

## CO-ORDINATE GEOMETRY TANGENTS and NORMALS TO CIRCLES

1. Find the equation of the **tangent** to the circle with equation  $x^2 + y^2 = 10$  at the point  $(-3, 1)$ .
  
2. Find the equation of the **normal** to the circle with equation  $x^2 + y^2 = 40$  at the point  $(6, 2)$ .
  
3. Find the equation of the circle which has the line joining  $(-3, -6)$  and  $(9, 2)$  as diameter.
  
4. Find the centre and radius of the circle with equation  $x^2 + y^2 - 6y = 0$ .  
  
Find also the co-ordinates of the points of intersection of the line  $x - 2y + 3 = 0$  and this circle.     {Hint: simultaneous equations!}
  
5. Prove that the line  $y = x + 3$  does **not** intersect the circle with equation  $x^2 + y^2 - 6x + 8y = 7$ .
  
6. Prove that the line  $y = 3x - 1$  does **not** intersect the circle with equation  $x^2 + y^2 - 8x - 2y + 8 = 0$ .
  
7. Find the equation of the **normal** to the circle  $x^2 + y^2 = 2x - 6y$  at the point  $(2, -6)$ .
  
8. Find the equation of the **tangent** to the circle  $x^2 + y^2 + 4x - 2y = 21$  at the point  $(3, 2)$ .
  
9. The straight line  $y = 20 - 3x$  meets the circle  $x^2 + y^2 - 2x - 14y = 0$  at the points  $A$  and  $B$ . Calculate the exact length of the chord  $AB$ .  
{Hint: use simultaneous equations to first find the co-ordinates of  $A$  and  $B$ !}
  
10. Show that the straight line  $y = x - 8$  is a **tangent** to the circle  $x^2 + y^2 - 6x + 2y + 2 = 0$  and find the co-ordinates of the point of contact.
  
11. Prove that the line  $y = 3x + 1$  is a **tangent** to the circle  $x^2 + y^2 - 14x - 4y + 13 = 0$ .

12. A circle passes through the point  $(3, 2)$  and is such that the straight lines  $x = 1$  and  $x = 11$  are **tangents** to the circle. Find the equation of each of the circles which satisfy these conditions.
- \*13. Find the equations of the two circles each of which **touches** both co-ordinate axes and passes through the point  $(9, 2)$ .

Answers.

1.  $y = 3x + 10.$

2.  $3y + x = 0.$

3.  $x^2 + y^2 - 6x + 4y - 39 = 0.$

4. Centre  $(0, 3)$ ; radius 3.

$(3, 3)$  and  $(-\frac{9}{5}, \frac{3}{5}).$

7.  $y = -3x.$

8.  $y = 17 - 5x.$

9.  $\sqrt{160}$  or  $4\sqrt{10}.$

10.  $(5, -3).$

12.  $(x - 6)^2 + (y - 6)^2 = 25$  and  $(x - 6)^2 + (y + 2)^2 = 25.$

13.  $x^2 + y^2 - 10x - 10y + 25 = 0$  and  $x^2 + y^2 - 34x - 34y + 289 = 0.$