5. What are the equations of the line tangent to the curve which is parameterized by \( \mathbf{r}(t) = (3t^3 + 2t) \mathbf{i} + 6t^2 \mathbf{j} + 4t^3 \mathbf{k} \) at \( t = 1 \)?

\[
\begin{align*}
\mathbf{r}(1) &= 5\mathbf{i} + 6\mathbf{j} + 14\mathbf{k} \\
\mathbf{r}'(1) &= (9t^2 + 2)\mathbf{i} + 12t \mathbf{j} + 12t^2 \mathbf{k} \\
\mathbf{r}''(1) &= 11\mathbf{i} + 12\mathbf{j} + 12\mathbf{k}
\end{align*}
\]

Tangent line:

\[
\begin{align*}
x &= 5 + 11t \\
y &= 6 + 12t \\
z &= 4 + 12t
\end{align*}
\]

6. Find the equation of the plane tangent to the surface \( z = x^2 + 3y^3 \) at the point where \( x = 3 \) and \( y = -1 \). The \( z \)-coordinate is \( z = 6 \).

View the surface as the level set \( \phi = x^2 + 3y^3 - z \)

\[
\nabla \phi \text{ is normal to level sets}
\]

\[
\nabla (\text{RHS}) = 2x\mathbf{i} + 9y^2 \mathbf{j} - \mathbf{k}
\]

\[
\nabla (\text{RHS}) \big|_{(x,y,z)} = 6\mathbf{i} + 9\mathbf{j} - \mathbf{k}
\]

\[
6(x-3) + 9(y+1) - (z-6) = 0
\]