



Class 9 Maths – Ganita Manjari

Chapter 12: Quadrilaterals



Exercise Set 12.4 – Solutions

Q1. Justify why the plane cannot be tiled with a regular pentagon.

A regular pentagon has **5 equal angles**.

The sum of the interior angles of a pentagon is:

$$(5 - 2) \times 180^\circ = 540^\circ$$

Therefore, each interior angle of a regular pentagon is:

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

For a regular polygon to tile the plane by itself, the angles meeting at a point must add up to **360°**.

Now:

$$360^\circ \div 108^\circ = 3\frac{1}{3}$$

So, a whole number of regular pentagons cannot meet exactly around a point.

For example:

$$3 \times 108^\circ = 324^\circ$$

leaving:

$$360^\circ - 324^\circ = 36^\circ$$

and

$$4 \times 108^\circ = 432^\circ > 360^\circ$$

Therefore, the plane cannot be completely covered by regular pentagons without gaps or overlaps.

✓ **Answer:**

A regular pentagon cannot tile the plane because 108° does not divide 360° exactly.

Q2. Draw a non-convex 4-gon DART. Show how we can tile the plane with copies of DART. Both methods that we discussed earlier will work. Which do you prefer?

Solution:

A **non-convex 4-gon** has one interior angle greater than 180° . Draw an irregular quadrilateral and label its vertices:

D → **A** → **R** → **T**

so that one of its angles is greater than 180° .

The textbook states that **both tiling methods discussed earlier work** for DART.

Method 1: Using copies of the same 4-gon

1. Draw one non-convex 4-gon DART.
2. Make several identical copies of DART.
3. Arrange the copies by matching corresponding sides and vertices.
4. Rotate or translate copies where necessary.
5. Continue the pattern in all directions.
6. The copies fit together without gaps or overlaps, forming a tiling of the plane.

Method 2: Pairing/rearranging copies

1. Take two identical copies of DART.
2. Place them together along suitable corresponding sides.
3. The copies combine to form a larger repeating shape.
4. Repeat this combined arrangement horizontally and vertically.

5. Continue the pattern to cover the plane.

Conclusion

A non-convex 4-gon such as **DART** can be used to tile the plane using either of the two methods discussed in the chapter.

 **Answer:**

Both methods work. The choice of method is a matter of preference.