Info 3

# Introduction to MATLAB

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# Exam (Solution)

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## Commands (3 pts)

Write the right MATLAB commands to calculate the following expressions:

$$E_1 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

```
E1= (-b-sqrt(b^2-4*a*c))/(2*a)
```

$$E_2 = \frac{b + e^{a+2}}{b - 1}$$

```
E2 = (b + exp(a + 2))/(b-1)
```

$$E_3 = \sqrt{|\alpha - 3|} + \frac{sin\beta + 1}{e^{\alpha} + \sqrt{a - 1}}$$

```
E3 = sqrt(abs(alpha - 3)) + (sin(beta)+1) / (exp(alpha)+sqrt(a-1))
```

## Input and Output functions (3 pts)

1. Give the output of the following commands using MATLAB Command window.

```
>> n = input ('Please enter a value :');
Please enter a value :
>> disp ('Please enter your last name :')
Please enter your last name :
>> D = 10; disp ( sqrt (D -1) - 1)
     2
>> D = 'Student '; disp ('I am a %s', D)
Error using disp
Too many input arguments.
```

```
>>  a = 1; fprintf ('Product of %d , %.2f and %f is %.3f \n', a , a, 1, a*a)
Product of 1 , 1.00 and 1.000000 is 1.000
>> A = 5.12345; B = 5; fprintf ('A - B = %.3f - %.2f = %.1f \n', A, B, A-B)
A - B = 5.123 - 5.00 = 0.1
```

**Matrix construction (5pts)**

1. Given the matrix P, provide the execution of these commands:

$$P = \begin{pmatrix} 2 & 0 & 1 \\ 9 & 3 & 6 \\ 5 & 4 & 7 \end{pmatrix}$$

```
>> P(2,2)
ans =

     3

>> P(2,:)
ans =

     9     3     6

>> P1 = P(:,end)
P1 =

     1
     6
     7

>> P2 = P(1:3, 2:3)
P2 =

     0     1
     3     6
     4     7

>> size(P)
ans =

     3     3

>> numel(P+1)
ans =

     9
```

2. Write a code to construct a 3-by-5 matrix $A$ where: $A(i,j) = \begin{cases} i - j^3 & i \neq j \\ i^3 - j & i = j \end{cases}$

```
% A code to construct a 3-by-5 matrix A
A = zeros(3,5);
  for i = 1:3
      for j = 1:5
         if i != j
             A(i,j) = i- j^3;
         else
             A(i,j) = i^3 - j;
         end
      end
  end
```

3. Give the corresponding command to extract and display
   a. The last column of the matrix A.
      `A(:,end)`
   b. The matrix containing the elements indicated by x in the indicated matrix.
   c. `A(2:3, 3:5)`
4. Replace the indicated elements with their squares.
   `A(2:3, 3:5) = (A(2:3, 3:5)).^2`

**Functions (3 pts)**

1. Write a function to calculate the surface area of a rectangular prism given by:

$$Surfacearea = 2(lw + lh + wh)$$

   where: $w$ is the base width, $l$ is the base length and $h$ represents the height.

```
function  s_area = rect_prism (w, h, l)
 % This function calculates the surface area of a rectangular prism given by:
 % Surface_Area =  2(lw + lh + wh)
 % where: w is the base width, l is the base length and h represents the height.

 % Calculate the area
 s_area =  2*(l*w + l*h + w*h );
end
```

2. Give the corresponding command to calculate the surface area of a rectangular prism with: w = 2, h = 1 and l = 0.5 using the developed function.
   `S1 = rect_prism (2, 1, 0.5)`

**Plots (2 pts)**

Write the commands window to plot the functions f1 and f2 in the interval [-1, 10] arranged by the step 0.5 in the same graph where:

$$f_1(x) = x^2 - 1, f_2(x) = x + 1$$

```
x = -1:0.5:10;
y1 = x.^2-1;
y2 = x+1;
figure
plot(x,y1, x,y2);
xlabel('x values');
ylabel('y values');
title('plots of the functions f1 and f2');
legend('function f1', 'function f2');
```

**Application (4pts)**

A factory recorded the electricity consumption (in Kw) for three different machines over 5 days. The data are stored in the matrix *Elt* as follows.:

$$Elt = \begin{vmatrix} 48 & 55 & 60 & 45 & 50 \\ 80 & 75 & 85 & 90 & 70 \\ 32 & 40 & 25 & 35 & 30 \end{vmatrix}$$

1. Write commands that compute and display:
   a) The average consumption of each machine.

```
disp('The average consumption of each day : ');
Average_cons_day = mean(Elt, 2)
```

   b) The highest consumption of each day.

```
disp('The highest consumption of each day: ');
highest_cons_day = max(Elt)
```

   c) The day having the highest total consumption and the value of that consumption.

```
disp('The day having the highest total consumption and the value of that
consumption:')
[highest_tcons, highest_day] = max(sum(Elt))
```

2. Give the command(s) that change (swap)the data of the first machine with the third machine.

```
Elt([1,end],:) = Elt([end,1],:);
```

   Alternative solution

```
E = Elt([1,:);
Elt(1,:) = Elt([3,:);
Elt(3,:) = E;
```