BME 240L Lab 4

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Problem 1:

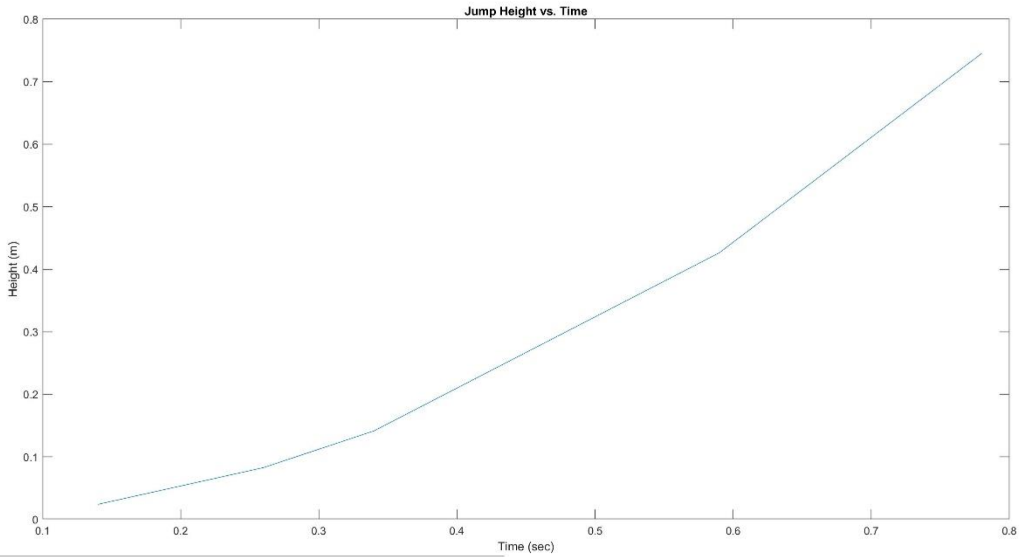
Code:

```
%% Problem 1 - Jump Height

%Calculates heights for jumps of given time
y1 = jump_height(.14);
y2 = jump_height(.26);
y3 = jump_height(.34);
y4 = jump_height(.59);
y5 = jump_height(.78);

%Stores X and Y values in a vector
X = [.14,.26,.34,.59,.78]
Y = [y1,y2,y3,y4,y5]

%plots x and y values
plot(X,Y)
title('Jump Height vs. Time') %Graph Title
xlabel('Time (sec)'); %X axis label
ylabel('Height (m)'); %Y axis label
annotation('textbox', [0,0.05,0.5,0],'string','This a figure that shows
the relationship between 5 flight times (.14,.26,.34,.59,.78 sec) and
the heights of the resulting jumps.');
```

Function:

```
function [height] = jump_height(time)
%Calculates jump height based on flight time, using given equations 1.1
and
%1.2
height = ((9.8*time/2)^2) / (2*9.8);
end
```

Graphs:




This a figure that shows the relationship between 5 flight times (.14,.26,.34,.59,.78 sec) and the heights of the resulting jumps.

Problem 2:

Code:

```
%% Problem 2 - Hip Forces
% Given Values
FW=667;
FC1=0;
FC2=120;
FC3=120;
A=.1;
B=.08;
C1=0;
C2=.3;
C3=.3;


disp('First is standing with no cane, next is standing with a cane
ipsilateral, and finally is standing with a cane contralateral')
disp('first is FM and second is FJ')

%Calculate values
[FM1,FJ1] = Standing_No_Cane(FW,FC1,A,B,C1);
[FM2,FJ2] = Standing_Cane_On_Same_Side(FW,FC2,A,B,C2);
[FM3,FJ3] = Standing_Cane_On_Other_Side(FW,FC3,A,B,C3);
format long g %format values

%display values
disp([FM1,FJ1])
disp([FM2,FJ2])
disp([FM3,FJ3])
```

Functions:

```
function [FM,FJ] = Standing_No_Cane(FW,FC,A,B,C)
%Calculates FM and FJ given FW,FC,A,B,C
FM = (FW*A)/B;
FJ = FM+FW-FC;
end

function [FM,FJ] = Standing_Cane_On_Same_Side(FW,FC,A,B,C)
%Calculates FM and FJ given FW,FC,A,B,C
FM = ((FW*A)+(FC*(C-A)))/B;
FJ = FM+FW-FC;
end

function [FM,FJ] = Standing_Cane_On_Other_Side(FW,FC,A,B,C)
%Calculates FM and FJ given FW,FC,A,B,C
FM = ((FW*A)-(FC*(C+A)))/B;
FJ = FM+FW-FC;
end
```

