1. (a) Plot of \( f(x) = x^2 + x - 2 \)

\[ (0,2) \]

\[ (1,5) \]

\[ (2,8) \]

\[ (3,15) \]

(b) \( f'(x) = 2x + 1 \), so the equation for the tangent line to \( f(x) \) at \( x = 2 \) is \( T(x) = f(2) + f'(2)(x - 2) = 4 + 5(x - 2) = 5x - 6 \).

(c) A vector in the direction of the tangent line has a slope of 5, so the vector \( \langle 1,5 \rangle \) is a good choice. It is shown on the graph above based at \( (2,4) \).

2. (a) Plot of \( \begin{cases} x = t \\ y = t^2 + t - 2 \end{cases} \) for \( 0 \leq t < 4 \). This is different from the graph above because the domain is restricted.

(b) The vectors based at \( (0,0) \) and ending at \( (x(t), y(t)) \) for \( t = 0,1,2,3 \) are shown on the graph above.

(c) \( \langle x'(2), y'(2) \rangle = \langle 1,5 \rangle \). This represents velocity - this vector is shown on the curve in the graph below 1.a.

(d) The speed of the particle is the magnitude of the velocity, or \( \sqrt{1^2 + 5^2} = \sqrt{26} \).
3. (a)-(d) shown below. The red arrows (from left to right) are the vectors \((-8,3), (-5,2), (-2, -1),\) and \((1,0).\) The black arrows show how these are obtained by adding the multiples \(-v, 0, v,\) and \(2v\) of the vector \(v = (3, -1)\) to the vector \((-5,2).\)

\[\begin{align*}
\text{Diagram}
\end{align*}\]

• (e) If we allow the scalar \(t\) to vary in the parametric equation \((-5,2) + t(3,-1)\) we get a line through the point \((-5,2)\) in the direction of the vector \((3,-1).\)

4. (a) \(l(t) = (-5 + 2t, 2 + 3t, 1 - t) = (-5, 2, 1) + t(2, 3, -1),\) so \(p = (-5, 2, 1)\) and \(v = (2, 3, -1).\)

(b) Plot of the line from part (a)

\[\begin{align*}
\text{Plot of line}
\end{align*}\]

(c) \(v\) is called the direction vector because it points in the direction of the line.

5. Let \(a = (-\sqrt{3}, 0, -1, 0)\) and \(b = (1, 1, 0, 1)\) be vectors in \(\mathbb{R}^4.\)

(a) The distance between \((-\sqrt{3}, 0, -1, 0)\) and \((1, 1, 0, 1)\) is \(\sqrt{(1 + \sqrt{3})^2 + 1^2 + 1^2 + 1^2} = \sqrt{7 + 2\sqrt{3}}.\)

(b) The angle between \(a\) and \(b\) is found by:

\[
\arccos\left(\frac{a \cdot b}{|a||b|}\right) = \arccos\left(\frac{-\sqrt{3}}{2\sqrt{3}}\right) = \arccos(-1/2) = 2\pi/3
\]