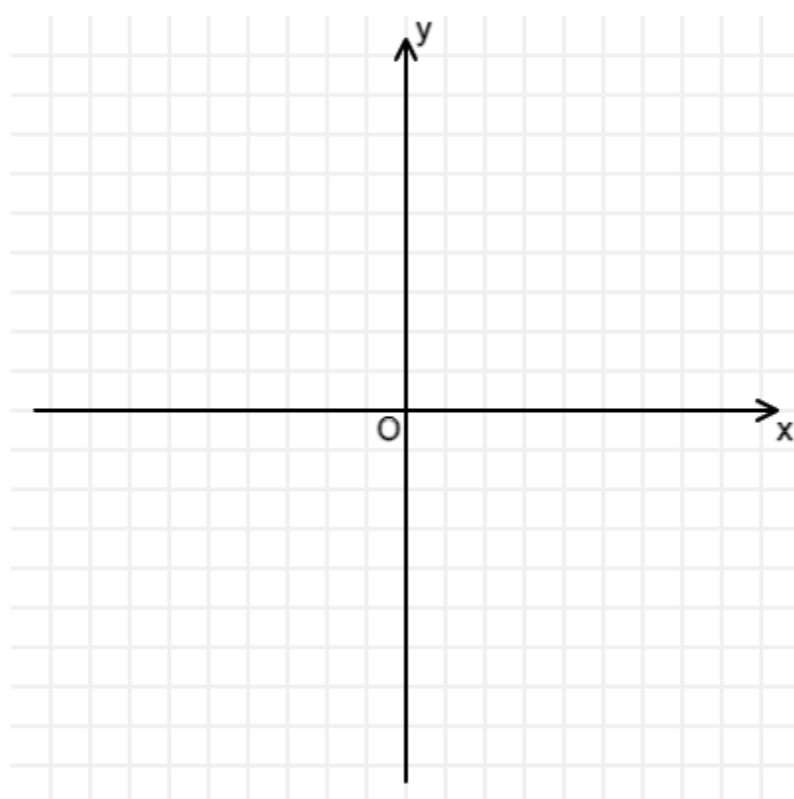


Transformations of Graphs 2ii

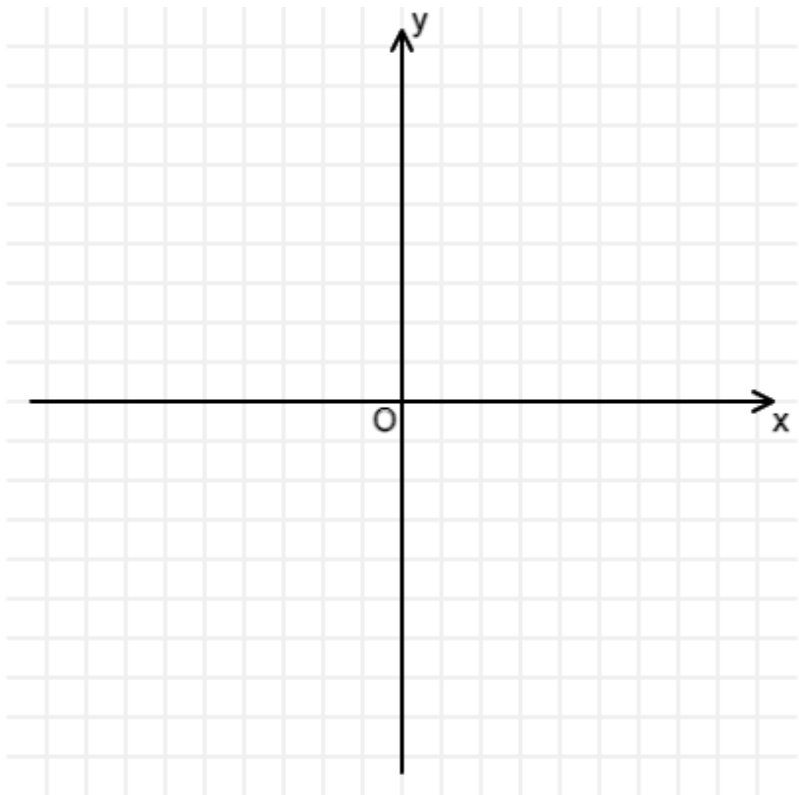
Part A Sketch the curve $y = \frac{1}{x}$

Sketch the curve $y = \frac{1}{x}$.



