

Kinetic Energy in Generalized Coordinates:

In[52]:= $n = 1$

Out[52]= 1

In[61]:= $s = 3$

Out[61]= 3

In[54]:= $q_1 = r$

Out[54]= r

In[55]:= $q_2 = \theta$

Out[55]= θ

In[56]:= $q_3 = z$

Out[56]= z

In[57]:= $x_1 = q_1 \cos[q_2]$

Out[57]= $r \cos[\theta]$

In[58]:= $x_2 = q_1 \sin[q_2]$

Out[58]= $r \sin[\theta]$

In[59]:= $x_3 = q_3$

Out[59]= z

In[62]:=
$$T = \sum_{a=1}^n \sum_{i=1}^s \sum_{j=1}^s \sum_{k=1}^s (D[x_i, q_j] \times D[x_i, q_k] \times \text{OverDot}[q_j] \times \text{OverDot}[q_k]) // \text{FullSimplify}$$