



Higher Mathematics

Circles - Questions

Marks are indicated in brackets after each question number

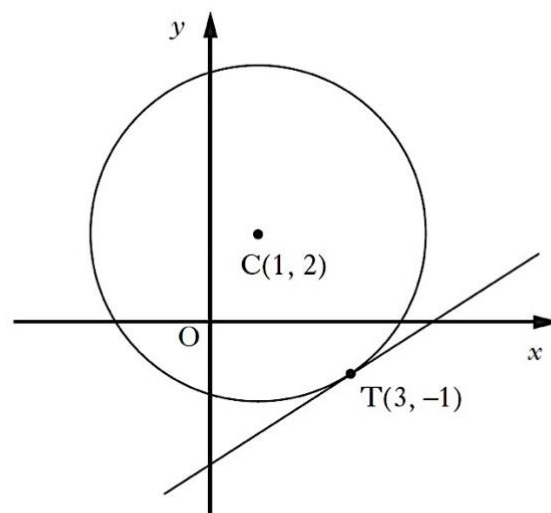
2013 Paper 1 Question 22, (2) (3) (3) (4)

A circle C_1 has equation $x^2 + y^2 + 2x + 4y - 27 = 0$.

- (a) Write down the centre and calculate the radius of C_1 .
- (b) The point $P(3, 2)$ lies on the circle C_1 .
Find the equation of the tangent at P .
- (c) A second circle C_2 has centre $(10, -1)$. The radius of C_2 is half of the radius of C_1 .
Show that the equation of C_2 is $x^2 + y^2 - 20x + 2y + 93 = 0$.
- (d) Show that the tangent found in part (b) is also a tangent to circle C_2 .

2014 Paper 1 Question 2, (2)

The diagram shows a circle with centre $C(1, 2)$ and the tangent at $T(3, -1)$.



What is the gradient of this tangent?



2014 Paper 1 Question 23, (4) (3) (3)

- (a) Find P and Q, the points of intersection of the line $y = 3x - 5$ and the circle C_1 with equation $x^2 + y^2 + 2x - 4y - 15 = 0$.
- (b) T is the centre of C_1 .
Show that PT and QT are perpendicular.
- (c) A second circle C_2 passes through P, Q and T.
Find the equation of C_2 .

2014 Paper 2 Question 8, (5)

Given that the equation

$$x^2 + y^2 - 2px - 4py + 3p + 2 = 0$$

represents a circle, determine the range of values of p .

2015 Paper 1 Question 11, (4) (6)

T(-2, -5) lies on the circumference of the circle with equation

$$(x + 8)^2 + (y + 2)^2 = 45.$$

- (a) Find the equation of the tangent to the circle passing through T.
- (b) This tangent is also a tangent to a parabola with equation $y = -2x^2 + px + 1 - p$, where $p > 3$.
Determine the value of p .

2015 Paper 1 Question 14, (2)

The circle with equation $x^2 + y^2 - 12x - 10y + k = 0$ meets the coordinate axes at exactly three points.

What is the value of k ?