Part B Sketch the curve $y = x^4$

Sketch the curve $y = x^4$.



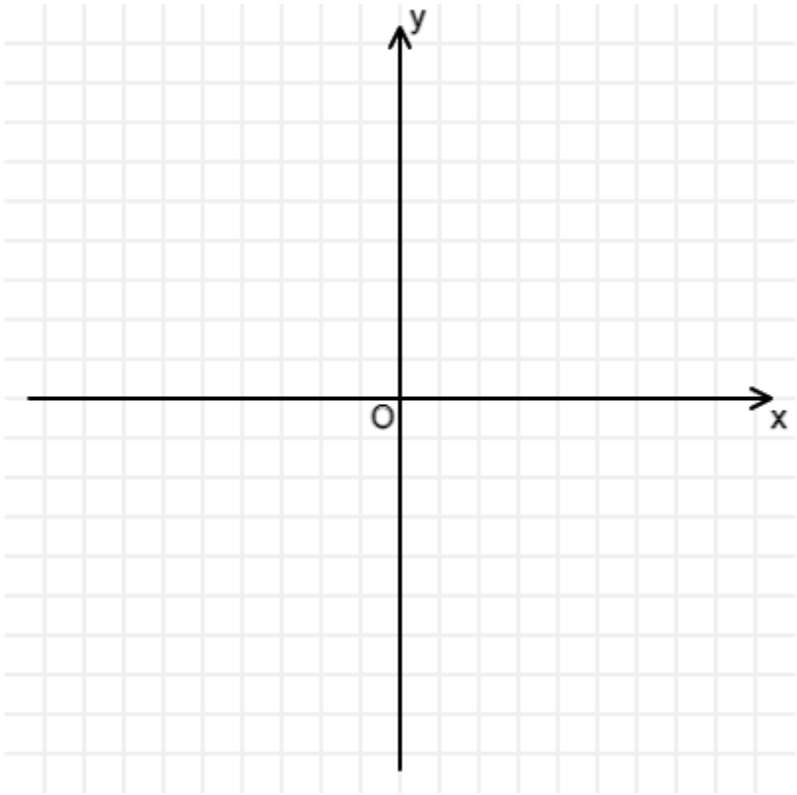
Part C Transformation from $y = x^3$ onto $y = 8x^3$

Which TWO of the following describe a single transformation that maps the curve $y = x^3$ onto the curve $y = 8x^3$?

- ☐ A stretch of scale factor 8 parallel to the y -axis
- ☐ A translation +8 units parallel to the y -axis.
- ☐ A stretch of scale factor $\frac{1}{2}$ parallel to the x -axis.
- ☐ A stretch of scale factor 8 parallel to the x -axis.
- ☐ A stretch of scale factor $\frac{1}{8}$ parallel to the y -axis.
- ☐ A stretch of scale factor $\frac{1}{8}$ parallel to the x -axis.

Part D Sketch the curve $y = -\frac{1}{x}$

Sketch the curve $y = -\frac{1}{x}$.



Part E State the equation

The curve $y = -\frac{1}{x}$ is translated by $+2$ units parallel to the x -axis in the positive direction. State the equation of the transformed curve.

The following symbols may be useful: x , y

Part F Transformation from $y = -\frac{1}{x}$ onto $y = -\frac{1}{3x}$

Which TWO of the following describe a single transformation that maps the curve $y = -\frac{1}{x}$ onto the curve $y = -\frac{1}{3x}$?

- ☐ A stretch of scale factor $\frac{1}{3}$ parallel to the x -axis.
 - ☐ A translation by $+3$ units parallel to the x -axis.
 - ☐ A stretch of scale factor 3 parallel to the x -axis.
 - ☐ A stretch of scale factor $\frac{1}{3}$ parallel to the y -axis.
 - ☐ A stretch of scale factor 3 parallel to the y -axis.
-

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Transformations of Graphs 3ii

A Level



The graph of $y = f(x)$ for $-2 \leq x \leq 2$ is shown in **Figure 1**.

