FDA Lab-3

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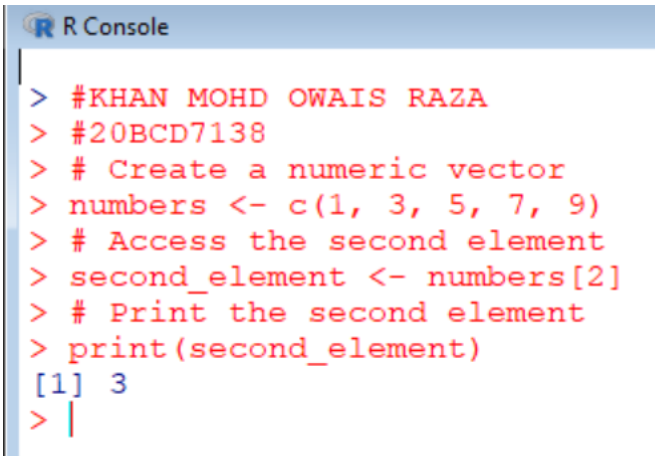
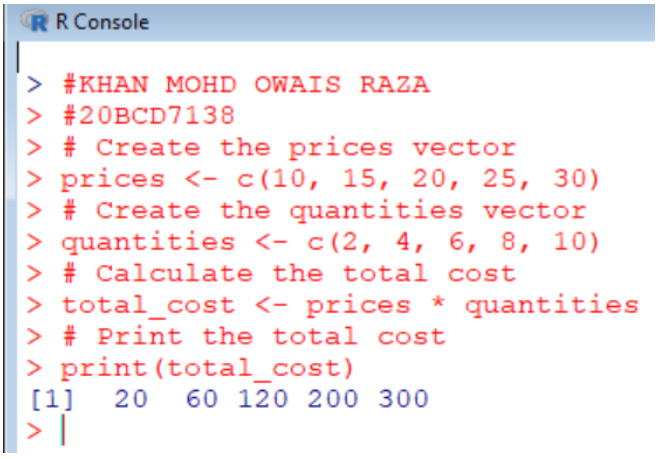
1] Create a numeric vector with elements 1, 3, 5, 7, 9 and assign it to a variable named "numbers".
Access the second element of the vector "numbers" created in the previous question.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create a numeric vector
numbers <- c(1, 3, 5, 7, 9)
# Access the second element
second_element <- numbers[2]
# Print the second element
print(second_element)
```



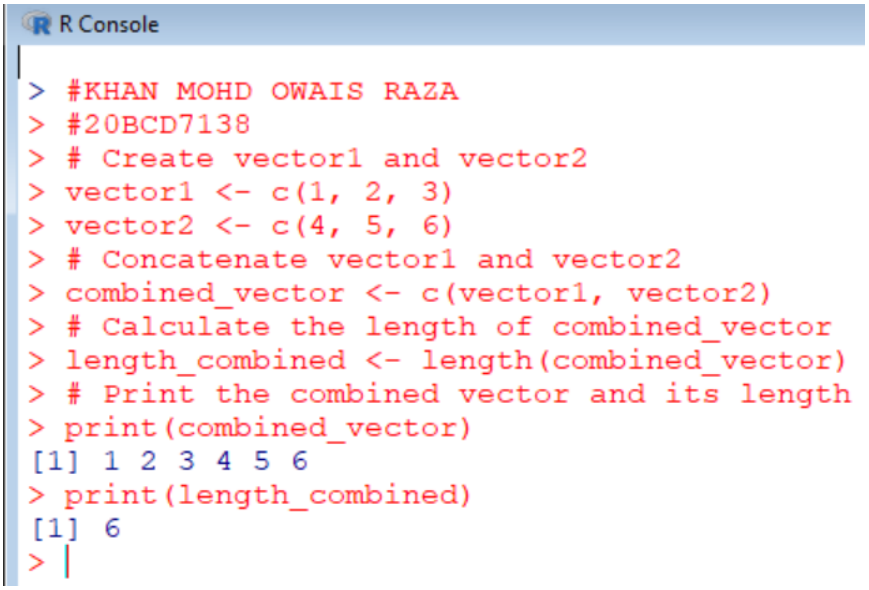
2] Create a vector "prices" with elements 10, 15, 20, 25, 30 and a vector "quantities" with elements 2, 4, 6, 8, 10. Calculate the total cost by multiplying the corresponding elements of both vectors.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create the prices vector
prices <- c(10, 15, 20, 25, 30)
# Create the quantities vector
quantities <- c(2, 4, 6, 8, 10)
# Calculate the total cost
total_cost <- prices * quantities
# Print the total cost
print(total_cost)
```



3] Concatenate the vectors "vector1" and "vector2" to create a new vector named "combined_vector". Calculate the length of the vector "combined_vector".

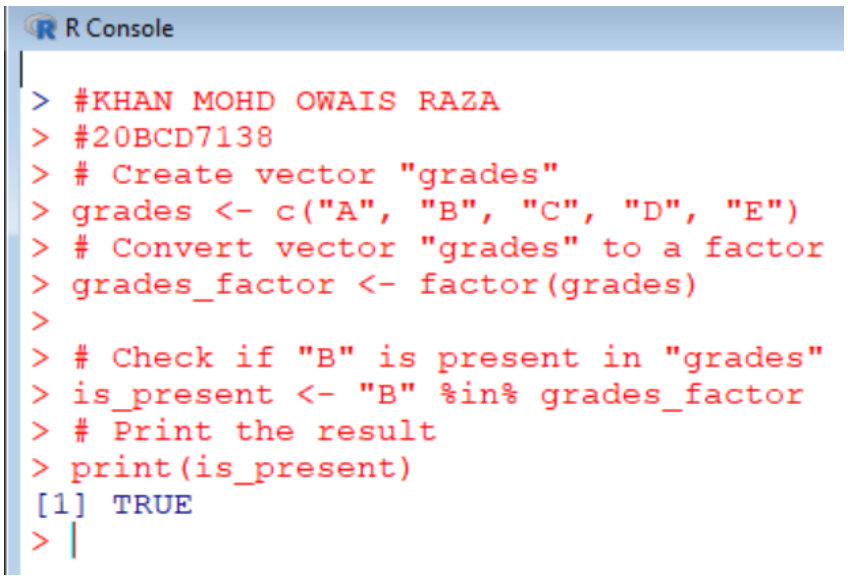
```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector1 and vector2
vector1 <- c(1, 2, 3)
vector2 <- c(4, 5, 6)
# Concatenate vector1 and vector2
combined_vector <- c(vector1, vector2)
# Calculate the length of combined_vector
length_combined <- length(combined_vector)
# Print the combined vector and its length
print(combined_vector)
print(length_combined)
```



