$$(\frac{l\sin\left(\theta(t)\right)}{2}-l\cos\left(\beta(t)\right))\hat{\mathbf{i}}_{\mathbf{Sys}}+(-l\sin\left(\beta(t)\right)-\frac{l\cos\left(\theta(t)\right)}{2})\hat{\mathbf{j}}_{\mathbf{Sys}} \tag{1}$$

$$(\frac{l\sin\left(\phi(t)\right)}{2}+l\cos\left(\beta(t)\right))\hat{\mathbf{i}}_{\mathbf{Sys}}+(l\sin\left(\beta(t)\right)-\frac{l\cos\left(\phi(t)\right)}{2})\hat{\mathbf{j}}_{\mathbf{Sys}} \tag{2}$$

$$(l\sin\left(\beta(t)\right)\frac{d}{dt}\beta(t)+\frac{l\cos\left(\theta(t)\right)\frac{d}{dt}\theta(t)}{2})\hat{\mathbf{i}}_{\mathbf{Sys}}+(\frac{l\sin\left(\theta(t)\right)\frac{d}{dt}\theta(t)}{2}-l\cos\left(\beta(t)\right)\frac{d}{dt}\beta(t))\hat{\mathbf{j}}_{\mathbf{Sys}} \tag{3}$$

$$(-l\sin\left(\beta(t)\right)\frac{d}{dt}\beta(t)+\frac{l\cos\left(\phi(t)\right)\frac{d}{dt}\phi(t)}{2})\hat{\mathbf{i}}_{\mathbf{Sys}}+(\frac{l\sin\left(\phi(t)\right)\frac{d}{dt}\phi(t)}{2}+l\cos\left(\beta(t)\right)\frac{d}{dt}\beta(t))\hat{\mathbf{j}}_{\mathbf{Sys}} \tag{4}$$

$$\frac{l\left(\hat{\mathbf{i}}_{\mathbf{Sys}}\left(2\sin\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)-\sin\left(\theta(t)\right)\left(\frac{d}{dt}\theta(t)\right)^2+2\cos\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\cos\left(\theta(t)\right)\frac{d^2}{dt^2}\theta(t)\right)+\hat{\mathbf{j}}_{\mathbf{Sys}}\left(2\sin\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\sin\left(\theta(t)\right)\frac{d^2}{dt^2}\theta(t)-2\cos\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)+\cos\left(\theta(t)\right)\left(\frac{d}{dt}\theta(t)\right)^2\right)\right)}{2} \tag{5}$$

$$\frac{l\left(\hat{\mathbf{i}}_{\mathbf{Sys}}\left(-2\sin\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)-\sin\left(\phi(t)\right)\left(\frac{d}{dt}\phi(t)\right)^2-2\cos\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\cos\left(\phi(t)\right)\frac{d^2}{dt^2}\phi(t)\right)+\hat{\mathbf{j}}_{\mathbf{Sys}}\left(-2\sin\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\sin\left(\phi(t)\right)\frac{d^2}{dt^2}\phi(t)+2\cos\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)+\cos\left(\phi(t)\right)\left(\frac{d}{dt}\phi(t)\right)^2\right)\right)}{2} \tag{6}$$

$$(-\frac{glm_1\sin\left(\theta(t)\right)}{2})\hat{\mathbf{k}}_{\mathbf{Sys}}=(\frac{l^2m_1\frac{d^2}{dt^2}\theta(t)}{12})\hat{\mathbf{k}}_{\mathbf{Sys}} \tag{7}$$

$$\hat{\mathbf{0}} \tag{8}$$

$$(\frac{l\sin\left(\theta(t)\right)}{2})\hat{\mathbf{i}}_{\mathbf{Sys}}+(-\frac{l\cos\left(\theta(t)\right)}{2})\hat{\mathbf{j}}_{\mathbf{Sys}} \tag{9}$$

$$\frac{lm_1\left(\hat{\mathbf{i}}_{\mathbf{Sys}}\left(2\sin\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)-\sin\left(\theta(t)\right)\left(\frac{d}{dt}\theta(t)\right)^2+2\cos\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\cos\left(\theta(t)\right)\frac{d^2}{dt^2}\theta(t)\right)+\hat{\mathbf{j}}_{\mathbf{Sys}}\left(2\sin\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\sin\left(\theta(t)\right)\frac{d^2}{dt^2}\theta(t)-2\cos\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)+\cos\left(\theta(t)\right)\left(\frac{d}{dt}\theta(t)\right)^2\right)\right)}{2} \tag{10}$$

$$\frac{\left(\sin\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\frac{\sin\left(\theta(t)\right)\frac{d^2}{dt^2}\theta(t)}{2}+\cos\left(\beta(t)\right)\frac{d}{dt}-\beta(t)+\cos\left(\theta(t)\right)\left(\frac{d}{dt}\theta(t)\right)^2\right)\sin\left(\theta(t)\right)}{2}+\frac{\left(\sin\left(\beta(t)\right)\frac{d^2}{dt^2}\beta(t)+\frac{\sin\left(\theta(t)\right)\left(\frac{d}{dt}\theta(t)\right)^2}{2}+\cos\left(\beta(t)\right)\left(\frac{d}{dt}\beta(t)\right)^2+\frac{\cos\left(\theta(t)\right)\frac{d^2}{dt^2}\theta(t)}{2}\right)\cos\left(\theta(t)\right)}{2}=51 \tag{11}$$