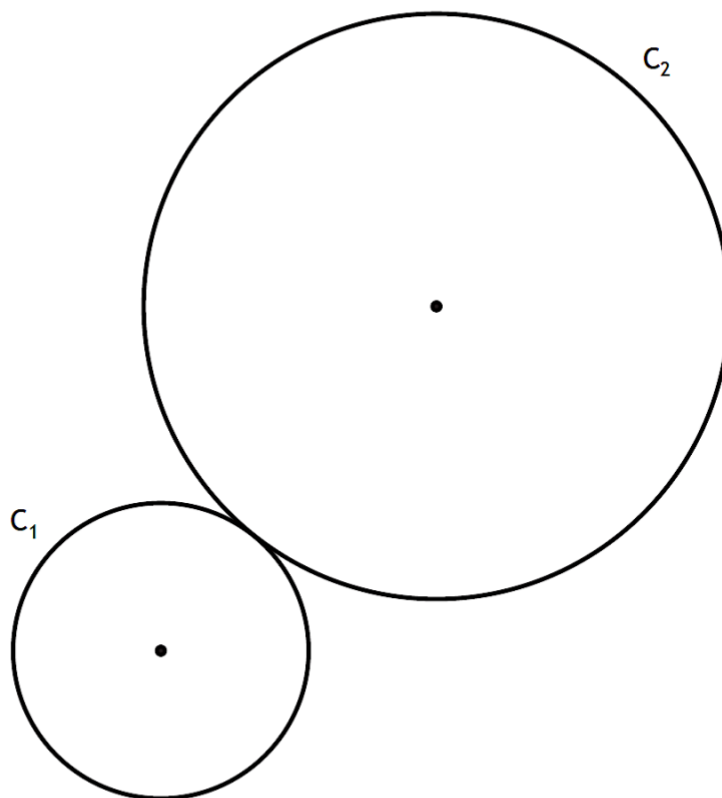


2015 Paper 2 Question 5, (4) (4)

Circle C_1 has equation $x^2 + y^2 + 6x + 10y + 9 = 0$.

The centre of circle C_2 is $(9, 11)$.

Circles C_1 and C_2 touch externally.



(a) Determine the radius of C_2 .

A third circle, C_3 , is drawn such that:

- both C_1 and C_2 touch C_3 internally
- the centres of C_1 , C_2 and C_3 are collinear.

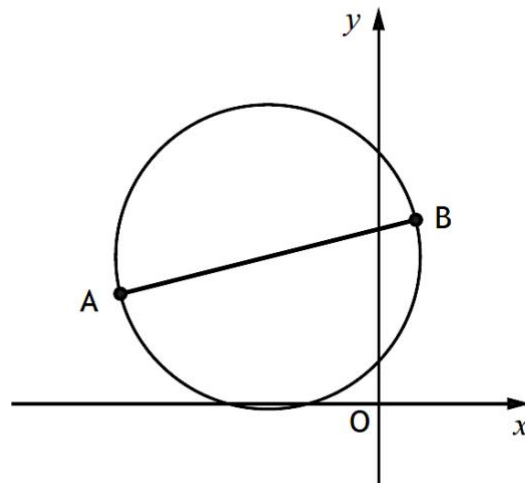
(b) Determine the equation of C_3 .



2016 Paper 1 Question 4, (3)

A and B are the points $(-7, 3)$ and $(1, 5)$.

AB is a diameter of a circle.



Find the equation of this circle.

2016 Paper 1 Question 8, (5)

Show that the line with equation $y = 3x - 5$ is a tangent to the circle with equation $x^2 + y^2 + 2x - 4y - 5 = 0$ and find the coordinates of the point of contact.

2016 Paper 2 Question 4, (4) (3)

Circles C_1 and C_2 have equations $(x + 5)^2 + (y - 6)^2 = 9$ and $x^2 + y^2 - 6x - 16 = 0$ respectively.

- (a) Write down the centres and radii of C_1 and C_2 .
- (b) Show that C_1 and C_2 do not intersect.

2017 Paper 1 Question 2, (4)

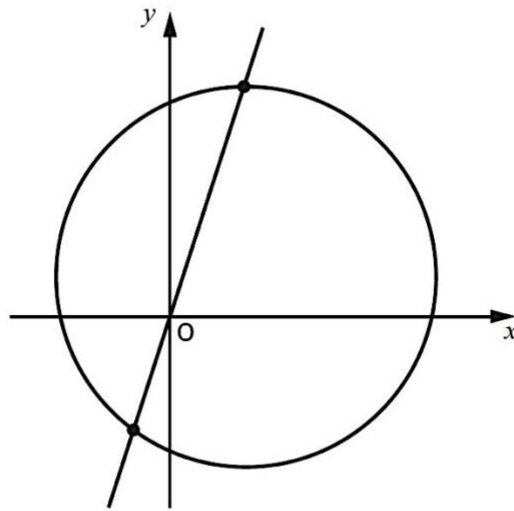
The point $P(-2, 1)$ lies on the circle $x^2 + y^2 - 8x - 6y - 15 = 0$.

Find the equation of the tangent to the circle at P .



2017 Paper 2 Question 3, (5)

The line $y=3x$ intersects the circle with equation $(x-2)^2 + (y-1)^2 = 25$.