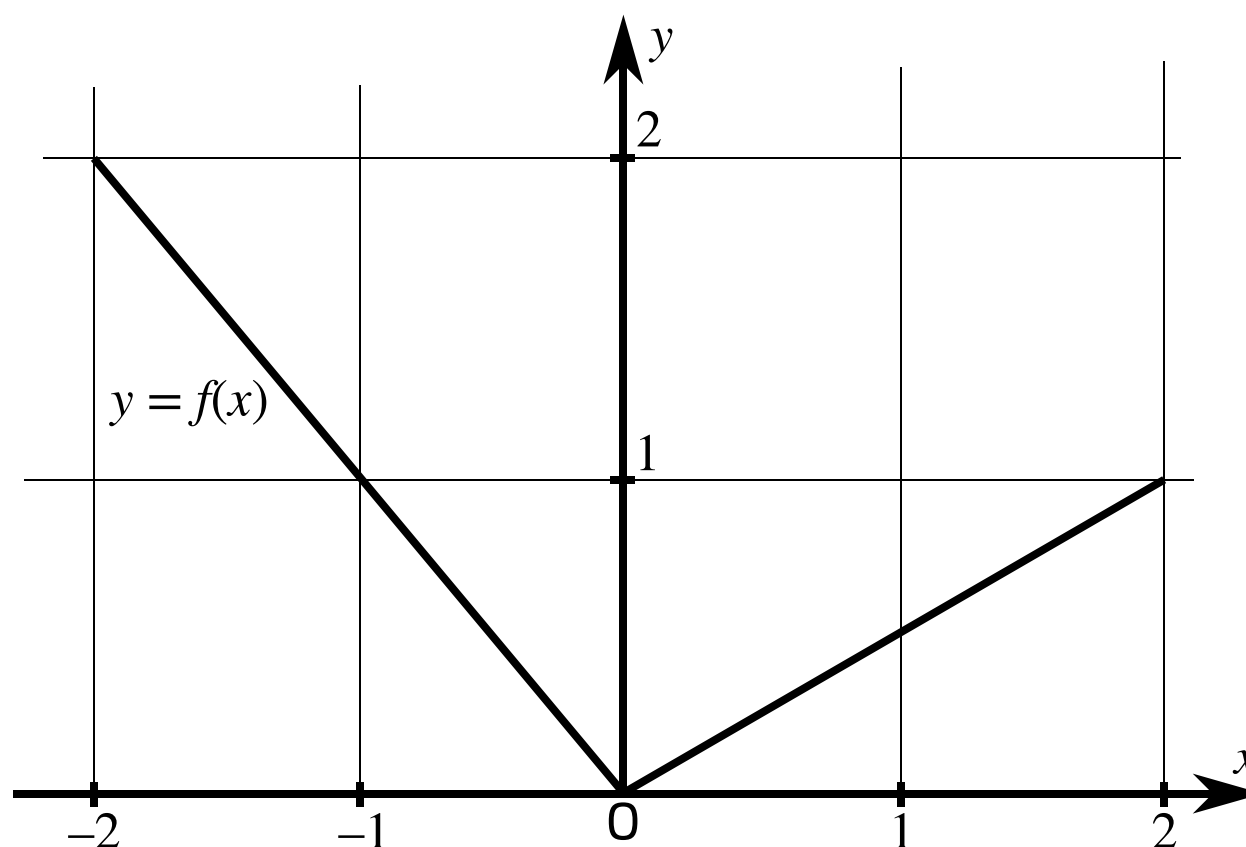


Figure 1: The graph of $y = f(x)$ for $-2 \leq x \leq 2$.

Part A Sketch $y = f(-x)$

Sketch the curve $y = f(-x)$ for $-2 \leq x \leq 2$.

What is the y -value of the curve $y = f(-x)$ when $x = 1$?