4] Create a vector "grades" with elements "A", "B", "C", "D", "E" and convert it to a factor. Check if the value "B" is present in the vector "grades" created in the previous question.

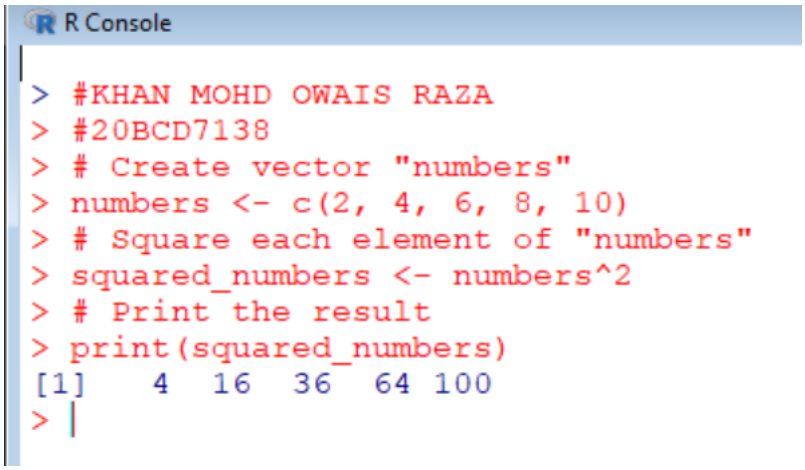
```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector "grades"
grades <- c("A", "B", "C", "D", "E")
# Convert vector "grades" to a factor
grades_factor <- factor(grades)
# Check if "B" is present in "grades"
```

```
is_present <- "B" %in% grades_factor
# Print the result
print(is_present)
```



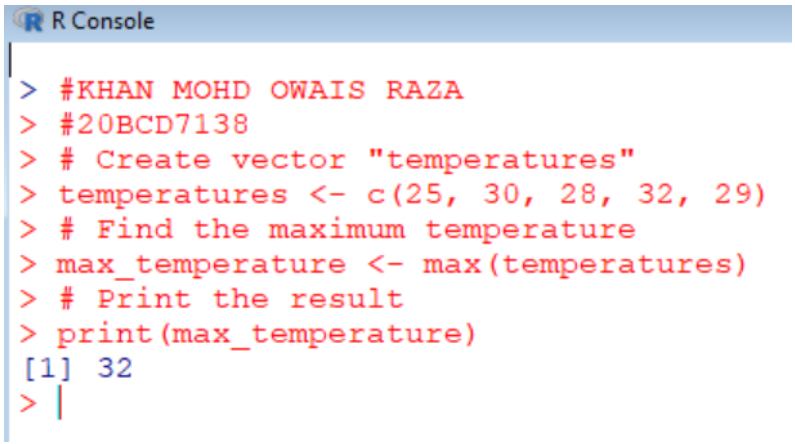
5] Create a vector "numbers" with elements 2, 4, 6, 8, 10. Square each element of the vector and store the result in a new vector named "squared_numbers".

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector "numbers"
numbers <- c(2, 4, 6, 8, 10)
# Square each element of "numbers"
squared_numbers <- numbers^2
# Print the result
print(squared_numbers)
```



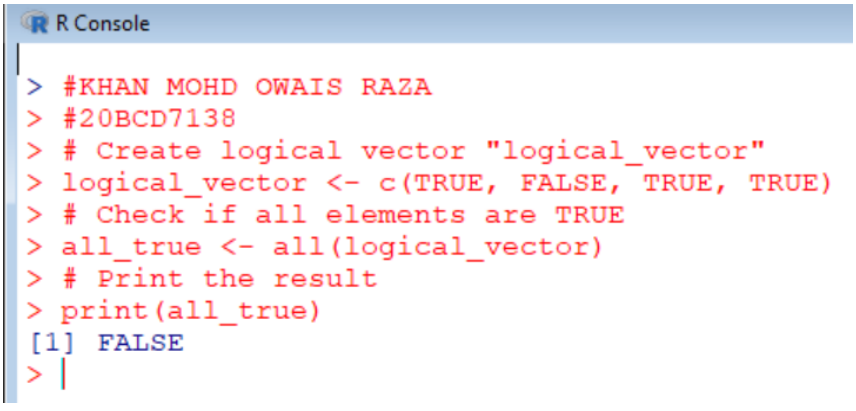
6] Create a vector "temperatures" with elements 25, 30, 28, 32, 29. Find the maximum temperature from the vector.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector "temperatures"
temperatures <- c(25, 30, 28, 32, 29)
# Find the maximum temperature
max_temperature <- max(temperatures)
# Print the result
print(max_temperature)
```



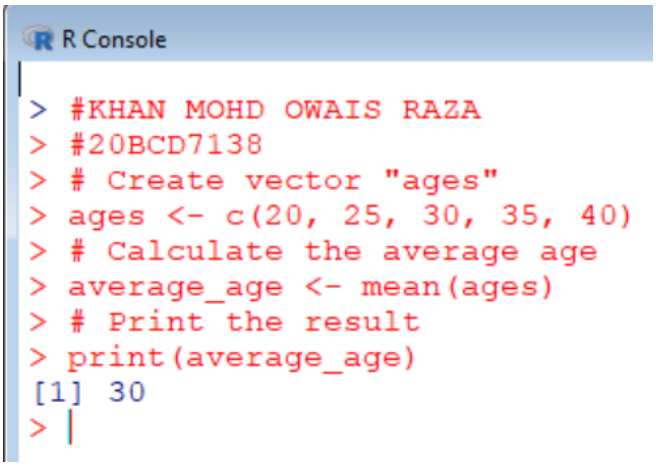
7] Create a logical vector "logical_vector" with elements TRUE, FALSE, TRUE, TRUE. Check if all the elements in the vector are TRUE.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create logical vector "logical_vector"
logical_vector <- c(TRUE, FALSE, TRUE, TRUE)
# Check if all elements are TRUE
all_true <- all(logical_vector)
# Print the result
print(all_true)
```



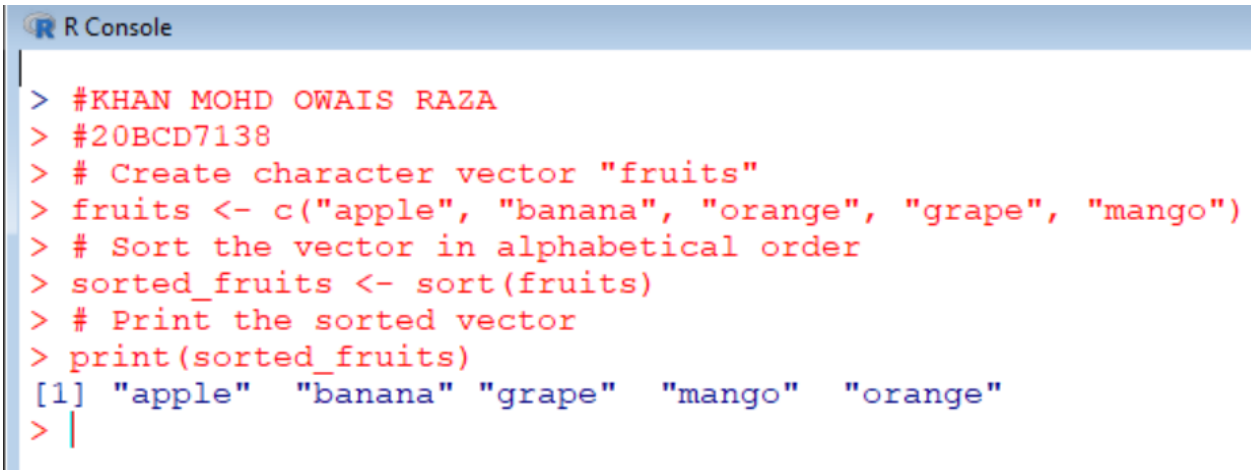
8] Create a vector "ages" with elements 20, 25, 30, 35, 40. Find the average age from the vector.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector "ages"
ages <- c(20, 25, 30, 35, 40)
# Calculate the average age
average_age <- mean(ages)
# Print the result
print(average_age)
```



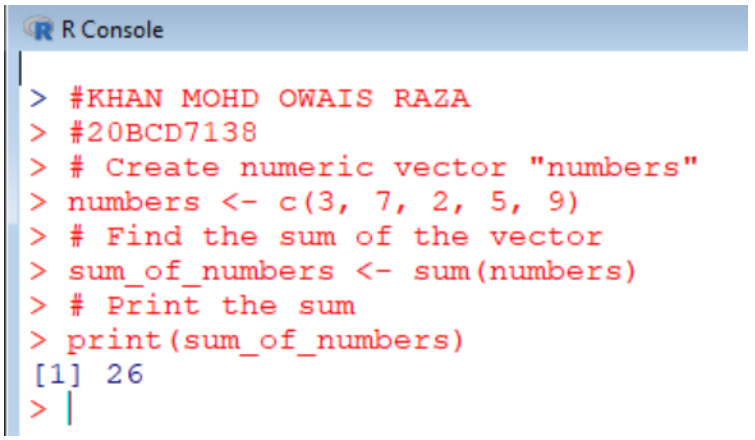
9] Create a character vector "fruits" with elements "apple", "banana", "orange", "grape", "mango". Sort the vector in alphabetical order.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create character vector "fruits"
fruits <- c("apple", "banana", "orange", "grape", "mango")
# Sort the vector in alphabetical order
sorted_fruits <- sort(fruits)
# Print the sorted vector
print(sorted_fruits)
```



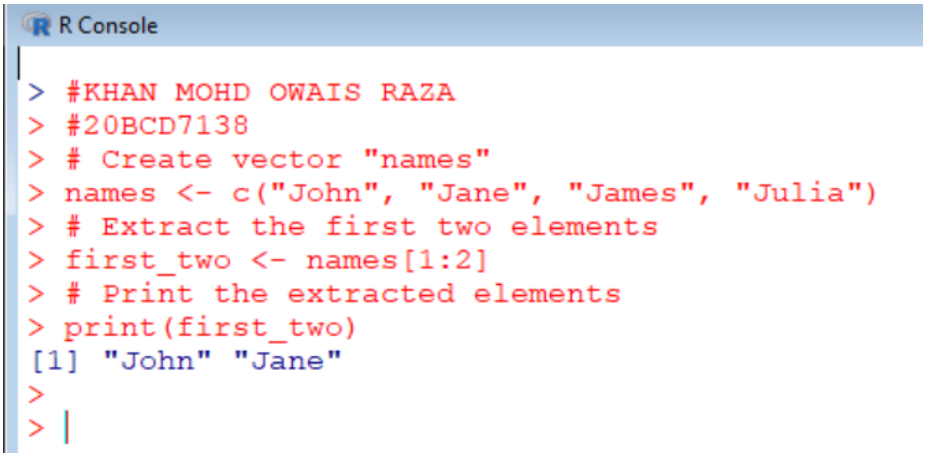
10] Create a numeric vector "numbers" with elements 3, 7, 2, 5, 9. Find the sum of the vector.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create numeric vector "numbers"
numbers <- c(3, 7, 2, 5, 9)
# Find the sum of the vector
sum_of_numbers <- sum(numbers)
# Print the sum
print(sum_of_numbers)
```



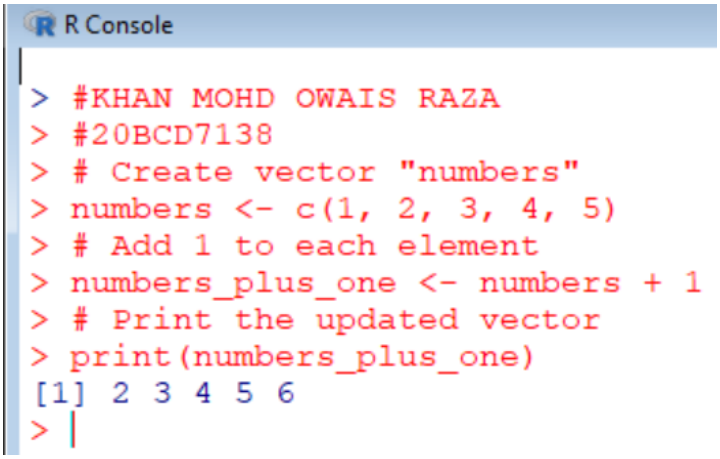
11] Create a vector "names" with elements "John", "Jane", "James", "Julia". Extract the first two elements of the vector.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector "names"
names <- c("John", "Jane", "James", "Julia")
# Extract the first two elements
first_two <- names[1:2]
# Print the extracted elements
print(first_two)
```



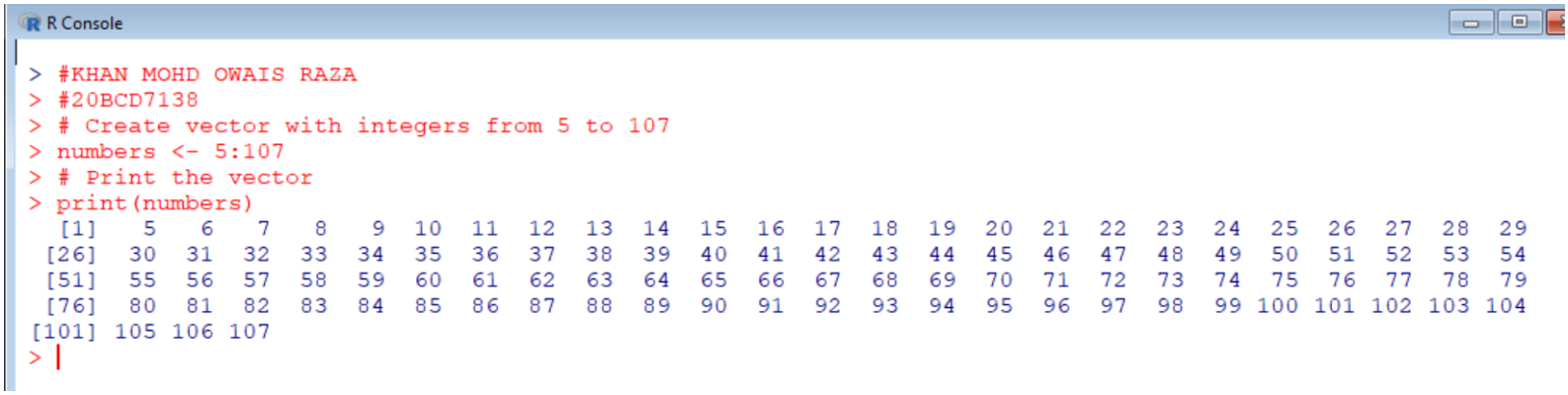
12] Create a numeric vector "numbers" with elements 1, 2, 3, 4, 5. Add 1 to each element of the vector.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector "numbers"
numbers <- c(1, 2, 3, 4, 5)
# Add 1 to each element
numbers_plus_one <- numbers + 1
# Print the updated vector
print(numbers_plus_one)
```



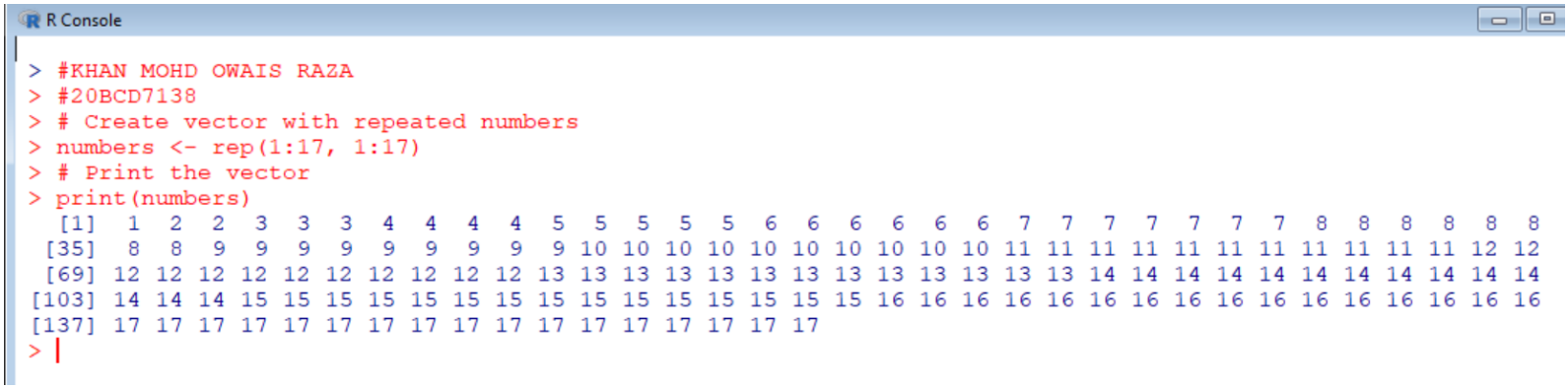
13] Create a numeric vector with all integers from 5 to 107.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector with integers from 5 to 107
numbers <- 5:107
# Print the vector
print(numbers)
```



14] Create a vector that contain all numbers from 1 to 17, where each number occurs the the same number of times as the number itself eg. 1, 2, 2, 3, 3, 3…

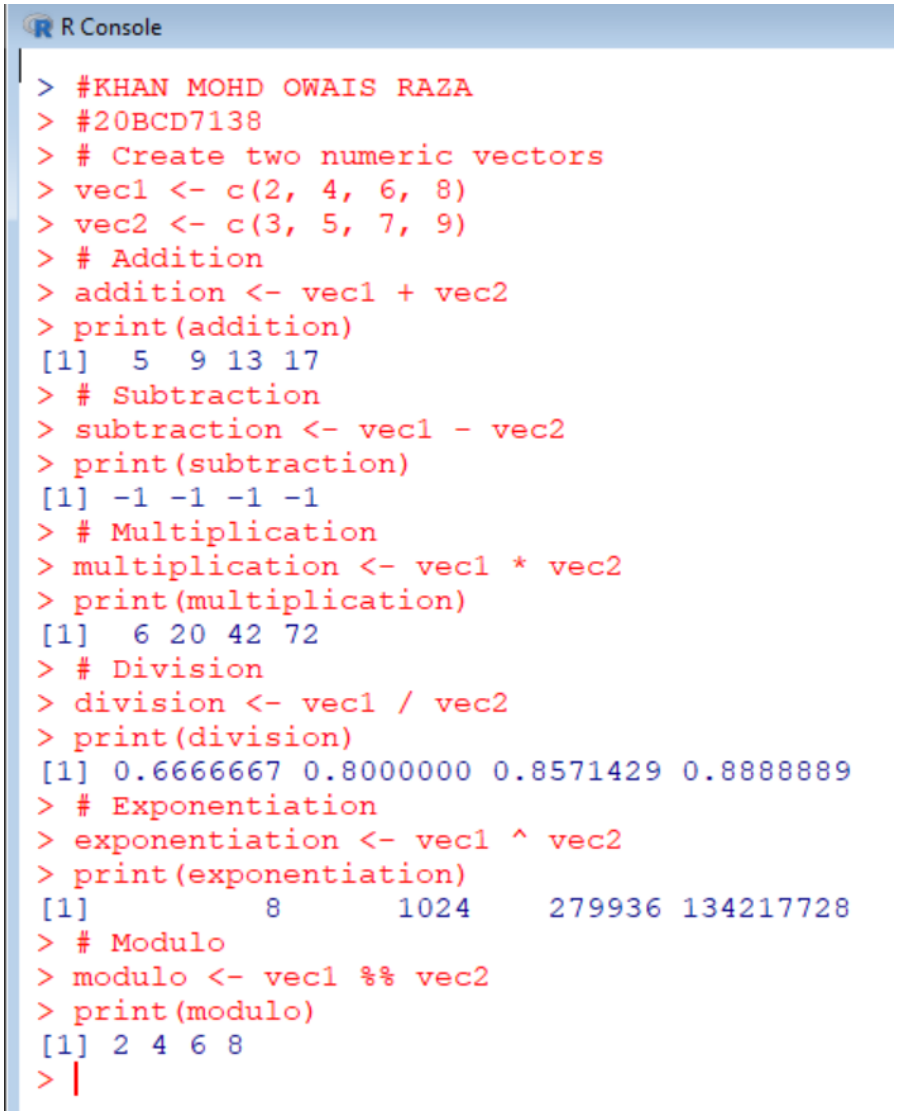
```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create vector with repeated numbers
numbers <- rep(1:17, 1:17)
# Print the vector
print(numbers)
```



15] Create two numeric vectors of length 4 and test run all the basic operators (as seen in the table earlier) with these two as arguments.

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create two numeric vectors
vec1 <- c(2, 4, 6, 8)
vec2 <- c(3, 5, 7, 9)
# Addition
addition <- vec1 + vec2
print(addition)
# Subtraction
subtraction <- vec1 - vec2
print(subtraction)
# Multiplication
multiplication <- vec1 * vec2
print(multiplication)
# Division
division <- vec1 / vec2
print(division)
# Exponentiation
exponentiation <- vec1 ^ vec2
```

