

3.2 Coordinates and straight lines

Name: _____ Class: _____ Date: _____

Total: 24 marks

KEY WORDS gradient • perpendicular lines

Coordinates and straight lines

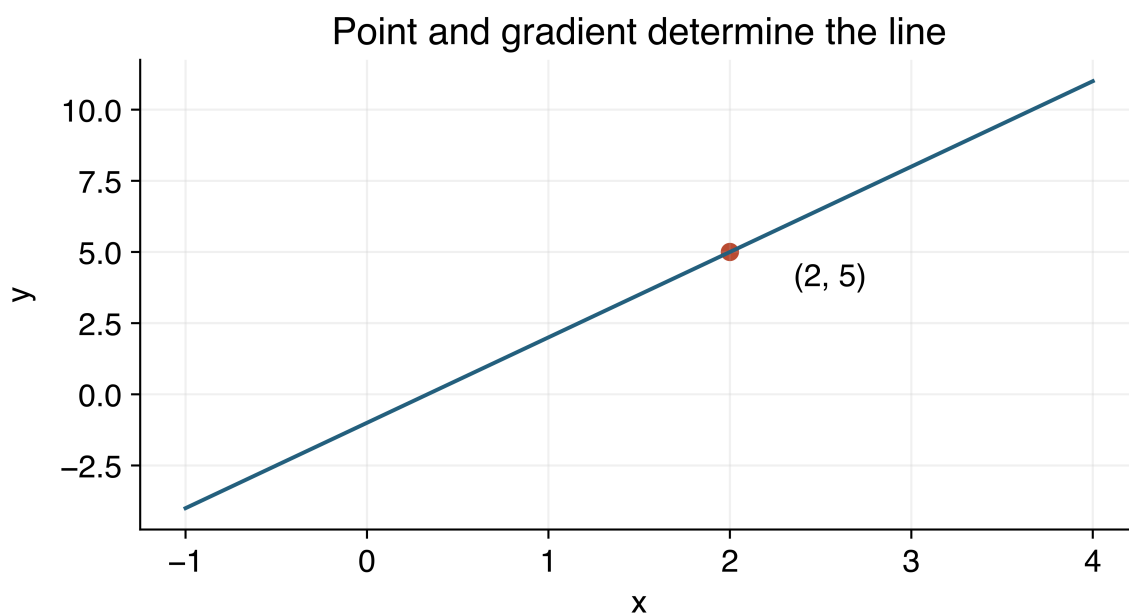
Objective

Plot and read coordinates in all four quadrants, find midpoints and gradients from two points, use $y = mx + c$, and write equations of parallel and perpendicular lines (objectives Foundation 3.3 A–I and Higher 3.3 F–G).

1 Key knowledge and worked examples

Coordinates, midpoints, gradients. The midpoint of (x_1, y_1) and (x_2, y_2) is $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$. The gradient between the same points is $m = \frac{y_2-y_1}{x_2-x_1}$: through $(1, 7)$ and $(2, 9)$ the gradient is 2. A line $y = mx + c$ has gradient m and y -intercept $(0, c)$: $y = 3x + 5$ has gradient 3, intercept $(0, 5)$. Vertical lines $x = k$ have no finite gradient; horizontal lines $y = c$ have gradient 0.

Parallel and perpendicular. Parallel lines share a gradient. Perpendicular gradients multiply to -1 : perpendicular to m is $-1/m$, so perpendicular to $\frac{3}{8}$ is $-\frac{8}{3}$. The line of gradient m through (x_1, y_1) is $y - y_1 = m(x - x_1)$. When an answer is wanted as $ax + by + c = 0$, multiply out so a, b, c are integers.



Original native-lesson illustration; labels belong to its worked example.

2 Practice

2.1 Find the midpoint of $(-5, 2)$ and $(3, 5)$. [2]

2.2 Find the gradient of the line through $(1, 7)$ and $(2, 9)$. [2]

2.3 Write down the equation of the line with gradient 6 through the point $(0, 2)$. [2]

2.4 For $y = 3x + 5$, write down the gradient and the coordinates of the y -intercept. [2]

2.5 A line has gradient $\frac{3}{8}$. Write down the gradient of any perpendicular line. [2]

2.6 Find the equation of the line through $(2, 5)$ with gradient 3. [2]

3 Exam-style questions

3.1 (*Edexcel 4MA1 2HR June 2024 Q21, adapted.*) $ABCD$ is a square. A has coordinates $(-5, 2)$ and B has coordinates $(3, 5)$. Find an equation of the line that passes through B and C , giving your answer in the form $ax + by + c = 0$ where a , b and c are integers. [4]

3.2 (*Original.*) A is $(-2, 3)$ and B is $(4, -1)$. Find the equation of the perpendicular bisector of AB , in the form $ax + by + c = 0$. [4]

3.3 (*Original.*) Line L passes through $(0, 4)$ and is parallel to $y = 5 - 2x$. (a) Write down the equation of L . (b) Determine whether the point $(3, -2)$ lies on L , justifying your answer. [4]

Solutions

2.1 $\left(\frac{-5+3}{2}, \frac{2+5}{2}\right) = (-1, 3.5)$.

2.2 $m = \frac{9-7}{2-1} = 2$.

2.3 $y = 6x + 2$ (intercept given directly).

2.4 Gradient 3; intercept $(0, 5)$.

2.5 $-\frac{1}{3/8} = -\frac{8}{3}$.

2.6 $y - 5 = 3(x - 2)$, so $y = 3x - 1$.

3.1 Gradient of AB : $\frac{5-2}{3-(-5)} = \frac{3}{8}$. Adjacent sides of a square are perpendicular, so the gradient of BC is $-\frac{8}{3}$. Through $B(3, 5)$: $y - 5 = -\frac{8}{3}(x - 3)$, so $3y - 15 = -8x + 24$, giving $8x + 3y - 39 = 0$.

3.2 Midpoint $\left(\frac{-2+4}{2}, \frac{3-1}{2}\right) = (1, 1)$. Gradient of AB is $\frac{-1-3}{4-(-2)} = -\frac{2}{3}$, so the bisector's gradient is $\frac{3}{2}$. Through $(1, 1)$: $y - 1 = \frac{3}{2}(x - 1)$, so $2y - 2 = 3x - 3$: $3x - 2y - 1 = 0$.

3.3 (a) Parallel, so gradient -2 : $y = -2x + 4$. (b) At $x = 3$: $y = -6 + 4 = -2$, which matches, so $(3, -2)$ lies on L .

Local review guidance: gradient then point-slope form, in that order; final integer-form equation as asked; the parallel/perpendicular reason stated through gradients. This is authored classroom guidance.