

ANALYTICAL GEOMETRY; MIDPOINT OF A LINE*

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Free High School Science Texts Project

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1 Analytical Geometry; Midpoint of a line

Sometimes, knowing the co-ordinates of the middle point or *midpoint* of a line is useful. For example, what is the midpoint of the line between point P with co-ordinates $(2; 1)$ and point Q with co-ordinates $(-2; -2)$.

The co-ordinates of the midpoint of any line between any two points A and B with co-ordinates $(x_1; y_1)$ and $(x_2; y_2)$, is generally calculated as follows. Let the midpoint of AB be at point S with co-ordinates $(X; Y)$. The aim is to calculate X and Y in terms of $(x_1; y_1)$ and $(x_2; y_2)$.

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Figure 1

$$\begin{aligned} X &= \frac{x_1+x_2}{2} \\ Y &= \frac{y_1+y_2}{2} \\ \text{A} \quad S &\left(\frac{x_1+x_2}{2}; \frac{y_1+y_2}{2}\right) \end{aligned} \tag{1}$$

Then the co-ordinates of the midpoint (S) of the line between point P with co-ordinates $(2; 1)$ and point Q

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with co-ordinates $(-2; -2)$ is:

$$\begin{aligned} X &= \frac{x_1+x_2}{2} \\ &= \frac{-2+2}{2} \\ &= 0 \\ Y &= \frac{y_1+y_2}{2} \\ &= \frac{-2+1}{2} \\ &= -\frac{1}{2} \end{aligned} \tag{2}$$

S is at $(0; -\frac{1}{2})$

It can be confirmed that the distance from each end point to the midpoint is equal. The co-ordinate of the midpoint S is $(0; -0,5)$.

$$\begin{aligned} PS &= \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \\ &= \sqrt{(0 - 2)^2 + (-0.5 - 1)^2} \\ &= \sqrt{(-2)^2 + (-1.5)^2} \\ &= \sqrt{4 + 2.25} \\ &= \sqrt{6.25} \end{aligned} \tag{3}$$

and

$$\begin{aligned} QS &= \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \\ &= \sqrt{(0 - (-2))^2 + (-0.5 - (-2))^2} \\ &= \sqrt{(0 + 2)^2 + (-0.5 + 2)^2} \\ &= \sqrt{(2)^2 + (-1.5)^2} \\ &= \sqrt{4 + 2.25} \\ &= \sqrt{6.25} \end{aligned} \tag{4}$$

It can be seen that $PS = QS$ as expected.

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Figure 2

The following video provides a summary of the midpoint of a line.

Khan academy video on midpoint of a line

This media object is a Flash object. Please view or download it at
<http://www.youtube.com/v/Ez_-RwV9WVo&rel=0>

Figure 3