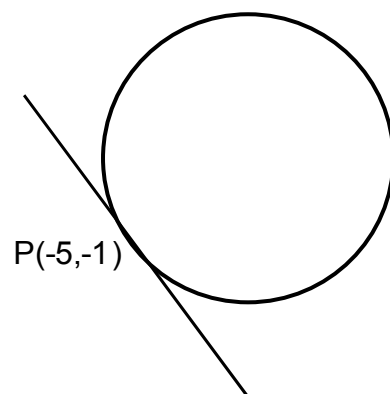


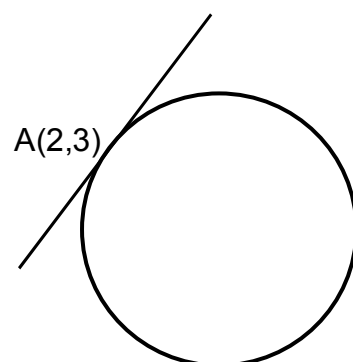
The Circle

1. Find the equation of the circle centre $(-4,7)$ which has the x-axis as a tangent.
2. Find the equation of the circle which has the lines $x = -4$, $x = 8$, $y = -2$ and $y = 10$ as tangents.
3. A circle has equation $x^2 + y^2 - 4x - 8y - 5 = 0$. Write down the equation of the tangent to this circle at the point $(-3,4)$.
4. A circle has equation $(x + 5)^2 + (y - 1)^2 = 16$. Write down the equation of the tangent to this circle at the point $A(-5,-3)$.

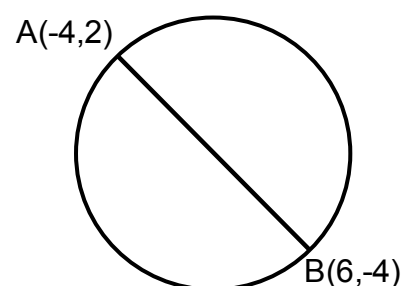
5. A circle has equation $x^2 + y^2 + 6x + 4 = 0$. Find the equation of the tangent to this circle at the point $P(-5,-1)$.



6. Find the equation of the tangent to the circle $x^2 + y^2 - 8x + 2y - 3 = 0$ at the point $A(2,3)$.



7. A is the point $(-4,2)$ and B is $(6,-4)$. Find the equation of the circle which has AB as a diameter.

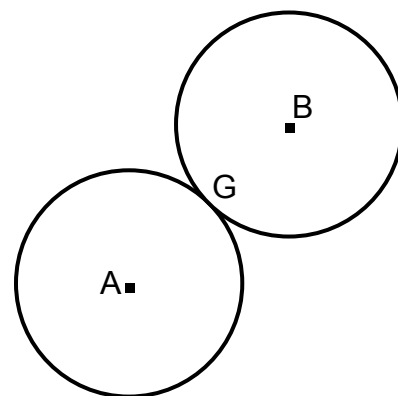


8. P is the point $(-5,3)$ and Q is $(5,-21)$. Find the equation of the circle which has PQ as diameter.

9. Two congruent circles with centres A and B touch at G.
The equations of the circles are

$$x^2 + y^2 + 8x - 4y - 5 = 0 \quad \text{and} \quad x^2 + y^2 - 4x - 20y + 79 = 0$$

- (a) Find the coordinates of G.
(b) Find the length of AB.



10. Two circles have equations

$$(x + 1)^2 + (y + 3)^2 = 20 \quad \text{and} \quad x^2 + y^2 - 10x - 18y + 26 = 0$$

- (a) Write down the centre and radius of each circle.
(b) Show that the circles touch at a single point.
(c) Find P, the point of contact of the circles.

11. Two circles have equations

$$x^2 + y^2 + 4x + 16y - 60 = 0 \quad \text{and} \quad x^2 + y^2 - 8x + 4y + 12 = 0$$

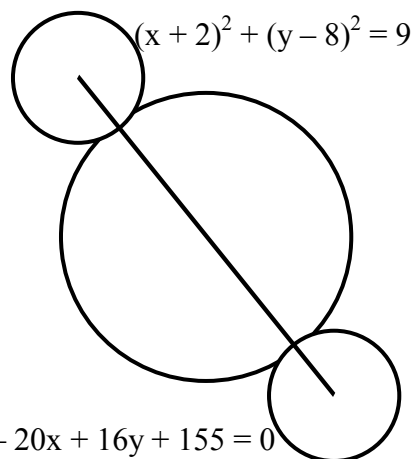
Show that these circles touch at a single point.

12. Three circles touch externally as shown.
The centres of the circles are collinear
and the equations of the two smaller
circles are

$$(x + 2)^2 + (y - 8)^2 = 9 \quad \text{and}$$

$$x^2 + y^2 - 20x + 16y + 155 = 0$$

Find the equation of the larger circle.