The following symbols may be useful: y

Part B Sketch $y = f(-x) + 2$

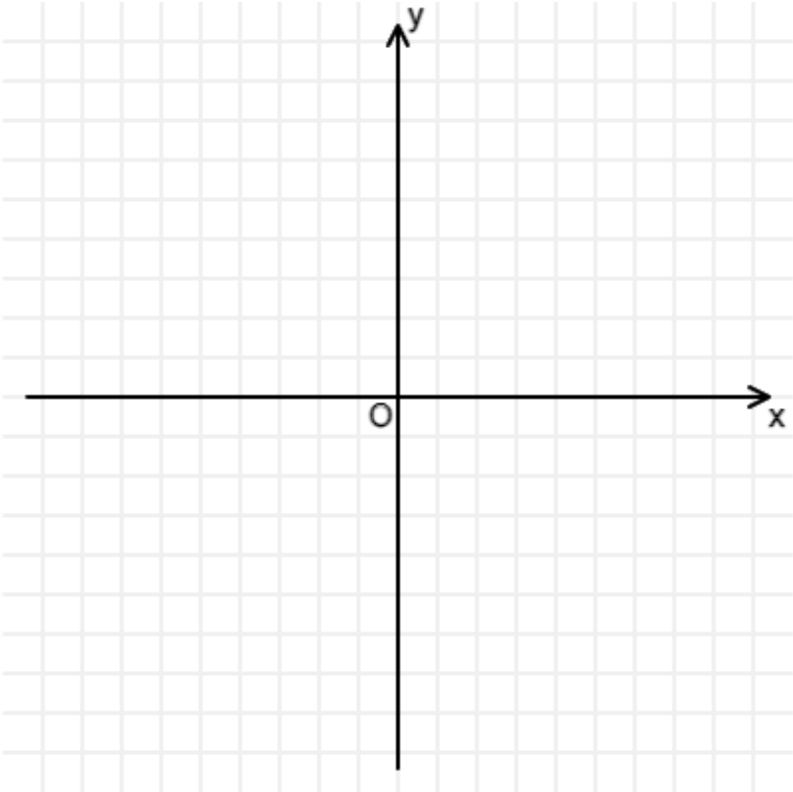
Sketch the curve $y = f(-x) + 2$ for $-2 \leq x \leq 2$.

What is the y -value of the curve $y = f(-x) + 2$ when $x = -2$?

The following symbols may be useful: y

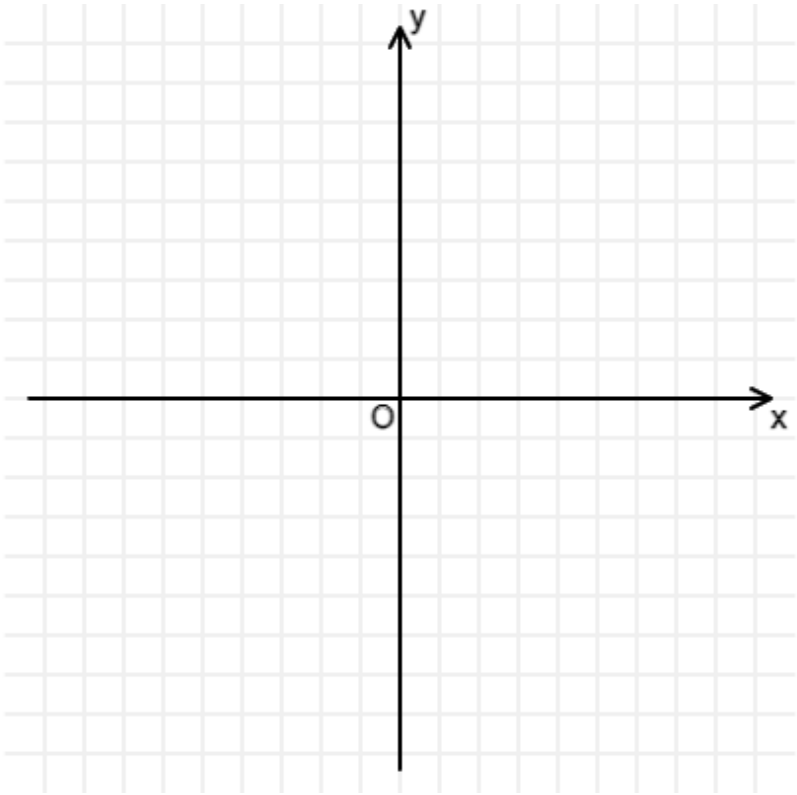
Part C Sketch $y = -\frac{1}{x^2}$

Sketch the curve $y = -\frac{1}{x^2}$.



