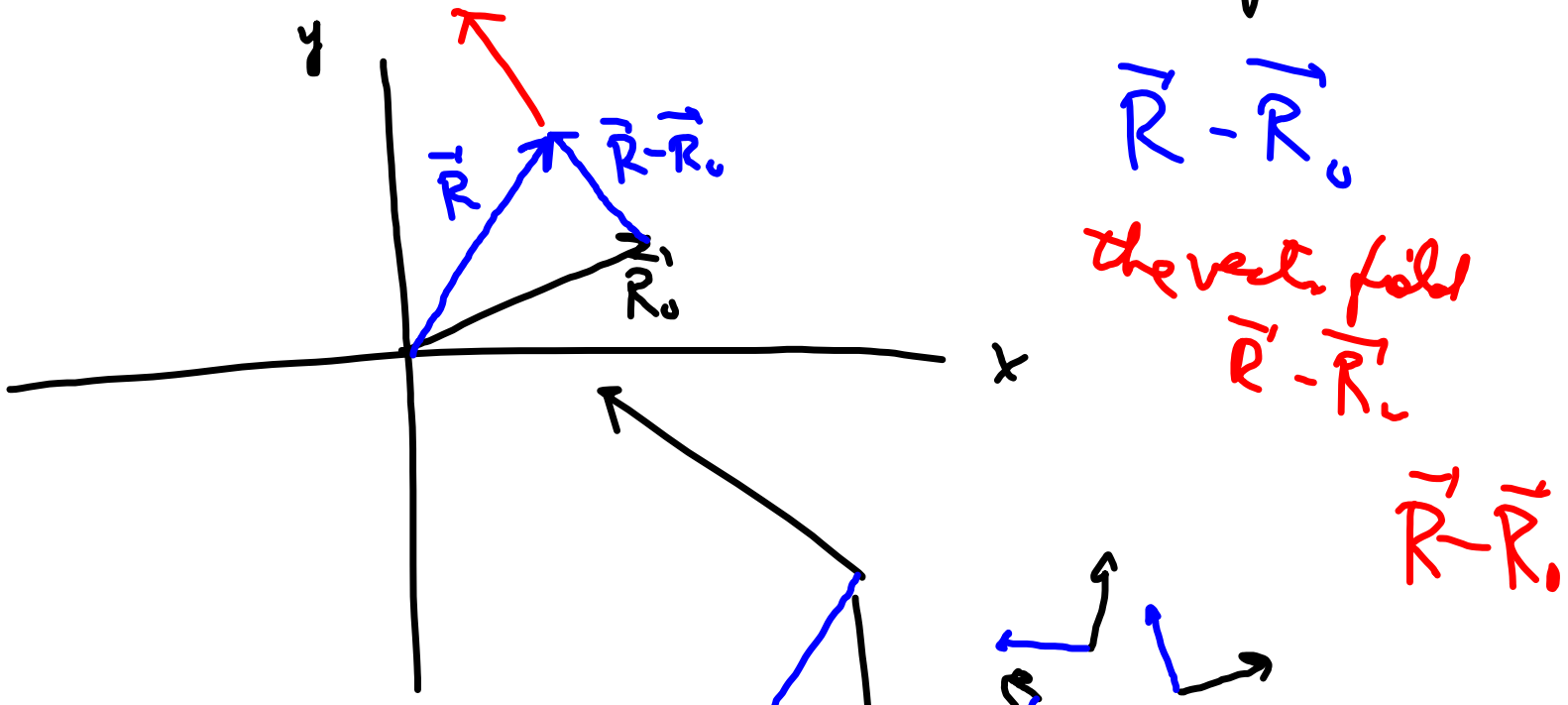
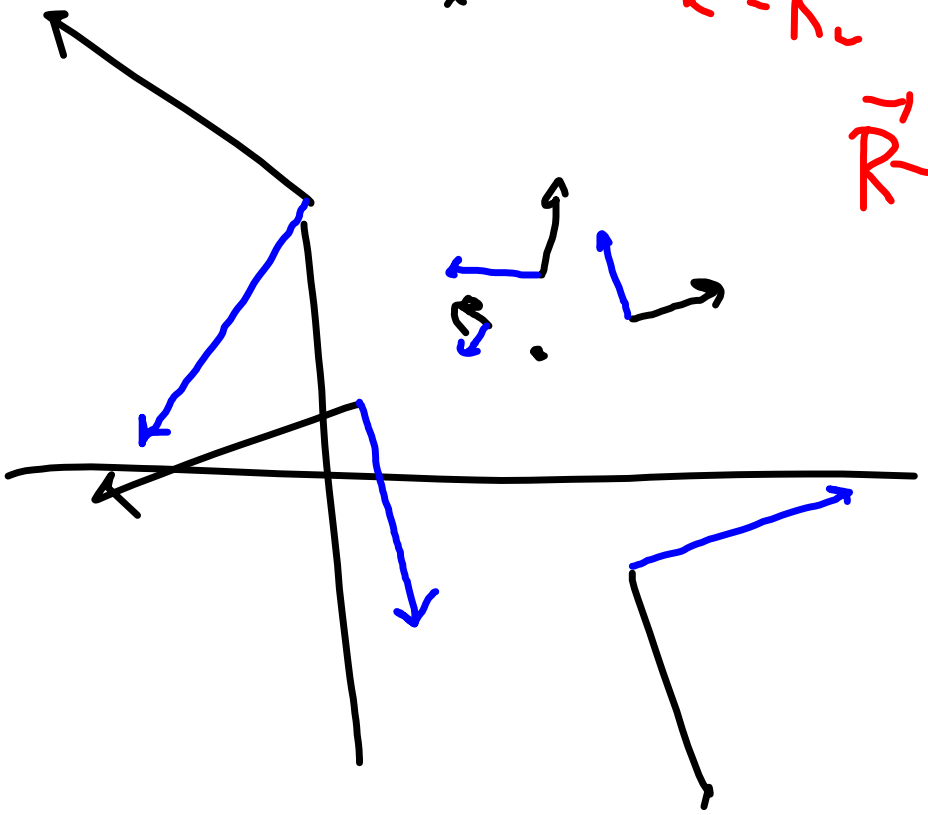
Sketch $\vec{k} \times (\vec{R} - \vec{R}_0)$ in the x-y plane.

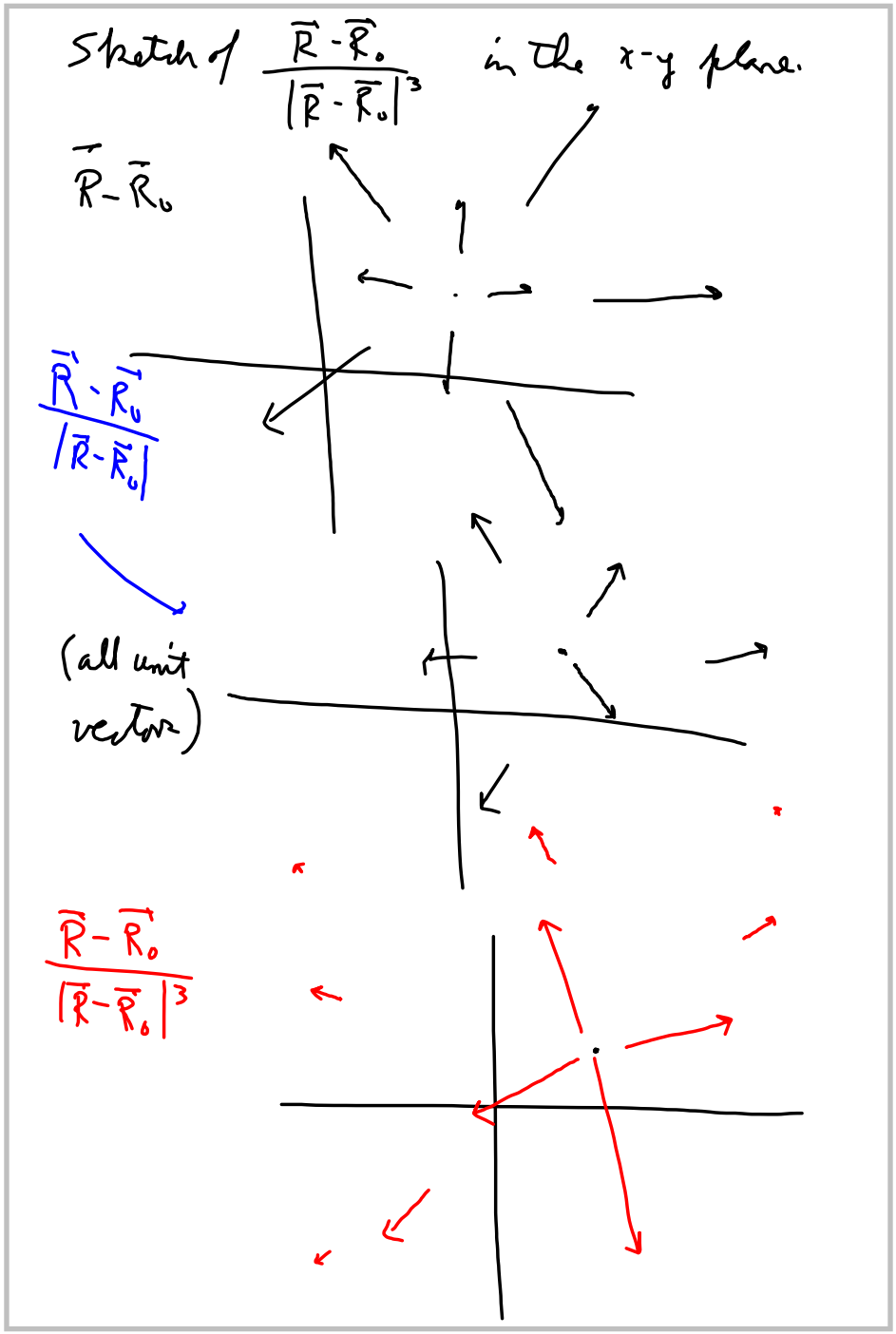


$\vec{R} - \vec{R}_0$

the vector field $\vec{R} - \vec{R}_0$

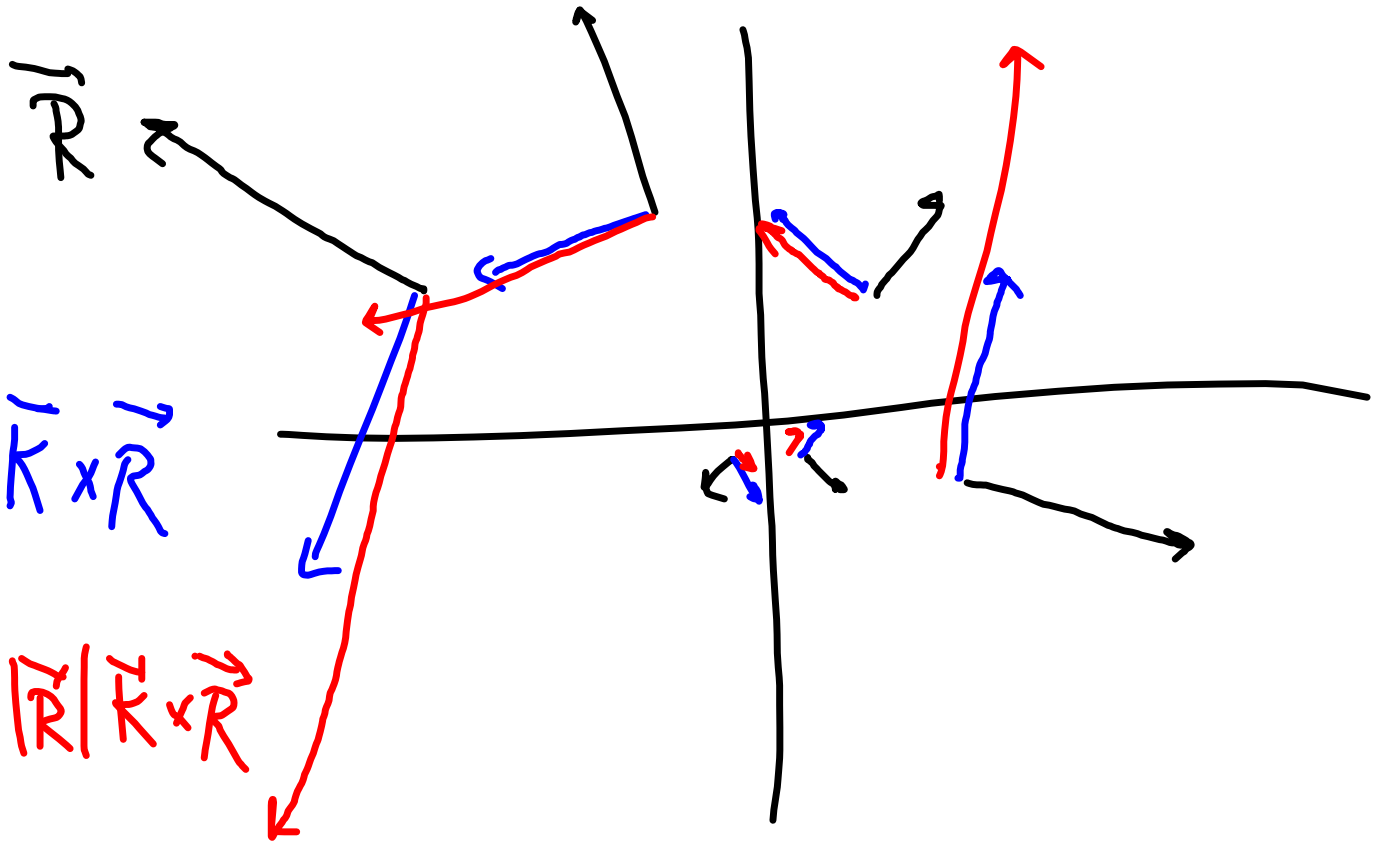


$\vec{k} \times (\vec{R} - \vec{R}_0)$


Sketch of $\frac{\vec{R}-\vec{R}_0}{|\vec{R}-\vec{R}_0|^3}$ in the x-y plane.
$\vec{R}-\vec{R}_0$
$\frac{\vec{R}-\vec{R}_0}{|\vec{R}-\vec{R}_0|}$
(all unit vectors)
$\frac{\vec{R}-\vec{R}_0}{|\vec{R}-\vec{R}_0|^3}$

Do a cross-product and change magnitude.

$$\vec{K} \times |\vec{R}|\,\vec{R} \equiv |\vec{R}|\;\vec{K} \times \vec{R}$$



$$\vec{F} = y^2\vec{i} + z^2\vec{j} + x\vec{k}$$

$$\vec{\nabla}\times\vec{F} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ \partial_x & \partial_y & \partial_z \\ y^2 & z^2 & x \end{vmatrix} = -2z\vec{i} - \vec{j} - 2y\vec{k}$$

curve $\vec{R} = x\vec{i} + y\vec{j} + z\vec{k} = \cos\pi t\,\vec{i} + \sin\pi t\,\vec{j} + t^2\vec{k}$

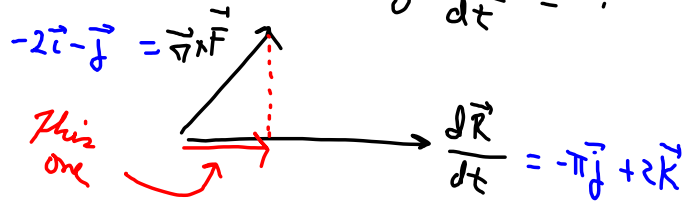
tangent $\frac{d\vec{R}}{dt} = -\pi\sin\pi t\,\vec{i} + \pi\cos\pi t\,\vec{j} + 2t\vec{k}$

at $t=1$

$$\vec{R}(1) = -\vec{i} + \vec{k}$$

$$\frac{d\vec{R}}{dt}(1) = -\pi\vec{j} + 2\vec{k}$$

Component of curl $\vec{F}$ along $\frac{d\vec{R}}{dt}$ = ?



$$\vec{B}_{\parallel} = \frac{\vec{B}\cdot\vec{A}}{\vec{A}\cdot\vec{A}}\vec{A} = \frac{\pi}{\pi^2+4}\left(-\pi\vec{j} + 2\vec{k}\right)$$

