SI-grunneiningar

ISQ Base Quantity	SI Base Unit
Length	meter (m)
Mass	kilogram (kg)
Time	second (s)
Electrical current	ampere (A)
Thermodynamic temperature	kelvin (K)
Amount of substance	mole (mol)
Luminous intensity	candela (cd)

Table 1.1 ISQ Base Quantities and Their SI Units

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Frá 2019 allar tengdar skammtafyrirbærum

Allar aðrar mælieiningar tengjast þessum, t.d.

lítri fyrir vökarúmmál
Pascal fyrir loftþrýsting
ohm fyrir rafviðnám
volt fyrir rafspennu.....

viddargreining

Base Quantity	Symbol for Dimension
Length	L
Mass	M
Time	T
Current	I
Thermodynamic temperature	Θ
Amount of substance	N
Luminous intensity	J

Table 1.3 Base Quantities and Their Dimensions

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En, einföldum okkur lífið aðeins:

Með heppilegri skölun jafna er hægt að notast aðeins við 3 grunnvíddir:

L, M, T

Víddagreining hjálpar okkur við að finna villur í reikningum

Dæmi um víddargreiningu

Hraði $[v] = \frac{L}{T}$

Hröðun $[a] = \frac{L}{T^2}$

Orka $[E] = M\frac{L^2}{T^2}$

$$s = s_0 + vt + \frac{1}{2}gt^2$$

$$L \quad L \quad \frac{L}{T}T \quad \frac{L}{T^2}T^2$$

→ allt í samræmi!

Massaþéttleiki $[\rho] = \frac{M}{L^3}$

Fínstrúktúrfastinn víddarlaus:

heppileg skölun, eða samantekt

$$\alpha = \frac{1}{4\pi\epsilon_0}\frac{e^2}{\hbar c}, \qquad 1 = [\alpha] = \left[\frac{e^2}{\epsilon_0}\frac{1}{\hbar c}\right] = \left[\frac{e^2}{\epsilon_0}\right]\left(\frac{T}{ML^2}\right)\left(\frac{T}{L}\right)$$

$$\rightarrow \left[e^2/\epsilon_0\right] = \frac{ML^3}{T^2}$$

$$x = a\sin(\omega t) \rightarrow [a] = L,\ [\omega t] = 1,\ \rightarrow [\omega] = \frac{1}{T}$$

$$E = E_0\cos(kx) \rightarrow [E_0] = M\frac{L^2}{T^2},\ [kx] = 1,$$

$$\rightarrow [k] = \frac{1}{L}$$

$$s = \int dt\, v \rightarrow [s] = T \cdot \frac{L}{T} = L$$

$$\frac{dx}{dt} = v \rightarrow [v] = \frac{L}{T}$$

Vigur- og skalarmælistærðir

Hraði (velocity) hefur lengd (speed, ferð) og stefnu, táknum sem vigur:

$$\vec{v}\,, \quad v = |\vec{v}|$$

Sama gildir um staðsetningu, hröðun, rafsvið, segulsvið, kraft,....

Massi, hleðsla, þéttleiki, vinna, afl og orka eru skalarstærðir með enga stefnu

Vigrar eru í sjálfu sér óháðir hnitakerfum, en tengum við þau seinna

Notaðir til að einfalda framsetningu án þess að drukkna í "bókhaldi" um hnit

Samsíða eða hornréttir ....