Part D Sketch $y = 3 - \frac{1}{x^2}$

Sketch the curve $y = 3 - \frac{1}{x^2}$.



Part E State the equation

The curve $y = -\frac{1}{x^2}$ is stretched parallel to the y -axis by scale factor 2. State the equation of the transformed curve.

The following symbols may be useful: x , y

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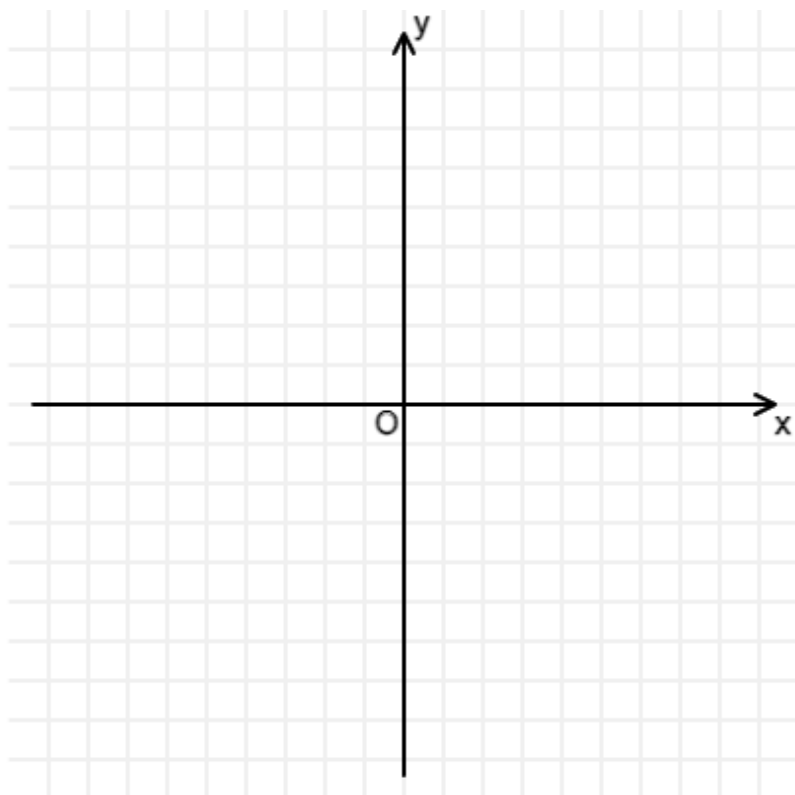
Transformations of Graphs 1i

A Level



Part A Sketch y

Find the roots of the curve $y = x^2(3 - x)$ and sketch it.



Part B Translate y

The curve $y = x^2(3 - x)$ is translated by two units in the positive direction parallel to the x axis.

State the equation of the curve after this transformation.

The following symbols may be useful: x , y

Part C Find transformation of y

Which of these describes the transformation of the curve $y = x^2(3 - x)$ to $y = \frac{1}{2}x^2(3 - x)$?

- ☐ A stretch of scale factor 2 parallel to the x -axis.
- ☐ A stretch of scale factor $\frac{1}{2}$ parallel to the x -axis.
- ☐ A stretch of scale factor 2 parallel to the y -axis.
- ☐ A stretch of scale factor $\frac{1}{2}$ parallel to the y -axis.
-

Part D Vertical translation of $f(x)$

The curve $y = f(x)$ passes through the point P with coordinates $(2, 5)$.

State the coordinates of the point corresponding to P on the curve $y = f(x) + 2$.

(,)

Part E Lateral stretching of $f(x)$

The curve $y = f(x)$ passes through the point P with coordinates $(2, 5)$.

