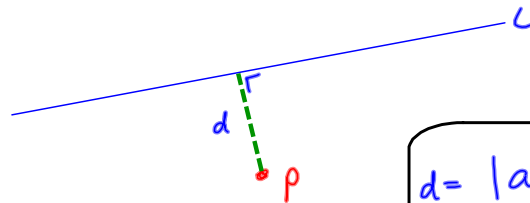


Coordinate Geometry: The Line

chapter

1

Section 1.6 Perpendicular distance from a point to a line



$$d = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$$

PROJECT MATHS - STRAND 2

PROJECT MATHS
Text & Tests 4
LEAVING CERTIFICATE
HIGHER LEVEL

$$d = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$$

Example 1

- Find the perpendicular distance from the point $(1, -4)$ to the line $3x - y - 2 = 0$.
- Find the distance between the parallel lines $3x - 4y + 12 = 0$ and $3x - 4y - 1 = 0$.

$$L: 3x - y - 2 = 0$$

$$a=3, b=-1, c=-2$$

$$\text{pt } (1, -4)$$

$$x_1=1, y_1=-4$$

$$d = \frac{|3(1) - (-4) - 2|}{\sqrt{(3)^2 + (-1)^2}}$$

$$= \frac{|5|}{\sqrt{10}} = \frac{5}{\sqrt{10}} = \frac{\sqrt{10}}{2}$$

to get distance between
// lines we need a
pt. on one of them

distance between $(0, 3)$
and K ?

$$L: 3x - 4y + 12 = 0$$

$$x=0 \Rightarrow 3(0) - 4y + 12 = 0$$

$$-4y = -12 \Rightarrow y = 3 \Rightarrow (0, 3) \in L$$

$$K: 3x - 4y - 1 = 0$$

$$d = \frac{|3(0) - 4(3) - 1|}{\sqrt{3^2 + 4^2}} = \frac{|-12 - 1|}{5} = \frac{13}{5}$$

Example 3

Find the equations of the two lines which are parallel to the line $3x - 4y - 1 = 0$ and 3 units from it.

- ① All lines // to $3x - 4y - 1 = 0$ have the equation:
 $3x - 4y + k = 0$

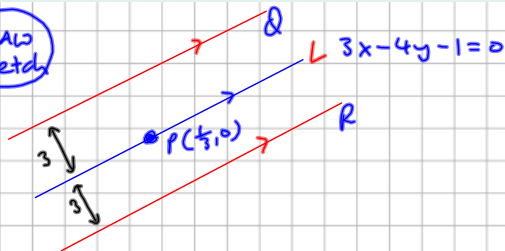
- ② Pick a point on L
 $y = 0$
 $3x - 1 = 0$
 $x = +1/3$
 pt $(\frac{1}{3}, 0)$

- ③ Use distance formula

$$d = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$$

- ④ Parallel lines with distance 3 units

DRAW SKETCH



$$3 = \frac{|3(\frac{1}{3}) - 4(0) + k|}{\sqrt{3^2 + 4^2}}$$

$$3 = \frac{|1 + k|}{5} \Rightarrow 15 = |1 + k|$$

either : $1 + k = 15 \Rightarrow k_Q = 14$
 OR : $1 + k = -15 \Rightarrow k_R = -16$

Q : $3x - 4y + 14 = 0$
 R : $3x - 4y - 16 = 0$

Exercise 1.6

1. Find the perpendicular distance from $(2, -4)$ to $3x - 4y - 17 = 0$.

$$d = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$$

$a = 3$
 $b = -4$
 $c = -17$
 $x_1 = 2$
 $y_1 = -4$

$$\begin{aligned} d &= \frac{|3(2) - 4(-4) - 17|}{\sqrt{3^2 + 4^2}} \\ &= \frac{|6 + 16 - 17|}{\sqrt{9 + 16}} \\ &= \frac{|5|}{\sqrt{25}} = \frac{5}{5} \\ &= 1 \end{aligned}$$