$$\mathbf{r}(t) = \langle 4t, 6t^2, 2t^3 \rangle \quad \Rightarrow \quad \mathbf{r}'(t) = \langle 4, 12t, 6t^2 \rangle \,.$$

Then $\mathbf{r}'(1) = \langle 4, 12, 6 \rangle$ and $|\mathbf{r}'(1)| = \sqrt{4^2 + 12^2 + 6^2} = 14$, so

$\mathbf{T}(1) = \dfrac{\mathbf{r}'(1)}{|\mathbf{r}'(1)|} = \frac{1}{14} \langle 4, 12, 6 \rangle = \left\langle \frac{2}{7}, \frac{6}{7}, \frac{3}{7} \right\rangle$. $\mathbf{r}''(t) = \langle 0, 12, 12t \rangle$, so

$$\begin{aligned}
\mathbf{r}'(t) \times \mathbf{r}''(t) &= \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ 4 & 12t & 6t^2 \\ 0 & 12 & 12t \end{vmatrix} \\
&= \begin{vmatrix} 12t & 6t^2 \\ 12 & 12t \end{vmatrix} \mathbf{i} - \begin{vmatrix} 4 & 6t^2 \\ 0 & 12t \end{vmatrix} \mathbf{j} + \begin{vmatrix} 4 & 12t \\ 0 & 12 \end{vmatrix} \mathbf{k} \\
&= (144t^2 - 72t^2)\,\mathbf{i} - (48t - 0)\,\mathbf{j} + (48 - 0)\,\mathbf{k} = \langle 72t^2, -48t, 48 \rangle
\end{aligned}$$