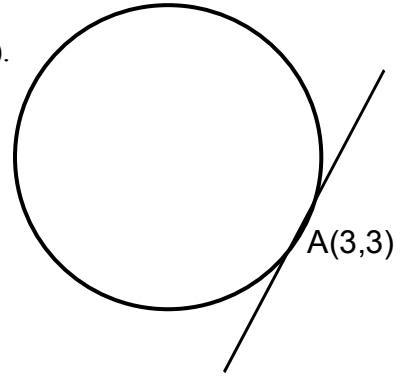


13. The circle $x^2 + y^2 + 4x - 7y - 8 = 0$ cuts the y-axis at two points.
Find the coordinates of these points.

14. The circle $x^2 + y^2 - 2x + 10y - 24 = 0$ cuts the x-axis at the points
A and B. Find the length of AB.

15. (a) A circle has equation $(x + 3)^2 + (y - 6)^2 = 61$.
Find the equation of the tangent to this circle at the point A(3,3).

(b) Show that this tangent is also a tangent to the circle with
equation $x^2 + y^2 + 6x - 7y - 10 = 0$ and find the point
of contact.



16. Show that the line $y = -3x - 10$ is a tangent to the circle with equation
 $x^2 + y^2 - 8x + 4y - 20 = 0$ and find the point of contact.

17. (a) Find the equation of the tangent to the curve $y = 2x^3 - 4x^2 - 7x + 12$
at the point where $x = 2$.

(b) Show that this tangent is also a tangent to the circle
 $x^2 + y^2 - 6x + 2y + 10 = 0$ and find the point of contact.

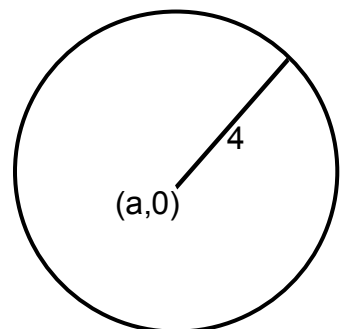
18. Show that the line $y = 2x + 1$ does not intersect the circle with equation
 $x^2 + y^2 - 2x + 4y + 1 = 0$.

19. For what range of values of p does the equation $x^2 + y^2 + 2px + 2py + 6p + 8 = 0$
represent a circle.

20. For what range of values of k does the equation $x^2 + y^2 - 2kx + 4ky + 4 - k = 0$
represent a circle.

21. (a) A circle has centre $(a,0)$, $a > 0$ and radius 4 units.
Write down the equation of this circle.

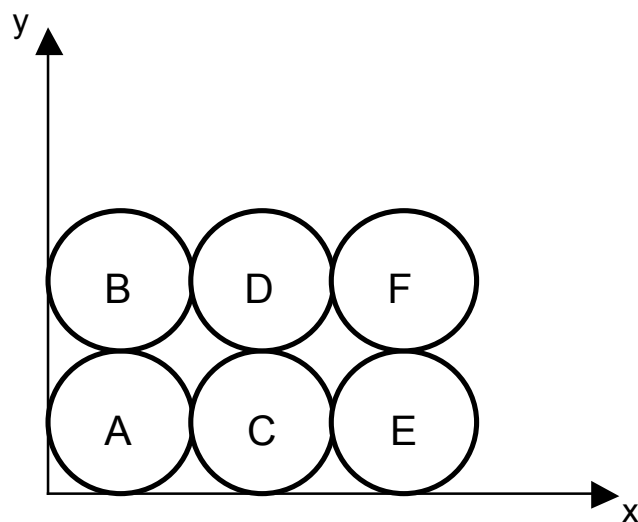
(b) Show that if $y = x$ is a tangent to this circle then $a = 4\sqrt{2}$.



22. The diagram shows six identical circles.

Circle A has equation
 $x^2 + y^2 - 6x - 6y + 9 = 0$.

- Write down the equation of circle F.
- Find the point of contact between the circles C and D.



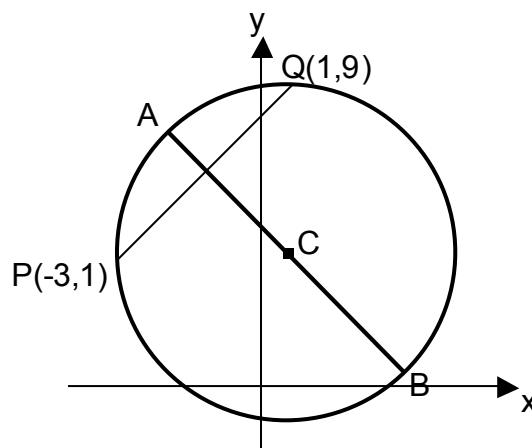
23. (a) Find the equation of AB, the perpendicular bisector of the line joining the points P(-3,1) and Q(1,9).

- C is the centre of a circle passing through P and Q. Given that QC is parallel to the y-axis, determine the equation of the circle.

- The tangents at P and Q intersect at T.

Write down

- the equation of the tangent at Q
- the coordinates of T.



24. The diagram shows a tangent kite ABCD and a circle centre C.

A is the point (-8,0) and B is (4,9).
 The radius CD is parallel to the y-axis.

- Find the coordinates of D and write down the equation of CD.
- Find the equation of the line BC.
- Find the coordinates of C and hence determine the equation of the circle.