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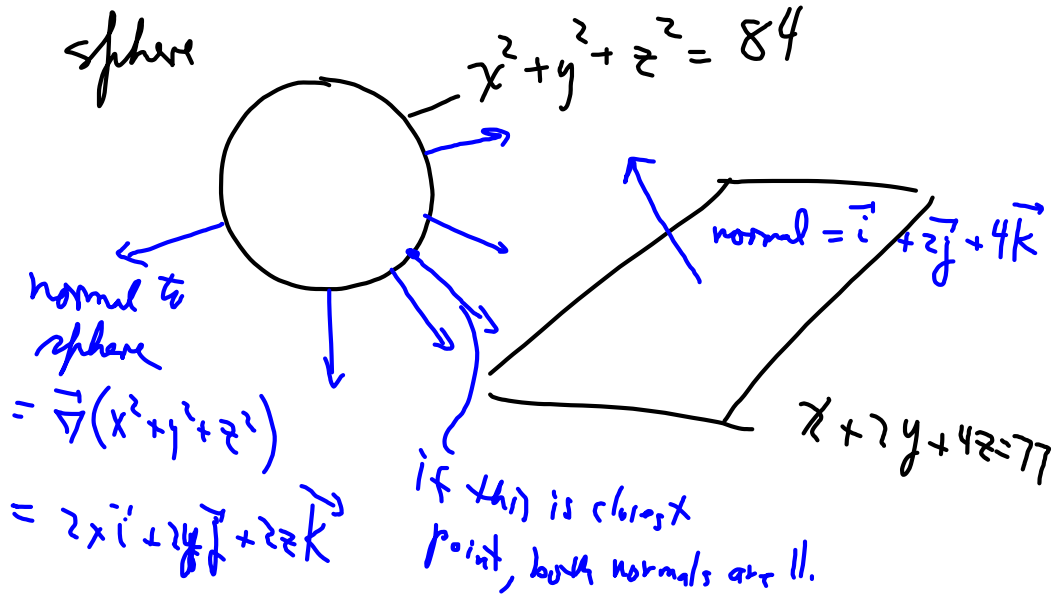


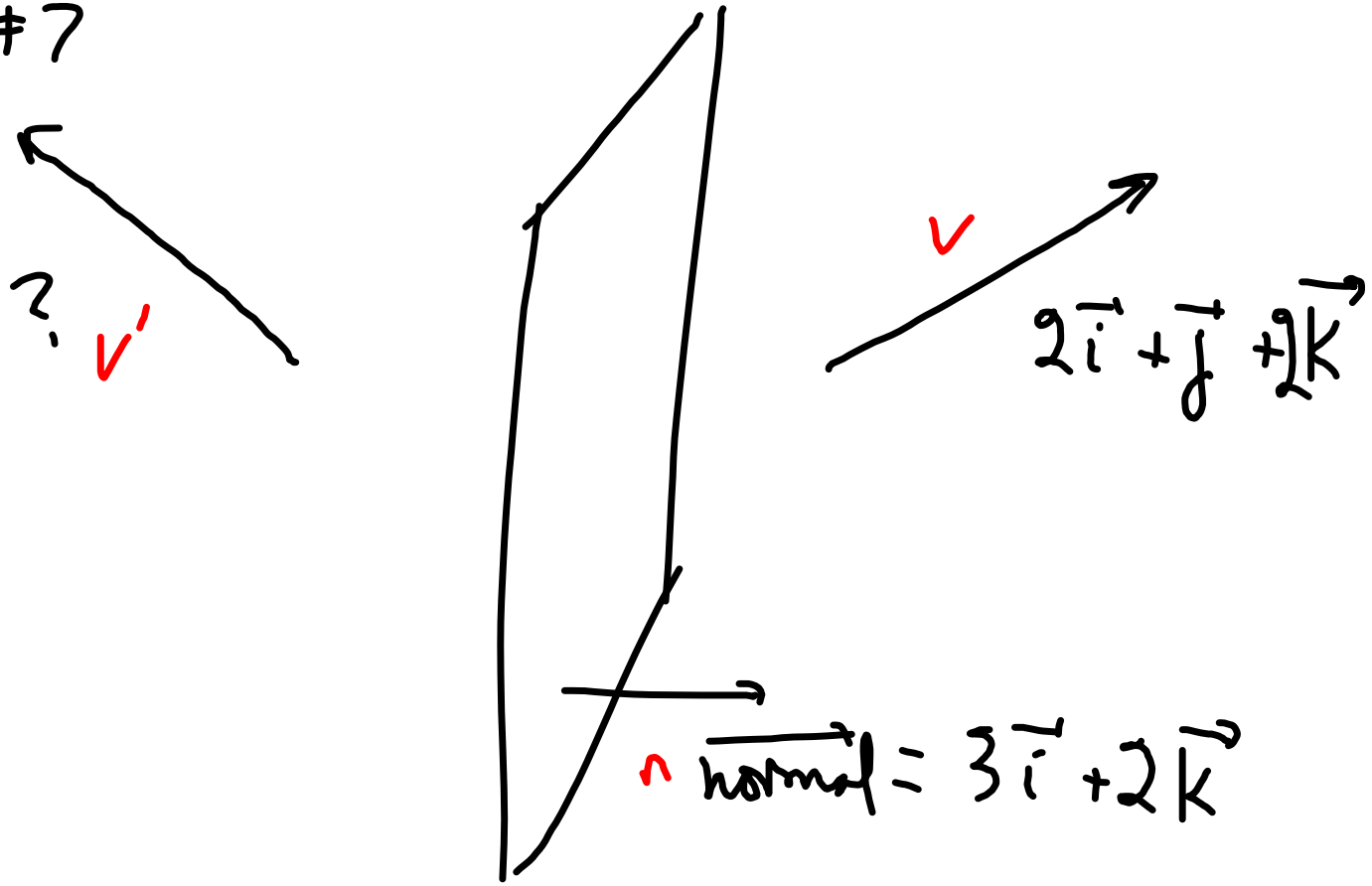
Strategy:

