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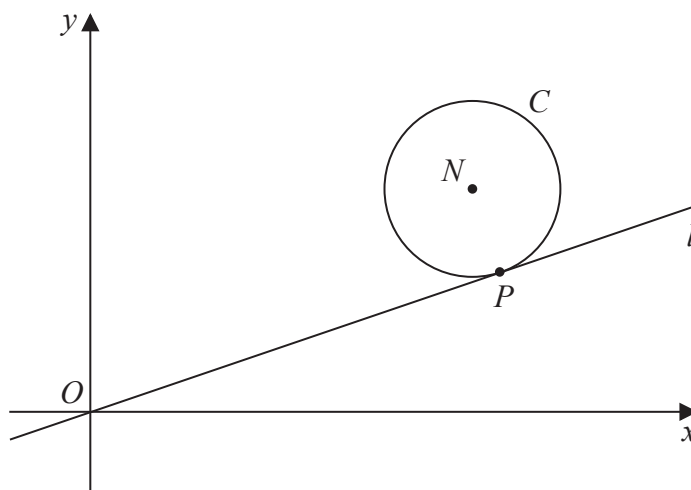


Figure 4

Figure 4 shows a sketch of a circle  $C$  with centre  $N(7, 4)$

The line  $l$  with equation  $y = \frac{1}{3}x$  is a tangent to  $C$  at the point  $P$ .

Find

(a) the equation of line  $PN$  in the form  $y = mx + c$ , where  $m$  and  $c$  are constants, (2)

(b) an equation for  $C$ . (4)

The line with equation  $y = \frac{1}{3}x + k$ , where  $k$  is a non-zero constant, is also a tangent to  $C$ .

(c) Find the value of  $k$ . (3)

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7. The circle  $C$  has equation

$$x^2 + y^2 - 10x + 4y + 11 = 0$$

(a) Find

- (i) the coordinates of the centre of  $C$ ,
- (ii) the exact radius of  $C$ , giving your answer as a simplified surd. (4)

The line  $l$  has equation  $y = 3x + k$  where  $k$  is a constant.

Given that  $l$  is a tangent to  $C$ ,

- (b) find the possible values of  $k$ , giving your answers as simplified surds. (5)

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14. The circle  $C$  has equation

$$x^2 + y^2 - 6x + 10y + 9 = 0$$

(a) Find

- (i) the coordinates of the centre of  $C$
- (ii) the radius of  $C$

(3)

The line with equation  $y = kx$ , where  $k$  is a constant, cuts  $C$  at two distinct points.

(b) Find the range of values for  $k$ .

(6)

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10. A circle  $C$  has equation

$$x^2 + y^2 - 4x + 8y - 8 = 0$$

(a) Find

- (i) the coordinates of the centre of  $C$ ,
- (ii) the exact radius of  $C$ .

(3)

The straight line with equation  $x = k$ , where  $k$  is a constant, is a tangent to  $C$ .

(b) Find the possible values for  $k$ .

(2)

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11. (i) A circle  $C_1$  has equation

$$x^2 + y^2 + 18x - 2y + 30 = 0$$

The line  $l$  is the tangent to  $C_1$  at the point  $P(-5, 7)$ .

Find an equation of  $l$  in the form  $ax + by + c = 0$ , where  $a$ ,  $b$  and  $c$  are integers to be found.

(5)

(ii) A different circle  $C_2$  has equation

$$x^2 + y^2 - 8x + 12y + k = 0$$

where  $k$  is a constant.

Given that  $C_2$  lies entirely in the 4th quadrant, find the range of possible values for  $k$ .

(4)

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5. The circle  $C$  has equation

$$x^2 + y^2 - 10x + 6y + 30 = 0$$

Find

- (a) the coordinates of the centre of  $C$ , **(2)**
- (b) the radius of  $C$ , **(2)**
- (c) the  $y$  coordinates of the points where the circle  $C$  crosses the line with equation  $x = 4$ ,  
giving your answers as simplified surds. **(3)**

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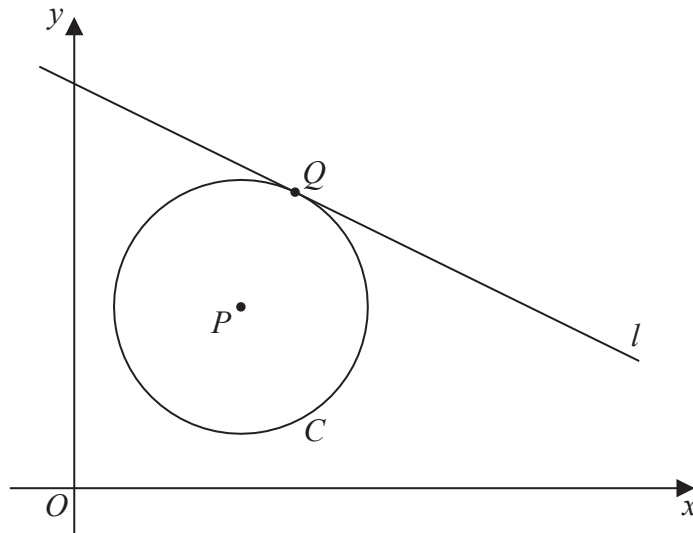


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**Figure 2**

The circle  $C$  has centre  $P(7, 8)$  and passes through the point  $Q(10, 13)$ , as shown in Figure 2.

