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Topic 11: Further Coordinate Geometry (4049)

THE ABOUT

CHAPTER ANALYSIS

- Coordinate Geometry of circles of the form
  - $(x-a)^2+(y-b)^2=r^2$
  - $x^2+y^2+2gx+2fy+c=0$

  (excluding problems involving 2 circles)

MASTERY

- Relatively straight forward chapter
- 2 **key** concepts

EXAM

- Concepts usually tested as a stand-alone topic
- Concepts from the earlier chapter (Coordinate Geometry) are relevant here

WEIGHTAGE

- High overall weightage
- Tested consistently every year
- Typically, an 10m question, 1 question in one of the papers

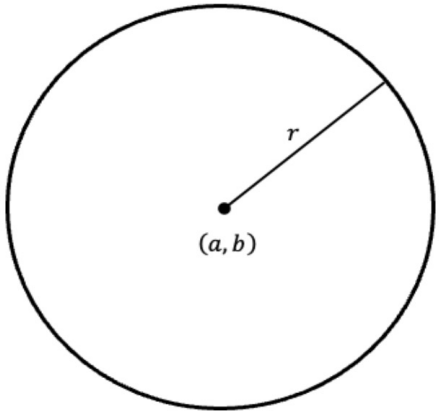
KEY CONCEPT

Equation of Circles

Important properties of Circles

Equation of Circles

There are 2 forms of the equation of circles that students must know



Standard Form

$$(x-a)^2+(y-b)^2=r^2$$

- Centre: (a, b)
- Radius: r

General Form

$$x^2+y^2+2gx+2fy+c=0$$

- Centre: $(-g, -f)$
- Radius: $\sqrt{g^2+f^2-c}$

Example 1

$$x^2+y^2-8x+13y=25$$

Find the centre and radius

$$x^2+y^2+2(-4)x+2\left(\frac{13}{2}\right)y-25=0$$

- Centre:
$$\left(4,-\frac{13}{2}\right)$$
- Radius:
$$\sqrt{(-4)^2+\left(\frac{13}{2}\right)^2-25}=\sqrt{\frac{333}{4}}\ \text{units}$$

Example 2

$$(x+2)^2+(y-3)^2=25$$

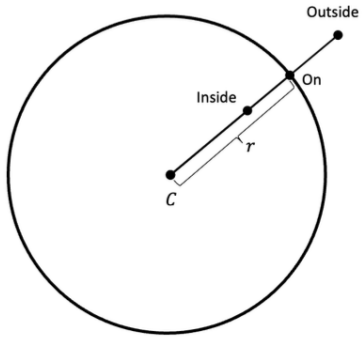
Find the centre and radius

- Centre:
$$(-2,3)$$
- Radius:
$$\sqrt{25}=5\ \text{units}$$

Important properties of Circles

Inside, On, or Outside of the Circle

To test or determine if a point is inside, on, or outside of a circle, always use the length between the point to the centre and the radius of the circle to compare

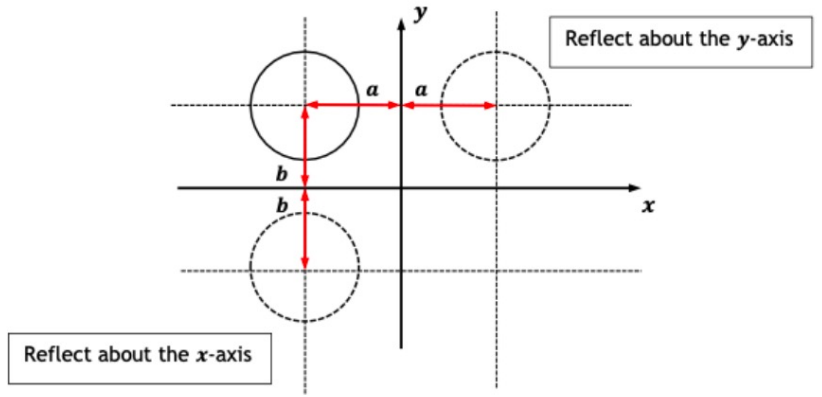


Test	Result
Inside the circle	Radius > Length
On the circle	Radius = Length
Outside the circle	Radius < Length

Note: Another test to determine if a point is on the circle is to substitute the point into the equation of the circle. If the equation holds, then the point is on the circle

Reflections

This concept on reflections is usually tested in this chapter



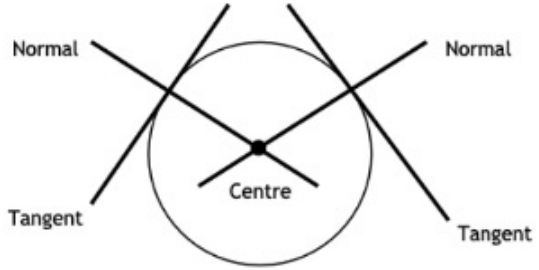
Things to note:

- Radius of the circle does not change
- Distance between the centre of the original circle to the axis remains the same (a, b)
- For the centre, reflecting about the x-axis, the x-coordinate does not change, the y-coordinate changes
- For the centre, reflecting about the y-axis, the x-coordinate changes, the y-coordinate does not change

Important properties of Circles

Normals / Perpendicular Bisectors

This concept of Normals[1] / Perpendicular bisectors is usually tested in this chapter

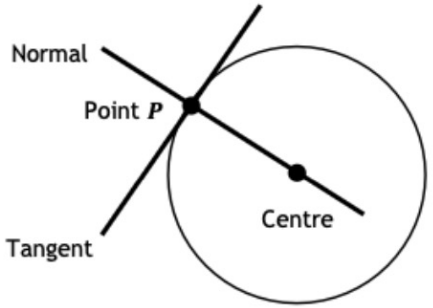


Take note of the following:

- Any 2 normals of a circle will intersect at the centre of the circle

Equations of tangents to the circle

This is a **challenging** question type and many students struggle with it



Some questions may ask students to find the equation of a tangent to a circle at a specific point. This is a little more challenging as 'O' level students are not introduced to the concept of implicit differentiation. So how to find?

1. Find the gradient of the line connecting the point in question and the centre of the circle. This line corresponds to the normal of the circle at that point
2. Using the property that the "product of the gradients of perpendicular lines is -1", find the gradient of the tangent line at the point
3. Use the gradient-line equation to find the final equation of the tangent

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