C24

Symmetry

CHAPTER ASSIGNMENT · 68 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Draw diagrams neatly in pencil. Use a calculator only where a question needs one, and give lengths to 3 significant figures. All diagrams are not drawn to scale.

Practice questions from *Cambridge IGCSE Mathematics Core and Extended* (4th edition), Chapter 24 (Symmetry), for classroom use. The book's diagrams are described in words in brackets. The Check yourself and Chapter quiz questions are Guru Jazzy's own.

Exercise 24.1 · Planes and axes of symmetry

24.1.1 Draw each of the solid shapes below twice, then: (i) on each drawing of the shape, draw a different plane of symmetry, (ii) state how many planes of symmetry the shape has in total.

(The book shows these solids. (b) is a prism shaped like a block with a rectangular notch cut out of the middle of its bottom edge, the same all the way through.)

Solid	Planes of symmetry in total
(a) cuboid	
(b) prism (notched block)	
(c) equilateral triangular prism	
(d) square-based pyramid	
(e) cylinder	
(f) cone	
(g) sphere	
(h) cube	

24.1.2 For each of the solid shapes shown below determine the order of rotational symmetry about the axis shown.

(The axis in each book diagram is described in words.)

Shape	Axis shown	Order
(a) cuboid	through the centres of its two largest faces	
(b) prism (notched block)	vertical, through the middle of the top face and the notch	
(c) equilateral triangular prism	along its length, through the centres of the two triangular ends	
(d) square-based pyramid	vertical, through the apex and the centre of the base	
(e) cylinder	its vertical central axis	
(f) cone	vertical, through the apex and the centre of the base	
(g) sphere	through the centre (a diameter)	
(h) cube	a diagonal from one vertex through the centre to the opposite vertex	

Exercise 24.2 · Equal chords and perpendicular bisectors

24.2.1 In the diagram, O is the centre of the circle, PQ and RS are chords of equal length and M and N are their respective midpoints.

(Diagram: a circle with centre O. Chord PQ is on the left of the circle with midpoint M; chord RS is across the top with midpoint N.)

(a) What kind of triangle is ΔPOQ? [1]

(b) Describe the line ON in relation to RS. [1]

(c) If angle *POQ* is 80°, calculate angle *OQP*. [2]

(d) Calculate angle *ORS*. [1]

(e) If PQ is 6 cm calculate the length OM. [2]

(f) Calculate the diameter of the circle. [2]

24.2.2 In the diagram O is the centre of the circle. AB and CD are equal chords and the points R and S are their midpoints respectively.

(Diagram: a circle with centre O. Chord AB runs from the left of the circle down to the bottom, with midpoint R; chord CD runs from the top down to the right, with midpoint S.)

State whether the statements below are true or false, giving reasons for your answers.

(a) angle *COD* = 2 × angle *AOR*. [2]

(b) OR = OS. [2]

(c) If angle *ROB* is 60° then ΔAOB is equilateral. [2]

(d) OR and OS are perpendicular bisectors of AB and CD respectively. [2]

24.2.3 Using the diagram, state whether the following statements are true or false, giving reasons for your answer.

(Diagram: four points T, U, V and W are each joined to a point O, forming triangles VOW and TOU. No circle is drawn.)

(a) If ΔVOW and ΔTOU are isosceles triangles, then T, U, V and W would all lie on the circumference of a circle with its centre at O. [2]

(b) If ΔVOW and ΔTOU are congruent isosceles triangles, then T, U, V and W would all lie on the circumference of a circle with its centre at O. [2]

Exercise 24.3 · Tangents from an external point

24.3.1 Copy each of the diagrams below and calculate the size of the angle marked x° in each case. Assume that the lines drawn from points on the circumference are tangents.

(The diagrams are described in words. O is the centre of each circle.)

(a) Tangents from R touch the circle at P and Q. Angle ORQ = 20°. x° is angle POR, at the centre. [2]

(b) Tangents from Q touch the circle at T and S. Angle TOS = 108°. x° is angle TQS. [2]

(c) Tangents from M touch the circle at L and N, and the chord LN is drawn. Angle LMN = 42°. x° is angle OLN. [3]

24.3.2 Copy each of the diagrams below and calculate the length of the side marked y cm in each case. Assume that the lines drawn from points on the circumference are tangents.

