Concepts

Taylor series expansion:

$$f(x) = f(x_0) + f'(x_0)(x-x_0) + f''(x_0)\frac{(x-x_0)^2}{2!}$$

$$+ f'''(x_0)\frac{(x-x_0)^3}{3!} + \ldots\ldots f^{(n)}(x_0)\frac{(x-x_0)^n}{n!}$$

For example, if $f(x) = \ln x$, the Taylor's expansion out to $n=3$ with $x_0 = 1$ is

$f(x) = \ln x$ $\qquad f(1) = 0$

$f'(x) = x^{-1}$ $\qquad f'(1) = 1$

$f''(x) = -x^{-2}$ $\qquad f''(1) = -1$

$f'''(x) = 2x^{-3}$ $\qquad f'''(1) = 2$

Therefore, for $x_0 = 1$

$$\ln x = 0 + \frac{1}{1!}(x-1) - \frac{1}{2!}(x-1)^2 + \frac{2}{3!}(x-1)^3$$

or

$$\boxed{\ln x = (x-1) - \frac{1}{2}(x-1)^2 + \frac{1}{3}(x-1)^3 + H.O.T.}$$

If $x = 1.1$, $\ln(1.1) = 0.1 - \frac{1}{2}(0.1)^2 + \frac{1}{3}(0.1)^3 \approx 0.0953$

$\ln(1.1) = 0.095310179$ is true solution

Vector notation

$$\boxed{\vec{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}}$$

where A_x, A_y, A_z are $\pm$ scalar quantities

parallel to the direction of $\hat{i}, \hat{j}, \hat{k}$.

$\hat{i}, \hat{j}, \hat{k}$ are also called unit vectors

Example

$\boxed{\vec{V} = u\hat{i} + v\hat{j} + w\hat{k}}$, where

$u \equiv$ zonal motion $= \frac{dx}{dt}$ (east-west motion)

$v \equiv$ meridional motion $= \frac{dy}{dt}$ (north-south motion)

$w \equiv$ vertical motion $= \frac{dz}{dt}$ (ascending-descending motion)

Vector $\vec{A}$ also written in some places as

$\underset{\sim}{A}$, $/A$, or as a "boldface A"