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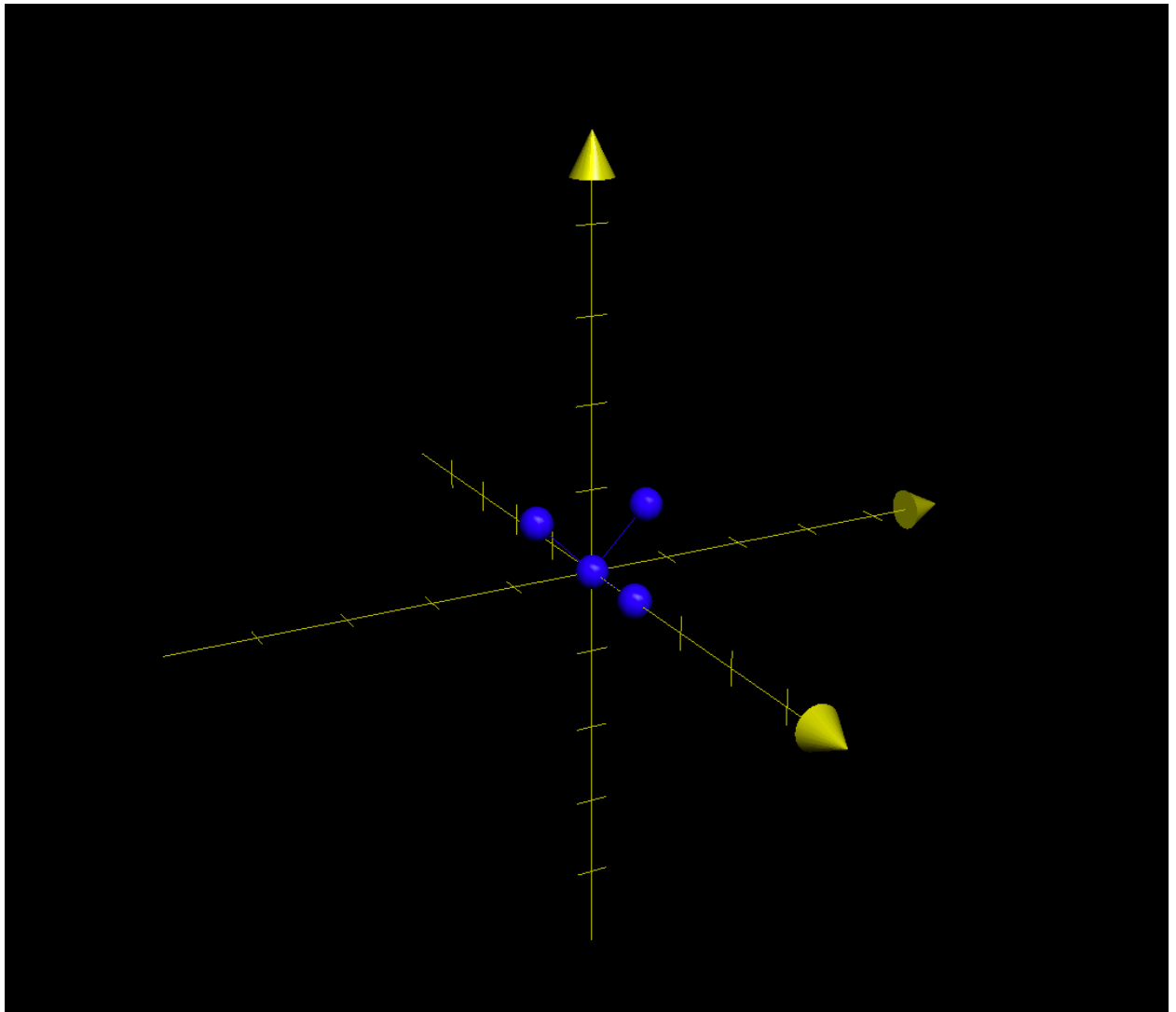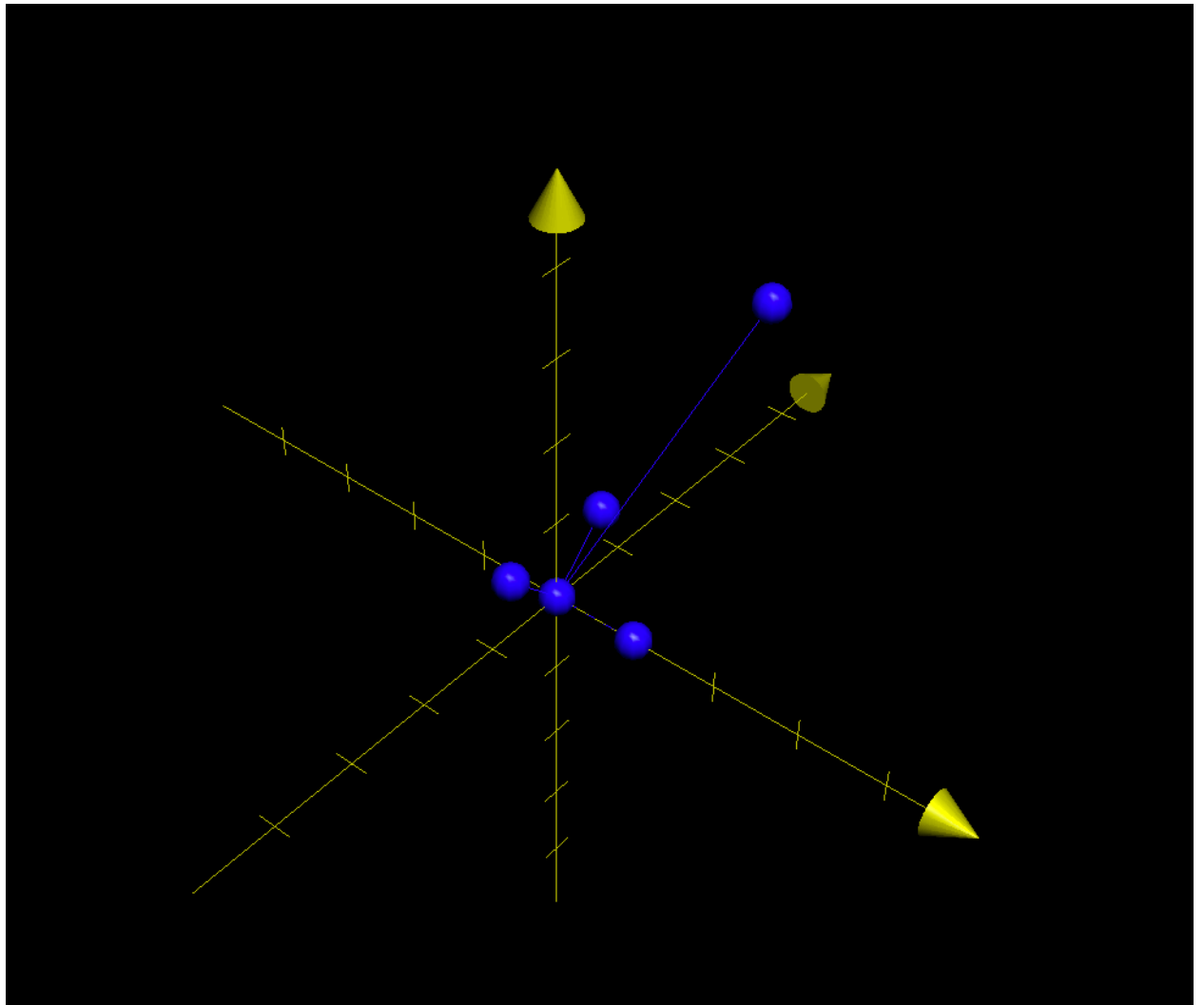
The basis:

The vector:

Axler 6.B ex 3

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

$e_1 = (1,0,0), \quad e_2 = $ normalize$\big((1,1,1)-(1,0,0)\big)$

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

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

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

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

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

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

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

$0 + \frac{-1}{2} + \frac{1}{2} = 0 \;\checkmark$ So all pairwise inner
$\qquad\qquad\qquad\qquad\qquad$ Products are zero

$v = (1,2,3)$

$\quad = \big\langle (1,2,3),(1,0,0)\big\rangle e_1 + \Big\langle (1,2,3),\left(0,\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)\Big\rangle e_2 + \Big\langle (1,2,3),\left(0,\frac{-1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)\Big\rangle \times e_3$

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

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

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

The working out: