1. Find the tangent line to the curve \( \mathbf{r} = (5t, \sin(t + \pi/2), (2t/\pi)^2) \) at the point \((5\pi, -1, 4)\).

\textbf{Solution:} Given the vector equation for the curve above as a function of the parameter \( t \), the derivative will give the tangent vector at any point with a given parameter value. The derivative is:

\[ \mathbf{r}'(t) = (5, \cos(t + \pi/2), 8t/\pi^2) \]

It is easy to see that the curve is equal to the point \((5\pi, -1, 4)\) at the parameter value \( t = \pi \). Plugging this value into the derivative equation, we see that the tangent vector at the point is \((5, 0, 8/\pi)\). Therefore, the tangent line passes through \((5\pi, -1, 4)\), and is parallel to the vector \((5, 0, 8/\pi)\), so the parametric equations of the line are:

\[
\begin{align*}
x &= 5\pi + 5t \\
y &= -1 \\
z &= 4 + 8t/\pi
\end{align*}
\]