Grade 11: Exponential Functions Worksheet

Objectives:

- Üstel fonksiyonu oluşturur, tanım ve görüntü kümesini açıklar.
- Üstel fonksiyonların birebir ve örten olduğunu gösterir.

Necessary materials:

- TI84 Plus Graphing Display Calculator
- Computer for Excel activity
- Paper-pencil

Time required: 60 minutes

Warm-up: Have you ever heard about the story about a Brahman and a king?

The story says that, one day a Brahman wants to give a good lesson to a king. When the king asked the Brahman to demand anything from the king, then he would make real it; the Brahman wanted a grain of wheat for the first square of a chessboard and twice of the previous one for each square until all the squares were filled with wheat according to this rule. Here is a figure below. Look at the figure and guess whether the king was able to make Brahman's desire real.

Make your estimation: ....
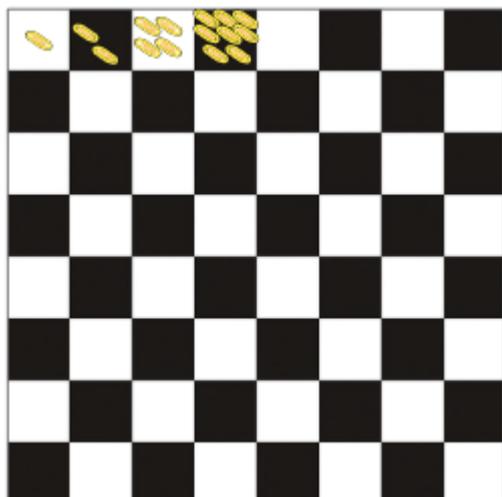
Now, examine your estimation by using Excel:

- Open an Excel worksheet and give a name to the first cell for square#1, such as S1.
- Since there are 64 squares on a chessboard, it will be effective to use the way: After naming the first cell, took the cell on the right bottom corner (see the **sign** +) and pull it until the 64th square.

- You must already have all the 64 names on the first column.
- To do the calculations, write **1** for the first grain of wheat on the next cell of S1 (or whatever you named it).
- Decide what you must do to calculate how many grains of wheat will be for S2 (As you see on the figure, it is already **2**).
- To use any formulate in a cell; begin with a **sign =** . To use any value of a cell, choose the cell (you will see the selected cell in a different color) and make the operations with **signs + (addition), - (subtraction), * (multiplication), / (division), ^ (exponentiation)** and so forth whether necessary.
- When you want to use a formula for the following cells, then took the cell on the right bottom corner again and pull it down.
- Then you will get such a spreadsheet (it is just a part of the whole sheet). Examine and compare it with yours.

	B2			f_x	=B1*2	
	A	**B**		**C**	**D**	
1	S1	1				
2	S2	2				
3	S3	4				
4	S4	8				
5	S5	16				
6	S6	32				
7	S7	64				
8	S8	128				
9	S9	256				
10	S10	512				
11	S11	1024				
12	S12	2048				
13	S13	4096				
14	S14	8192				
15	S15	16384				

Note: *E* means *10^(number).*

Here are the questions:

- **What is the number for the last cell (S64)? What do you think about your estimation now?**

- **Do you observe any pattern/rule/algorithm here? If so, can you express it as a function?**

Q1) Sketch the graphs of the following functions by using your TI calculators.

