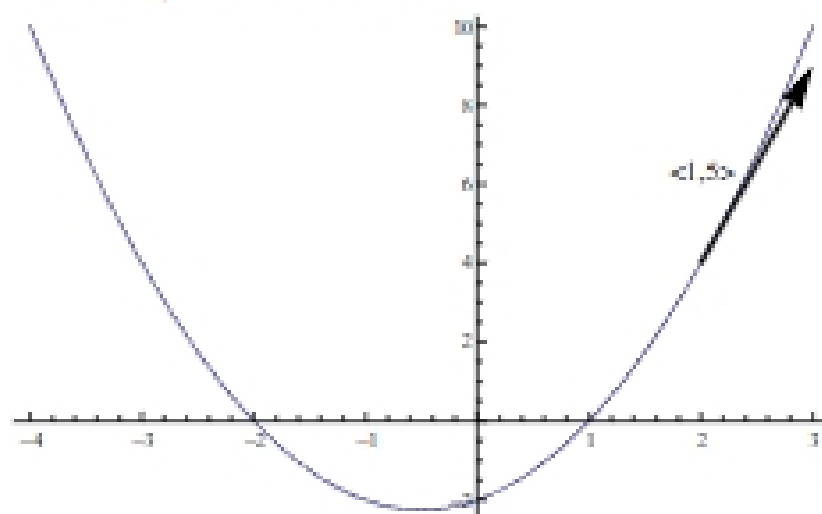
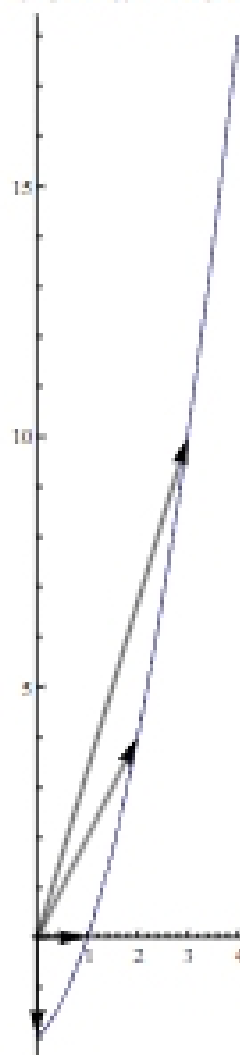


1. (a) Plot of $f(x) = x^2 + x - 2$



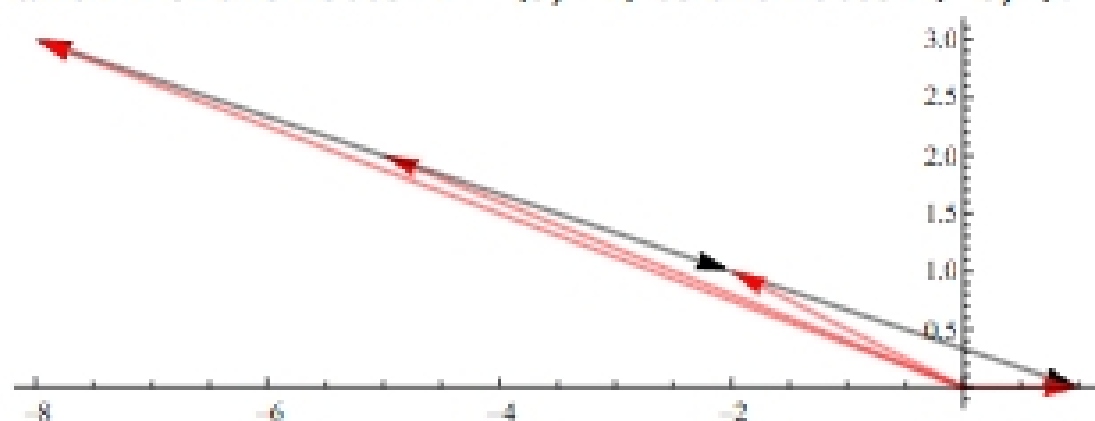
- (b) $f'(x) = 2x + 1$, so the equation for the tangent line to $f(x)$ at $x = 2$ is $T(x) = f(2) + f'(2)(x - 2) = 4 + 5(x - 2) = 5x - 6$.
- (c) A vector in the direction of the tangent line has a slope of 5, so the vector $\langle 1, 5 \rangle$ is a good choice. It is shown on the graph above based 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.

