Problem 2

```
function [ tau_solve ] = Problem2fnc( M1,M2,L1,L2,theta1,theta2 )

syms l1 l2 m1 m2 g  t1(t) t2(t) t1d(t) t2d(t)  t1dd(t) t2dd(t) I1 I2
syms t1_temp t2_temp
```

Get the links

Get the link 1 positions and velocity

```
x1 = [ l1*cos(t1(t));...
       l1*sin(t1(t))];

x2 = [ x1(1) + l2*cos(t1(t) + t2(t));...
       x1(2) + l2*cos(t1(t) + t2(t))];
```

Get the link 2 positions and velocity

```
x1_d = diff(x1,t);
x1_d = subs(x1_d, {diff(t1(t), t) }, {t1d(t)});


x2_d = diff(x2,t);

x2_d = subs(x2_d, {diff(t2(t), t) }, {t2d(t)});
```

Solve fot the interia of the links

```
I1 = (1/3)*m1*(l1)^2;
I2 = (1/12)*m2*(L2)^2;
```

```
Not enough input arguments.

Error in Problem2fnc (line 30)
I2 = (1/12)*m2*(L2)^2;
```

sovle for the kinetic engery including the rotationa energery

```
K1 = 0.5*m1*(x1_d.'*x1_d) + 0.5*I1*t1(t)^2;

K2 = 0.5*m1*(x2_d.'*x2_d) + 0.5*I1*(t1(t)+t2(t))^2;
```

solve for the potentional energy of the arm

```
P1 = m1*g*(0.5*l1)*sin(t1(t));
P2 = m2*g*( l1*sin(t1(t)) + .5*l2*sin(t1(t)+t2(t)));
```

get the largrange

```
L = simplify((K1+K2)-(P1+P2));
```

get dL/dq for theta 1,2

```
temp = subs(L,{t1(t)},{t1_temp});
```

```
dL_dt1 = diff( temp  , t1_temp);
dL_dt1 = subs(dL_dt1,{t1_temp},{t1(t)});

temp = subs(L,{t2(t)},{t2_temp});
dL_dt2 = diff( temp  , t2_temp);
dL_dt2 = subs(dL_dt2,{t2_temp},{t2(t)});
```

get dL/dqd for theta 1,2

```
temp = subs(L,{t1d(t)},{t1_temp});
dL_ddt1 = diff( temp  , t1_temp);
dL_ddt1 = subs(dL_ddt1,{t1_temp},{t1d(t)});

temp = subs(L,{t2d(t)},{t2_temp});
dL_ddt2 = diff( temp  , t2_temp);
dL_ddt2 = subs(dL_ddt2,{t2_temp},{t2d(t)});
```

get d(dL/dqd)/dt for theta 1,2

```
d_dt_1 = diff(dL_ddt1,t);
d_dt_1 = subs( d_dt_1, {diff(t1d(t), t),diff(t2d(t), t)},{t1dd(t),
 t2dd(t)});
d_dt_1 = subs(d_dt_1, {diff(t1(t), t) , diff(t2(t), t) },
 {t1d(t),t2d(t)});
%
d_dt_2 = diff(dL_ddt2,t);
d_dt_2 = subs( d_dt_2, {diff(t1d(t), t),diff(t2d(t), t)},{t1dd(t),
 t2dd(t)});
d_dt_2 = subs(d_dt_2, {diff(t1(t), t) , diff(t2(t), t) },
 {t1d(t),t2d(t)});
```

get tau 1,2

```
tau_1 =simplify( d_dt_1 - dL_dt1)
tau_2 =simplify( d_dt_2 - dL_dt2)
tau = [tau_1;tau_2];
```

plug in values

```
tau_solve = simplify(subs(tau, {m1,m2,l1,l2,t1(t),t2(t)},
{M1,M2,L1,L2,theta1,theta2 }))
```

```
end
```

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