**3A Ellipses**



1. The ellipse has equation
.
2. Sketch .
3. Write down its parametric equations.
4. The ellipse has parameter equations:

Determine its Cartesian equation.

**3B Hyperbolas**

1. The hyperbola has equation
.
2. Sketch .
3. Write down the equations of the asymptotes of .
4. Find parametric Equations for .
5. A hyperbola H has parametric equations
6. Find a Cartesian equation for .
7. Sketch .
8. Write down the equations of the asymptotes of .

**3C Eccentricity**

Ellipse

Parabola

Hyperbola

1. Show that for , the ellipse with focus and directrix has equation .
2. Find foci of the ellipse with equation and give the equation of the directrices. Hence sketch the ellipse.

1. Find foci of the ellipse with equation and give the equation of the directrices. Hence sketch the ellipse.

1. If is a point on an ellipse , prove that

1. Show that for , the hyperbola with foci at and directrices at has equation

1. Sketch the hyperbola with equation , indicating the foci, directrices and equations of the asymptotes.
2. Sketch the hyperbola with equation , indicating the foci, directrices and equations of the asymptotes.

A quick note on hyperbolas and ellipses:

For hyperbolas, you don’t care which of and are bigger. For ellipses, swapping the and has the effect of rotating the ellipse and hence the foci/directrices too. We don’t get this same rotation for hyperbolas.

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Note:

**3D Gradients of an Ellipse**

1. Find the equation of the tangent to the ellipse with equation at the point
2. Show that the equation of the normal to the ellipse with equation at the point is

Notes on tangents and normals to an ellipse

1. The point lies on the ellipse with parametric equations
.
2. Find the value of at the point .
3. Find the equation of the normal to the ellipse at point .
4. Show that the condition for to be a tangent to the ellipse is
5. The ellipse has the equation . The line is normal to the ellipse at the point and passes through the point , where cuts the -axis, as shown in the diagram.

Find the exact coordinates of the point , where cuts the positive-axis.



**3E Gradients of a Hyperbola**

1. Find the equation of the tangent to the hyperbola with equation at the point
2. Prove that the equation of a tangent to the hyperbola at the point is
3. Show that an equation of the normal to the hyperbola with equation at is .
4. Show that the condition for the line to be a tangent to the hyperbola is that and satisfy
5. The tangent to the hyperbola with equation at the point crosses the -axis at the point . Find the value of .
6. The hyperbola has equation .

The line is the tangent to at the point . The line passes through the origin and is perpendicular to The lines and intersect at the point .

Show that the coordinates of the point are .

**3F More Loci**

1. The tangent to the ellipse with equation at the point crosses the -axis at and the -axis at .

Find an equation for the locus of the mid-point of as moves around the ellipse.

1. The normal at and the normal at to the parabola with equation meet at .
2. Find the coordinates of .

The chord passes through the focus of the parabola.

1. Show that
2. Show that the locus of is a parabola with equation