For the following data frame:

```
data("mtcars")
head(mtcars)
```

```
##                   mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

Keep in mind the following...

```
x <- 1:10 # create vector
x >= 3 # greater than or equal to
```

```
##  [1] FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
x < 9 # less than 9
```

```
##  [1]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE
```

```
x > 3 & x < 7 # greater than 3 AND less than 7
```

```
##  [1] FALSE FALSE FALSE  TRUE  TRUE  TRUE FALSE FALSE FALSE FALSE
```

```
x >= 9 | x <= 2 # greater than or equal to 9 OR less than or equal to 2
```

```
##  [1]  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE
```

```
x %in% 5:10 # present in a given set
```

```
##  [1] FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
x == 3 # equal to 3
```

```
##  [1] FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

```
x != 3 # not equal to 3
```

```
##  [1]  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```
x %% 2 == 0 # modulo division (does remainder equal 0 when divided by 2)
```

```
##  [1] FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE FALSE  TRUE
```

```
xor(x == 3, x > 1) # matches ONLY ONE of the conditions...NOT BOTH
```

```
##  [1] FALSE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

Exercise 1

Use logical operators to output only those rows of mtcars where column mpg is between 15 and 20 (excluding 15 and 20).

Exercise 2

Use logical operators to output only those rows of mtcars where column cyl is equal to 6 and column am is not 0.

Exercise 3

Use logical operators to output only those rows of mtcars where column gear or carb has the value 4.

Exercise 4

Use logical operators to output only the even rows of mtcars.

Exercise 5

Use logical operators and change every fourth element in column mpg to 0.

Exercise 6

Output only those rows of mtcars where columns vs and am have the same value 1, solve this without using == operator.

Exercise 7

(TRUE + TRUE) * FALSE , what does this expression evaluate to and why?

Exercise 8

Output only those rows of mtcars where at least vs or am have the value 1, solve this without using == or !=.

Exercise 9

Explain the difference between | , || , & and &&.

Exercise 10

Change all values that are 0 in the column am in mtcars to 2.

Exercise 11

Add 2 to every element in the column vs without using numbers.

Exercise 12

Output only those rows of data where vs and am have different values, solve this without using == or !=.