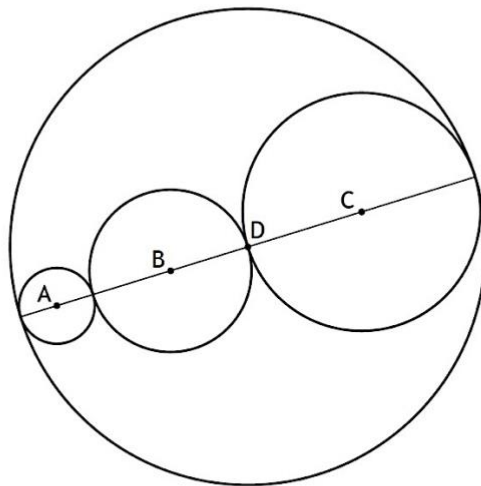


Find the coordinates of the points of intersection.

2017 Paper 2 Question 10, (3) (4)

(a) Show that the points $A(-7, -2)$, $B(2, 1)$ and $C(17, 6)$ are collinear.

Three circles with centres A , B and C are drawn inside a circle with centre D as shown.



The circles with centres A , B and C have radii r_A , r_B and r_C respectively.

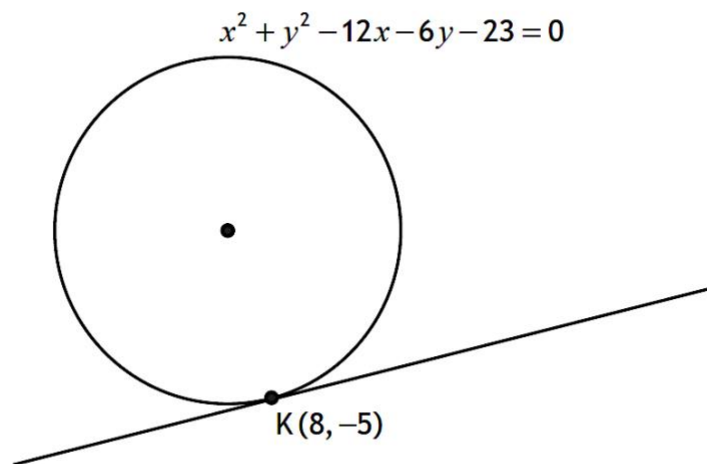
- $r_A = \sqrt{10}$
- $r_B = 2r_A$
- $r_C = r_A + r_B$

(b) Determine the equation of the circle with centre D .



2018 Paper 1 Question 4, (4)

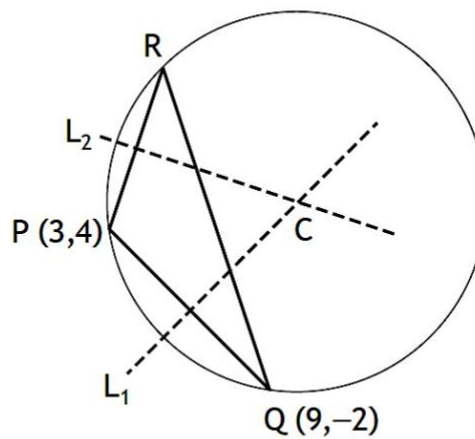
The point $K(8, -5)$ lies on the circle with equation $x^2 + y^2 - 12x - 6y - 23 = 0$.



Find the equation of the tangent to the circle at K .

2018 Paper 2 Question 5, (3) (2) (2)

C is the centre of the circle which passes through the vertices of triangle PQR .



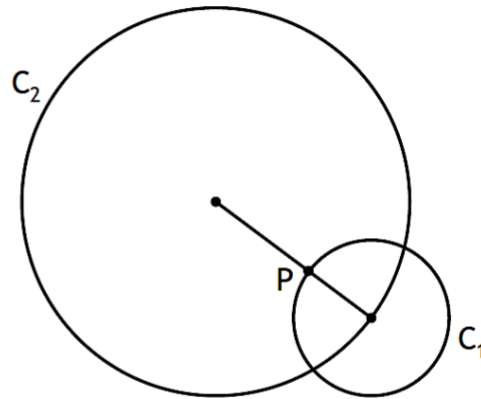
(c) Determine the equation of this circle.