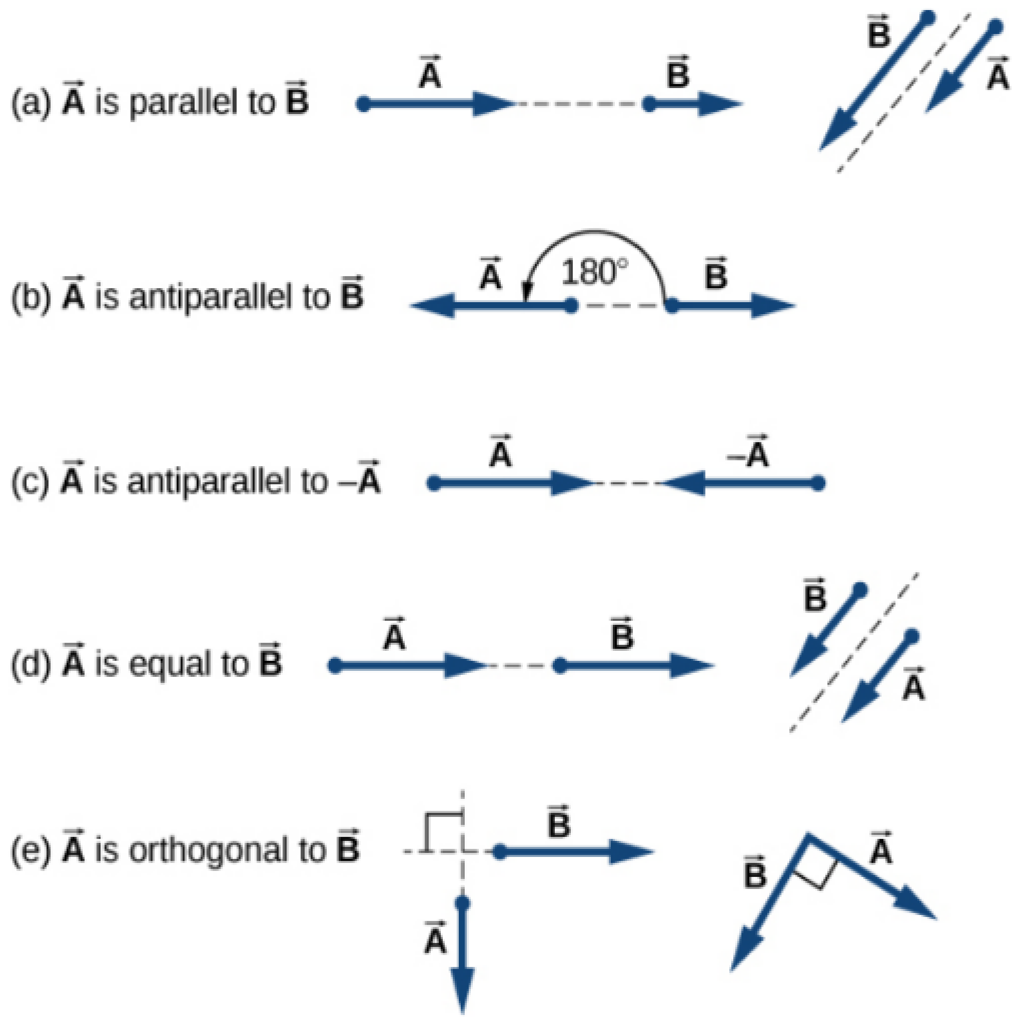

Figure 2.5 Various relations between two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$. (a) $\vec{\mathbf{A}} \neq \vec{\mathbf{B}}$ because $A \neq B$. (b) $\vec{\mathbf{A}} \neq \vec{\mathbf{B}}$ because they are not parallel and $A \neq B$. (c) $\vec{\mathbf{A}} \neq -\vec{\mathbf{A}}$ because they have different directions (even though $\left|\vec{\mathbf{A}}\right| = \left|-\vec{\mathbf{A}}\right| = A$). (d) $\vec{\mathbf{A}} = \vec{\mathbf{B}}$ because they are parallel *and* have identical magnitudes $A = B$. (e) $\vec{\mathbf{A}} \neq \vec{\mathbf{B}}$ because they have different directions (are not parallel); here, their directions differ by $90°$—meaning, they are orthogonal.