(a) Find the length  $PQ$ , giving your answer as an exact value. (2)

(b) Hence write down an equation for  $C$ . (2)

The line  $l$  is a tangent to  $C$  at the point  $Q$ , as shown in Figure 2.

(c) Find an equation for  $l$ , giving your answer in the form  $ax + by + c = 0$ , where  $a, b$  and  $c$  are integers. (4)

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13. The circle  $C$  has equation

$$(x - 3)^2 + (y + 4)^2 = 30$$

Write down

(a) (i) the coordinates of the centre of  $C$ ,

(ii) the exact value of the radius of  $C$ .

(2)

Given that the point  $P$  with coordinates  $(6, k)$ , where  $k$  is a constant, lies inside circle  $C$ ,

(b) show that

$$k^2 + 8k - 5 < 0$$

(3)

(c) Hence find the exact set of values of  $k$  for which  $P$  lies inside  $C$ .

(4)

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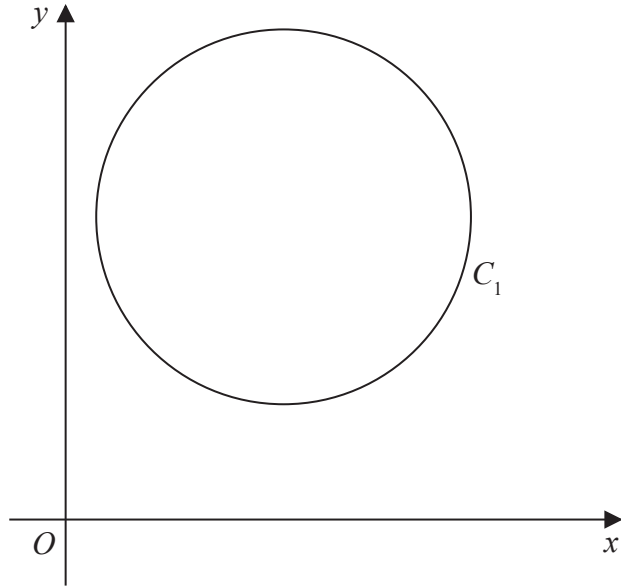


Figure 5

Figure 5 shows a sketch of the circle  $C_1$

The points  $A(1, 4)$  and  $B(7, 8)$  lie on  $C_1$

Given that  $AB$  is a diameter of the circle  $C_1$

(a) find the coordinates for the centre of  $C_1$  (2)

(b) find the exact radius of  $C_1$  simplifying your answer. (2)

Two distinct circles  $C_2$  and  $C_3$  each have centre  $(0, 0)$ .

Given that each of these circles touch circle  $C_1$

(c) find the equation of circle  $C_2$  and the equation of circle  $C_3$  (4)

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13. The circle  $C$  has centre  $A(1, -3)$  and passes through the point  $P(8, -2)$ .

(a) Find an equation for the circle  $C$ . (4)

The line  $l_1$  is the tangent to  $C$  at the point  $P$ .

(b) Find an equation for  $l_1$ , giving your answer in the form  $y = mx + c$  (4)

The line  $l_2$ , with equation  $y = x + 6$ , is the tangent to  $C$  at the point  $Q$ .

(c) Find the coordinates of the point  $Q$ . (5)

Horizontal lines for writing answers.

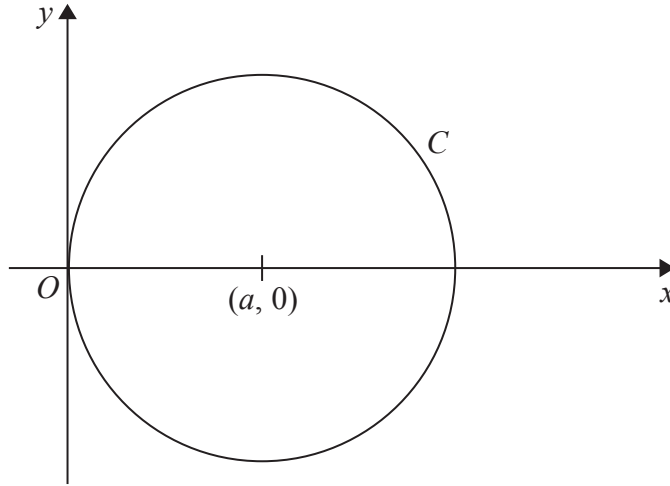
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12.



