

Answer: 9

Exterior angle 40° , and $360 \div 40 = 9$.

- 56 The interior angles of a polygon total 1440° . How many sides has it?

Answer: 10

$180(n - 2) = 1440$, so $n - 2 = 8$ and $n = 10$.

- 57 The interior angles of a polygon total 900° . How many sides has it?

Answer: 7

$180(n - 2) = 900$, so $n - 2 = 5$ and $n = 7$.

- 58 A regular polygon has 15 sides. What is each exterior angle, in degrees?

Answer: 24

$360 \div 15 = 24^\circ$.

- 59 A regular polygon has 18 sides. What is each interior angle, in degrees?

Answer: 160

Exterior angle $360 \div 18 = 20^\circ$, so interior $= 180 - 20 = 160^\circ$.

- 60 Can a regular polygon have an interior angle of 100° ?

- ☐ Yes
- ☐ No

Answer: No

That would need an exterior angle of 80° , and $360 \div 80 = 4.5$ — not a whole number of sides.

D · Word problems — Polygons in the real world.

- 61 A stop sign is a regular octagon. What is each interior angle, in degrees?

Answer: 135

Exterior $360 \div 8 = 45^\circ$, interior 135° .

- 62 A honeycomb cell is a regular hexagon. What is each interior angle, in degrees?

Answer: 120

$720 \div 6 = 120^\circ$.

- 63** A 50p coin has 7 sides. What is the name of that polygon? Give the number of sides.

Answer: 7

Seven sides makes a heptagon.

- 64** A floor tile is a regular pentagon. What is each interior angle, in degrees?

Answer: 108

$540 \div 5 = 108^\circ$.

- 65** Three regular hexagons meet at a point on a honeycomb. Do their angles fit exactly? Give the total, in degrees.

Answer: 360

$3 \times 120 = 360^\circ$, so they fit with no gap — which is why bees use hexagons.

- 66** A road sign is a triangle. What do its angles total, in degrees?

Answer: 180

Any triangle totals 180° .

- 67** A window frame is a regular dodecagon. What is each exterior angle, in degrees?

Answer: 30

$360 \div 12 = 30^\circ$.

- 68** A garden bed is a regular decagon. What do its interior angles total, in degrees?

Answer: 1440

$180 \times 8 = 1440^\circ$.