1. Coordinate Frames

(a) (3 points) Express point $P$ in each of the three coordinate frames.

\[
\begin{align*}
P_W &= (2, 0) \\
P_A &= (-0.5, 2) \\
P_B &= (3, 1)
\end{align*}
\]

(b) (3 points) Express point $V$ in each of the three coordinate frames.

\[
\begin{align*}
V_W &= \langle 1, 2 \rangle \\
V_A &= \langle -1, -1 \rangle \\
V_B &= \langle 0, -1 \rangle
\end{align*}
\]

See the sketches of $V$ in the figure above.

(c) (2 points) Find the $3 \times 3$ homogeneous transformation matrix which takes a point from $F_A$ and expresses it in terms of $F_W$. I.e., determine $M$, where $P_W = MP_A$.

\[
\begin{bmatrix}
0 & 0 & 1 \\
0 & 0 & 1 \\
0 & 0 & 1
\end{bmatrix}
\]

\[
\text{expressed wrt } F_W \quad \text{(see above)}
\]

(d) (2 points) Find the $3 \times 3$ homogeneous transformation matrix which takes a point from $F_B$ and expresses it in terms of $F_A$. I.e., determine $M$, where $P_A = MP_B$.

\[
\begin{bmatrix}
0 & 0 & 1 \\
0 & 0 & 1 \\
0 & 0 & 1
\end{bmatrix}
\]

\[
\text{expressed wrt } F_A \quad \text{(see above)}
\]