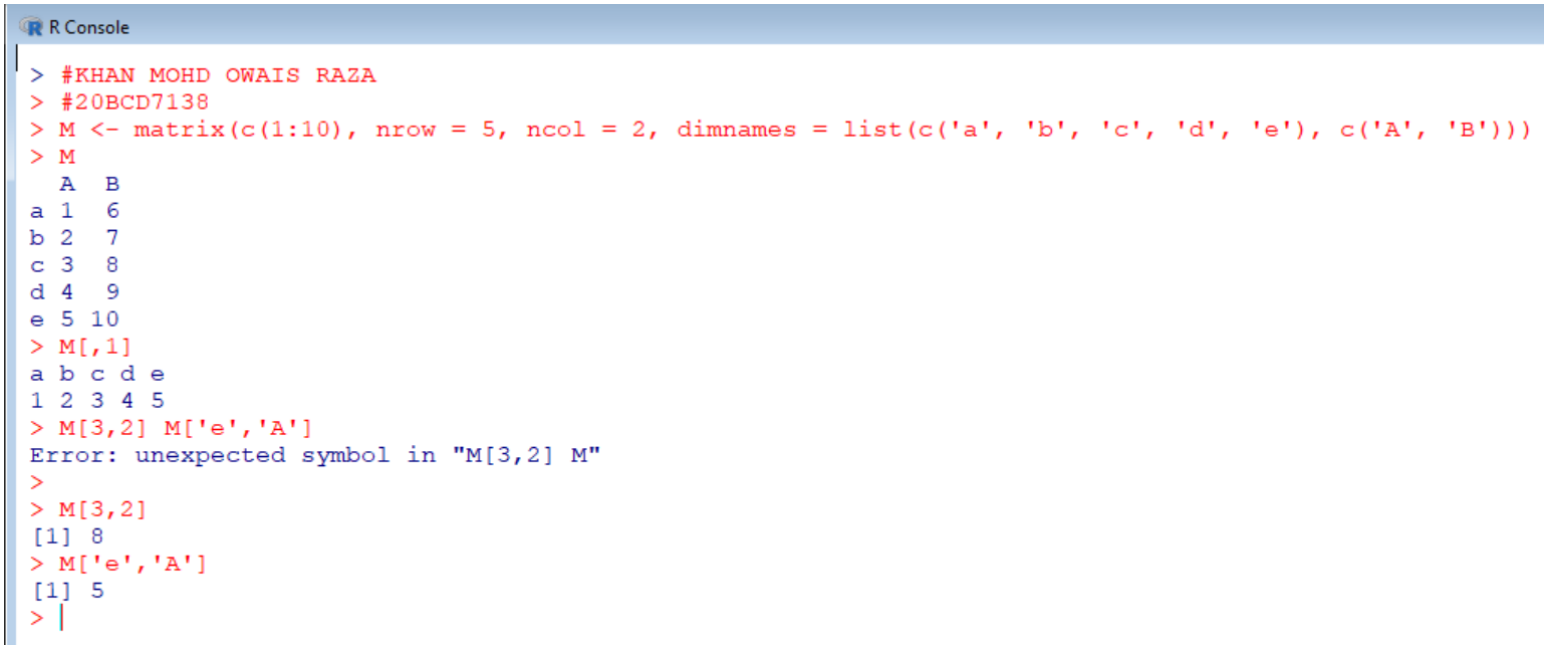
```
print(exponentiation)
# Modulo
modulo <- vec1 %% vec2
print(modulo)
```



MATRICES

1] If M=matrix(c(1:10),nrow=5,ncol=2, dimnames=list(c('a','b','c','d','e'),c('A','B')))
What is the value of: M ?
Consider the matrix M, What is the value of: M[1,], M[,1], M[3,2], M['e','A'] ?

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
M <- matrix(c(1:10), nrow = 5, ncol = 2, dimnames = list(c('a',
'b', 'c', 'd', 'e'), c('A', 'B')))
```



2] Consider the matrix N
N=matrix(c(1:9),nrow=3,ncol=3, dimnames=list(c('a','b','c'),c('A','B','C')))
What is the value of: diag(N) ?
What is the value of: diag(4,3,3) ?

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
N <- matrix(c(1:9), nrow = 3, ncol = 3, dimnames = list(c('a',
'b', 'c'), c('A', 'B', 'C')))
diag(N)
diag(4, 3, 3)
```

```
R Console
> #KHAN MOHD OWAIS RAZA
> #20BCD7138
> N <- matrix(c(1:9), nrow = 3, ncol = 3, dimnames = list(c('a', 'b', 'c'), c('A', 'B', 'C')))
> diag(N)
[1] 1 5 9
> diag(4, 3, 3)
     [,1] [,2] [,3]
[1,]    4    0    0
[2,]    0    4    0
[3,]    0    0    4
> 
```

3] If M=matrix(c(1:9),3,3,byrow=T, dimnames=list(c('a','b','c'),c('d','e','f'))) What is the value of:
rownames(M)
colnames(M)

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
M <- matrix(c(1:9), 3, 3, byrow = TRUE, dimnames = list(c('a',
'b', 'c'), c('d', 'e', 'f')))
rowcol_names <- list(rownames(M), colnames(M))
```

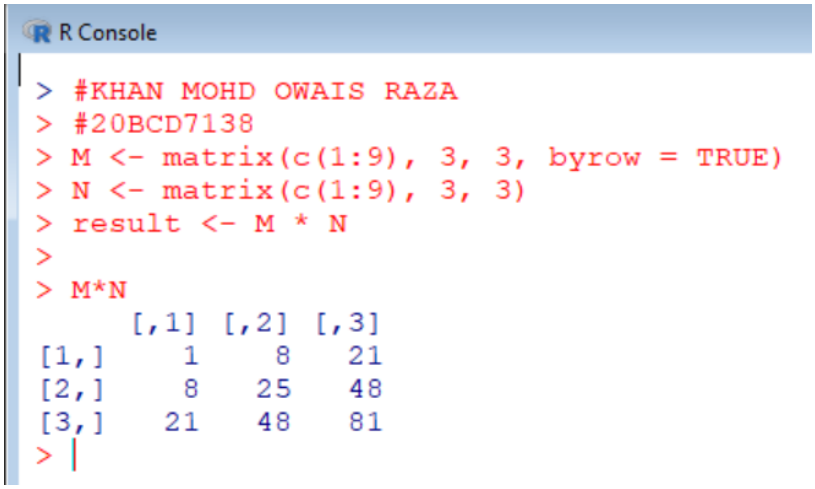
```
R Console
> #KHAN MOHD OWAIS RAZA
> #20BCD7138
> M <- matrix(c(1:9), 3, 3, byrow = TRUE, dimnames = list(c('a', 'b', 'c'), c('d', 'e', 'f')))
> rowcol_names <- list(rownames(M), colnames(M))
> 
> rownames(M)
[1] "a" "b" "c"
> colnames(M)
[1] "d" "e" "f"
> 
```

4] What is the value of: upper.tri(M), lower.tri(M), lower.tri(M,diag=T) ?