2018 Paper 2 Question 12, (1) (1) (2) (2) (1)

Circle C_1 has equation $(x-13)^2 + (y+4)^2 = 100$.

Circle C_2 has equation $x^2 + y^2 + 14x - 22y + c = 0$.



- (a) (i) Write down the coordinates of the centre of C_1 .
(ii) The centre of C_1 lies on the circumference of C_2 .
Show that $c = -455$.

The line joining the centres of the circles intersects C_1 at P.

- (b) (i) Determine the ratio in which P divides the line joining the centres of the circles.
(ii) Hence, or otherwise, determine the coordinates of P.

P is the centre of a third circle, C_3 .

C_2 touches C_3 internally.

- (c) Determine the equation of C_3 .

2019 Paper 1 Question 3, (2)

Circle C_1 has equation $x^2 + y^2 - 6x - 2y - 26 = 0$.

Circle C_2 has centre $(4, -2)$.

The radius of C_2 is equal to the radius of C_1 .

Find the equation of circle C_2 .



2019 Paper 1 Question 16, (2) (4)

The point P has coordinates $(4, k)$.

C is the centre of the circle with equation $(x-1)^2 + (y+2)^2 = 25$.

- (a) Show that the distance between the points P and C is given by $\sqrt{k^2 + 4k + 13}$.
- (b) Hence, or otherwise, find the range of values of k such that P lies outside the circle.

2022 Paper 1 Question 14, (2) (2) (2)

C_1 is the circle with equation $(x-7)^2 + (y+5)^2 = 100$.

- (a)
 - (i) State the centre and radius of C_1 .
 - (ii) Hence, or otherwise, show that the point $P(-2, 7)$ lies outside C_1 .

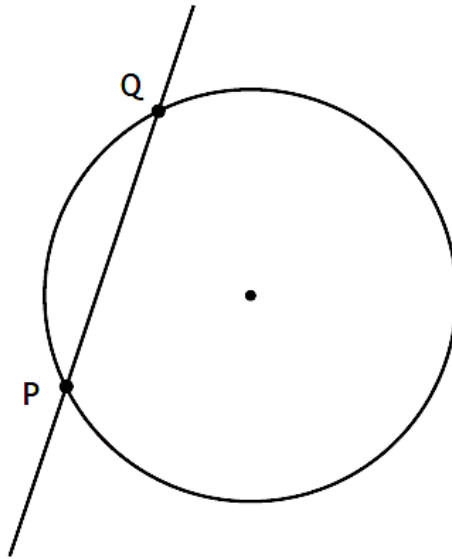
C_2 is a circle with centre P and radius r .

- (b) Determine the value(s) of r for which circles C_1 and C_2 have exactly one point of intersection.



2022 Paper 2 Question 9, (5) (4)

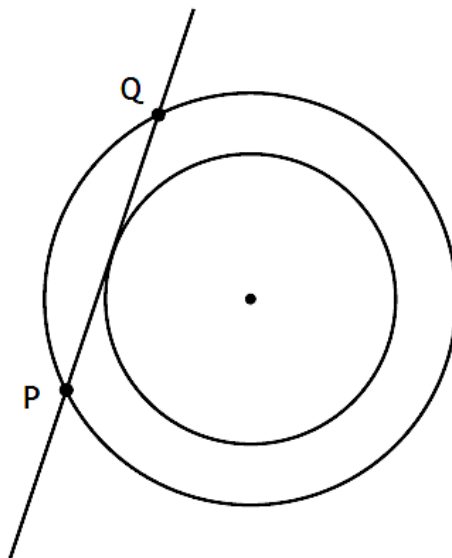
The line $y = 3x + 7$ intersects the circle $x^2 + y^2 - 4x - 6y - 7 = 0$ at the points P and Q.



(a) Find the coordinates of P and Q.

PQ is a tangent to a second, smaller circle.

This circle is concentric with the first.



(b) Determine the equation of the smaller circle.



