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1 Equation of a line

The equation of a line is

$$y = mx + b\,,$$

where m is a slope and b is the y-intercept. Given two points $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$, the slope m can be expressed by:

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{\Delta y}{\Delta x} = \frac{\text{"rise"}}{\text{"run"}}\,.$$

1.1 Point slope intercept equation

$$y - y_1 = m(x - x_1)$$

1.2 Example 1

A line passes through points $(1, 4)$ and $(2, 10)$ find the equation of a line. Solution:

$$y = 6x - 2$$

1.3 Example 2

A line passes through a point $(1, 4)$ and has a slope 6, find the equation of a line. Solution:

$$y = 6x - 2$$

2 Exponentials and Logarithms

$$a^x a^y = a^{x+y}$$
$$\frac{a^x}{a^y} = a^{x-y}$$
$$(a^x)^y = a^{xy}$$
$$(ab)^x = a^x b^x$$

$$\log_a xy = \log_a x + \log_a y$$
$$\log_a \frac{x}{y} = \log_a x - \log_a y$$
$$\log_a x^y = y \log_a x$$
$$\log_e x = \ln(x)$$
$$e^{\ln x} = x$$
$$\ln e^x = x$$

2.1 Example 3

$$\ln x = 5$$

Express x:

$$e^{\ln x} = e^5$$

$$x = e^5$$

2.2 Example 4

$$2 = e^y$$

Express y:

$$\ln 2 = \ln e^y = y \ln e = y$$

2.3 Example 5

Derive the formula $\log_a x = \frac{\ln x}{\ln a}$:

$$a^y = x$$

Then $y = \log_a x$. Let's take a (natural) logarithm of both sides:

$$\ln a^y = \ln x$$

$$y \ln a = \ln x$$

$$y = \frac{\ln x}{\ln a}$$

E.g. we have

$$y = \frac{\ln x}{\ln a} = \log_a x$$