Homework #1

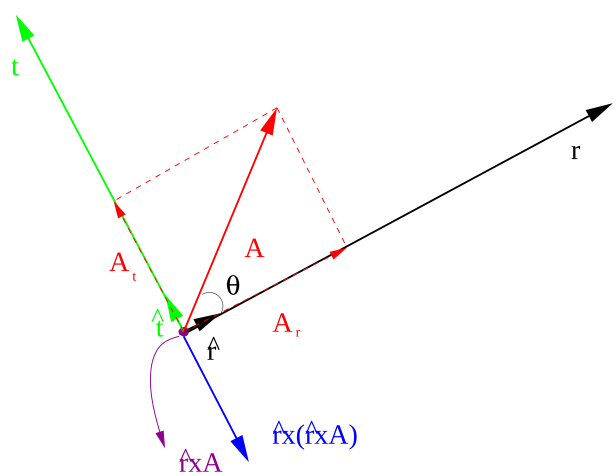
Problem 7 - 3.2.10:

The problem tells us that we can express **A** as:

$$\mathbf{A} = A_r\hat{\mathbf{r}} + A_t\hat{\mathbf{t}}. \tag{1}$$

As we can see from the figure

$$\mathbf{A}_r = (\mathbf{A}.\hat{\mathbf{r}})\hat{\mathbf{r}}. \tag{2}$$



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

$$\hat{\mathbf{t}}.\hat{\mathbf{r}} = 0, \tag{3}$$

and

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

From the figure we see that

$$-\hat{\mathbf{r}} \times (\hat{\mathbf{r}} \times \mathbf{A}) \parallel \hat{\mathbf{t}}, \tag{5}$$

and

$$A_t = Asin\theta. \tag{6}$$

But

$$\hat{\mathbf{r}} \times \mathbf{A} = A\sin\theta\hat{\mathbf{z}}, \tag{7}$$

then

$$-\hat{\mathbf{r}} \times (\hat{\mathbf{r}} \times \mathbf{A}) = Asin\theta\hat{\mathbf{t}} = A_t\hat{\mathbf{t}}, \tag{8}$$

and we see that then

$$\mathbf{A}_t = -\hat{\mathbf{r}} \times (\hat{\mathbf{r}} \times \mathbf{A}). \tag{9}$$