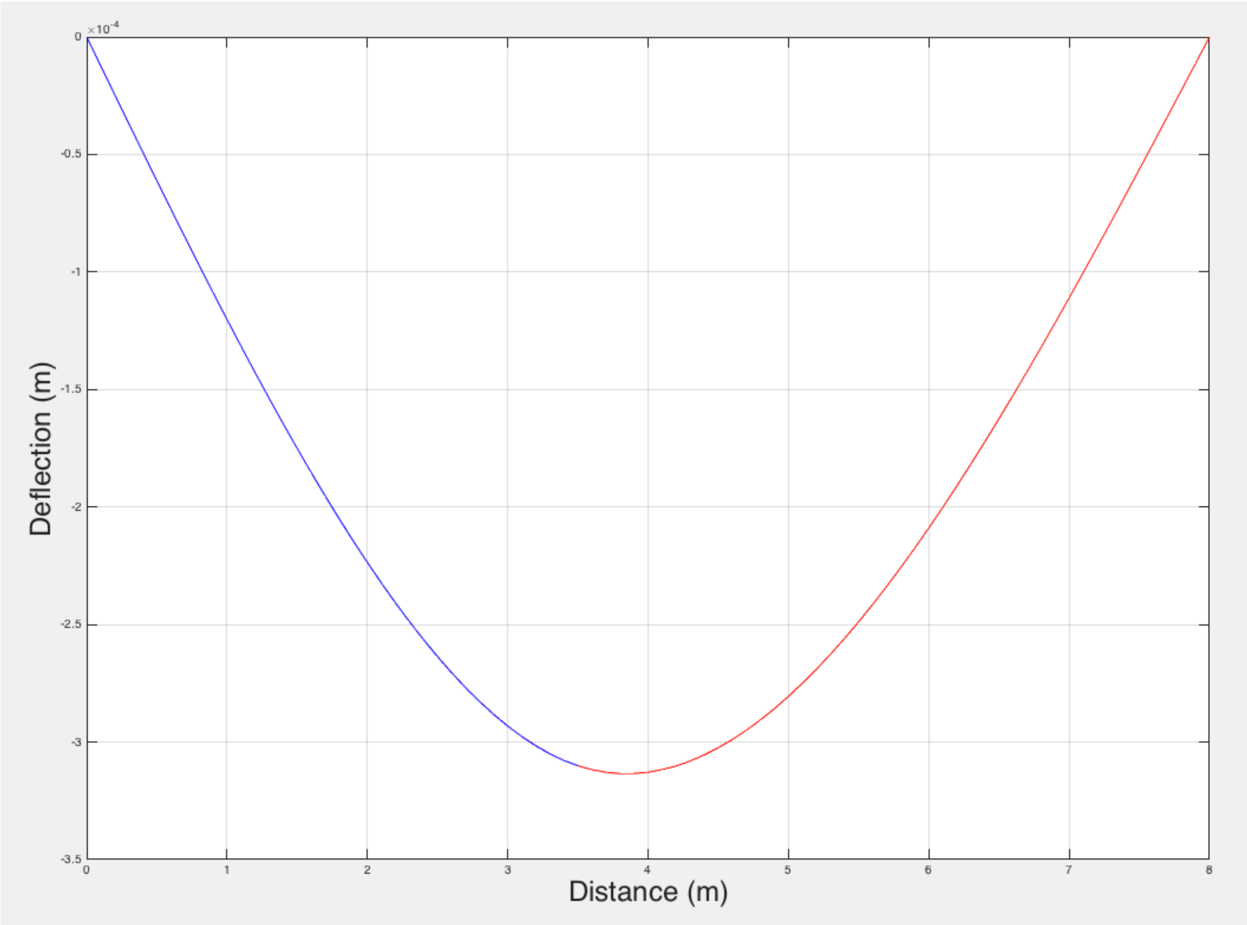
Assignment 5: Matlab Basics

Problem 1

Task 2



Task 3

Reaction at left datum point is 3375 N.

Reaction at right datum point is 2625 N.

```
%% ---------Problem 1 ----------%%
%% Task 1 & 2
W = 6000; % load(N)
E = 200e9; % Modulus of elasticity (N/m2)
I = 0.001; % Moment of inertia (m4)
a = 3.5; % distance from left beam point (m)
b = 4.5; % distance from right beam point (m)
l = 8;
```

```
x = 0:0.1:3.5; % Initialize x
v = 4.5:-0.1:0; % initialize v

% Deflections
ya = - W.* b.* x.* (l.^2 - x.^2 - b.^2)/(6*E*I*l); % deflection of the beam
from left datum point in meters

yb = - W.* a.* v.* (l.^2 - v.^2 - a.^2)/(6*E*I*l); % deflection of the beam
from right hand side datum point in meters

% To plot figure in order, first create a new v matrix
v1 = 3.5:0.1:l;

% Plot figure
figure
plot(x,ya,'b')
hold on
plot(v1,yb,'r')
grid
xlabel('Distance (m)','FontSize',24)
ylabel('Deflection (m)','FontSize',24)

%% Task 3
reaction_A = W*b/l;
reaction_B = W*a/l;
disp(['Reaction at left datum point is ',num2str(reaction_A),' N.'])
disp(['Reaction at right datum point is ',num2str(reaction_B),' N.'])
```

Problem 2

Task 1

St = 1105.1 m

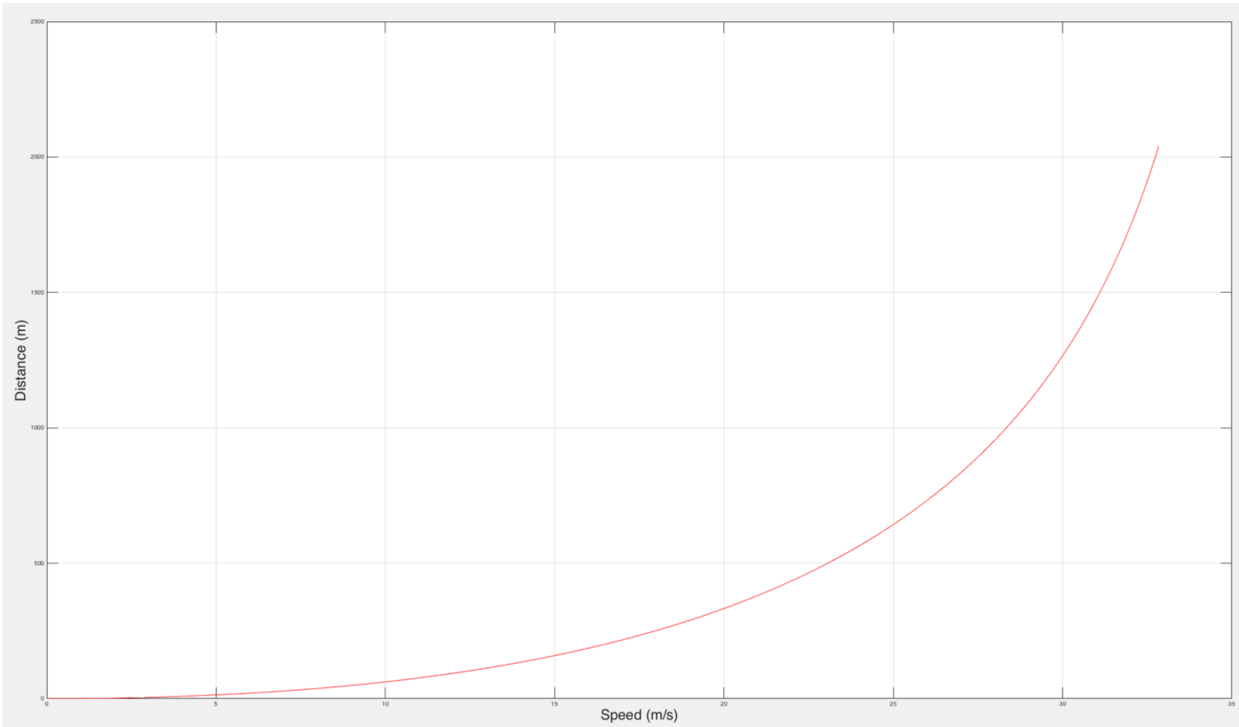
Vt = 29.06 m/s

Task 2

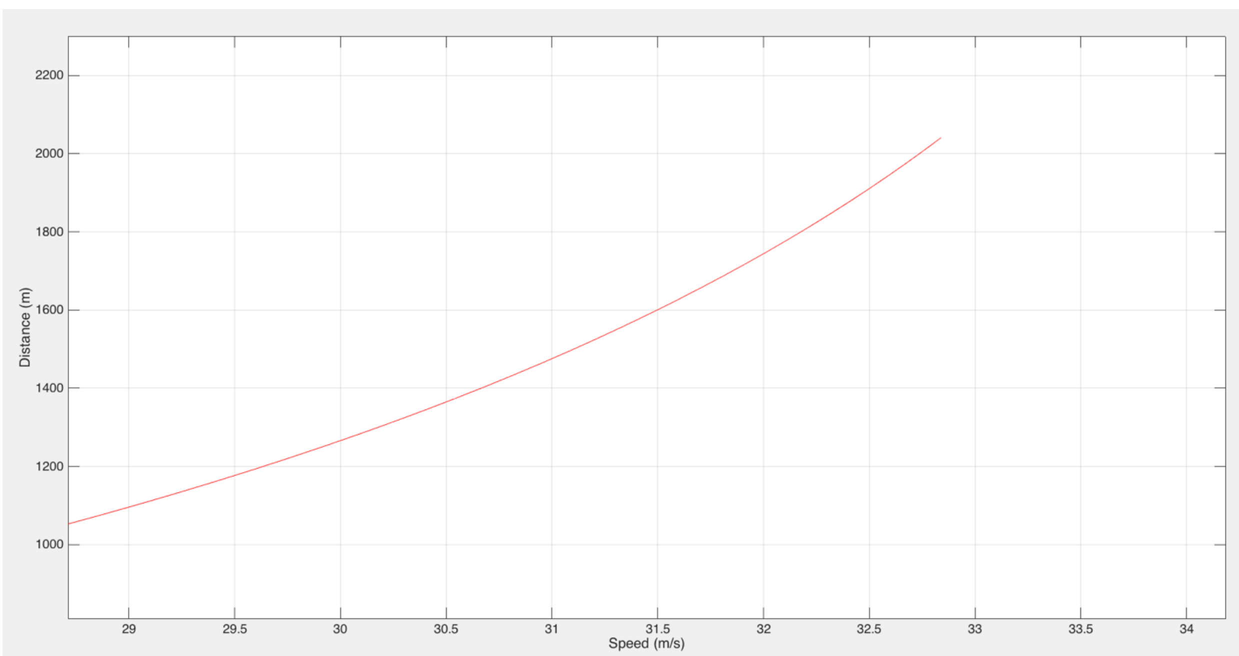
Speed after 90 seconds is 32.8407 m/s.

Distance after 90 seconds is 2041.4026 m.

Task 3



Task 4



70mph ≈ 31.29 m/s

The acceleration ramp needed is about 1546 m or just 1,550 meters.

```
%% ---------Problem 2 ----------%%
%% Task 1
V0 = 0; % Initial velocity of the truck (m/s)
k1 = 1.0; % An acceleration constant (m/s2)
k2 = 0.028; % Second acceleration constant (1/s)
t = 60; % time (seconds)

Vt = k1.*(1-exp(-k2.*t))/k2 + V0.*exp(-k2.*t); % Velocity (m/s) of the truck
as a function of time (t)

St = k1.*t/k2 - k1*(1-exp(-k2.*t))/(k2.^2) + V0*(1-exp(-k2.*t))/k2; %
Distance traveled by the truck (m)

%% Task 2
t = 0:1:90;

Vt = k1.*(1-exp(-k2.*t))/k2 + V0.*exp(-k2.*t); % Velocity (m/s) of the truck
as a function of time (t)

St = k1.*t/k2 - k1*(1-exp(-k2.*t))/(k2.^2) + V0*(1-exp(-k2.*t))/k2; %
Distance traveled by the truck (m)

disp(['Speed after 90 seconds is ',num2str(Vt(end)),' m/s.'])
disp(['Distance after 90 seconds is ',num2str(St(end)),' m.'])

%% Task 3
figure
plot(Vt,St,'r')
grid
xlabel('Speed (m/s)','FontSize',24)
ylabel('Distance (m)','FontSize',24)

%% Task 4
k_mph_to_ms = 0.44704;
v = 70*k_mph_to_ms;
```

Problem 3

Task 1 & 2

For thin walls

V is 18.2288 m/s.

d is 16.9706 m.

Q is 0.56509 m3/s.

F is 17658 N.

For thick wall

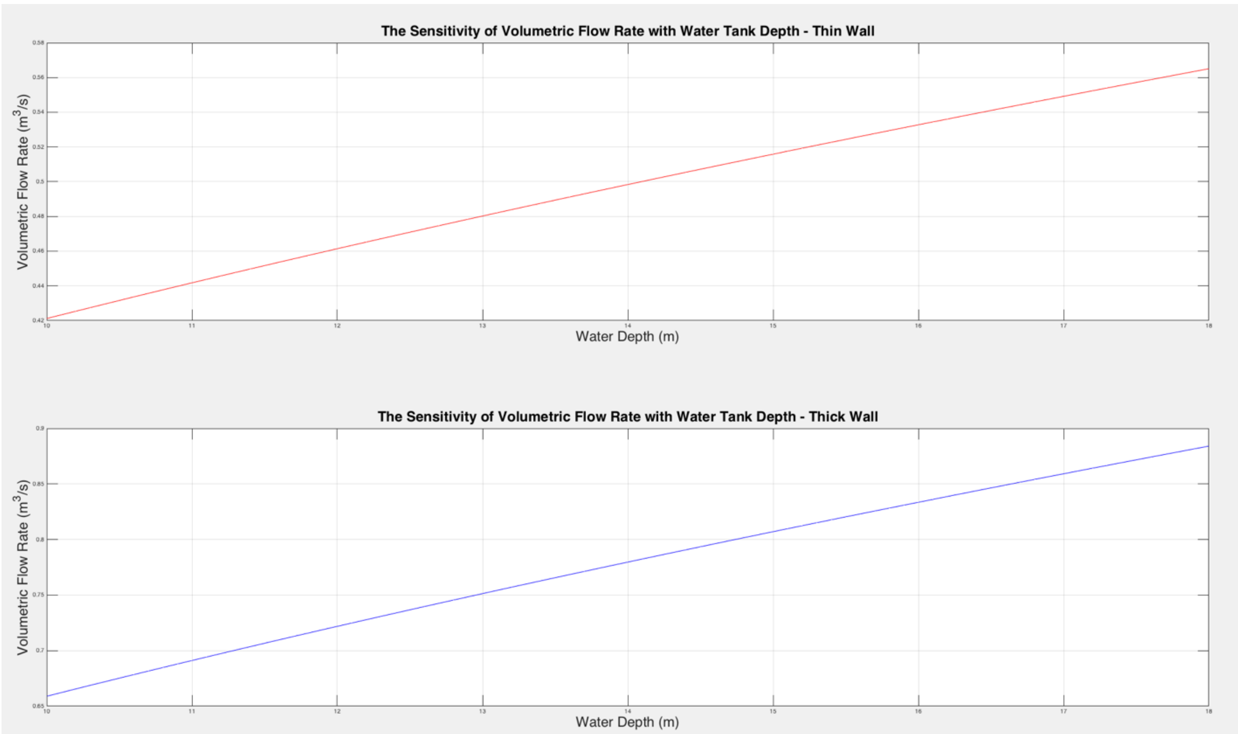
V is 18.2288 m/s.

d is 16.9706 m.

Q is 0.8841 m3/s.

F is 17658 N.

Task 3




```
%% ---------Problem 3 ----------%%
%% Task 1 & 2
% eq_f - equivalent friction (0.94 for water)
% spec_w - specific weight of the water (1000 kg/m3)
% contr_coeff - contraction coefficient (0.62 for thin-walled tanks, 0.97
% otherwise)
% g - gravity constant (9.81 m/s2)

h1 = 18; % water depth to the leaking point (meters)
h2 = 4; % distance from the bottom of the tank to the leaking point (meters)
A = 0.05; % area of the leaking orifice (m2);
eq_f = 0.97;
spec_w = 1000;
keyword = 'thick';
g = 9.81;
```

```
contr = strcmp(keyword,'thin');
 if contr == 1
     contr_coeff = 0.62; % thin wall
 else
     contr_coeff = 0.97; % thick wall
 end

v = eq_f*sqrt(2*g.*h1);% % velocity of the leaking water flow (m/s)
d = 2*sqrt(h1*h2); % horizontal distance traveled by the leaking water
(meters)
Q = eq_f.* contr_coeff.* A.* sqrt(2*g*h1); % volumetric flow rate (m3/s)
F = 2 * spec_w.* g.* A.* h1; % reaction force acting on the tank (Newtons)

if contr == 1
    fprintf('\nFor thin wall \n')
else
    fprintf('\nFor thick wall \n')
end
fprintf(['\nV is ',num2str(v),' m/s. \n', 'd is ',num2str(d),' m.\n','Q is ',
...
    num2str(Q), ' m3/s. \n','F is ',num2str(F),' N. \n'])

%% Task 3
h1 = 10:0.1:18;

contr_coeff_thin = 0.62; % thin wall
contr_coeff_thick = 0.97; % thick wall

Q_thin = eq_f.* contr_coeff_thin.* A.* sqrt(2*g*h1); % volumetric flow rate
(m3/s)
Q_thick = eq_f.* contr_coeff_thick.* A.* sqrt(2*g*h1); % volumetric flow rate
(m3/s)

figure
subplot(2,1,1)
plot(h1,Q_thin,'r')
xlabel('Water Depth (m)','FontSize',24)
ylabel('Volumetric Flow Rate (m^3/s)','FontSize',24)
title('The Sensitivity of Volumetric Flow Rate with Water Tank Depth - Thin
Wall','FontSize',24)
grid

subplot(2,1,2)
plot(h1,Q_thick,'b')
xlabel('Water Depth (m)','FontSize',24)
ylabel('Volumetric Flow Rate (m^3/s)','FontSize',24)
title('The Sensitivity of Volumetric Flow Rate with Water Tank Depth - Thick
Wall','FontSize',24)
grid
```