2023 Paper 2 Question 11, (3) (3)

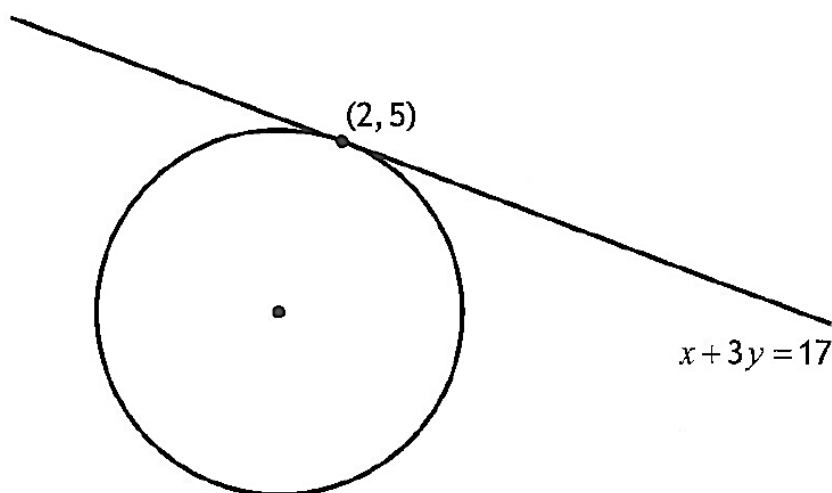
Circle C_1 has equation $(x-4)^2 + (y+2)^2 = 37$.

Circle C_2 has equation $x^2 + y^2 + 2x - 6y - 7 = 0$.

- (a) Calculate the distance between the centres of C_1 and C_2 .
- (b) Hence, show that C_1 and C_2 intersect at two distinct points.

2023 Paper 2 Question 15, (4)

The line $x + 3y = 17$ is a tangent to a circle at the point $(2, 5)$.



The centre of the circle lies on the y -axis.

Find the coordinates of the centre of the circle.

2024 Paper 1 Question 7, (4)

The line $y = 2x$ is a tangent to the circle with equation $x^2 + y^2 - 14x - 8y + 45 = 0$.

Determine the coordinates of the point of contact.



2024 Paper 1 Question 13, (4) (4)

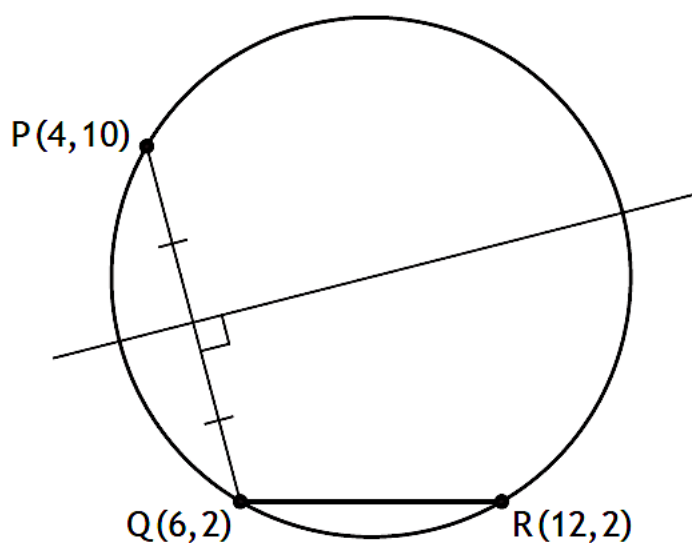
P and Q are the points $(4, 10)$ and $(6, 2)$ respectively.

(a) Find the equation of the perpendicular bisector of PQ.

The point R has coordinates $(12, 2)$.

A circle passes through the points P, Q and R.

The chord QR is horizontal.



(b) Find the equation of the circle.



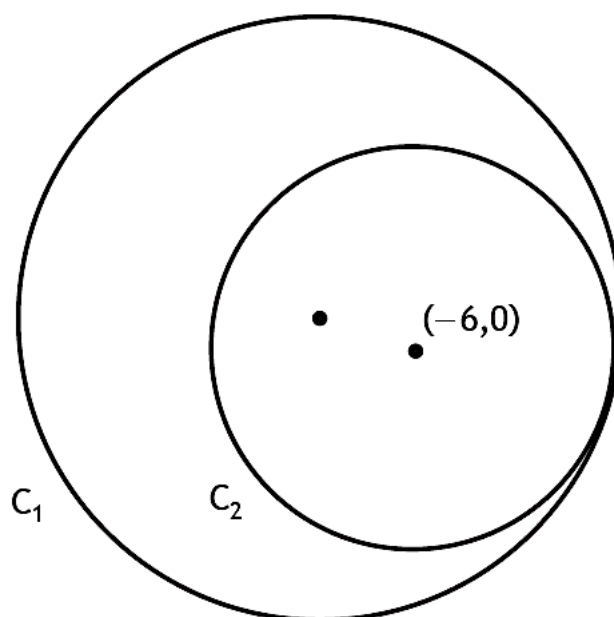
2024 Paper 2 Question 10, (2) (2)