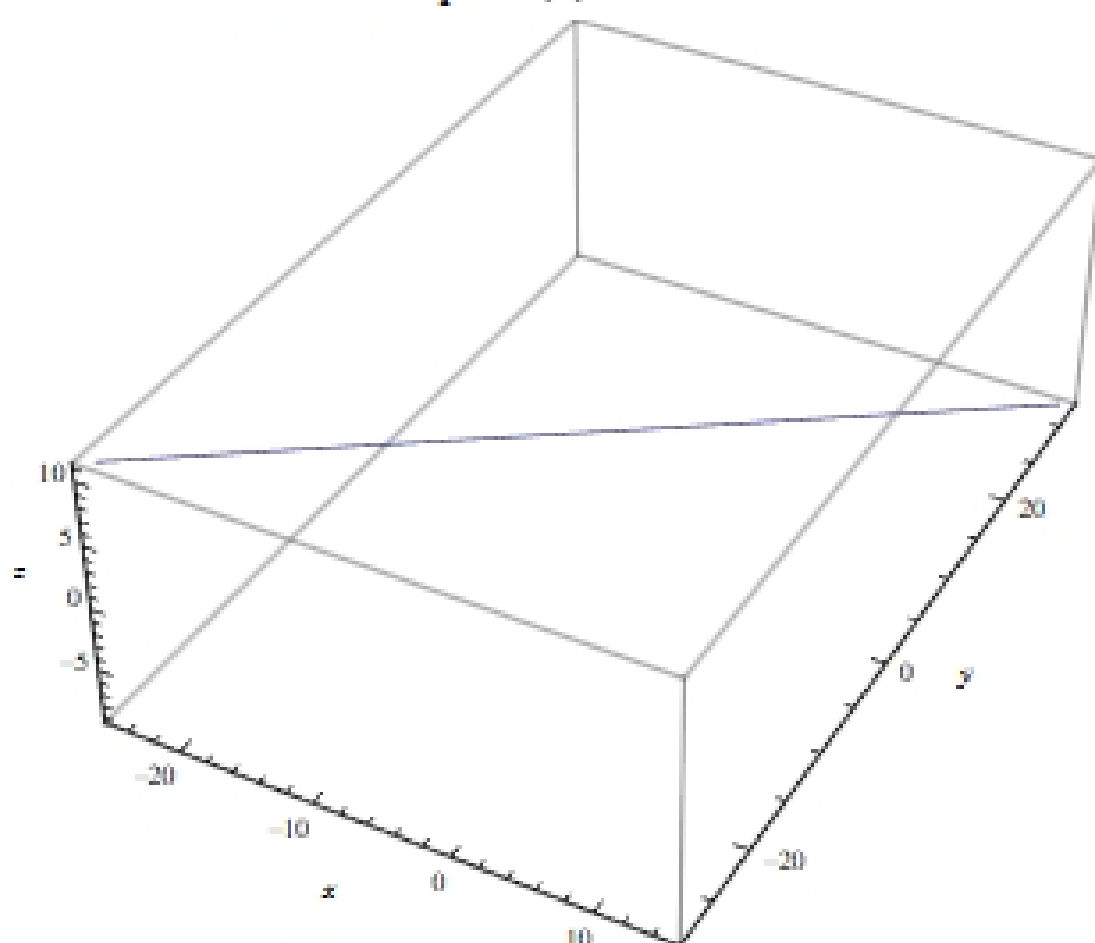


- (b) The vectors based at $(0, 0)$ and ending at $(x(t), y(t))$ for $t = 0, 1, 2, 3$ are shown on the graph above.
- (c) $\langle x'(2), y'(2) \rangle = \langle 1, 5 \rangle$. This represents velocity - this vector is shown on the curve in the graph below 1.a.
- (d) The speed of the particle is the 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 $\langle -8, 3 \rangle$, $\langle -5, 2 \rangle$, $\langle -2, -1 \rangle$, and $\langle 1, 0 \rangle$. The black arrows show how these are obtained by adding the multiples $-v$, 0 , v , and $2v$ of the vector $v = \langle 3, -1 \rangle$ to the vector $\langle -5, 2 \rangle$.



- (e) If we allow the scalar t to vary in the parametric equation $\langle -5, 2 \rangle + t \langle 3, -1 \rangle$ we get a line through the point $(-5, 2)$ in the direction of the vector $\langle 3, -1 \rangle$.
4. (a) $\mathbf{l}(t) = \langle -5 + 2t, 2 + 3t, 1 - t \rangle = \langle -5, 2, 1 \rangle + t \langle 2, 3, -1 \rangle$, so $\mathbf{p} = \langle -5, 2, 1 \rangle$ and $\mathbf{v} = \langle 2, 3, -1 \rangle$.
- (b) Plot of the line from part (a)



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

5. Let $\mathbf{a} = \langle -\sqrt{3}, 0, -1, 0 \rangle$ and $\mathbf{b} = \langle 1, 1, 0, 1 \rangle$ 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 \mathbf{a} and \mathbf{b} is found by:

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