State the coordinates of the point corresponding to P on the curve $y = f(2x)$.

(,)

Part F Find transformation of $f(x)$

Which of the following describes the single transformation that maps the curve $y = f(x)$ onto $y = f(x + 4)$?

- ☐ A translation of -4 units parallel to the y -axis.
 - ☐ A translation of 4 units parallel to the x -axis.
 - ☐ A translation of -4 units parallel to the x -axis.
 - ☐ A translation of 4 units parallel to the y -axis.
-

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Lateral and Vertical Translations

Pre-Uni Maths for Sciences 2.5.2

A Level

Investigate the transformations of the following functions.

Part A Lateral translation

Consider the function $f(x) = x^2 + 2x + 1$. The function $g(x) = f(x - a)$, where a is a constant. If $g(1) = 9$ find the value of a , given that it is positive.

The following symbols may be useful: a

Part B Vertical translation

Consider the function $r(u) = \frac{2}{u - 2}$. The function $s(u) = r(u) + b$, where b is a constant. If $s(0) = 1$, find the value of b .

The following symbols may be useful: b

Part C Lateral and vertical translation

Consider the function $p(r) = \frac{1}{r}$. The function $q(r) = p(r - c) + d$, where c and d are constants. If $q(0) = 1$ and $q(2) = 3$, find the values of c and d .

Find the value of c .

The following symbols may be useful: c

Find the value of d .

The following symbols may be useful: d

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Reflection and Symmetry

A Level**Pre-Uni Maths for Sciences E2.10**

The following questions ask you to deduce the symmetry properties of a number of functions. There are three choices:

- even - a function for which $f(x) = f(-x)$ which is also described as being symmetric about the vertical axis,
- odd - a function for which $f(x) = -f(-x)$ which is also described as being antisymmetric about the vertical axis (or symmetric about zero),
- neither even nor odd.

Where relevant you may assume that a and b are non-zero constants.

Part A **Even functions**

Decide which of the following functions are even.

☐ $(x - a)(x + a)$

☐ $\frac{a}{x^2} + bx^2$

☐ $(x - a)(x + b) \ (a \neq b)$

☐ $x^2(a + bx)$

☐ $ax^2 + bx^4$

☐ $ax^2 + b$

☐ $a(x + b)^2$

☐ $a \cos x$

☐ $\frac{a}{x^2} + b$

☐ ax^2

☐ $a \sin x$

Part B **Odd functions**

Decide which of the following functions are odd.

☐ $a \tan x$

☐ $(x + a)^{\frac{1}{3}}$

☐ $x(a + bx^2)$

☐ $x^{\frac{1}{3}}$

☐ $\frac{a}{x} + bx^3$

☐ ax

☐ $a \sin x$

☐ $\frac{a}{x}$

☐ $\frac{a}{x} + b$

☐ $x^2(a + bx)$

☐ $\frac{a}{x} + \frac{b}{x^3}$

Part C Neither odd nor even functions

Decide which of the following functions are neither odd nor even.

- ☐ $ax - b$
 - ☐ $a \tan(x + 45^\circ)$
 - ☐ $ax^{\frac{1}{2}}$
 - ☐ $(x - a)(x + a)$
 - ☐ $(x - a)(x + a)^2$
 - ☐ $a\left(\frac{1}{x^2} - \frac{1}{b^2}\right)$
 - ☐ $a(b - x)^{\frac{1}{2}}$
 - ☐ $x(ax^2 + b)$
 - ☐ $\cos x + \sin x$
 - ☐ $\frac{a}{(x - b)^2}$
 - ☐ $x^2(ax + b)$
-

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Circles 1ii

A Level

The circle with equation $x^2 + y^2 - 6x - k = 0$ has radius 4.

The points $A(3, a)$ and $B(-1, 0)$ lie on the circumference of the circle, with $a > 0$.

Part A Centre

By completing the square for x and y find the coordinates of the centre of the circle.

(,)

Part B Value of k

Find the value of k .

The following symbols may be useful: k

Part C Length AB

Calculate the length of AB, giving your answer in simplified surd form.

