**1b)** just sub into equation (1), k1 = 100 N/m

**1c)** sub into equation (1), k1 = -58.82 N/m

No realistic answer exists as this answer indicates that the top springs are applying a force in the same direction as the force acting on them and therefore the springs would infinitely extend

**2a)** Break up the forces into vertical and horizontal components and use algebra to solve for TA and TB OR can use matrix operations. TA = 1207.78N or 1211N via MATLAB. TB = 2949.48N or 2947N via MATLAB,

**2b)** Yes, the tensions are equal at theta = 2.5 degrees with a force of 2097N.

function [TA,TB] = calcRangeOfTensions

theta=0:0.5:20;

A=[cosd(15) cosd(20); sind(15) -sind(20)];

for i=1:length(theta)

C=[4000\*cosd(theta(i));-4000\*sind(theta(i))];

x=inv(A)\*C;

TA(i)=x(1);

TB(i)=x(2);

end

plot(theta, TA,'rs', theta,TB,'go');

grid on;

xlabel("theta(degrees)");

ylabel("F(N)");

end

**3a)** when the string is unstretched, theta = 0, therefore lOD = lOA + lAD, so lAD = lOD – lOA

lAD = 480 – 250 = 230mm

**3b)** using trigonometry and simplified triangle diagram

c2=a2+b2

(lAD)2=(lOD-lOA\*cos(theta))2+(lOA\*sin(theta))2

lAD = sqrt((lOD-lOA\*cos(theta))2+(lOA\*sin(theta))2

**3c)** Using trigonometry and portraying system as a triangle again

Alpha is also the angle between OD and the spring.

Sin(alpha) = O/H

O = lOA \* sin(theta)

H = lAD

Therefore alpha = arcsin((lOA\*sin(theta)) / lAD)

**3d)** Force of a spring is F = kx, where x is extension. The extension of the spring is simply the length of the stretched spring subtracted from the length of the unstretched spring. Therefore x is lAD – LO and therefore F = k \* ( lAD – LO)

**5)**

function [u0, v0] = GetVelocityFromSetup(lrest,lmax,lmin,k,L)

N = length(k);

xmax = zeros(1,N);

xmin = zeros(1,N);

Espring = zeros(1,N);

Etotal = 0;

mball = 0.0127;

lball = 0.53;

larm = 0.51;

marm = 0.388;

% calculate xmax and xmin for each spring

for i = 1:N

xmax(i) = lmax(i) - lrest(i);

xmin(i) = lmin(i) - lrest(i);

end

% calculate the energy for each spring and sum up the energy of each

% spring to get the total energy

for i = 1:N

Espring(i) = 0.5\*k(i)\*(xmax(i)^2-(xmin(i))^2)+L(i)\*(xmax(i)-xmin(i));

Etotal = Etotal + Espring(i);

end

% calculate the moment of inertia

Iarm = (1/3)\*marm\*larm^2;

Iball = mball\*lball^2;

% calculate the total moment of inertia and use it to calculate the

% angular velocity

I = Iarm + Iball;

ang\_vel = sqrt((2\*Etotal)/I);

% calculate u0 and v0

V0 = ang\_vel\*lball;

u0 = V0\*cosd(45);

v0 = V0\*sind(45);

end