

$$\text{In[5]:= } V = -ma * g * la * \text{Cos}[qb] - mb * g * (wa * \text{Cos}[qb] + lb * \text{Cos}[qb])$$

$$\text{Out[5]= } -g la ma \text{Cos}[qb] - g mb (lb \text{Cos}[qb] + wa \text{Cos}[qb])$$

$$\text{In[6]:= } T = 1/2 * (ma * la * ((qa)'[t])^2 + mb * (wb^2 * ((qa)'[t])^2 + lb^2 * ((qb)'[t])^2 + 2 * wa * lb * (qa)'[t] * (qb)'[t] * \text{Cos}[qa - qb]))$$

$$\text{Out[6]= } \frac{1}{2} (la ma qa'[t]^2 + mb (wb^2 qa'[t]^2 + 2 lb wa \text{Cos}[qa - qb] qa'[t] qb'[t] + lb^2 qb'[t]^2))$$

$$\text{In[7]:= } dLdqap = ma * la^2 * x2 + mb * wa^2 * x2 + wa * lb * x5 * \text{Cos}[x1 - x4]$$

$$\text{Out[7]= } la^2 ma x2 + mb wa^2 x2 + lb wa x5 \text{Cos}[x1 - x4]$$

$$\text{In[8]:= } dLdqbp = mb * lb^2 * x5 * \text{Cos}[x1 - x4]$$

$$\text{Out[8]= } lb^2 mb x5 \text{Cos}[x1 - x4]$$

$$\text{In[9]:= } dtdLdqa = x3 * (ma * la^2 + mb * wb^2) + wa * lb * x6 * \text{Cos}[x1 - x4] + wa * lb * x5^2 * \text{Sin}[x1 - x4] - wa * lb * x2 * x5 - wa * lb * x1 * x5 * \text{Sin}[x1 - x4]$$

$$\text{Out[9]= } (la^2 ma + mb wb^2) x3 - lb wa x2 x5 + lb wa x6 \text{Cos}[x1 - x4] - lb wa x1 x5 \text{Sin}[x1 - x4] + lb wa x5^2 \text{Sin}[x1 - x4]$$

$$\text{In[10]:= } dtdLdqb = mb * lb * x6 + wa * lb * x3 * \text{Cos}[x1 - x4] + wa * lb * x2 * x5 * \text{Sin}[x1 - x4] - wa * lb * x2^2 * \text{Sin}[x1 - x4]$$

$$\text{Out[10]= } lb mb x6 + lb wa x3 \text{Cos}[x1 - x4] - lb wa x2^2 \text{Sin}[x1 - x4] + lb wa x2 x5 \text{Sin}[x1 - x4]$$

$$\text{In[11]:= } \text{eqns} = \{ \\ dtdLdqa - dLdqap == 2 * T1 + 2 * w1 / l2 * T2, \\ dtdLdqb - dLdqbp == 2 * T2 \\ \}$$

$$\text{Out[11]= } \left\{ -la^2 ma x2 - mb wa^2 x2 + (la^2 ma + mb wb^2) x3 - lb wa x2 x5 - lb wa x5 \text{Cos}[x1 - x4] + lb wa x6 \text{Cos}[x1 - x4] - lb wa x1 x5 \text{Sin}[x1 - x4] + lb wa x5^2 \text{Sin}[x1 - x4] == 2 T1 + \frac{2 T2 w1}{l2}, \right. \\ \left. lb mb x6 + lb wa x3 \text{Cos}[x1 - x4] - lb^2 mb x5 \text{Cos}[x1 - x4] - lb wa x2^2 \text{Sin}[x1 - x4] + lb wa x2 x5 \text{Sin}[x1 - x4] == 2 T2 \right\}$$

In[12]:= **Solve[eqns, {x3, x6}]**

Out[12]=
$$\left\{ \left\{ x3 \rightarrow - \left(\left(-lb\,wa\,\cos[x1 - x4] \right. \right. \right. \right. \\ \left. \left. \left. \left(-2\,T2 - lb^2\,mb\,x5\,\cos[x1 - x4] - lb\,wa\,x2^2\,\sin[x1 - x4] + lb\,wa\,x2\,x5\,\sin[x1 - x4] \right) + \right. \right. \right. \\ \left. \left. \left. lb\,mb \left(-2\,T1 - \frac{2\,T2\,w1}{l2} - la^2\,ma\,x2 - mb\,wa^2\,x2 - lb\,wa\,x2\,x5 - lb\,wa\,x5\,\cos[x1 - x4] - \right. \right. \right. \\ \left. \left. \left. lb\,wa\,x1\,x5\,\sin[x1 - x4] + lb\,wa\,x5^2\,\sin[x1 - x4] \right) \right) \right) \right) / \\ \left. \left(lb\,mb \left(la^2\,ma + mb\,wb^2 \right) - lb^2\,wa^2\,\cos[x1 - x4]^2 \right) \right\}, x6 \rightarrow \\ - \left(\left(2\,l2\,la^2\,ma\,T2 + 2\,l2\,mb\,T2\,wb^2 - 2\,l2\,lb\,T1\,wa\,\cos[x1 - x4] - 2\,lb\,T2\,w1\,wa\,\cos[x1 - x4] - \right. \right. \\ \left. \left. l2\,la^2\,lb\,ma\,wa\,x2\,\cos[x1 - x4] - l2\,lb\,mb\,wa^3\,x2\,\cos[x1 - x4] + \right. \right. \\ \left. \left. l2\,la^2\,lb^2\,ma\,mb\,x5\,\cos[x1 - x4] + l2\,lb^2\,mb^2\,wb^2\,x5\,\cos[x1 - x4] - \right. \right. \\ \left. \left. l2\,lb^2\,wa^2\,x2\,x5\,\cos[x1 - x4] - l2\,lb^2\,wa^2\,x5\,\cos[x1 - x4]^2 + \right. \right. \\ \left. \left. l2\,la^2\,lb\,ma\,wa\,x2^2\,\sin[x1 - x4] + l2\,lb\,mb\,wa\,wb^2\,x2^2\,\sin[x1 - x4] - \right. \right. \\ \left. \left. l2\,la^2\,lb\,ma\,wa\,x2\,x5\,\sin[x1 - x4] - l2\,lb\,mb\,wa\,wb^2\,x2\,x5\,\sin[x1 - x4] - \right. \right. \\ \left. \left. l2\,lb^2\,wa^2\,x1\,x5\,\cos[x1 - x4] \times \sin[x1 - x4] + l2\,lb^2\,wa^2\,x5^2\,\cos[x1 - x4] \times \sin[x1 - x4] \right) \right) / \\ \left. \left(l2\,lb \left(-la^2\,ma\,mb - mb^2\,wb^2 + lb\,wa^2\,\cos[x1 - x4]^2 \right) \right) \right\} \}$$