**Figure 3**

Figure 3 shows a circle  $C$

$C$  touches the  $y$ -axis and has centre at the point  $(a, 0)$  where  $a$  is a positive constant.

(a) Write down an equation for  $C$  in terms of  $a$  (2)

Given that the point  $P(4, -3)$  lies on  $C$ ,

(b) find the value of  $a$  (3)

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15. The points  $A$  and  $B$  have coordinates  $(-8, -8)$  and  $(12, 2)$  respectively.  $AB$  is the diameter of a circle  $C$ .

(a) Find an equation for the circle  $C$ .

(6)

The point  $(4, 8)$  also lies on  $C$ .

(b) Find an equation of the tangent to  $C$  at the point  $(4, 8)$ , giving your answer in the form  $ax + by + c = 0$

(4)

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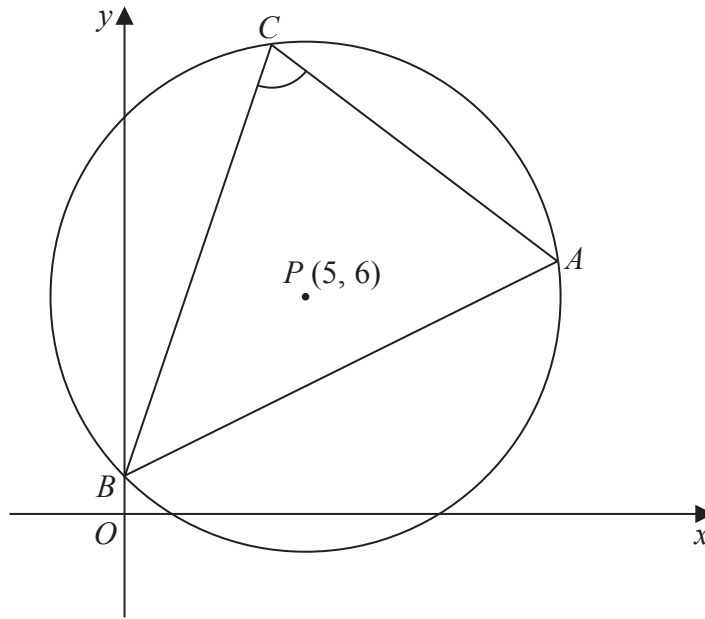


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Figure 4

The circle shown in Figure 4 has centre  $P(5, 6)$  and passes through the point  $A(12, 7)$ .

Find

(a) the exact radius of the circle, (2)

(b) an equation of the circle, (3)

(c) an equation of the tangent to the circle at the point  $A$ . (4)

The circle also passes through the points  $B(0, 1)$  and  $C(4, 13)$ .

(d) Use the cosine rule on triangle  $ABC$  to find the size of the angle  $BCA$ , giving your answer in degrees to 3 significant figures. (5)

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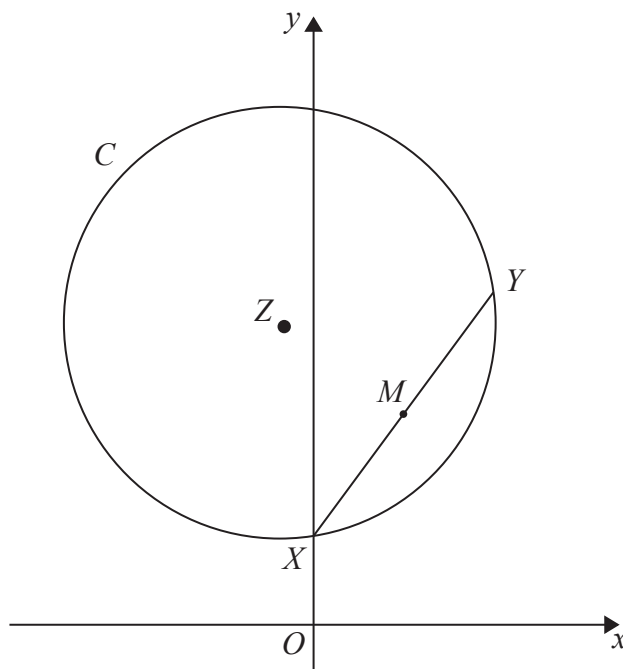


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**Figure 3**

The points  $X$  and  $Y$  have coordinates  $(0, 3)$  and  $(6, 11)$  respectively.  $XY$  is a chord of a circle  $C$  with centre  $Z$ , as shown in Figure 3.

(a) Find the gradient of  $XY$ . (2)

The point  $M$  is the midpoint of  $XY$ .

(b) Find an equation for the line which passes through  $Z$  and  $M$ . (5)

Given that the  $y$  coordinate of  $Z$  is 10,

(c) find the  $x$  coordinate of  $Z$ , (2)

(d) find the equation of the circle  $C$ , giving your answer in the form

$$x^2 + y^2 + ax + by + c = 0$$

where  $a$ ,  $b$  and  $c$  are constants. (5)

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