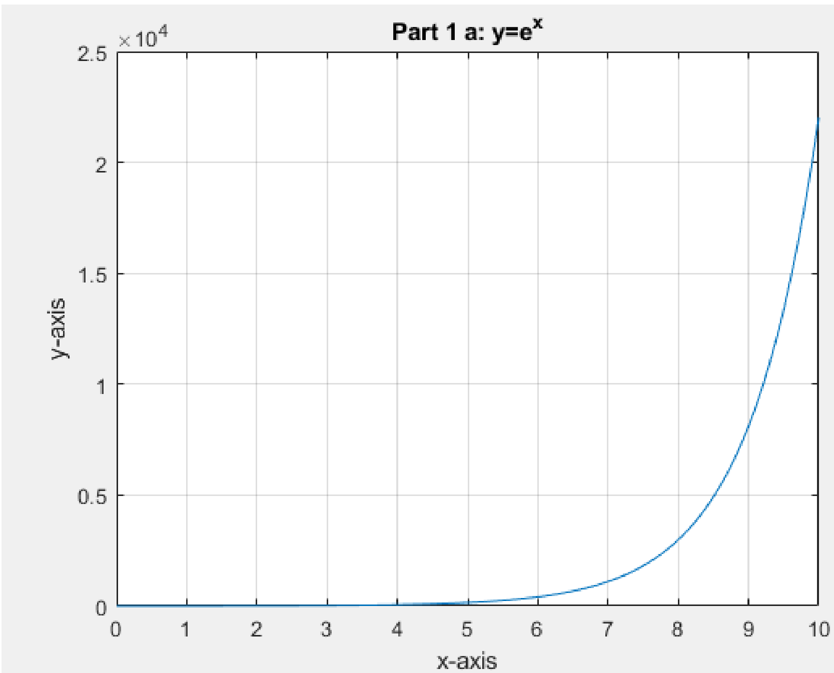
Part 1. Practice 'Basic Plotting Skills' Examples: Graphs – Gavin Binder

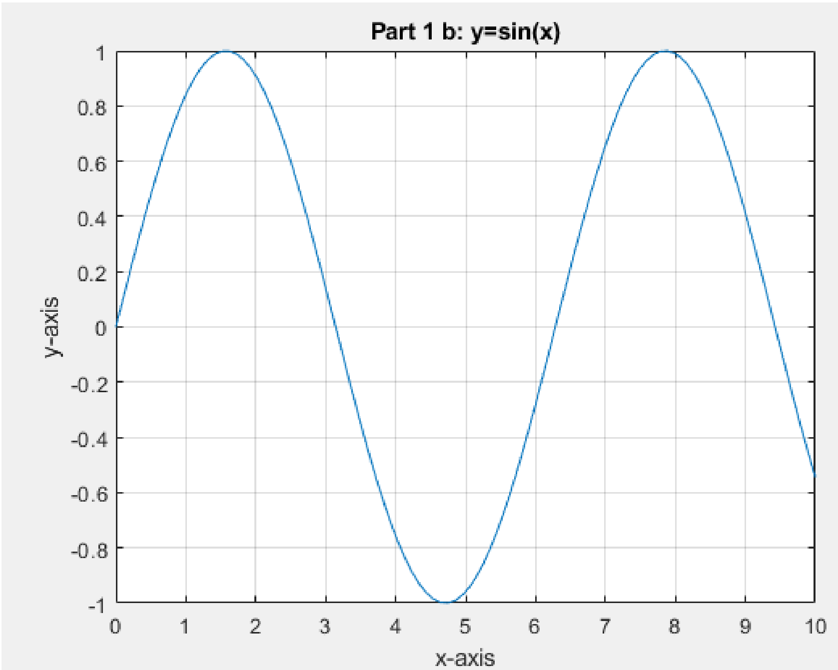
Part 1a.

```
x = linspace(0,10,100);
y = exp(x);
plot(x,y)
title("Part 1 a: y=e^x")
xlabel("x-axis")
ylabel("y-axis")
grid on
```



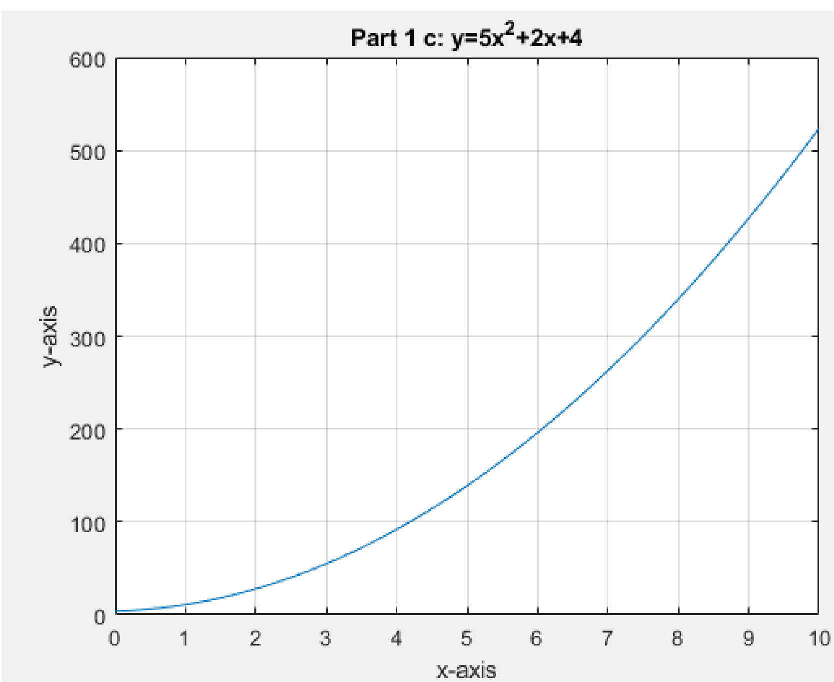
Part 1b.

```
x = linspace(0,10,100);
y = 5*x.^(2)+2*x+4;
plot(x,y)
title("Part 1 c: y=5x^2+2x+4")
xlabel("x-axis")
ylabel("y-axis")
grid on
```



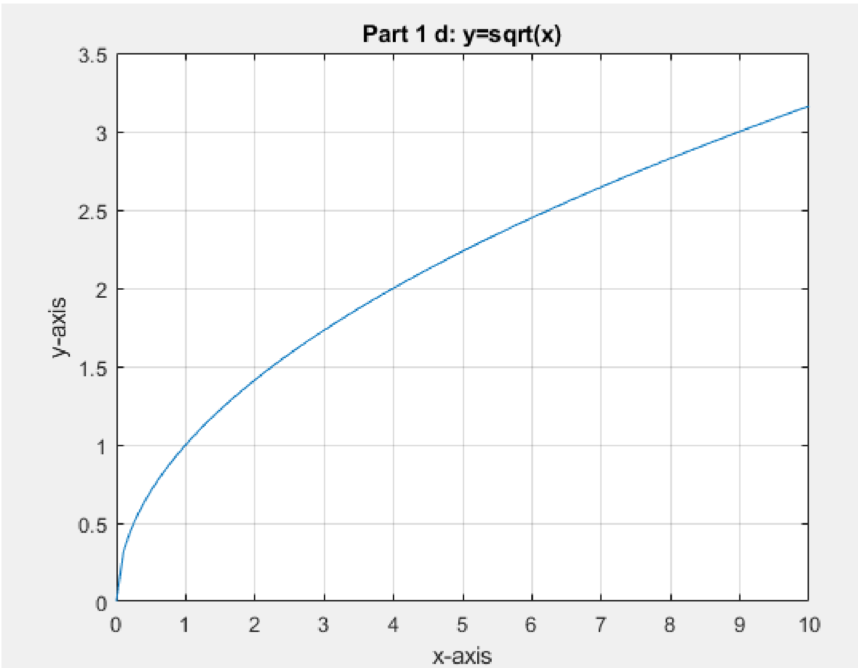
Part 1c.

```
x = linspace(0,10,100);
y = 5*x.^(2)+2*x+4;
plot(x,y)
title("Part 1 c: y=5x^2+2x+4")
xlabel("x-axis")
ylabel("y-axis")
grid on
```



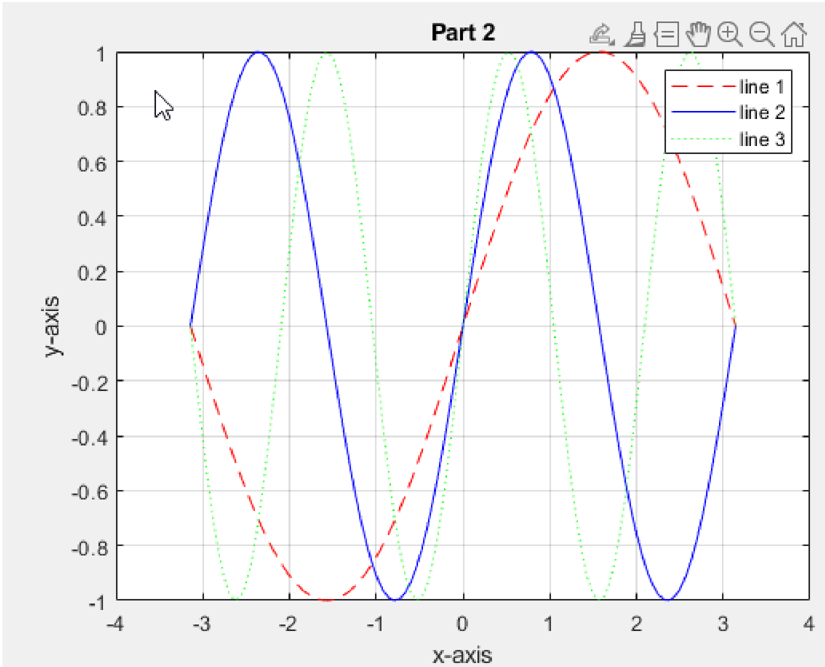
Part 1d.

```
x = linspace(0,10,100);
y = sqrt(x);
plot(x,y)
title("Part 1 d: y=sqrt(x)")
xlabel("x-axis")
ylabel("y-axis")
grid on
```



Part 2. 'More plots with special format': Graphs – Gavin Binder

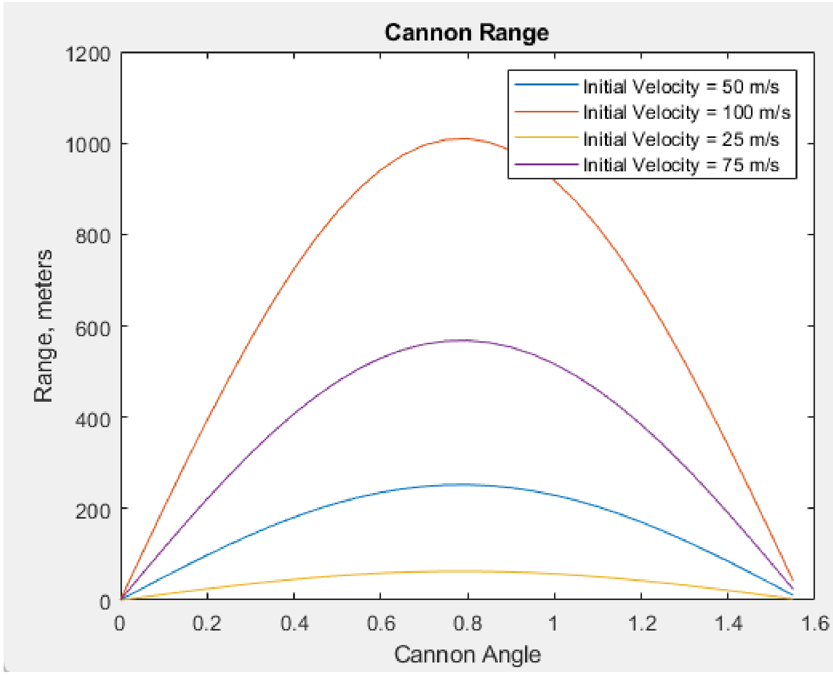
```
x=linspace(-pi,pi,100);
y1=sin(x);
y2=sin(2*x);
y3=sin(3*x);
plot(x,y1,'--r',x,y2,'-b',x,y3,':g')
title("Part 2")
xlabel("x-axis")
ylabel("y-axis")
grid on
legend('line 1', 'line 2', 'line 3')
text(2,100,'y1 = red, y2 = blue, y3 = green')
```



Part 3. Intro to STEM application' Problem – Projectile motion – Gavin Binder

Part 3a.

```
% Define constants
g= 9.9;
v1=50;
v2=100;
v3=25;
v4=75;
% Define angle vector
angle=0:0.05:pi/2;
% Calculate range
R1=v1^2/g*sin(2*angle);
R2=v2^2/g*sin(2*angle);
R3=v3^2/g*sin(2*angle);
R4=v4^2/g*sin(2*angle);
% Plot results
plot(angle,R1,angle,R2,angle,R3,angle,R4)
title('Cannon Range')
xlabel('Cannon Angle')
ylabel('Range, meters')
legend('Initial Velocity = 50 m/s','Initial Velocity = 100 m/s', ...
    'Initial Velocity = 25 m/s','Initial Velocity = 75 m/s')
```

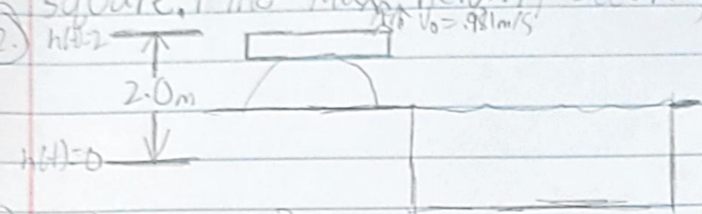

Cannon Range
Initial Velocity = 50 m/s
Initial Velocity = 100 m/s
Initial Velocity = 25 m/s
Initial Velocity = 75 m/s
Range, meters
1200
1000
800
600
400
200
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Cannon Angle

Part 3b.

Part 3-B

(1.) A diver jumps from a diving board 2m. above water, with initial velocity of .981 m/s. Height $h(t) = -4.905t^2 + .981t + 2.0$m. Find the time when the diver hits the water using quadratic formula and complete the square. Find max. height, occuring at $t = 0.1$sec. Sketch.

(2.)



(3.) $h(t) = -4.905t^2 + .981t + 2.0$

(4.) $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

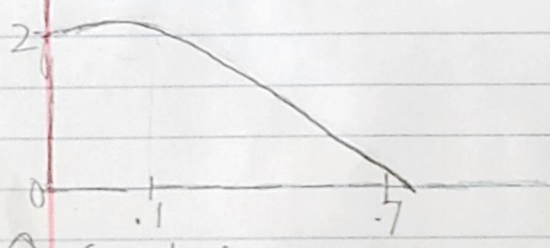
(5.) $-4.905t^2 + .981t + 2.0 = 0 \Rightarrow t^2 - .2t - .4077 = 0$

$t = \frac{-(-.2) \pm \sqrt{(-.2)^2 - 4(1)(-.4077)}}{2(1)} = \boxed{.7463}$ or $-.5463$

$t^2 - .2t + \left(\frac{-.2}{2}\right)^2 = .4077 + \left(\frac{-.2}{2}\right)^2 \Rightarrow (t - .1)^2 = (\pm\sqrt{.4177})$

$\Rightarrow t = (.1 \pm .6463) = -.5463, \boxed{.7463}$

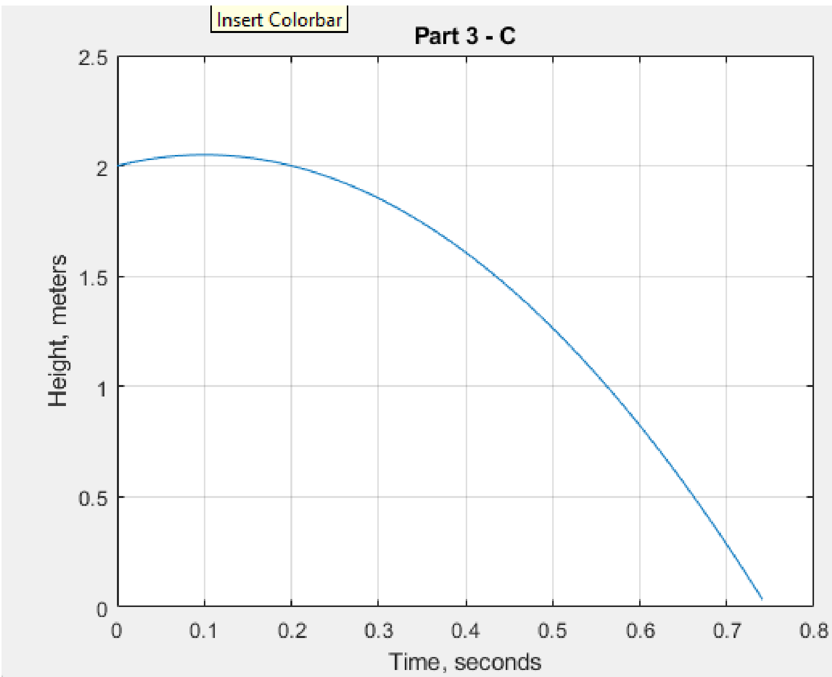
$h_{max} = h(.1) = -4.905(.1)^2 + .981(.1) + 2.0 = \boxed{2.049m}$



(6.) Checked using desmos.

Part 3c.

```
a=1;
b=-0.2;
c=-0.4007;
val_1=(-(b)+sqrt(b.^2-4*a*c))/2*a
val_2=(-(b)-sqrt(b.^2-4*a*c))/2*a
t=linspace(0,val_1,100);
h=-4.905*t.^2+0.981*t+2.0;
x=0.1;
h_max=-4.905*x.^2+0.981*x+2.0
plot(t,h)
title('Part 3 - C')
xlabel('Time, seconds')
ylabel('Height, meters')
grid on
```



Part 4. Intro to STEM application' Problem – electrical circuits – Gavin Binder

Part 4a.

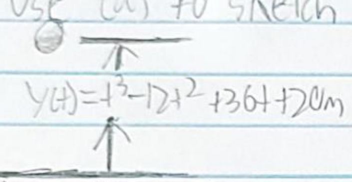
4-A

(1) Height given by: $y(t)=t^3-12t^2+36t+20m$.

(a) Find position and acceleration at velocity $V=0$.

(b) Use (a) to sketch $y(t)$ for $0 \le t \le 9s$.

(2)



(3) $y(t)=t^3-12t^2+36t+20m$

(4) $\frac{d}{dt}y(t)=v(t)$, $\frac{d}{dt}v(t)=a(t)$

(5) $v(t)=3t^2-24t+36\ m/s$

$a(t)=6t-24\ m/s^2$

$3(t^2-8t+16)=0$

$t=2,6$

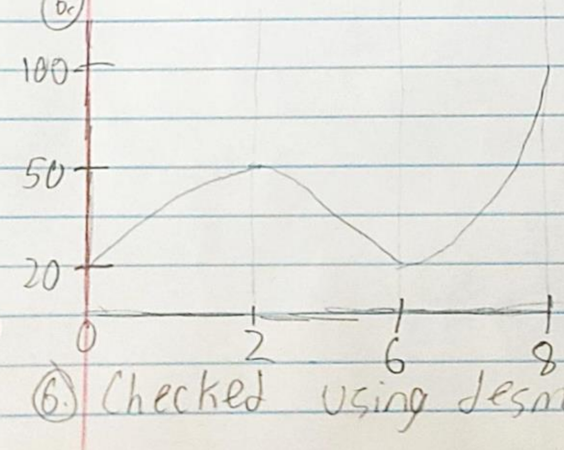
$y(2)=2^3-12(2)^2+36(2)+20=\boxed{52\ m}$

$a(2)=6(2)-24=\boxed{12\ m/s^2}$

$y(6)=6^3-12(6)^2+36(6)+20=\boxed{20\ m}$

$a(6)=6(6)-24=\boxed{12\ m/s^2}$

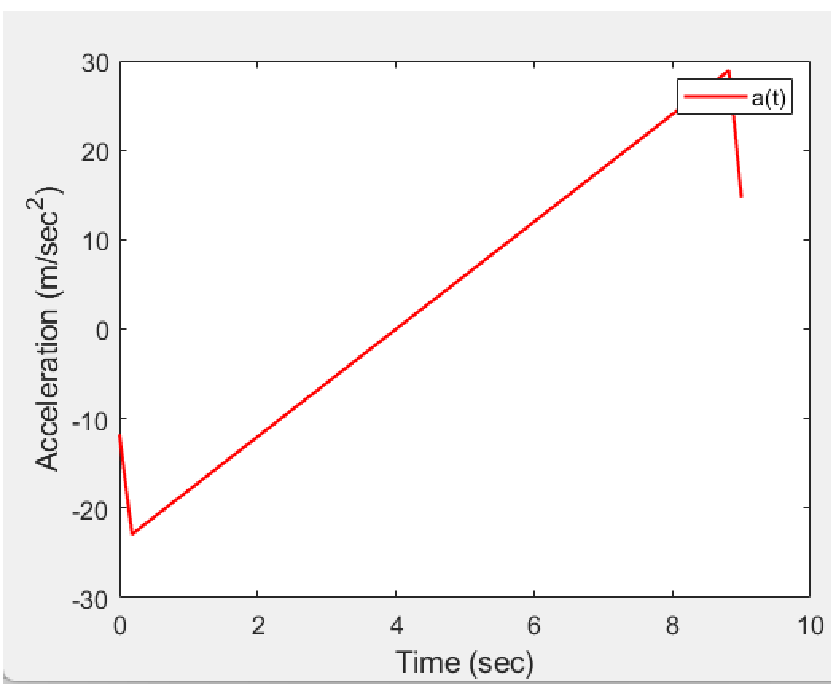
(b.)

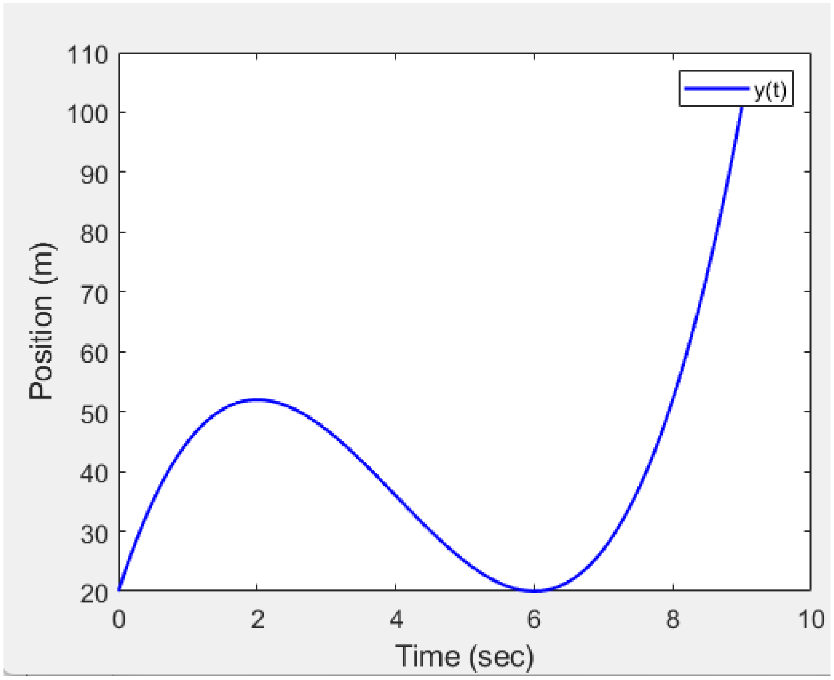


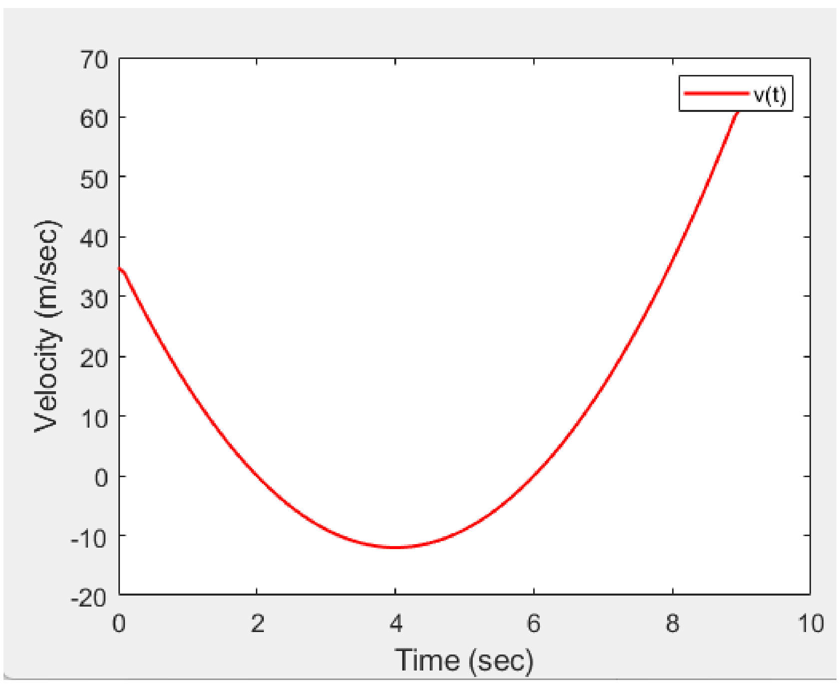
(6.) Checked using desmos

Part 4b.

```
clear
clear
close all
t = linspace(0,9,100);
y = t.^3-12*t.^2+36*t+20;

figure
plot(t,y,'b','linewidth',1.5)
set(gca,'fontsize',12)
xlabel('Time (sec)','fontsize',14)
ylabel('Position (m)','FontSize',14)
legend('y(t)')

dy_dt=gradient(y,t);
plot(t,dy_dt,'r','linewidth',1.5)
set(gca,'fontsize',12)
xlabel('Time (sec)','fontsize',14)
ylabel('Velocity (m/sec)','FontSize',14)
legend('v(t)')

dv_dt=gradient(dy_dt,t);
figure
plot(t,dv_dt,'r','linewidth',1.5)
set(gca,'fontsize',12)
xlabel('Time (sec)','fontsize',14)
ylabel('Acceleration (m/sec^2)','FontSize',14)
legend('a(t)')
```




110
100
90
80
70
60
50
40
30
20
0
2
4
6
8
10
Position (m)
Time (sec)
y(t)


70
60
50
40
30
20
10
0
-10
-20
0
2
4
6
8
10
Velocity (m/sec)
Time (sec)
v(t)

Part 5. Intro to STEM application' Problem – electrical circuits – Gavin Binder

Part 5a.

5-A

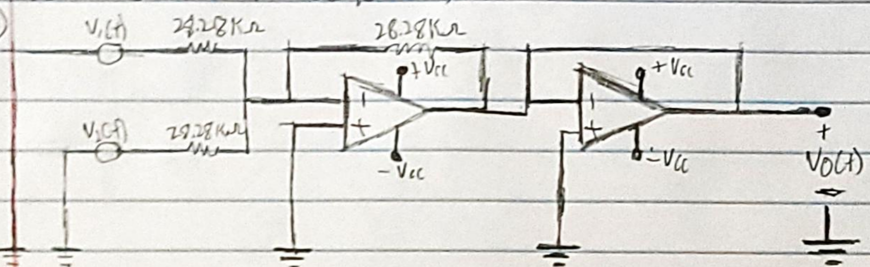
① Two voltages $V_1(t) = 10\sqrt{2}\sin(500\pi t - \frac{3\pi}{4})V$ and $V_2(t) = 5\sin(500\pi t)V$ are applied to the Op-Amp circuit shown in Fig. P6.29.

ⓐ Write down amplitude, frequency (Hz), period (sec.), phase angle/shift (rad.) and time shift (sec.) of $V_1(t)$.

ⓑ Plot one cycle of the voltage $V_1(t)$, and indicate the earliest time after $t = 0$ when the voltage is $10\sqrt{2}$ V.

ⓒ $V_0(t) = V_1(t) + V_2(t)$. Write $V_0(t)$ in rectangular form (find M and θ).

②



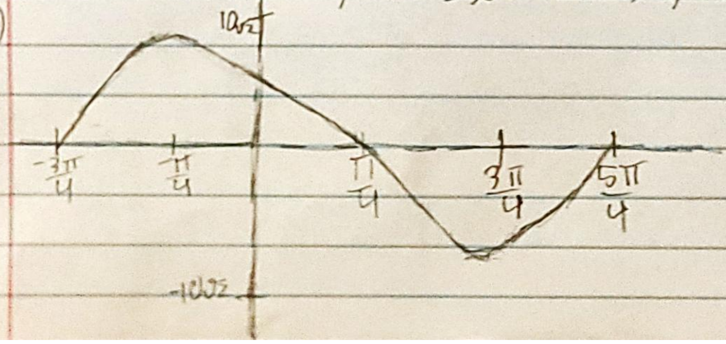
③ $V_1(t) = 10\sqrt{2}\sin(500\pi t - \frac{3\pi}{4})V$, $V_2(t) = 5\sin(500\pi t)V$

④ $TS = \frac{\theta}{w}$, $f = \frac{w}{2\pi}$, $T = \frac{1}{f}$

⑤ ⓐ $A = 10\sqrt{2}V$, $w = 500\pi$ rad/sec, $f = \frac{500\pi}{2\pi} = 250Hz$,

$\theta = \frac{3\pi}{4}$ rad $= 135°$, $T = \frac{1}{250} = .004se$, $TS = \frac{\frac{3\pi}{4}}{500\pi} = -1.5mS$

⑥



(c) $V_0 = V_1 + V_2 = 10\sqrt{2}(500\pi t - \frac{3\pi}{4}) + 5\sin(500\pi t)$

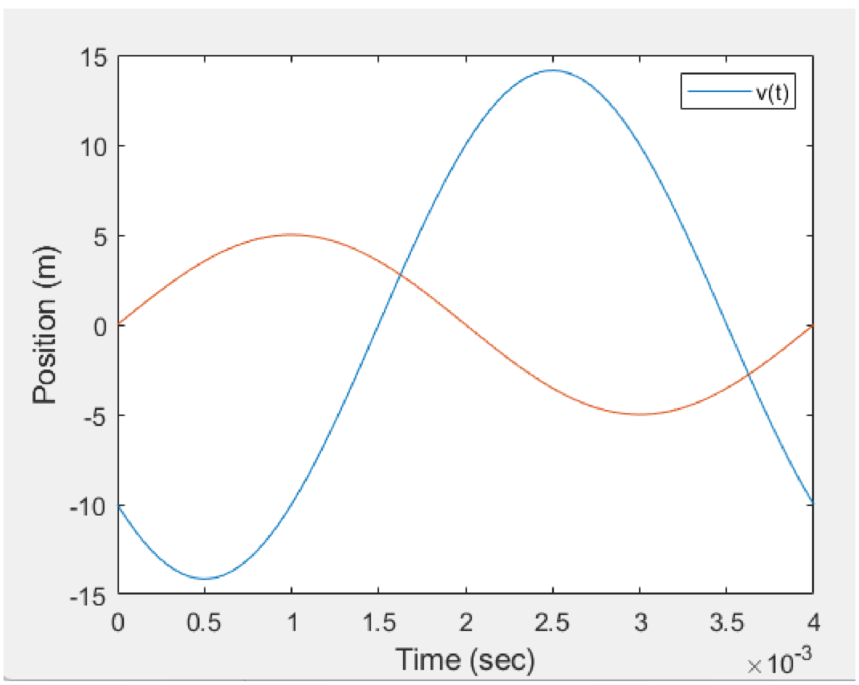
$V_0 = 11.18\sin(500\pi t - 153.4^\circ)V$

$M = 11.18$, $\theta = -153.4^\circ$

(b) Checked using desmos.

Part 5b.

```
clear
clear
close all
t = linspace(0,0.004,100);
v1 = 10*sqrt(2)*sin(500*pi*t-3*pi/4);
v2 = 5*sin(500*pi*t);

figure
plot(t,v1,t,v2)
set(gca,'fontsize',12)
xlabel('Time (sec)','FontSize',14)
ylabel('Position (m)','FontSize',14)
legend('v(t)')
```



Part 6. Reflection on new P3F group ‘collaboration’ activities

Part 6a

The group consists of myself, Ryan Thompson, and Francisco Ribas. Communication happened mainly through Discord messages, and everything went very smoothly in terms of collaboration. For the presentation, I did the formatting, introduction, and conclusion. Ryan did the calculations and Frankie did the problem statement and MATLAB code. For Mini Project 4, we mostly just helped with the MATLAB portions, helping each other if when we need it.

Part 6b

- Graph manipulation, as MATLAB allows for many different options in terms of formatting and changing graphs to suite your needs.
- Image processing and computer visions, as you can use MATLAB to analyze images and build algorithms.