```
> upper.tri(M)
      [,1]  [,2]  [,3]
[1,] FALSE  TRUE  TRUE
[2,] FALSE FALSE  TRUE
[3,] FALSE FALSE FALSE
> lower.tri(M)
      [,1]  [,2]  [,3]
[1,] FALSE FALSE FALSE
[2,]  TRUE FALSE FALSE
[3,]  TRUE  TRUE FALSE
> lower.tri(M, diag = T)
     [,1]  [,2]  [,3]
[1,] TRUE FALSE FALSE
[2,] TRUE  TRUE FALSE
[3,] TRUE  TRUE  TRUE
> 
```

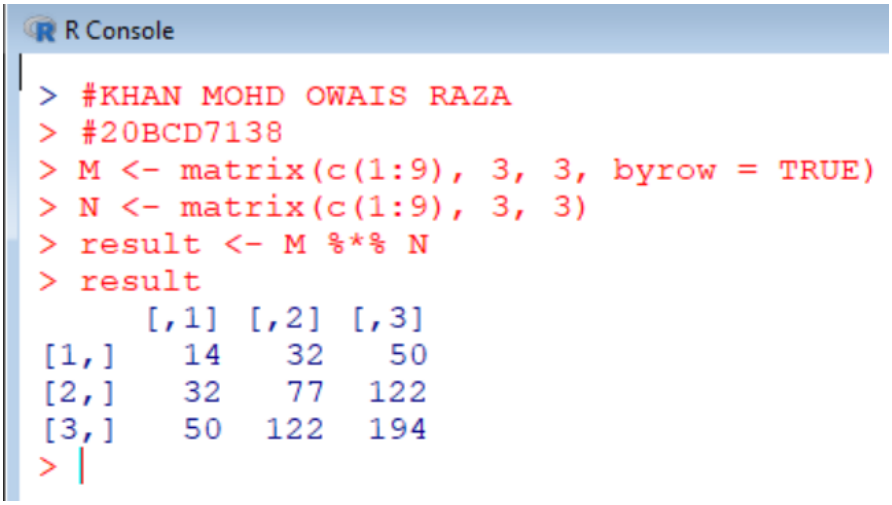
5] Consider two matrix, M,N M=matrix(c(1:9),3,3,byrow=T) N=matrix(c(1:9),3,3) What is the value of: M*N?

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
M <- matrix(c(1:9), 3, 3, byrow = TRUE)
N <- matrix(c(1:9), 3, 3)
result <- M * N
```



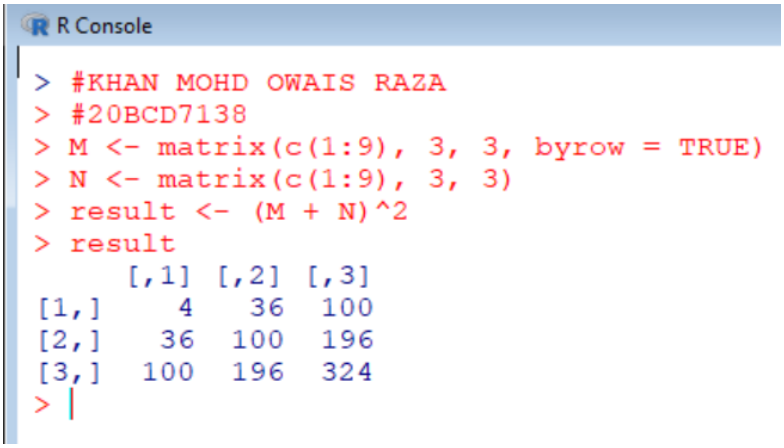
6] Consider two matrix, M, N M=matrix(c(1:9),3,3,byrow=T) N=matrix(c(1:9),3,3) What is the value of: M%*%N ?

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
M <- matrix(c(1:9), 3, 3, byrow = TRUE)
N <- matrix(c(1:9), 3, 3)
result <- M %*% N
result
```



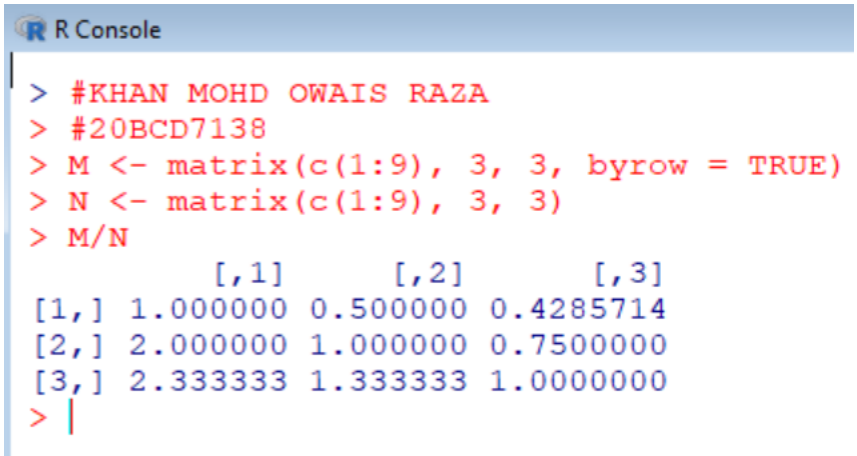
7] Consider two matrix, M,N M=matrix(c(1:9),3,3,byrow=T) N=matrix(c(1:9),3,3) What is the value of: (M+N)^2 ?

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
M <- matrix(c(1:9), 3, 3, byrow = TRUE)
N <- matrix(c(1:9), 3, 3)
result <- (M + N)^2
result
```



8] Consider two matrix, M,N M=matrix(c(1:9),3,3,byrow=T) N=matrix(c(1:9),3,3) What is the value of: M/N ?

