Problem 7-3.2.10:

The problem tells us that we can express $\mathbf{A}$ as:

$$
\begin{equation*}
\mathbf{A}=A_{r} \hat{\mathbf{r}}+A_{t} \hat{\mathbf{t}} \tag{1}
\end{equation*}
$$

As we can see from the figure

$$
\begin{equation*}
\mathbf{A}_{r}=(\mathbf{A} \cdot \hat{\mathbf{r}}) \hat{\mathbf{r}} \tag{2}
\end{equation*}
$$



Now we need to express $\hat{\mathbf{t}}$ in terms of $\mathbf{A}$ and $\hat{\mathbf{r}}$. We know that

$$
\begin{equation*}
\hat{\mathbf{t}} . \hat{\mathbf{r}}=0, \tag{3}
\end{equation*}
$$

and

$$
\begin{equation*}
\hat{\mathbf{t}} .(\hat{\mathbf{r}} \times \mathbf{A})=0 \tag{4}
\end{equation*}
$$

From the figure we see that

$$
\begin{equation*}
-\hat{\mathbf{r}} \times(\hat{\mathbf{r}} \times \mathbf{A}) \| \hat{\mathbf{t}} \tag{5}
\end{equation*}
$$

and

$$
\begin{equation*}
A_{t}=A \sin \theta \tag{6}
\end{equation*}
$$

But

$$
\begin{equation*}
\hat{\mathbf{r}} \times \mathbf{A}=A \sin \theta \hat{\mathbf{z}} \tag{7}
\end{equation*}
$$

then

$$
\begin{equation*}
-\hat{\mathbf{r}} \times(\hat{\mathbf{r}} \times \mathbf{A})=A \sin \theta \hat{\mathbf{t}}=A_{t} \hat{\mathbf{t}} \tag{8}
\end{equation*}
$$

and we see that then

$$
\begin{equation*}
\mathbf{A}_{t}=-\hat{\mathbf{r}} \times(\hat{\mathbf{r}} \times \mathbf{A}) \tag{9}
\end{equation*}
$$