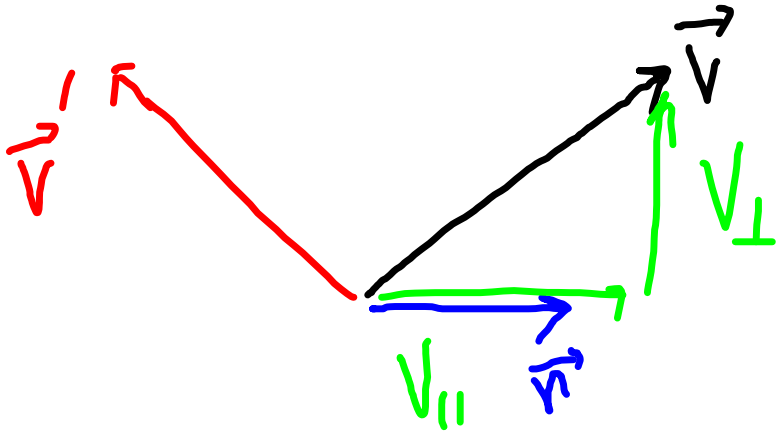
enforce $\parallel$ by taking $\left(\vec{\text{sphere normal}}\right) \times \left(\vec{\text{plane normal}}\right) = 0$

3 equations in (x,y,z)

also $x^2+y^2+z^2=84$

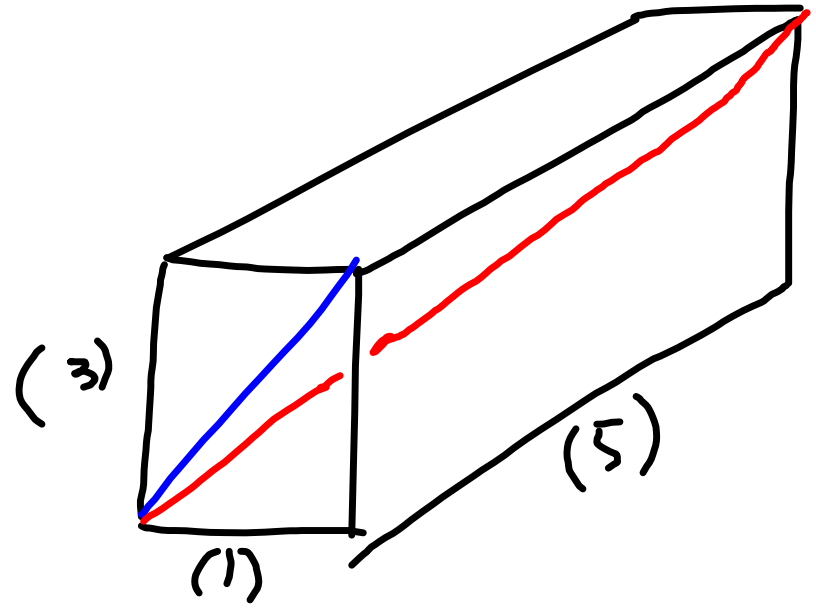
2002 #7





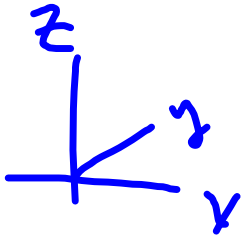
$\vec{v}' = \vec{v}_\perp - \vec{v}_{||}$

2000 #4



face diagonal

$= 1\vec{i} + 3\vec{k}$



body diagonal

$= 1\vec{i} + 5\vec{j} + 3\vec{k}$

$\vec{A} \cdot \vec{B} = |A|\,|B| \cos\theta$