LESSON PLAN

Subject: Mathematics

Topic: Properties of functions

Age of students: 16

Language level:B1, B2

Time: 40 min

Content aims
After completing the lesson, the student will be able to:
Differentiate properties of functions.
Determine domain and range of the function.
Describe graphs of functions.
Construct graphs of functions.

Language aims:
After completing the lesson, the student will be able to:
Use new vocabulary within the topics.
Interpret and communicate mathematics.

Pre-requisites:
- Properties of functions;
- Graphs of functions.

Materials: Worksheet “The common properties of the function”.

Procedure steps:
1. Students fill in gaps in common properties of the function.
2. Students read, listen and compare.
3. Students fill in gaps in properties of exponential function.
4. Students read, listen and compare.
5. Students fill in gaps in properties of function y = sinx.
6. Students read, listenand compare.
7. Students fill in gaps in properties of function y = ctgx.
8. Students read, listen and compare.

Attachment:

The common properties of the function

Fill in the gaps with the following words: *even, odd, monotonic, zeros, odd, even, range, domain, periodic.*

- The values that x may assume are called the ……………………… of the function, and the values of y (that correspond to each value of x) are called the ……………………… or value region.
- The function is called ………………………in the interval if it is only increasing or decreasing in this interval.
- By the ………………………of function, we mean those values of x for which the function will equal 0.
- Function $y = f(x)$ is called ………………………if equality $f(-x) = f(x)$ is true for all arguments from the domain of the function.
- Function $y = f(x)$ is called ………………………if equality $f(-x) = -f(x)$ is true for all arguments from the domain of the function.
- If, for all numbers x, the value of a function at $x + p$ is equal to the value at x ($f(x + p) = f(x)$) then we say that the function is ………………………and has period p.
- The graph of the ………………………function is symmetric with respect to y-axis, but the graph of the ………………………function is symmetric with respect to zero.

The properties of exponential function $y = a^x$, $a > 0,\ a \neq 1$.

To sketch the graph of the function y = a^x you have to revise the following properties of that function:

1) The domain of the function is D(a^x) = ………………………
2) The range of the function is E(a^x) = ………………………
3) The function is …………………………..…… because the equalities $f(-x) = -f(x)$ and $f(-x) = f(x)$ are not true for all the $x \in D(y)$. That is

why its graph is symmetric ………….…….. with respect to …………………….….., ……………… with respect to …………………….….. .

4) The function y = a^x is monotonic:
   - It is increasing in interval ……………….. if ………………………….
   - It is decreasing in interval ………………. if ………………………….

5) The function has ……….. zeros (when a^x = 0).
   The graph intersects y-axis in the point ……………………….

Sketch the graph for all the $x \in R$ taking into account the properties of the function y $= a^x$.

The properties of trigonometric function y = sin x

To sketch the graph of the function y = sin x over the interval $[-\pi;\pi]$ you have to revise the following properties of that function:

1) The domain of the function is D (sin x) = ………………………
2) The range of the function is E (sin x) = ………………………
3) The function is ……………………… because the equality $f(-x) = -f(x)$ is true for all the $x \in D(y)$. That is why its graph is symmetric with respect to ……………………….
4) The function y = sin x is monotonic in following intervals:
   - It is increasing if ………………………………………………
   - It is decreasing if ………………………………………………
5) The function is periodic, its period is ……………………….
6) The zeros of the function are ……………………… (where sin x = 0).
   The graph intersects y-axis in the points ……………………….

7) The maximum value of the function is …………… when x = ………………………. And the minimum value of the function is ……….. when x = ……………………….

Draw the coordinate system, choosing one unit on y-axis as two squares and π radians on x-axis as 6 squares (because $\pi \approx 3$). Sketch the graph of the function y = sin x (sine curve) over the interval $[-\pi;\pi]$ using the revised properties of it.

Sketch the graph for all the $x \in R$ taking into account the properties of the function y = sin x.

Sketch the graph of the function y = cosx taking into account the equality $\cos x = \sin\left(\frac{\pi}{2} + x\right) = \sin\left(x + \frac{\pi}{2}\right)$.

The properties of trigonometric function y = ctg x

To sketch the graph of the function y = ctg x over the interval $(0;\pi)$ you have to revise the following properties of that function:

1) The domain of the function is D (ctg x) = ………………………
2) The range of the function is E (ctg x) = ………………………
3) The function is ……………………… because the equality $f(-x) = -f(x)$ is true for all the $x \in D(y)$. That is why its graph is symmetric with respect to ……………………….
4) The function y = ctg x is monotonic in following intervals:
   - It is ……………………. increasing.
   - It is decreasing if ……………………………………….

5) The function is periodic, its period is ……………………….
6) The zeros of the function are ……………………… (when ctg x = 0).

   The graph intersects y-axis in the point ……………………….

7) The function has …………… maximum …….. minimum value.

Draw the coordinate system, choosing one unit on y-axis as two squares and π radians on x-axis as 6 squares (because $\pi \approx 3$). Sketch the graph of the function y = ctg x (tangent curve) over the interval $\left(0;\pi\right)$ using the revised properties of it.

Sketch the graph for all the $x \in R$ taking into account the properties of the function y = ctg x.