(The diagrams are described in words. In each one, two tangents are drawn from an external point C to a circle with centre O, and O is joined to C.)

(a) The radius is 5 cm and OC = 12 cm. y cm is the length of a tangent. [2]

(b) The radius is 3.1 cm and the tangent is 8.8 cm. y cm is the length OC. [2]

(c) OC = 9.3 cm and the angle between OC and a tangent at C is 22°. y cm is the radius. [2]

Student assessment 1

SA1.1 Draw a two-dimensional shape with exactly:

(a) rotational symmetry of order 2, [1]

(b) rotational symmetry of order 4, [1]

(c) rotational symmetry of order 6. [1]

SA1.2 Draw and name a three-dimensional shape with the following orders of rotational symmetry. Mark the position of the axis of symmetry clearly.

(a) Order 2 [2]

(b) Order 3 [2]

(c) Order 8 [2]

SA1.3 In the diagram, OM and ON are perpendicular bisectors of AB and XY respectively. OM = ON. Prove that AB and XY are chords of equal length. [4]

(Diagram: a circle with centre O. Chord AB is on the left with midpoint M; chord XY is on the right with midpoint N. OM and ON are drawn as dashed lines.)

SA1.4 In the diagram, XY and YZ are both tangents to the circle with centre O.

(Diagram: tangents from Y touch the circle at X and Z. The radius OX = 5 cm. Angle OYX = 24°. The chord XZ is drawn.)

(a) Calculate angle *OZX*. [2]

(b) Calculate the length XZ. [3]

SA1.5 In the diagram, LN and MN are both tangents to the circle centre O. If angle *LNO* is 35°, calculate the circumference of the circle. [4]

(Diagram: tangents from N touch the circle at L and M. The tangent NM = 20 cm. O is joined to N, L and M.)

Check yourself

1 Explain why the diagonals of a rectangle are not lines of symmetry, even though they cut it into two congruent triangles. [2]

2 A regular polygon has rotational symmetry of order 10. How many lines of symmetry does it have, and what is the smallest turn that maps it onto itself? [2]

3 Draw a shape with rotational symmetry of order 3 but no lines of symmetry. [2]

4 A chord is 4 cm from the centre of a circle of radius 6 cm. Calculate the length of the chord. [3]

5 Tangents from C touch a circle with centre O at A and B. Angle AOB = 124°. Calculate angle ACB and angle OCA. [3]

Chapter quiz

Q1 How many lines of symmetry does a rectangle (not a square) have?

A	B	C	D
0	1	2	4

Q2 What is the order of rotational symmetry of a regular hexagon?

A	B	C	D
2	3	6	12

Q3 Which shape has rotational symmetry of order 2 but no lines of symmetry?

A	B	C	D
Kite	Parallelogram	Isosceles trapezium	Rhombus

Q4 A shape fits onto itself every 40°. What is its order of rotational symmetry?

A	B	C	D
4	8	9	40

Q5 A shape has rotational symmetry of order 1. What does that mean?

A	B	C	D
It has no rotational symmetry	It fits after a half-turn	It has one line of symmetry	It fits after every 1°

Q6 How many planes of symmetry does a cube have?

A	B	C	D
3	6	8	9

Q7 What is the order of rotational symmetry of a square-based pyramid about its vertical axis?

A	B	C	D
1	2	4	5

Q8 O is the centre of a circle and AB is a chord. What kind of triangle is OAB?

A	B	C	D
Equilateral	Isosceles	Right-angled	Scalene

Q9 A chord 16 cm long is in a circle of radius 10 cm. How far is it from the centre?

A	B	C	D
4 cm	6 cm	8 cm	12.8 cm

Q10 What angle does a tangent make with the radius at its point of contact?

A	B	C	D
45°	60°	90°	180°

Q11 Tangents from C touch a circle at A and B. AC = 7 cm. How long is BC?

A	B	C	D
3.5 cm	7 cm	14 cm	It cannot be found

Q12 Tangents CA and CB meet at C with angle ACB = 70°. O is the centre. Find angle AOB.

A	B	C	D
20°	70°	110°	140°

End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/o-level-mathematics/chapter-24-symmetry/