Output:

First is standing with no cane, next is standing with a cane ipsilateral, and finally is standing with a cane contralateral

first is FM and second is FJ

| | |
|---|---|
| 833.75 | 1500.75 |
| 1133.75 | 1680.75 |
| 233.75 | 780.75 |

Problem 3:

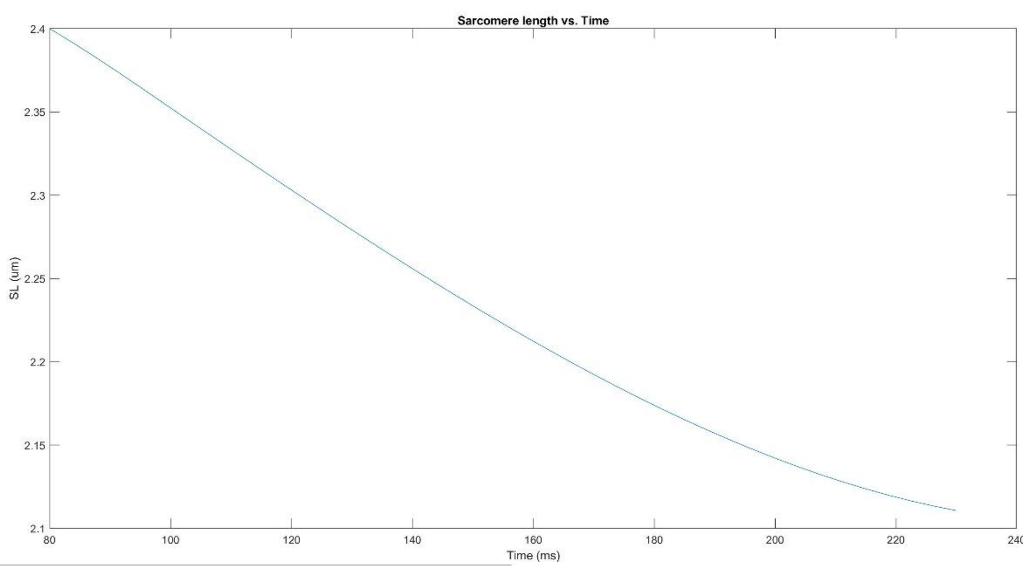
Code:

```
%% Problem 3 - Cardiac Mechanics pt. 1

% Use given start and ending times
t_start = 80
t_end = 230
%given initial values
y0 = 2.4

%Stores calculated values from ode45
[t,y] = ode45(@Cardiac_Mechanics, [t_start t_end],[y0]);
figure(2) %starts fig
plot(t,y) % Plots
title('Sarcomere length vs. Time') %Graph Title
xlabel('Time (ms)'); %X axis label
ylabel('SL (um)'); %Y axis label
annotation('textbox', [0,0.05,0.5,0],'string','A plot of sarcomere
length vs time, solved by ode45, using the conditions of 80ms to
230ms');
```

Function:

```
function [dSLdt] = Cardiac_Mechanics(t,SL)

T=40;
SL0=2.4;
SLZ = 1.6;
SL_rest = 2;
v_max = .006;
ta = 500;
t_max = 100;
B = 68.67;

t_star = t/ta;
tau = t_max/ta
%ft_star = 0

if t_star <= tau
    ft_star = sin((pi*t_star)/(2*tau)).^2;
else
    ft_star = sin((pi*(1-t_star))/(2*(1-tau))).^2;
end

dSLdt = v_max * ((T/((ft_star * B)*((1-(((SL-SL0)^2)/((SLZ-
SL0)^2))*(SL/SL_rest))))) -1)
end
```

Output:




A plot of sarcomere length vs time, solved by ode45, using the conditions of 80ms to 230ms

Problem 4:

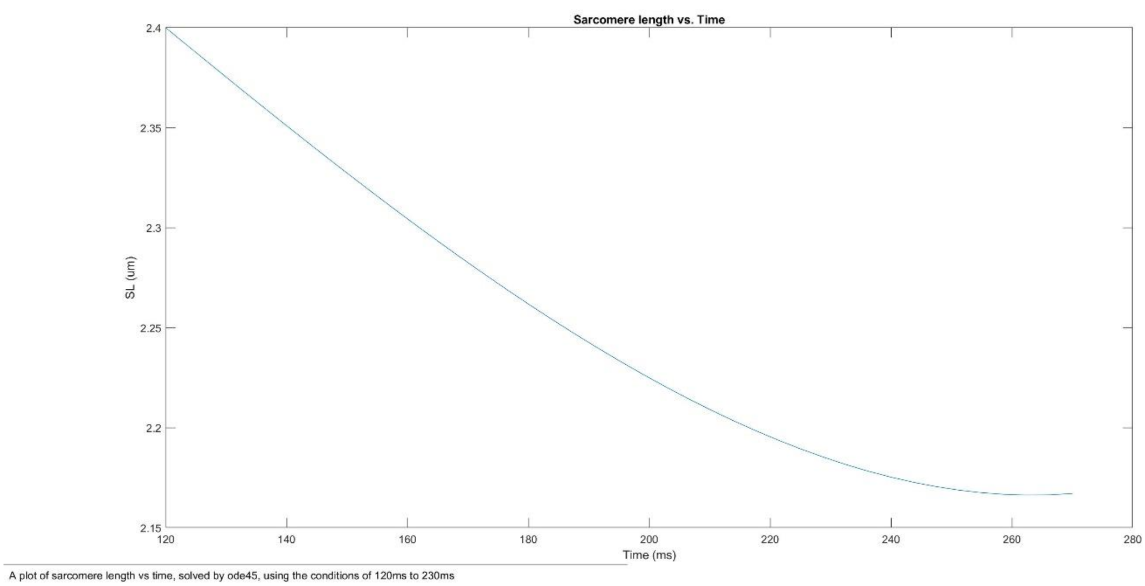
Code:

```
%% Problem 4 - Cardiac Mechanics pt. 2

%Given Start and stop times
t_start = 120
t_end = 270
%given initial values
y0 = 2.4
%Stores calculated values from ode45
[t,y] = ode45(@Cardiac_Mechanics, [t_start t_end],[y0]);
figure(3) % Starts fig
plot(t,y) % Plots
title('Sarcomere length vs. Time') %Graph Title
xlabel('Time (ms)'); %X axis label
ylabel('SL (um)'); %Y axis label
annotation('textbox', [0,0.05,0.5,0],'string','A plot of sarcomere length vs
time, solved by ode45, using the conditions of 120ms to 230ms');
```

Function:

Same as Problem 3.

Output:



## MATLAB Publish Output:

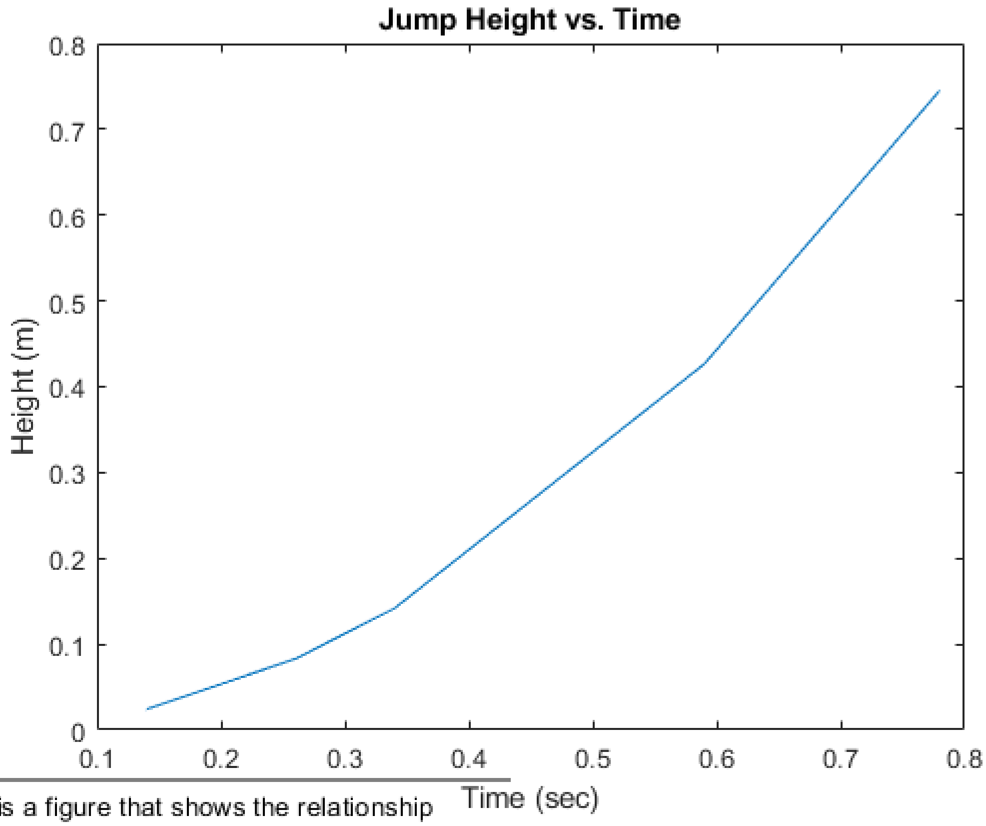
## Contents



## Problem 1 - Jump Height

```
%Calculates heights for jumps of given time
y1 = jump_height(.14);
y2 = jump_height(.26);
y3 = jump_height(.34);
y4 = jump_height(.59);
y5 = jump_height(.78);

%Stores X and Y values in a vector
X = [.14,.26,.34,.59,.78]
Y = [y1,y2,y3,y4,y5]

%plots x and y values
plot(X,Y)
title('Jump Height vs. Time') %Graph Title
xlabel('Time (sec)'); %X axis label
ylabel('Height (m)'); %Y axis label
annotation('textbox', [0,0.05,0.5,0],'string','This a figure that shows the
relationship between 5 flight times (.14,.26,.34,.59,.78 sec) and the heights of the
resulting jumps.');
```

```
X =

  Columns 1 through 3

                    0.14                      0.26                      0.34

  Columns 4 through 5

                    0.59                      0.78

Y =

  Columns 1 through 3

                 0.02401                   0.08281                   0.14161

  Columns 4 through 5

               0.4264225                   0.74529
```




This a figure that shows the relationship

## Problem 2 - Hip Forces

Given Values

```
FW=667;

FC1=0;

FC2=120;

FC3=120;

A=.1;

B=.08;

C1=0;

C2=.3;

C3=.3;
```

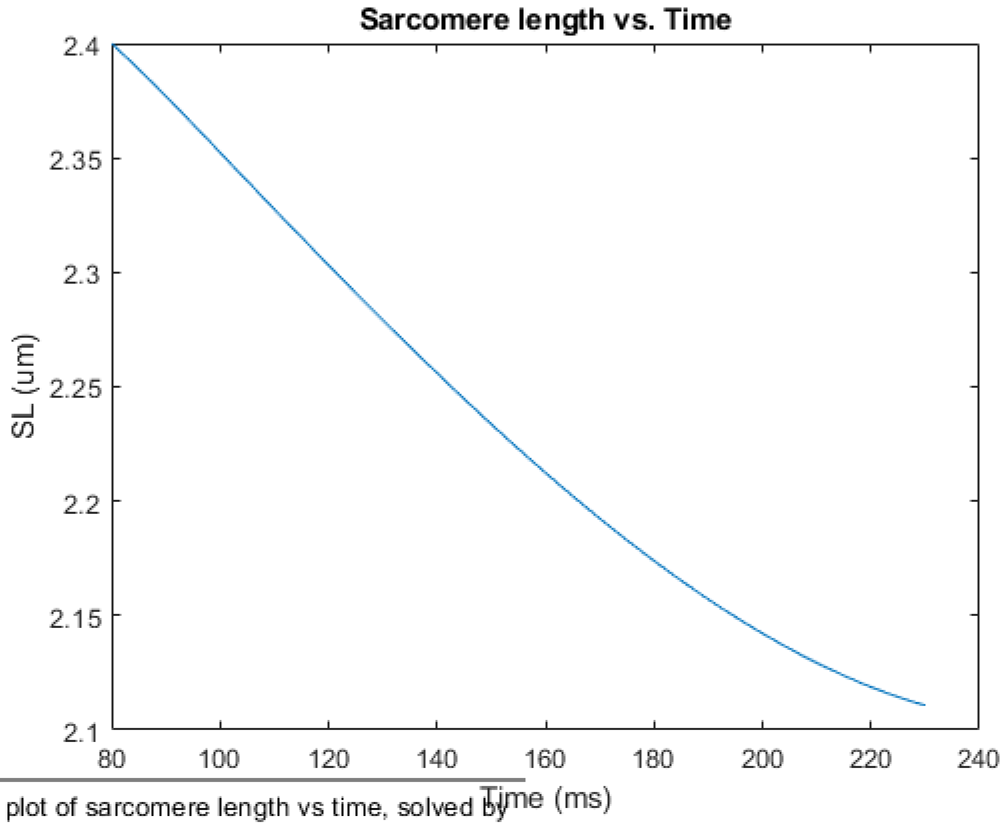
```
disp('First is standing with no cane, next is standing with a cane ipsilateral, and
finally is standing with a cane contralateral')
disp('first is FM and second is FJ')

%Calculate values
[FM1,FJ1] = Standing_No_Cane(FW,FC1,A,B,C1);
[FM2,FJ2] = Standing_Cane_On_Same_Side(FW,FC2,A,B,C2);
[FM3,FJ3] = Standing_Cane_On_Other_Side(FW,FC3,A,B,C3);
format long g %format values

%display values
disp([FM1,FJ1])
disp([FM2,FJ2])
disp([FM3,FJ3])
```

```
First is standing with no cane, next is standing with a cane ipsilateral, and finally
is standing with a cane contralateral

first is FM and second is FJ

                    833.75                   1500.75

                   1133.75                   1680.75

                    233.75                    780.75
```

