4.11 Angles in Polygons: Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 State, in degrees, the sum of the interior angles of a triangle.

(Total for Question 1 is 1 mark)

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2 Which of these gives the sum of the interior angles, in degrees, of a polygon with n sides?

- ☐ A) 180n
- ☐ B) (n - 2) x 180
- ☐ C) 360/n
- ☐ D) (n + 2) x 180

(Total for Question 2 is 1 mark)

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3 Write down the sum of the exterior angles of any polygon.

(Total for Question 3 is 1 mark)

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4 A regular polygon has 9 sides.
Calculate the size of each interior angle of the polygon.

(Total for Question 4 is 2 marks)

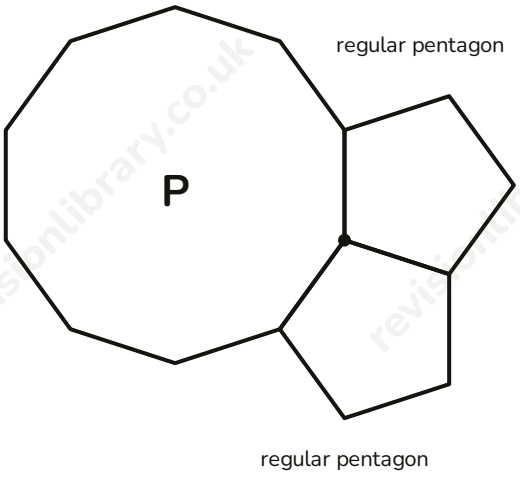
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5 A regular hexagon has an interior angle of 120 degrees. A regular nonagon (a 9-sided polygon) has an interior angle of 140 degrees.
Using calculations, explain why regular hexagons tessellate but regular nonagons do not.

(Total for Question 5 is 3 marks)

6 At a point, two regular pentagons and another regular polygon, P, meet exactly with no gaps or overlaps.
Work out the number of sides of polygon P.

Diagram NOT accurately drawn



(Total for Question 6 is 4 marks)

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7 A regular polygon has 45 sides.
Work out the size of each interior angle.

(Total for Question 7 is 2 marks)

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8 A nonagon (9-sided polygon) has one interior angle equal to 150 degrees. The remaining eight interior angles are all equal. Work out the size of each of the eight equal angles.

(Total for Question 8 is 4 marks)

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9 In a pentagon, three of the angles measure 101 degrees, 109 degrees and 113 degrees. The remaining two angles are in the ratio 3 : 4.

(a) Form and solve an equation to find the value of one part of the ratio. **(3)**

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(b) Hence work out the size of the larger of the two remaining angles. **(1)**

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(Total for Question 9 is 4 marks)

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10 A regular polygon has interior angle 156 degrees. Find the number of sides of the polygon.

(Total for Question 10 is 4 marks)

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11 Show that the interior angle of a regular n-sided polygon is 180 - 360/n degrees. You must justify each step.

(Total for Question 11 is 5 marks)

12 Priya is designing a tiled floor using two regular octagons and one square meeting at every vertex, with no gaps or overlaps.
Show, using calculations, that this arrangement fits exactly around a point.

(Total for Question 12 is 3 marks)

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13 Show that the sum of the exterior angles, taking one exterior angle at each vertex, of any convex polygon is 360 degrees. Give a clear justification.

(Total for Question 13 is 7 marks)

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14 Let sum(n) = (n - 2) * 180 be the sum of the interior angles of a polygon with n sides.

(a) Prove algebraically that sum(n + 1) - sum(n) = 180 for every whole number n, showing that increasing the number of sides of a polygon by 1 always increases the sum of its interior angles by exactly 180 degrees. **(3)**

(b) A polygon with 22 sides has an interior angle sum of 3600 degrees. Using the result from part (a), write down the sum of the interior angles of a polygon with 23 sides. **(2)**

(Total for Question 14 is 5 marks)

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Mark scheme · 4.11 Angles in Polygons: Test Pack

Question 1

180 (degrees) cao **B1**

Answer: 180 degrees

Question 2

B cao **B1**

Answer: B) (n - 2) x 180

Question 3

360 (degrees) cao **B1**

Answer: 360 degrees

Question 4

(9 - 2) x 180 / 9 oe **M1**

140 (degrees) cao **A1**

Answer: 140 degrees

Question 5

360 / 120 = 3 oe **M1**

360 / 140 = 2.57... (not a whole number) oe **M1**

correct conclusion linking calculations: hexagons tessellate because exactly 3 hexagons meet at a point (3 x 120 = 360); nonagons do not because a whole number of 140 degree angles cannot make exactly 360 **A1**

Answer: Hexagons tessellate (360/120 = 3 exactly); nonagons do not (360/140 is not a whole number).