Samlagning og frádráttur vigra

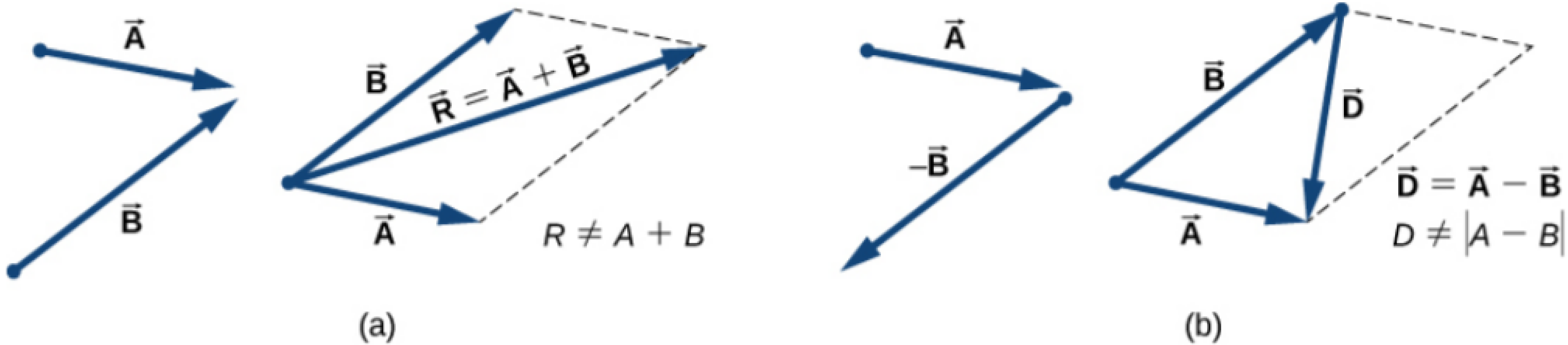

Figure 2.10 The parallelogram rule for the addition of two vectors. Make the parallel translation of each vector to a point where their

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Aflfræði Newtons, rafsegulfræði Maxwells og straumfræði hafa miklu einfaldari framsetningu en ella með vigrum...

Hægt að margfalda skalar og vigur

$$\boxed{\vec{F} = m\,\vec{a}}$$

"skölun á vigri", skalar og vigurstærðin þurfa ekki að hafa sömu vídd

Tvo vigra má innfalda

Scalar Product (Dot Product)

The **scalar product** $\vec{\mathbf{A}} \cdot \vec{\mathbf{B}}$ of two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ is a number defined by the equation

$$\vec{\mathbf{A}} \cdot \vec{\mathbf{B}} = AB\cos\varphi, \qquad (2.27)$$

where φ is the angle between the vectors (shown in Figure 2.27). The scalar product is also called the **dot product** because of the dot notation that indicates it.

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Innfeldi tvegga vigra býr til skalarstærð

