2. p. 37, problem 18.
Solution: Let’s first try to find the intersection point \((x_0, y_0, z_0)\). It has to satisfy the following two conditions:

(a) \((x_0, y_0, z_0) = (-1 + t, -2 + t, -1 + t)\) for some \(t \in \mathbb{R}\) since the point lies on the given line.
(b) The vector connecting \((3, 1, -2)\) to \((x_0, y_0, z_0)\) has to be perpendicular to the direction vector of the line, i.e. it has to be perpendicular to the vector \((1, 1, 1)\). (Note that the line is given by \((-1 + t, -2 + t, -1 + t) = (-1, -2, -1) + t(1, 1, 1)\)). So we get the equation

\[
(3 - x_0, 1 - y_0, -2 - z_0) \cdot (1, 1, 1) = 0.
\]

Let’s put these two conditions together, we get

\[
(3 - (-1 + t), 1 - (-2 + t), -2 - (-1 + t)) \cdot (1, 1, 1) = 0 \\
\Rightarrow (4 - t) + (3 - t) + (-1 - t) = 0 \\
\Rightarrow t = 2.
\]

So the intersection point is

\[
(x_0, y_0, z_0) = (-1 + 2, -2 + 2, -1 + 2) = (1, 0, 1).
\]

The required line is now the line through the given point \((3, 1, -2)\) and \((1, 0, 1)\). A possible equation is

\[
(3, 1, -2) + s(2, 1, -3), s \in \mathbb{R}.
\]

7. Let \(P = (1, 1, 0)\) and \(v = (-1, 1, 0)\) and \(w = (2, 0, 1)\). Furthermore let \(Q = (2, 3, -2)\).
Determine whether \(Q\) lies on the plane.
Solution: Perhaps the easiest way to solve this problem is to first write down the equation of the plane. We compute a normal vector to be

\[
n = (-1, 1, 0) \times (2, 0, 1) = (1, 1, -2).
\]

Then a point \((x, y, z)\) lies on the plane if it satisfies the equation

\[
(x - 1, y - 1, z - 0) \cdot (1, 1, -2) = 0,
\]

where the first vector is the vector connection \((x, y, z)\) to the base point \(P\). Plugging in \((x, y, z) = Q = (2, 3, -2)\) we see that \(Q\) does not lie on the plane.