Question 6

interior angle of a regular pentagon = (5 - 2) x 180 / 5 = 108 **M1**

360 - 2 x 108 (= 144) **M1**

exterior angle of P = 180 - 144 (= 36) or 360/n = 144 rearranged **M1**

n = 10 cao **A1**

Answer: 10 sides (regular decagon)

Question 7

(45 - 2) * 180 / 45 oe, or (45 - 2) * 180 (= 7740) soi **M1**

172 (degrees) cao **A1**

Answer: 172 degrees

Question 8

sum of interior angles = (9 - 2) * 180 = 7 * 180 **M1**

subtract the given 150 degrees: 1260 - 150 **M1**

divide the remaining sum by 8 to find each equal angle **M1**

138.75 degrees cao **A1**

Answer: Each of the eight equal angles is 138.75 degrees, since total = 7 * 180 = 1260; remaining = 1260 - 150 = 1110; each = 1110 / 8 = 138.75.

Question 9

(a) 540 - (101 + 109 + 113) (= 217) oe **M1**

(a) 3y + 4y = 217 (or 7y = 217) **M1**

(a) y = 31 cao **A1**

(a) Answer: 31 degrees

(b) 124 (degrees), ft 4 * their y from part (a) **B1**

(b) Answer: 124 degrees

Question 10

set (n - 2) * 180 / n = 156 **M1**

rearrange: 180n - 360 = 156n **M1**

n = 15 cao **A1**

verify n is an integer and > 2 **B1**

Answer: 15 sides, since (n - 2) * 180 = 156n gives 180n - 360 = 156n so 24n = 360 and n = 15.

Question 11

state sum of interior angles = (n - 2) * 180 **dM1**

divide sum by n to get each interior angle = (n - 2) * 180 / n **M1**

expand/ rearrange (n - 2) * 180 / n = (180n - 360) / n **M1**

simplify (180n - 360) / n to 180 - 360 / n **M1**

final form 180 - 360/n cao and clear justification **A1**

Answer: Starting from sum = (n - 2) * 180, each interior angle = ((n - 2) * 180) / n = (180n - 360) / n = 180 - 360 / n, so interior angle = 180 - 360/n degrees. Exterior angle = 180 - interior = 360 / n, consistent with the result above.

Question 12

interior angle of a regular octagon = (8 - 2) * 180 / 8 (= 135) soi **M1**

interior angle of a square = 90 stated **B1**

135 + 135 + 90 = 360, with a conclusion that the angles fit exactly around the point with no gap or overlap **A1**

Answer: 135 + 135 + 90 = 360, so two regular octagons and one square fit exactly around a point.

Question 13

define exterior angle at a vertex as 180 - interior angle (or state interior + exterior = 180) **dM1**

write sum of interior angles = (n - 2) * 180 **M1**

write sum of n exterior angles = n * 180 - sum of interior angles **M1**

substitute sum of interior angles to get n * 180 - (n - 2) * 180 **M1**

simplify to (n * 180 - n * 180 + 360) = 360 **M1**

conclude sum of exterior angles = 360 degrees cao **A1**

clear statement that this holds for any convex polygon using one exterior at each vertex **B1**

Answer: 360 degrees. Using exterior = 180 - interior and sum interior = (n - 2) * 180, sum exterior = n*180 - (n - 2)*180 = 360, so the sum is 360 degrees for any convex polygon taking one exterior angle at each vertex.

Question 14

(a) sum(n + 1) = (n + 1 - 2) * 180 = (n - 1) * 180 stated or used **M1**

(a) sum(n + 1) - sum(n) = (n - 1) * 180 - (n - 2) * 180 expanded correctly **M1**

(a) = 180 * [(n - 1) - (n - 2)] = 180 * 1 = 180 (cso, answer given, all algebra must be shown) **A1**

(a) Answer: sum(n + 1) - sum(n) = 180 (proven)

(b) 3600 + 180 (ft use of the 180 degree increase per extra side from part (a)) **M1**

(b) 3780 (degrees) cao **A1**

(b) Answer: 3780 degrees

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