## Problem 3 - Cardiac Mechanics pt. 1

```
% Use given start and ending times
t_start = 80
t_end = 230
%given initial values
y0 = 2.4

%Stores calculated values from ode45
[t,y] = ode45(@Cardiac_Mechanics, [t_start t_end],[y0]);
figure(2) %starts fig
plot(t,y); % Plots
title('Sarcomere length vs. Time') %Graph Title
xlabel('Time (ms)'); %X axis label
ylabel('SL (um)'); %Y axis label
annotation('textbox', [0,0.05,0.5,0],'string','A plot of sarcomere length vs time,
solved by ode45, using the conditions of 80ms to 230ms');
```

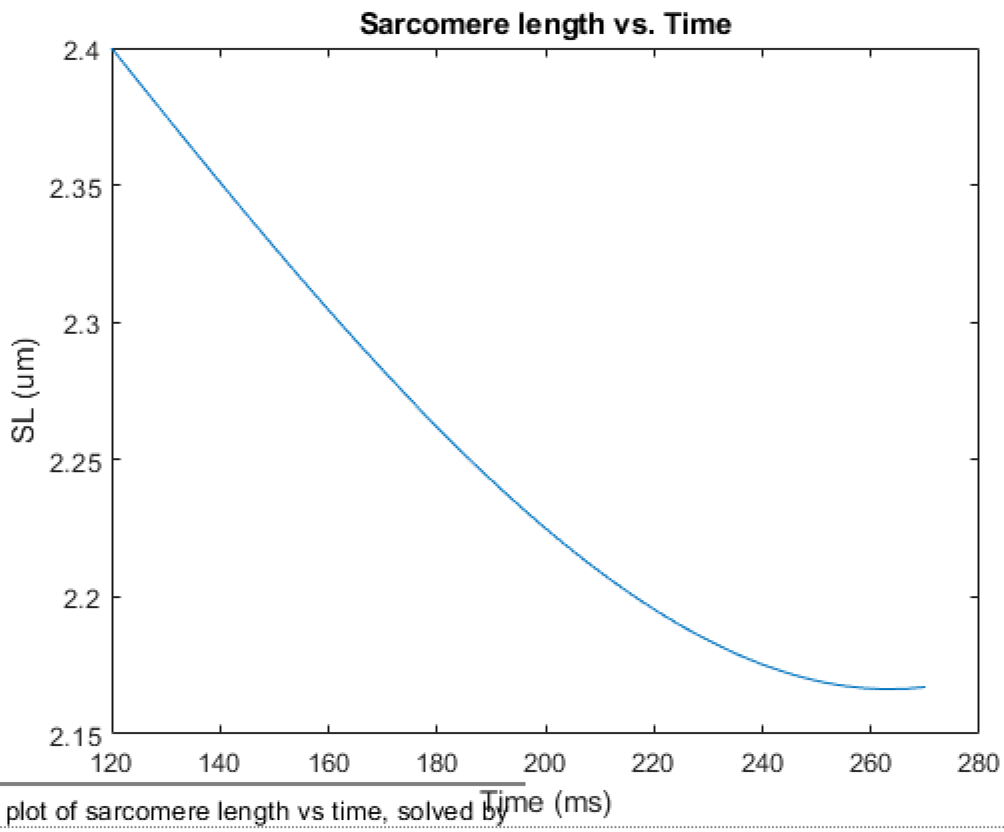
```
t_start =

    80

t_end =

   230

y0 =

                       2.4
```




## Problem 4 - Cardiac Mechanics pt. 2

```
%Given Start and stop times
t_start = 120
t_end = 270
%given initial values
y0 = 2.4
%Stores calculated values from ode45
[t,y] = ode45(@Cardiac_Mechanics, [t_start t_end],[y0]);
figure(3) % Starts fig
plot(t,y); % Plots
title('Sarcomere length vs. Time') %Graph Title
xlabel('Time (ms)'); %X axis label
ylabel('SL (um)'); %Y axis label
annotation('textbox', [0,0.05,0.5,0],'string','A plot of sarcomere length vs time,
solved by ode45, using the conditions of 120ms to 230ms');
```

```
t_start =

   120


t_end =

   270


y0 =

                       2.4
```




A plot of sarcomere length vs time, solved by