

# Coordinate geometry

A Level Maths · Knowledge organiser



## KEY DEFINITIONS

### Gradient

Change in  $y$  divided by change in  $x$  between two points on a line.

### Perpendicular lines

Lines at right angles; their gradients multiply to  $-1$ .

### Equation of a circle

$(x - a)^2 + (y - b)^2 = r^2$  has centre  $(a, b)$  and radius  $r$ .

### Parametric equations

$x$  and  $y$  are both given in terms of a third variable, the parameter  $t$ .

## KEY FORMULAS

**B** = given in the exam (formula booklet or list); learn the rest.

Line; gradient  $y - y_1 = m(x - x_1)$ ,  $m = \frac{y_2 - y_1}{x_2 - x_1}$

Perpendicular gradients  $m_1 m_2 = -1$

Midpoint; distance  $(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2})$ ,  $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Circle, centre  $(a, b)$ ,  $(x - a)^2 + (y - b)^2 = r^2$   
radius  $r$

Circles: tangent  $\perp$  radius; angle in a semicircle is  $90^\circ$ ;  
perpendicular from centre bisects a chord

Parametric  $\rightarrow$  Cartesian: eliminate  $t$ , e.g. with  $\sin^2 t + \cos^2 t = 1$

Sphere; cone

(curved surface,  $A = 4\pi r^2$ ;  $A = \pi r l$   
slant  $l$ ) **B**

## YOU SHOULD BE ABLE TO...

- Find the gradient and  $y$ -intercept of straight lines written in different forms, and rearrange equations such as  $3x + 2y = 7$  into the form  $y = mx + c$ .
- Calculate the distance between two points and use straight-line equations and intersections to find lengths and areas of triangles and other shapes on coordinate axes.
- Find the midpoint of a line segment and the equation of its perpendicular bisector, and use perpendicular bisectors of chords to locate the centre of a circle.
- Use the facts that a tangent is perpendicular to the radius and that the perpendicular from the centre bisects a chord to find tangent equations and lengths.
- Use parametric equations  $x = f(t)$  and  $y = g(t)$  to find points on a curve, and convert to a Cartesian equation by eliminating the parameter.
- Find where parametric curves meet the axes or a line by solving for the parameter, and model paths such as projectiles with parametric equations.

## WORKED EXAMPLE

**Find the centre and radius of the circle  $x^2 + y^2 - 4x + 6y - 12 = 0$ .**

1.  $(x - 2)^2 - 4 + (y + 3)^2 - 9 - 12 = 0$

2.  $(x - 2)^2 + (y + 3)^2 = 25$

**Answer: Centre  $(2, -3)$ , radius 5**

## COMMON MISTAKES

- X**  $F(x + a)$  moved in the  $+x$  direction
- X**  $F(2x)$  stretched by 2 instead of  $\frac{1}{2}$
- X** Asymptotes not transformed
- X** Perpendicular gradient taken as  $-m$