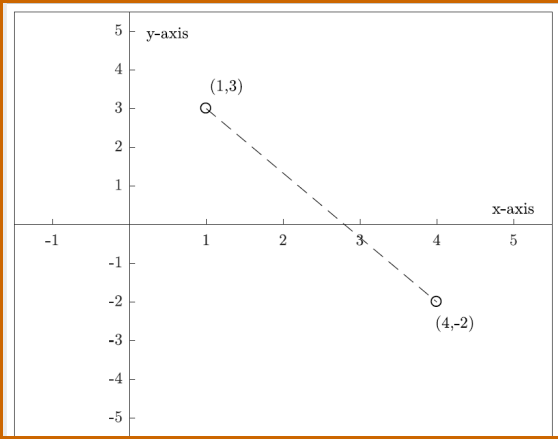
Where does a line cross an axis?
or
Where is the neutral plane?



One point lesson

Bjarne Christian Hagen

Where does a line cross an axis?
or
Where is the neutral plane?
One point lesson

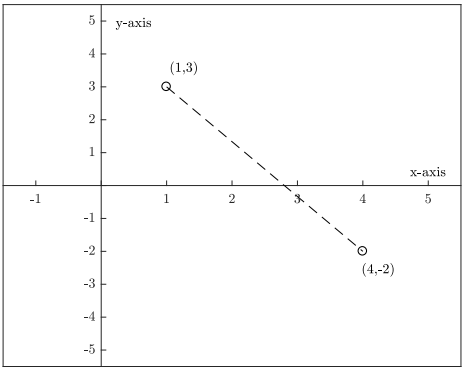
Bjarne Christian Hagen

Frontpage: Bjarne CHR. Hagen

ISBN: 978-82-996645-7-8 (Print, booklet)

ISBN: 978-82-996645-8-5 (PDF)

Question 1:
Given the two points shown in figure 1, find the point where a line between the two given points crosses the x-axis.



Figur 1: Line between to points crossing the x-axis.

Suggested solution:

The starting point for this question will be the equation for a line between two points:

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) \tag{1}$$

Since the line crosses the x-axis, y can be set equal to zero, and equation 1 can be re-written to solve for x.

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) \tag{2}$$

$$0 - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) \tag{3}$$

$$x = \frac{-(x_2 - x_1) \cdot y_1}{(y_2 - y_1)} + x_1 \tag{4}$$

Including the point informations in equation 4, the point where the line crosses the a-axis can be found:

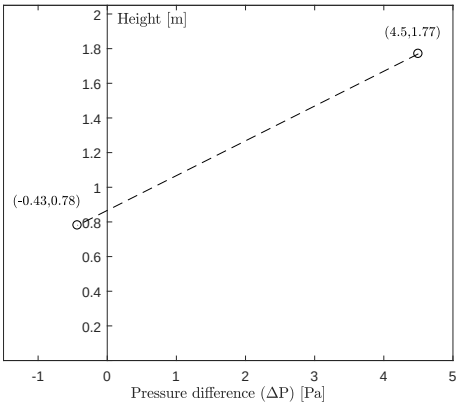
$$x = \frac{-(4-1) \cdot 3}{(-2-3)} + 1 \tag{5}$$

$$= 2.8 \tag{6}$$

The point where the line crosses the x-axis is found to be (2.8, 0). Comparing with figure 1, this looks like a reasonable answer.

Question 2:

Data from an experiment consists of two heights and two pressure differences. One of the pressures differences is positive and one is negative. The neutral plane in a room with a fire, is where the pressure difference is zero. Find height where the pressure difference is zero.



Figur 2: Line, between two pressure readings, crossing the y-axis.

Suggested solution:

Again the starting point for this question is the equation for a line between two points (see equation 1). However, this time the line crosses the y-axis, so x can be set equal to zero, and equation 1 can be re-written to solve for y.

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1) \tag{7}$$

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(0 - x_1) \tag{8}$$

$$y = -\frac{y_2 - y_1}{x_2 - x_1} \cdot x_1 + y_1 \tag{9}$$

Including the heights and the pressure in equation 9, the height of the nutral plane can be found:

$$y = \frac{y_2 - y_1}{x_2 - x_1} \cdot x_1 + y_1 \tag{10}$$

$$y = -\frac{0.78 \text{ m} - 1.77 \text{ m}}{-0.43 \text{ Pa} - 4.50 \text{ Pa}} \cdot 4.50 \text{ Pa} + 1.77 \text{ m} \tag{11}$$

$$= 0.87 \text{ m} \tag{12}$$

The point where the line crosses the y-axis or where the pressure difference is zero, is found to be 0.87 m. Comparing with figure 2, this looks like a reasonable answer.

Bjarne Christian Hagen took his master degree in fire protection at University of Maryland and his Ph.D at University of Bergen. He has worked at Western Norway University of Applied Sciences (HVL) since 1995, in addition to Gassco og Rogaland Brann og Sikkerhet (RBS).

Hagen is today Associate Professor at Department of Safety, Chemistry and Biomedical laboratory sciences at HVL.

This booklet is part of a small series of books where the author addresses issues where students are known to struggle. The problems or issues are addressed if students ask questions, or the lecturers point out the problem.