The circle C_1 has equation $x^2 + y^2 + 18x - 2y - 8 = 0$.

(a) Find the centre and radius of C_1 .

A second circle, C_2 , touches C_1 internally.

The centre of C_2 is $(-6, 0)$.



(b) Determine the equation of C_2 .

2025 Paper 1 Question 9, (4)

Find the coordinates of the points of intersection of the line with equation $y = x + 1$ and the circle with equation $x^2 + y^2 - 2x + 6y - 15 = 0$.



2025 Paper 2 Question 14, (2) (2) (3)

Circle C_1 has equation $(x+5)^2 + (y-6)^2 = 9$.

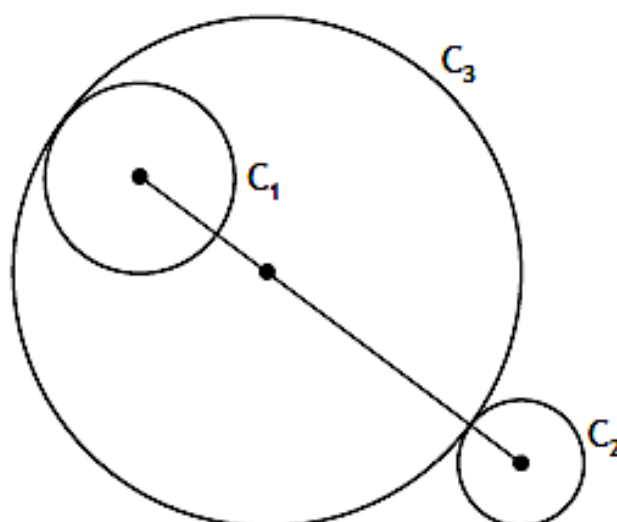
(a) State the centre and radius of C_1 .

Circle C_2 has equation $x^2 + y^2 - 14x + 6y + 54 = 0$.

(b) State the centre and radius of C_2 .

Circles C_1 , C_2 and C_3 are touching as shown in the diagram.

The centre of circle C_3 lies on the line joining the centres of C_1 and C_2 .



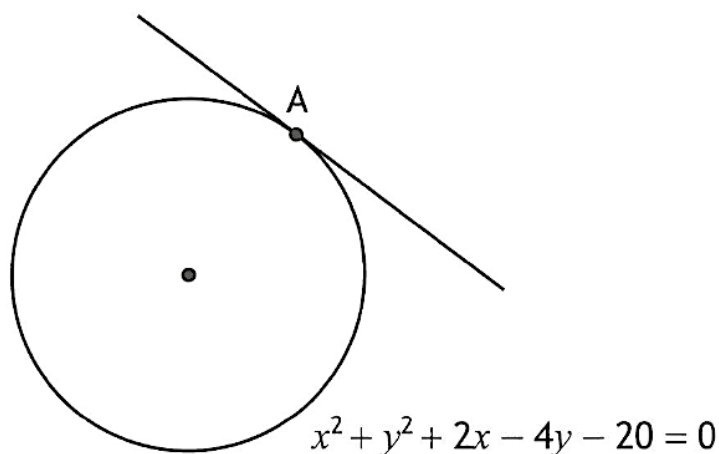
(c) Determine the equation of C_3 .



2026 Paper 1 Question 3, (4)

A circle has equation $x^2 + y^2 + 2x - 4y - 20 = 0$.

Point A(2,6) lies on the circle.



Find the equation of the tangent to the circle at A.

2026 Paper 2 Question 4, (2)

A circle has centre $(-2,5)$.

The point $(3,7)$ lies on the circle.

Find the equation of the circle.