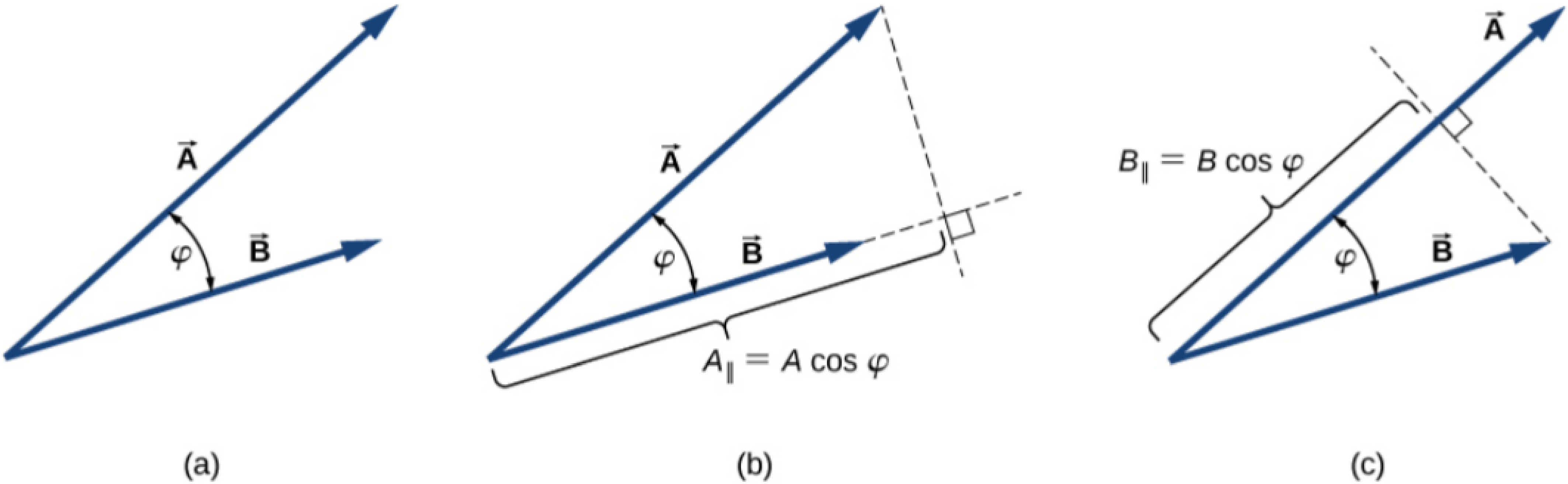


Figure 2.27 The scalar product of two vectors. (a) The angle between the two vectors. (b) The orthogonal projection $A_{||}$ of vector $\vec{\mathbf{A}}$ onto the direction of vector $\vec{\mathbf{B}}$. (c) The orthogonal projection $B_{||}$ of vector $\vec{\mathbf{B}}$ onto the direction of vector $\vec{\mathbf{A}}$.

Fyrir hornrétta vigra fæst

$$\bar{A} \cdot \bar{B} = 0$$

Víxlið

$$\bar{A} \cdot \bar{B} = \bar{B} \cdot \bar{A}$$

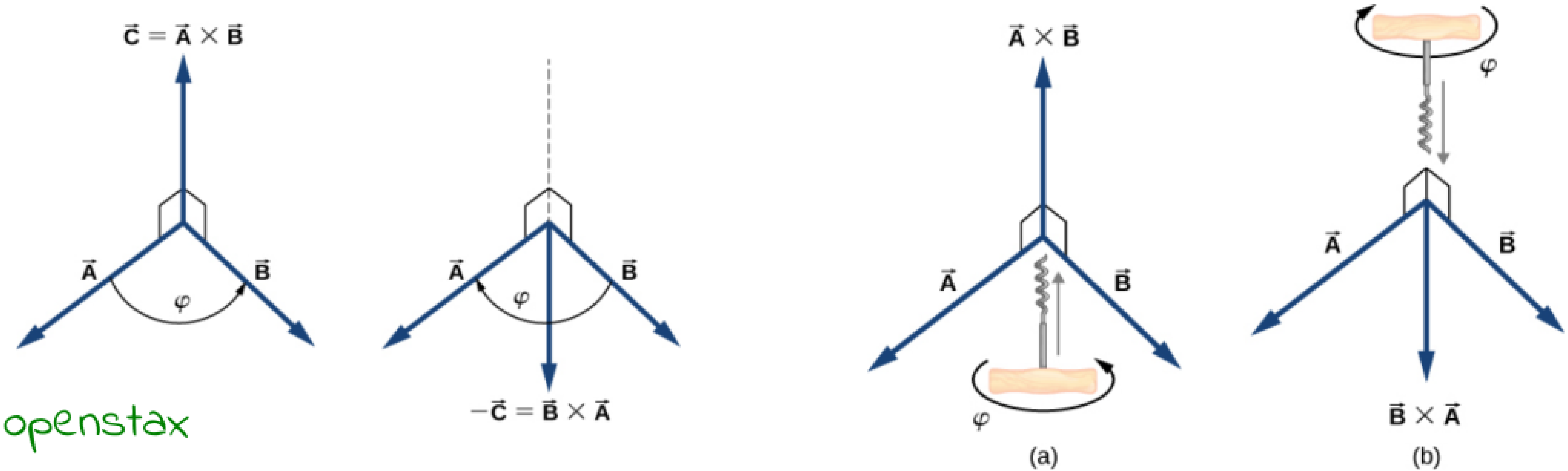
Krossfeldi tveggja vigra

Vector Product (Cross Product)

The **vector product** of two vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$ is denoted by $\vec{\mathbf{A}} \times \vec{\mathbf{B}}$ and is often referred to as a **cross product**. The vector product is a vector that has its direction perpendicular to both vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$. In other words, vector $\vec{\mathbf{A}} \times \vec{\mathbf{B}}$ is perpendicular to the plane that contains vectors $\vec{\mathbf{A}}$ and $\vec{\mathbf{B}}$, as shown in Figure 2.29. The magnitude of the vector product is defined as

$$\left|\vec{\mathbf{A}} \times \vec{\mathbf{B}}\right| = AB\sin\varphi, \tag{2.35}$$

where angle φ, between the two vectors, is measured from vector $\vec{\mathbf{A}}$ (first vector in the product) to vector $\vec{\mathbf{B}}$ (second vector in the product), as indicated in Figure 2.29, and is between 0° and 180°.