Part D Equation

Find the equation of the line AB. Give your answer in the form $y = mx + c$.

The following symbols may be useful: x , y

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Circles 3ii

A Level

A circle has centre $(3, 1)$ and radius 5, and a line has equation $y = 2x$.

Part A Circle equation

Write down the equation of the circle.

The following symbols may be useful: x , y

Part B Intersection points

Find the coordinates of the points of intersection of the line and the circle.

(,)

Part C Point on the line

Find the coordinates of the point on the line which is closest to the centre of the circle.

(,)



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Circles 2i

A Level

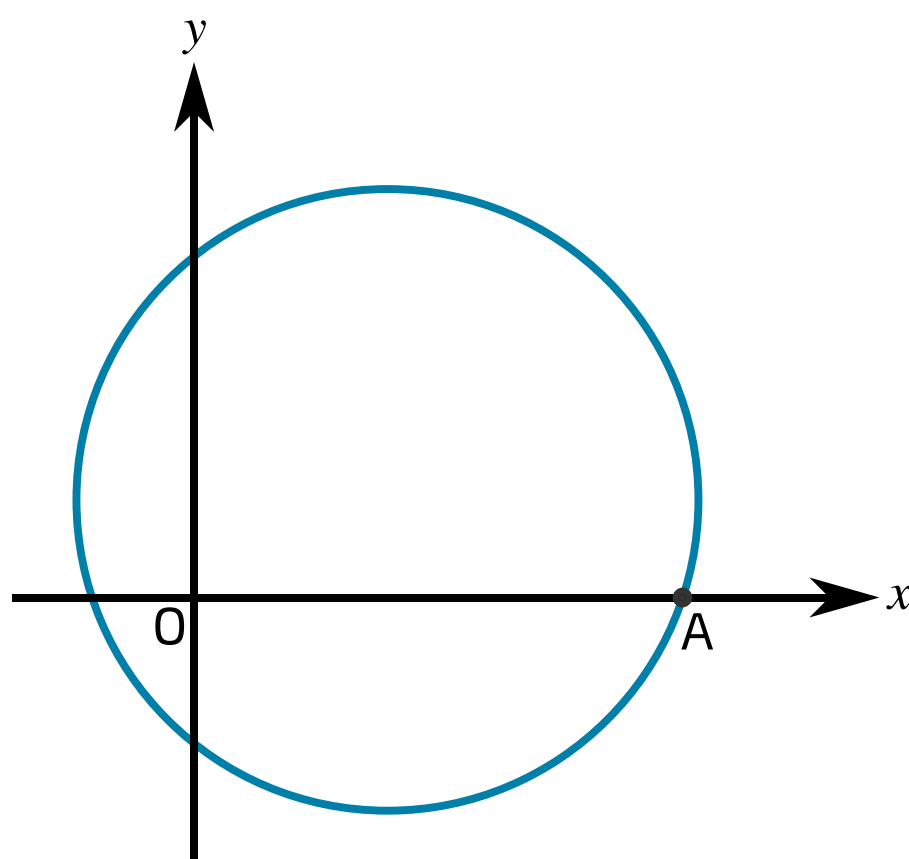


Figure 1: The circle with equation $x^2 + y^2 - 8x - 6y - 20 = 0$.

Figure 1 shows the circle with equation $x^2 + y^2 - 8x - 6y - 20 = 0$. The circle crosses the positive x axis at point A.

Part A Find centre

By completing the square for x and y find the coordinates of the centre of the circle.

(,)

Part B Find radius

Find the radius of the circle.

Part C Tangent to the circle at A

Find the equation of the tangent to the circle at A. Give your answer in the form $y = mx + c$.

The following symbols may be useful: x , y

Part D Another tangent to the circle

A second tangent to the circle is parallel to the tangent at A. Find the equation of this second tangent in the form $y = mx + c$.

The following symbols may be useful: x , y

Part E Find a radius

Another circle has its centre at the origin O and radius r . This circle lies wholly inside the first circle. Find the set of possible values of r . Give your answer as an inequality.

The following symbols may be useful: $<$, \leq , $>$, \geq , r

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