Vectors in Mathematica

K+K 1.2 : $\vec{A} = 3\hat{i} + \hat{j} + \hat{k}$ | $\vec{B} = -2\hat{i} - 3\hat{j} - \hat{k}$

$= (3, 1, 1)$ | $= (-2, -3, -1)$

Mathematica A = {3, 1, 1}; ← ; means "quiet"

B = {-2, -3, -1}; $\boxed{\text{S-E}}$

Dot-Product → .

A.B $\boxed{\text{S-E}}$

-10

Magnitude of a vector : Norm[A]

Norm[A] $\boxed{\text{S-E}}$

$\sqrt{11}$

$\cos\theta_{AB}$ = N[A.B/Norm[A]/Norm[B]]

$= -0.805823$

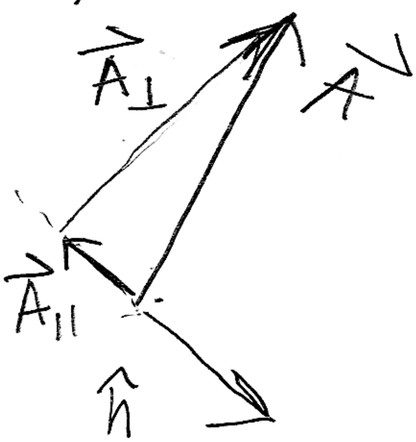
Cross-Product : Cross[A, B]

K+K 1.11 $\hat{n}$ = some unit vector

⇒ interesting direction in a problem.

Mathematica: n = {5, -6, 1/2.};

n = n/Norm[n] $\boxed{\text{S-E}}$



$$\vec{A}_{\parallel} = (\vec{A}\cdot\hat{n})\,\hat{n}$$

Mathematica: Apa=(A.n)n $\boxed{\text{S-E}}$

(0.77551, -0.930612, 0.077551)

n.Apa/Norm[n]/Norm[Apa] $\boxed{\text{S-E}}$

1.

could have returned -1. too, for other cases.

$$\vec{A}_\perp = (\hat{n}\times\vec{A})\times\hat{n}$$

Mathematica: Ape=Cross[Cross[n,A],n] $\boxed{\text{S-E}}$

(2.22449, 1.93061, 0.922449)

Apa+Ape $\boxed{\text{S-E}}$

{3., 1., 1.} (same as $\vec{A}$).

Apa.Ape $\boxed{\text{S-E}}$

$-8.32667\cdot 10^{-17}$

n.Ape/Norm[n]/Norm[Ape] $\boxed{\text{S-E}}$

$-4.72109\cdot 10^{-17}$

Parametric Plots

$$\vec{r}(t) = (x(t), y(t))$$
$$= x(t)\,\hat{\imath} + y(t)\,\hat{\jmath}$$

simple case: $x(t) = x_0 + v_x t$
$y(t) = y_0 + v_y t$

MM: take $x_0 = 1m$ $v_x = 2\ m/s$
$y_0 = -1m$ $v_y = -4\ m/s$

could plot 2 "normal" plots

Plot[1+2*t, {t, 0, 5}] S-E

Plot[-1-4*t, {t, 0, 5}] S-E

Or, ParametricPlot does both x + y as a function of time.

ParametricPlot[{1+2*t, -1-4*t}, {t, 0, 5}]

SetOptions[Plot, ParametricPlot, TextStyle → {FontSize → 18}]

or

x[t_] := 1+2*t

y[t_] := -1-4*t

ParametricPlot[{x[t], y[t]}, {t, 0, 5}]

Velocity and Speed

$$\vec{v} = \frac{d\vec{r}}{dt} = \left(\frac{dx}{dt}, \frac{dy}{dt}\right) = (\dot{x}, \dot{y})$$

$$= \underbrace{\frac{dx}{dt}}_{v_x(t)}\hat{\imath} + \underbrace{\frac{dy}{dt}}_{v_y(t)}\hat{\jmath} = \underbrace{\dot{x}}_{v_x(t)}\hat{\imath} + \underbrace{\dot{y}}_{v_y(t)}\hat{\jmath}$$

$$\vec{v} = \left(v_x(t), v_y(t)\right) = v_x(t)\hat{\imath} + v_y(t)\hat{\jmath}$$

Mathematica: D[x[t],t] $\boxed{\text{S-E}}$

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D[y[t],t] $\boxed{\text{S-E}}$

−4

$$\vec{v} = (2, -4)\ \text{m/s}$$

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vx[t_]:= D[x[t],t]
vy[t_]:= D[y[t],t]
ParametricPlot[{vx[t_], vy[t_]}, {t,0,5}]
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$$\text{Speed} = |\vec{v}| = \sqrt{v_x^2 + v_y^2}$$

Repeat / Replace with

$$x(t) = \left(\frac{t}{2\pi}\right) \cos\left[2\pi t\right]$$

$$y(t) = -\left(\frac{t}{2\pi}\right) \sin\left[2\pi t\right]$$

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