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
M <- matrix(c(1:9), 3, 3, byrow = TRUE)
N <- matrix(c(1:9), 3, 3)
M/N
```



9] Create a matrix "mat" with 3 rows and 4 columns containing the following elements: 1 2 3 4
5 6 7 8
9 10 11 12

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
mat <- matrix(c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), nrow = 3,
ncol = 4)
mat
```

R Console

```
> #KHAN MOHD OWAIS RAZA
> #20BCD7138
> mat <- matrix(c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), nrow = 3, ncol = 4)
> mat
     [,1] [,2] [,3] [,4]
[1,]    1    4    7   10
[2,]    2    5    8   11
[3,]    3    6    9   12
>
```

R Console

```
> # A. Find the dimensions (number of rows and columns) of the matrix "mat"
> dim(mat)
[1] 3 4
> # B. Extract the second row of the matrix "mat"
> mat[2, ]
[1]  2  5  8 11
> # C. Extract the last column of the matrix "mat"
> mat[, ncol(mat)]
[1] 10 11 12
> # D. Calculate the sum of all elements in the matrix "mat"
> sum(mat)
[1] 78
> # E. Multiply each element in the matrix "mat" by 2
> mat * 2
     [,1] [,2] [,3] [,4]
[1,]    2    8   14   20
[2,]    4   10   16   22
[3,]    6   12   18   24
> # F. Calculate the transpose of the matrix "mat"
> t(mat)
     [,1] [,2] [,3]
[1,]    1    2    3
[2,]    4    5    6
[3,]    7    8    9
[4,]   10   11   12
> # G. Find the maximum value in the matrix "mat"
> max(mat)
[1] 12
> # H. Perform element-wise addition of the matrix "mat" with itself
```

```
> mat + mat
     [,1] [,2] [,3] [,4]
[1,]    2    8   14   20
[2,]    4   10   16   22
[3,]    6   12   18   24
> # I. Check if any element in the matrix "mat" is greater than 10
> any(mat > 10)
[1] TRUE
> # J. Find the inverse of the matrix
> inv_mat <- solve(mat)
Error in solve.default(mat) : 'a' (3 x 4) must be square
> # K. Using the function eigen find the eigenvalue for A.
> A <- matrix(c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), nrow = 3, ncol =
> eigenvalues <- eigen(A)$values
> eigenvalues
[1]  5.3722813 -0.3722813
>
> # L. Find the eigenvalues and eigenvectors of A'A . Hint: Use crosspr
> ATA <- crossprod(A)  # Compute A'A
>
> eigen_result <- eigen(ATA)
> eigenvalues <- eigen_result$values
> eigenvectors <- eigen_result$vectors
> eigenvalues
[1]  6.483342e+02  1.665808e+00  4.227409e-14 -5.551115e-16
> eigenvectors
           [,1]        [,2]       [,3]       [,4]
[1,] -0.1408767  0.82471435 -0.5477226  0.0000000
[2,] -0.3439463  0.42626394  0.7302967  0.4082483
[3,] -0.5470159  0.02781353  0.1825742 -0.8164966
[4,] -0.7500855 -0.37063688 -0.3651484  0.4082483
>
```

DATAFRAMES

Create a data frame "df" with the following data:

Name	Age	City
John	25	London
Emma	30	New York
Mike	35	Paris

```
#KHAN MOHD OWAIS RAZA
#20BCD7138
# Create the data frame
df <- data.frame(
  Name = c("John", "Emma", "Mike"),
  Age = c(25, 30, 35),
  City = c("London", "New York", "Paris"))
```

```
# Print the data frame
df
```

R Console

```
> #KHAN MOHD OWAIS RAZA
> #20BCD7138
> # Create the data frame
> df <- data.frame(
+   Name = c("John", "Emma", "Mike"),
+   Age = c(25, 30, 35),
+   City = c("London", "New York", "Paris"))
> # Print the data frame
> df
  Name Age     City
1 John  25   London
2 Emma  30 New York
3 Mike  35    Paris
> 
> # A. Print the dataframe
> # Print the data frame
> df
  Name Age     City
1 John  25   London
2 Emma  30 New York
3 Mike  35    Paris
> # B. Find the number of rows and columns in the data frame "df"
> num_rows <- nrow(df)
> cat("Number of rows:", num_rows, "\n")
Number of rows: 3
> num_cols <- ncol(df)
> cat("Number of columns:", num_cols, "\n")
Number of columns: 3
> # C. Extract the "Age" column from the data frame "df
```

```
> age_column <- df$Age
> age_column <- df["Age"]
> # D. Extract the second row of the data frame "df"
> second_row <- df[2, ]
> print(second_row)
  Name Age     City
2 Emma  30 New York
> # E. Add a new column "Country" to the data frame "df" with values "UK", "USA", "France"
> df$Country <- c("UK", "USA", "France")
> print(df)
  Name Age     City Country
1 John  25   London      UK
2 Emma  30 New York     USA
3 Mike  35    Paris  France
```

```
> # F. Calculate the summary statistics (mean, median, min, max) for the
> #    numeric columns in the data frame "df"
>
> summary(df[, sapply(df, is.numeric)])
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   25.0    27.5    30.0    30.0    32.5    35.0
> # G. Replace the value "Paris" in the "City" column of the data frame "df" with "Berlin"
> df$City[df$City == "Paris"] <- "Berlin"
> df$City[df$City == "Paris"]
character(0)
> df$City
[1] "London"   "New York" "Berlin"
> |
```