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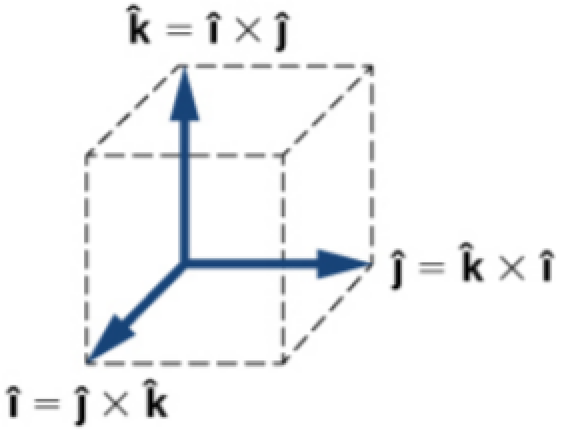
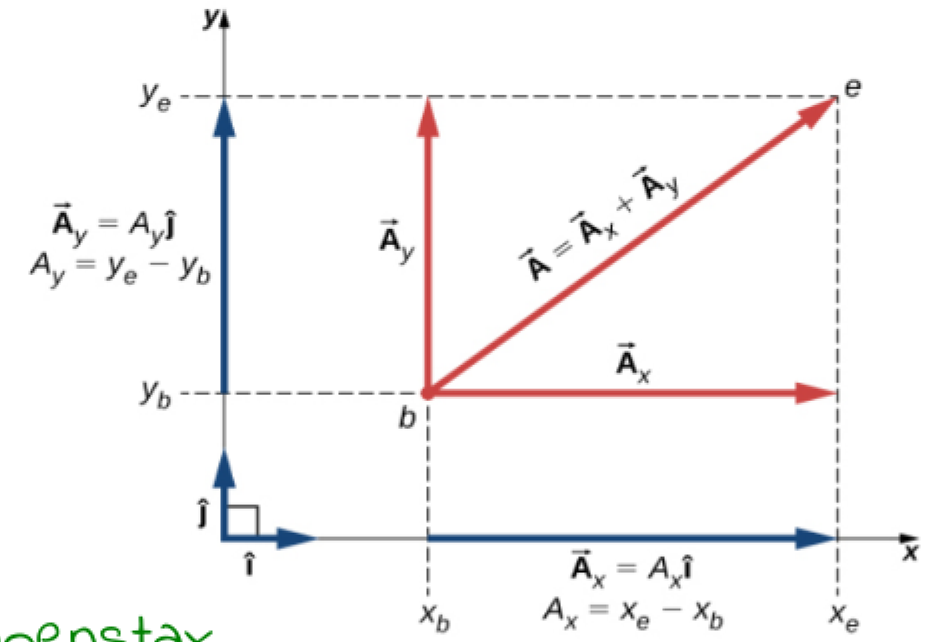
Krossfeldi tveggja vigra býr til þriðja vigurinn hornréttan í hina fyrri

Hnitakerfi, kartísk hnit



$$\begin{cases} \hat{\mathbf{i}} \times \hat{\mathbf{j}} = +\hat{\mathbf{k}}, \\ \hat{\mathbf{j}} \times \hat{\mathbf{k}} = +\hat{\mathbf{i}}, \\ \hat{\mathbf{k}} \times \hat{\mathbf{i}} = +\hat{\mathbf{j}}. \end{cases}$$



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Vigur táknaður með hnitum eða eingarvigrum hnitakerfis

$$\bar{A} = A_x \hat{i} + A_y \hat{j}$$

$$\bar{A} = (A_x , A_y)$$

Lengd vigurs $A = \sqrt{A_x^2 + A_y^2 + A_z^2}$

Pól- eða skauthnit

$$\begin{cases} x = r\cos\varphi \\ y = r\sin\varphi \end{cases}.$$

Tökum eftir að víddir r og φ eru ekki þær sömu

Einingarvigur fyrir hornstefnuna $\hat{t}$ eða $\hat{\varphi}$ er ekki með "fasta stefnu"

Lengd?