uugh I spent an hour trying to get LaTeX to position the image on the first page.
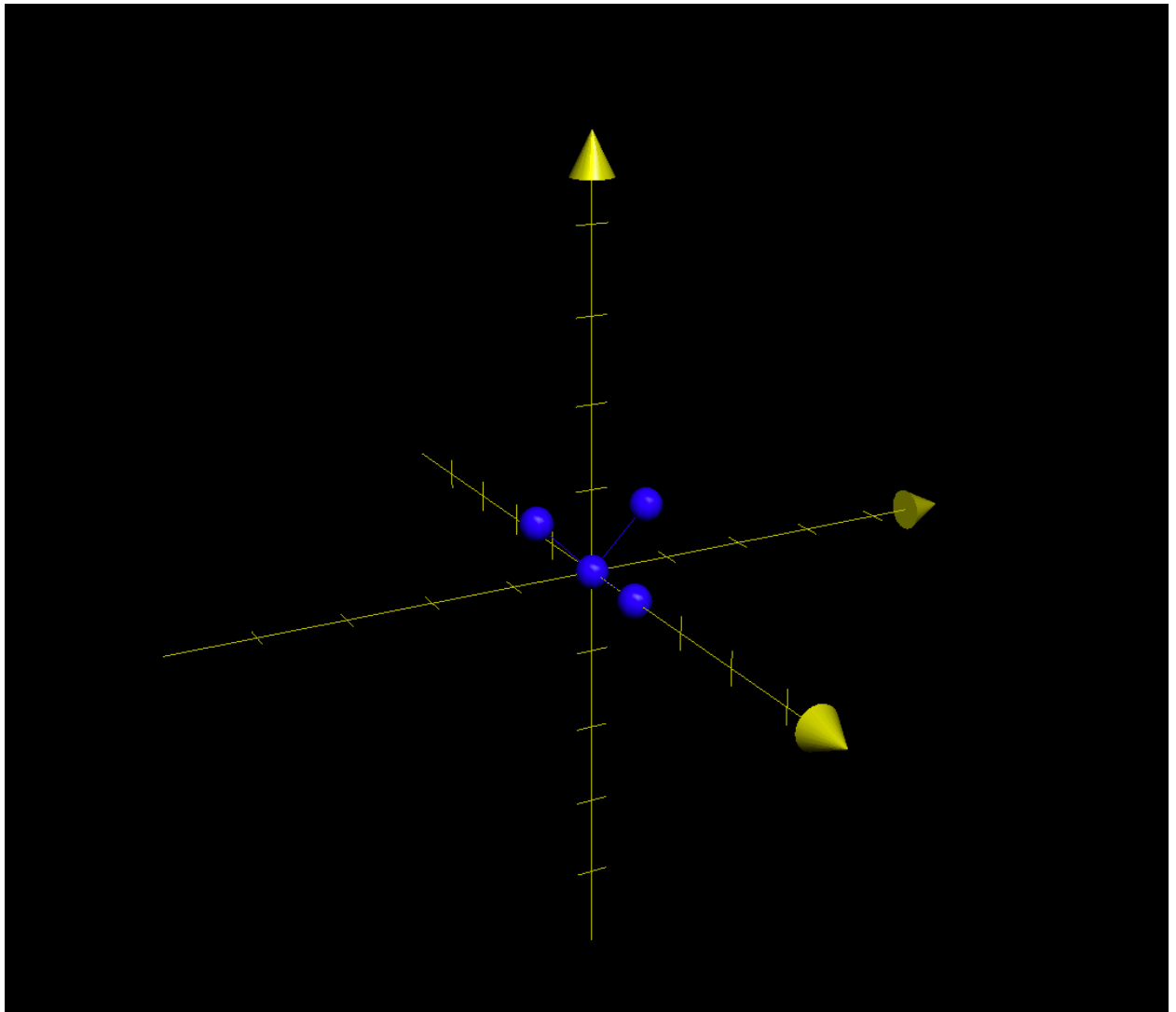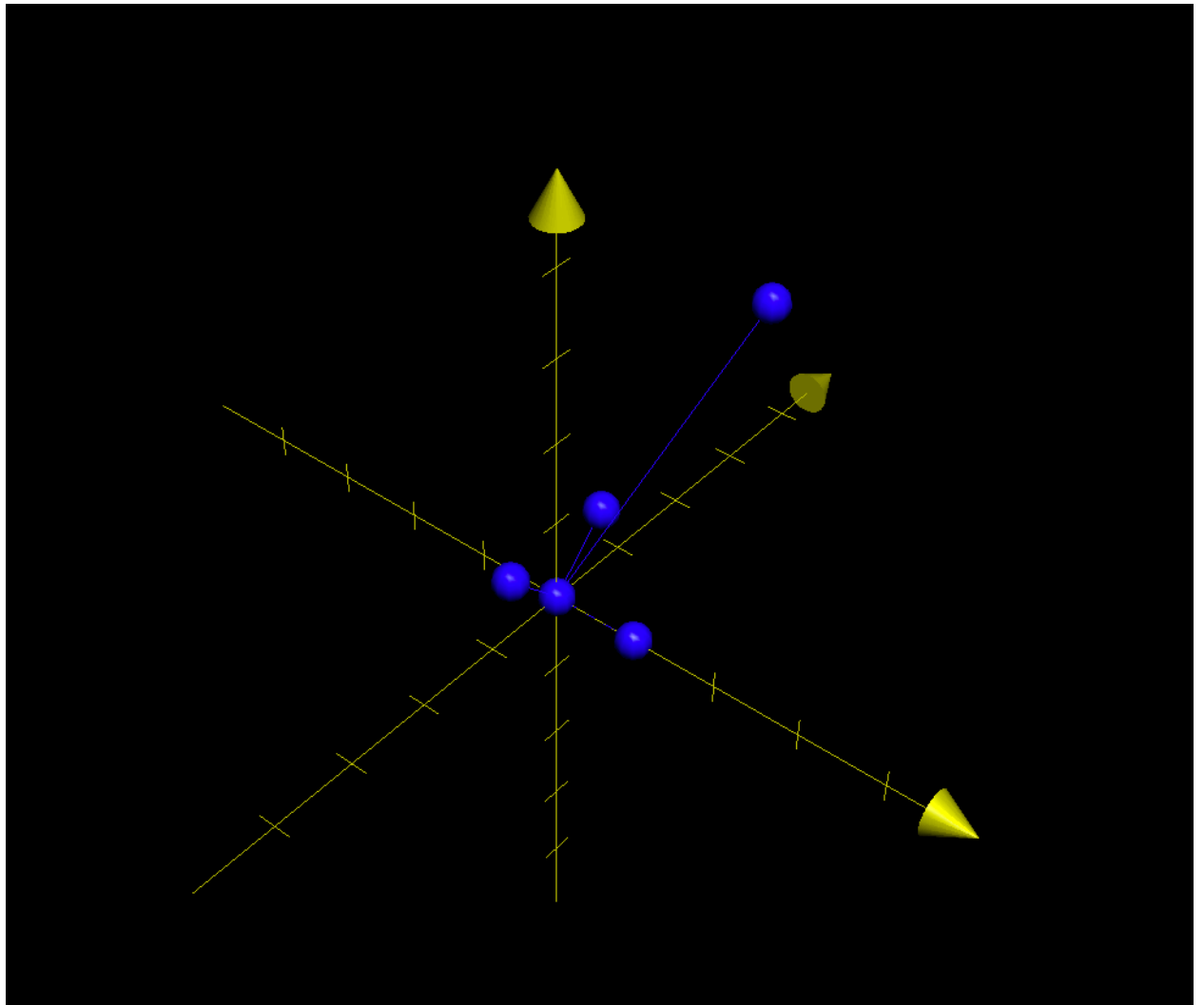
The basis:

The vector:

Change color in Grapher: Select an entry in the sidebar, then use Window > Show Inspector

Axler 6.B ex 3

orthonormality $(1,0,0), (1,1,1), (1,1,2)$

$e_1 = (1,0,0)$, $e_2 = $ normalize$((1,1,1)-(1,0,0))$

$\qquad\qquad\qquad\quad = $ normalize$((0,1,1))$

$\qquad\qquad\qquad\quad = (0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$

$e_3 = $ normalize$\left((1,1,2)-(1,0,0) - \frac{3}{\sqrt{2}}(0,\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}})\right)$

$\qquad = $ normalize$\left((0,1,2) - (0, \frac{3}{2}, \frac{3}{2})\right)$

$\qquad = $ normalize$\left((0, \frac{-1}{2}, \frac{1}{2})\right)$

$\qquad = (0, \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$

$(1,0,0), \quad (0, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}), \quad (0, \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}})$

$0 + \frac{-1}{2} + \frac{1}{2} = 0 \checkmark \qquad$ so all pairwise inner
$\qquad\qquad\qquad\qquad\qquad$ products are zero

$v = (1, 2, 3)$

$= \langle(1,2,3),(1,0,0)\rangle e_1 + \langle(1,2,3),(0,\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}})\rangle e_2 + \langle(1,2,3),(0,\frac{-1}{\sqrt{2}},\frac{1}{\sqrt{2}})\rangle$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \times e_3$

$\boxed{= 1e_1 + \frac{5}{\sqrt{2}} e_2 + \frac{1}{\sqrt{2}} e_3}$

$= (1, 0, 0) + (0, \frac{5}{2}, \frac{5}{2}) + (0, \frac{-1}{2}, \frac{1}{2})$

$= (1, \frac{4}{2}, \frac{6}{2}) \checkmark$

The working out: