```
%QS: 1. Basic Mathematical Operations

% 1.1

pi
```

```
ans = 3.1416
```

```
sqrt(2)
```

```
ans = 1.4142
```

```
exp(1)
```

```
ans = 2.7183
```

```
format long
pi
```

```
ans =
   3.141592653589793
```

```
sqrt(2)
```

```
ans =
   1.414213562373095
```

```
exp(1)
```

```
ans =
   2.718281828459046
```

```
% 1.2

1e20
```

```
ans =
     1.000000000000000e+20
```

```
3.54e-5
```

```
ans =
     3.540000000000000e-05
```

```
% 1.3

exp(3)
```

```
ans =
  20.085536923187668
```

```
tan(1)
```

```
ans =
   1.557407724654902
```

```
asin(sin(5))
```

```
ans =
```

```
 -1.283185307179586
```

```
sin (asin(5))
```

```
ans =
   5.000000000000000 - 0.000000000000000i
```

```
log(exp(-2 + 3*1i))
```

```
ans =
  -2.000000000000000 + 3.000000000000000i
```

```
% 1.4

z = 5.32 - 3.24*1i
```

```
z =
   5.320000000000000 - 3.240000000000000i
```

```
zc = conj(z)
```

```
zc =
   5.320000000000000 + 3.240000000000000i
```

```
modzsq = z*zc
```

```
modzsq =
   38.800000000000004
```

```
abs(z)^2
```

```
ans =
   38.800000000000011
```

```
sqrtz = sqrt(modzsq^0.5)*exp(angle(z)*0.5i)
```

```
sqrtz =
   2.403015251819990 - 0.674153024527434i
```

```
sqrt(z)
```

```
ans =
   2.403015251819990 - 0.674153024527434i
```

```
2*real(z)
```

```
ans =
   10.640000000000001
```

```
z+zc
```

```
ans =
   10.640000000000001
```

```
2*imag(z)
```

```
ans =
   -6.480000000000000
```

```
z-zc
```

```
ans =
  0.000000000000000 - 6.480000000000000i
```

```
% 1.5

e = 2.718
```

```
e =
   2.718000000000000
```

```
absolute_error = (exp(1) - e)
```

```
absolute_error =
     2.818284590455633e-04
```

```
relative_error = absolute_error/exp(1)
```

```
relative_error =
     1.036788960198905e-04
```

```
%QS: 2. Vector Operations

% 2.1

u = [4,3,7]
```

```
u = 1×3
     4     3     7
```

```
% 2.2

v = [3;5;2]
```

```
v = 3×1
     3
     5
     2
```

```
t_v = [3,5,2]'
```

```
t_v = 3×1
     3
     5
     2
```

```
%2.3

u+v
```

```
ans = 3×3
     7     6    10
     9     8    12
     6     5     9
```

```
element_wise_mult = u.*v
```

```
element_wise_mult = 3×3
    12     9    21
```

```
    20    15    35
     8     6    14
```

```
inner_product = dot(u,v)
```

```
inner_product =
    41
```

```
u-1
```

```
ans = 1×3
     3     2     6
```

```
% 2.4

% 2.4.1
u1 = (1:5)
```

```
u1 = 1×5
     1     2     3     4     5
```

```
% 2.4.2
u2 = (1:.5:3)
```

```
u2 = 1×5
   1.000000000000000   1.500000000000000   2.000000000000000   2.500000000000000 ⋯
```

```
% 2.4.3
u3 = (5:-1:1)
```

```
u3 = 1×5
     5     4     3     2     1
```

```
% 2.5

row = linspace(1,10,50 )
```

```
row = 1×50
   1.000000000000000   1.183673469387755   1.367346938775510   1.551020408163265 ⋯
```

```
% 2.6

enteries = length((1:pi:exp(10)))
```

```
enteries =
        7011
```

```
% 2.7

rand_int = rand(100,1).'
```

```
rand_int = 1×100
   0.709364830858073   0.754686681982361   0.276025076998578   0.679702676853675 ⋯
```

```
[val, index] = min(rand_int)
```

```
val =
   0.004634224134067
index =
```

75

```
% 2.8

% element wise multiplication of row vector of (1x5) with
% numbers varying from 0 to pi, with another row vector of
% (1x5) such that only the elements of index 2, 5 are printed
% rest are 0.

linspace(0, pi, 5) .* [0 1 0 0 1]
```

```
ans = 1×5
                   0   0.785398163397448                   0                   0 ···
```

```
% 2.9

A = 0:.1:10
```

```
A = 1×101
                   0   0.100000000000000   0.200000000000000   0.300000000000000 ···
```

```
A = A.^2
```

```
A = 1×101
10^2 ×
                   0   0.000100000000000   0.000400000000000   0.000900000000000 ···
```

```
result = sum(A)
```

```
result =
     3.383500000000000e+03
```

```
%QS: 3.    Matrix Operations

% 3.1

ones(4,4)
```

```
ans = 4×4
     1     1     1     1
     1     1     1     1
     1     1     1     1
     1     1     1     1
```

```
eye(4)
```

```
ans = 4×4
     1     0     0     0
     0     1     0     0
     0     0     1     0
     0     0     0     1
```

```
% 3.2

M = diag([5.4, -3.9, 3.5, 8.2, 1])
```

```
M = 5×5
```

```
   5.400000000000000                   0                   0                   0···
                   0  -3.900000000000000                   0                   0
                   0                   0   3.500000000000000                   0
                   0                   0                   0   8.199999999999999
                   0                   0                   0                   0
```

```
% 3.3

M1 = [1 2 3; 4 5 6; 3 8 9]
```

```
M1 = 3×3
     1     2     3
     4     5     6
     3     8     9
```

```
M2 = M1'
```

```
M2 = 3×3
     1     4     3
     2     5     8
     3     6     9
```

```
M1 + M2
```

```
ans = 3×3
     2     6     6
     6    10    14
     6    14    18
```

```
% 3.4

M3 = [3.2 -4.5; 7.6 8.1]
```

```
M3 = 2×2
   3.200000000000000  -4.500000000000000
   7.600000000000000   8.100000000000000
```

```
M3./max(M3,[],'all')
```

```
ans = 2×2
   0.395061728395062  -0.555555555555556
   0.938271604938272   1.000000000000000
```

```
% 3.5

M4 = [0.5 0.2; 0.4 0.7]
```

```
M4 = 2×2
   0.500000000000000   0.200000000000000
   0.400000000000000   0.700000000000000
```

```
M4*M4
```

```
ans = 2×2
   0.330000000000000   0.240000000000000
   0.480000000000000   0.570000000000000
```

```
M4^2
```

```
ans = 2×2
```

```
   0.330000000000000   0.240000000000000
   0.480000000000000   0.570000000000000
```

```
% 3.6

M5 = [1 1 1 1 1 1 1 1; -2 -1 0 1 2 3 4 5; 4 1 0 1 4 9 16 25]
```

```
M5 = 3×8
     1     1     1     1     1     1     1     1
    -2    -1     0     1     2     3     4     5
     4     1     0     1     4     9    16    25
```

```
M5(3,7)
```

```
ans =
    16
```

```
% 3.7

v1 = M5(3,:)
```

```
v1 = 1×8
     4     1     0     1     4     9    16    25
```

```
v2 = M5(:,7)
```

```
v2 = 3×1
     1
     4
    16
```

```
% 3.8

M
```

```
M = 5×5
   5.400000000000000                   0                   0                   0 ···
                   0  -3.900000000000000                   0                   0
                   0                   0   3.500000000000000                   0
                   0                   0                   0   8.199999999999999
                   0                   0                   0                   0
```

```
% the 2nd row elements are multiplied by 3.2
M(2, :) = 3.2*M(2,:)
```

```
M = 5×5
   5.400000000000000                   0                   0                   0 ···
                   0 -12.480000000000000                   0                   0
                   0                   0   3.500000000000000                   0
                   0                   0                   0   8.199999999999999
                   0                   0                   0                   0
```

```
% the 3nd row elements are added with 0.527 times the values
% of the elements of 1st row.

M(3, :) = M(3,:) + 0.527*M(1,:)
```

```
M = 5×5
   5.400000000000000                   0                   0                   0 ···
                   0 -12.480000000000000                   0                   0
```

```
   2.845800000000000                   0   3.500000000000000                   0
                   0                   0                   0   8.199999999999999
                   0                   0                   0                   0
```

```
% 3.9

M = [5 2 -1 1; 2 7 1 -2; 0 1 10 3; -1 3 2 9]
```

```
M = 4×4
     5     2    -1     1
     2     7     1    -2
     0     1    10     3
    -1     3     2     9
```

```
b = [13; 9; 1; 30]
```

```
b = 4×1
    13
     9
     1
    30
```

```
x = M \ b
```

```
x = 4×1
   1.000000000000000
   2.000000000000000
  -1.000000000000000
   3.000000000000000
```

```

%QS: 4.    Conditionals, Loops and User Defined Functions

% 4.1

sum_for = 0;
sz = size(M5)
```

```
sz = 1×2
     3     8
```

```
for r = 1:sz(1,1)
    for c = 1:sz(1,2)
        sum_for=sum_for+M5(r,c);
    end
end

sum_for
```

```
sum_for = 
    80
```

```
sum(sum(M5))
```

```
ans = 
    80
```

```
% 4.2
```

```
k=0;

while 1/k > pi/1000
    k=k+1;
end

k
```

```
k =
   319
```

```
% 4.3

mysinc(0)
```

```
ans =
     1
```

```
mysinc(2)
```

```
ans =
   0.454648713412841
```

```
sin(2)/2
```

```
ans =
   0.454648713412841
```

```
% 4.4

mfun1(0:3)
```

```
ans = 1×4
                   0   0.367879441171442   0.270670566473225   0.149361205103592
```

```
mfun2(0:3)
```

```
ans = 1×4
   1.000000000000000                   0  -0.135335283236613  -0.099574136735728
```

```
% 4.5

h = 1e-5;
derivative_central_approx (@sin,1,h)
```

```
ans =
   0.540302305856999
```

```
(sin(1 + h) - sin(1 - h))/(2*h)
```

```
ans =
   0.540302305856999
```

```
derivative_central_approx (@mfun1, 1, h)
```

```
ans =
     1.387778780781446e-11
```

```
mfun2(1)
```

```
ans =
     0
```

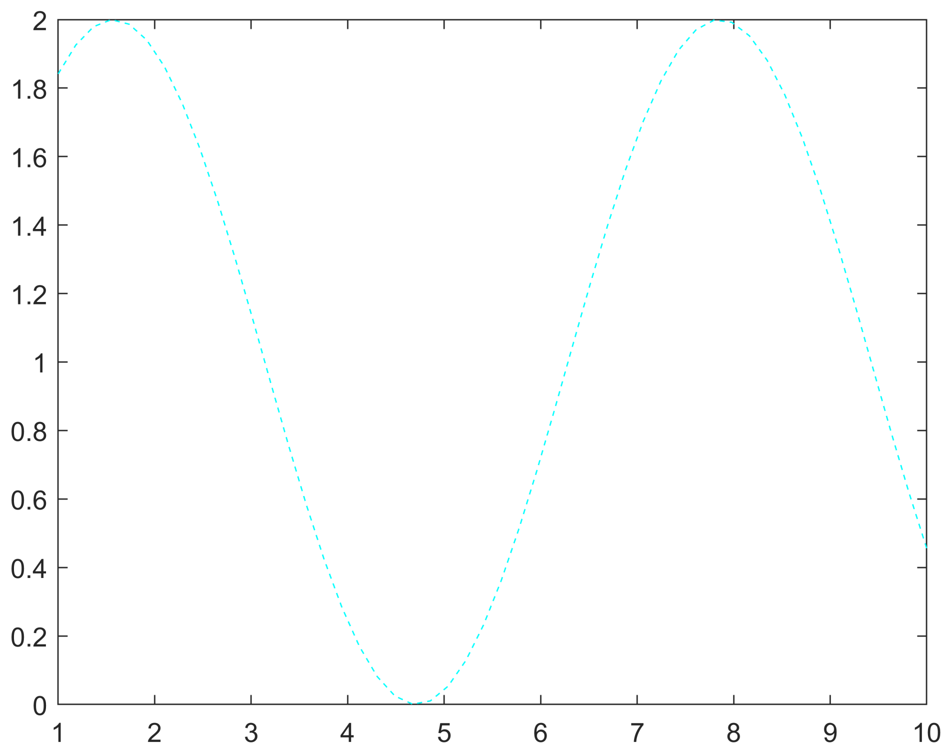
```
%QS: 5.     Plots

% 5.1

vec = linspace(1,10,50)
```

```
vec = 1×50
   1.000000000000000   1.183673469387755   1.367346938775510   1.551020408163265 ⋯
```

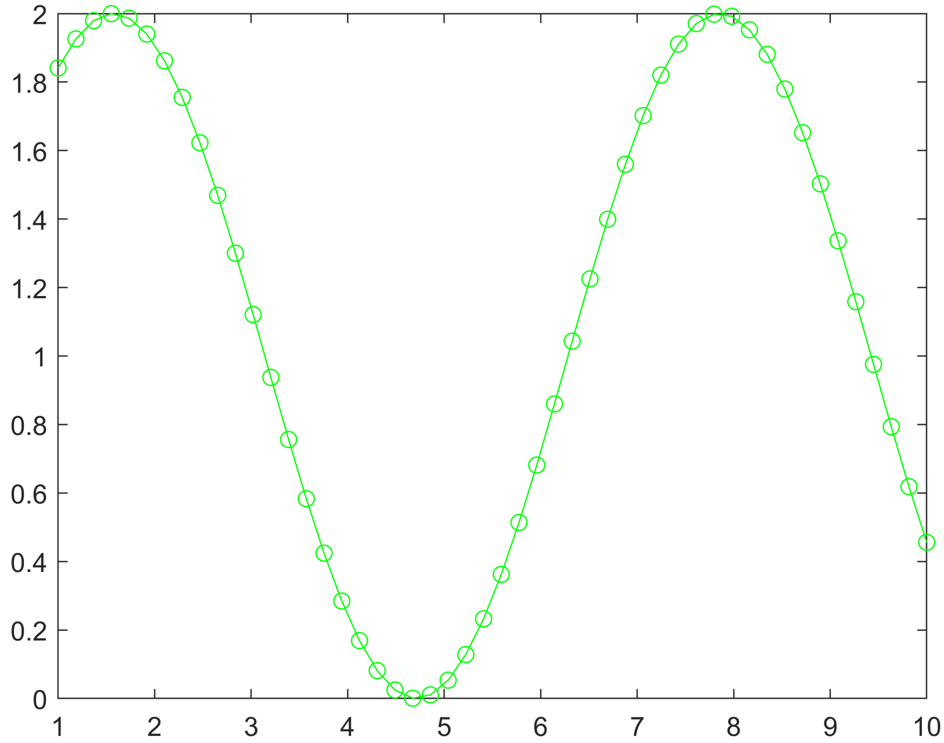
```
y = sin(vec) + 1
```

```
y = 1×50
   1.841470984807897   1.925999086458024   1.979375461044357   1.999804462893930 ⋯
```

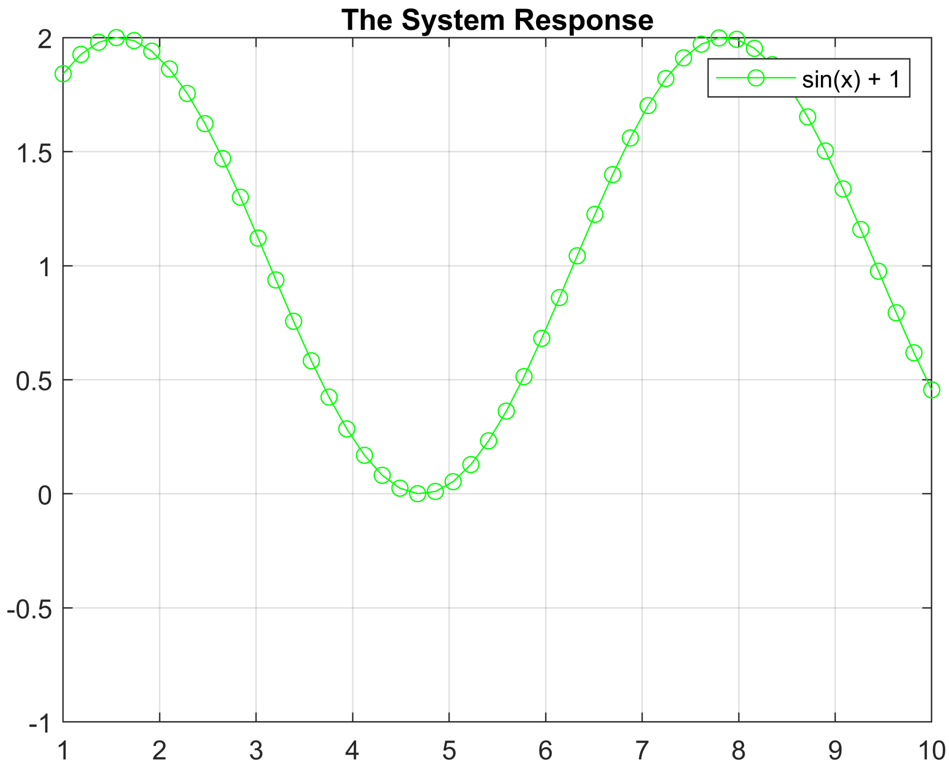
```
plot(vec,y,'c--')
```



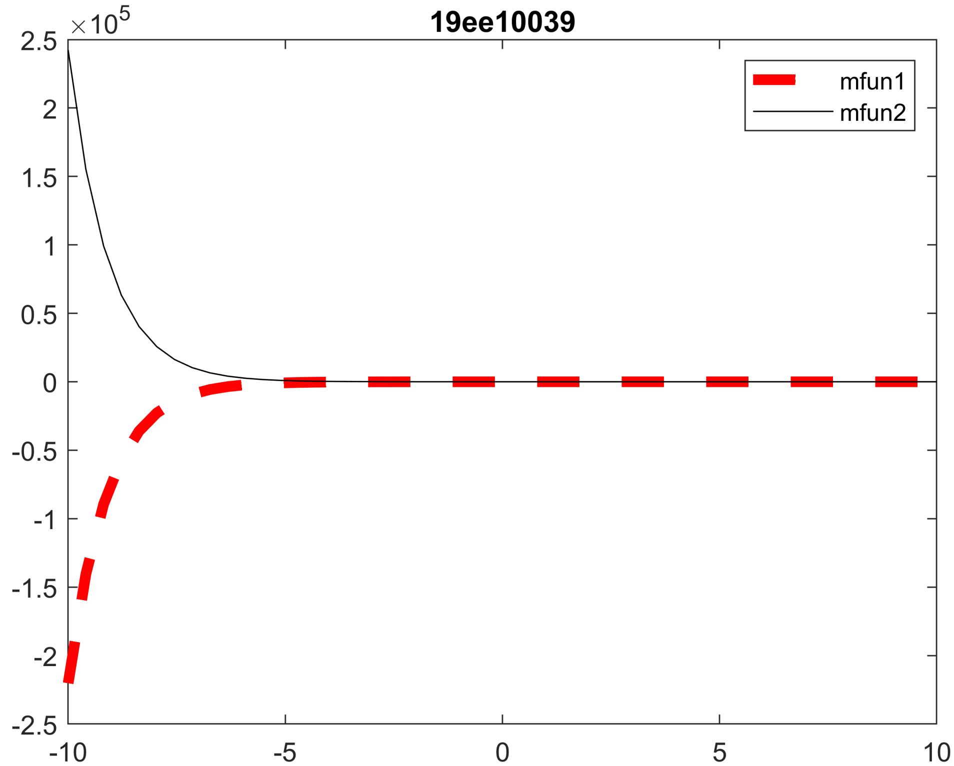

```
% 5.1.1

plot(vec,y,'go-')
```




```
% 5.1.2

plot(vec,y,'go-')
ylim([-1,2])
grid on
legend("sin(x) + 1")
title("The System Response")
```




```
% 5.2

vec_2 = linspace(-10,10,50);
plot(vec_2,mfun1(vec_2),'r--','LineWidth',4.0)
hold on
plot(vec_2,mfun2(vec_2),'black')
legend('mfun1','mfun2')
title('19ee10039')
hold off
```




```
%defined functions
```

```
function [y] = derivative_central_approx (f,x,h)
y=(f(x+h)-f(x-h))/(2*h);
end

function [y] = mysinc(x)
    if x==0
        y = 1;
    else
        y = sin(x)/x;
    end
end

function [y] = mfun2(x)
y=exp(-x)-x.*exp(-x);
end

function [y] = mfun1(x)
    y = x.*exp(-x);
end
```