$$
\begin{aligned}
\frac{du}{dt} - \beta y v &= -\frac{\partial \phi}{\partial x} + \nu \nabla_H^2 u, \\
\frac{\partial v}{\partial t} + \beta y u &= -\frac{\partial \phi}{\partial y} + \nu \nabla_H^2 v, \\
0 &= -\frac{\partial \phi}{\partial z} + \theta, \\
\frac{\partial \theta}{\partial t} + w &= Q + \nu \nabla_H^2 \theta, \\
\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} &= 0.
\end{aligned}
$$