$$y = 2^x \qquad\qquad y = 3^x \qquad\qquad y = 5^x$$

- First, press the button **Y=** to write the function 2^x. Press **2**, the button ^ and x on the place of $Y_1 =$. Then, you will get the function as 2^x or **2^(x)**. Both are correct.
- The next step, press the **GRAPH** button to sketch the function. Look at the figure below and compare it with yours.

```
Y1=2^(X)
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(graph showing exponential curve)

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X=0                Y=1
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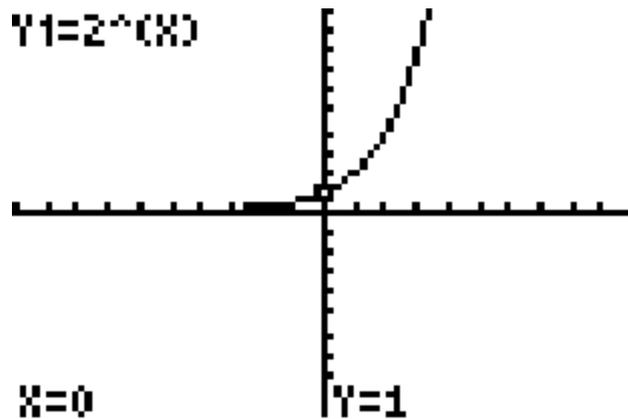
- Follow the same steps for the functions $y = 3^x$ and $y = 5^x$ and sketch them below:

Answer the following questions according to Q1:

    a. What differences do you observe when you sketch all these functions? Where/why do you think the differences caused?

    b. What is the y-intercept for each function?

    c. What can you say about x-intercept for each function?

    d. Any rule/pattern/algorithm you observed or something worth writing:

       ....
       ....
       ....

Q2) Sketch the graphs of the following functions by using your TI calculators.

$$y = 2^x \qquad\qquad y = 2^x + 1 \qquad\qquad y = 2^x - 3$$

Compare the figure with yours:

Y3=2^(X)-3

X=0   Y=-2

Answer the following questions according to Q2:

a. What differences do you observe when you sketch all these functions? Where/why do you think the differences caused?

b. What is the y-intercept for each function?

c. What can you say about x-intercept for each function?

d. Any rule/pattern/algorithm you observed or something worth writing:
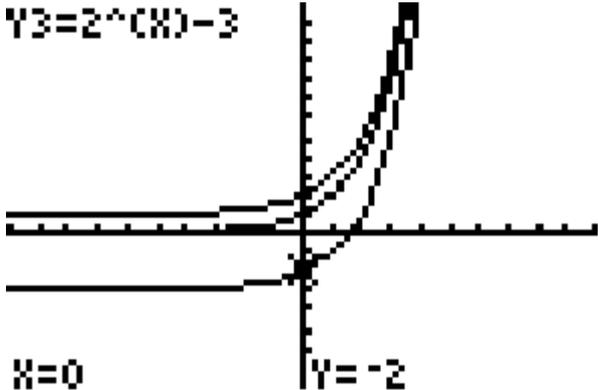..
....
....

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Q3) Sketch the graphs of the following functions by using your TI calculators.

$$y = 2^x \qquad\qquad y = 2^{x-1} \qquad\qquad y = 2^{x+3}$$

Answer the following questions according to Q3:

a. What differences do you observe when you sketch all these functions? Where/why do you think the differences caused?

b. What is the y-intercept for each function?

c. What can you say about x-intercept for each function?

d. Any rule/pattern/algorithm you observed or something worth writing:
....
....
....

Q4) Sketch the graphs of the following functions by using your TI calculators.

$$y = 2^x \qquad\qquad y = 3*2^x \qquad\qquad y = 5*2^x$$

Answer the following questions according to Q4:

a. What differences do you observe when you sketch all these functions? Where/why do you think the differences caused?

b. What is the y-intercept for each function?

c. What can you say about x-intercept for each function?

d. Any rule/pattern/algorithm you observed or something worth writing:
....
....
....

Q5) Sketch the graphs of the following functions by using your TI calculators.

$$y = 2^x \qquad\qquad y = \frac{1}{3} * 2^x \qquad\qquad y = \frac{1}{5} * 2^x$$

Answer the following questions according to Q5:

a. What differences do you observe when you sketch all these functions? Where/why do you think the differences caused?

b. What is the y-intercept for each function?

c. What can you say about x-intercept for each function?

d. Any rule/pattern/algorithm you observed or something worth writing:
....
....
....

Q6) Sketch the graphs of the following functions by using your TI calculators.

$y = 2^x$ $y = 2^{-x}$ $y = 2\verb|^||x|$

Note: To be able to write the function $\mathbf{y = 2\verb|^||x|}$; similarly press the button **Y=** and after writing **2** and the **button ^** ;

- for the absolute value function press **MATH** button,
- go to the next section **NUM** by using the arrow and you will get the screen below:

- **ENTER** the 1st row **abs** and write x into the sign of absolute value.

Answer the following questions according to Q6:

    a. What differences do you observe when you sketch all these functions? Where/why do you think the differences caused?

    b. What is the y-intercept for each function?

    c. What can you say about x-intercept for each function?

    d. Any rule/pattern/algorithm you observed or something worth writing:
        ....
        ....
        ....

Summary your observations & inferences about exponential functions:

....
....
....
....
....
....
....

Answer the following questions:

Q7) How do you define the domain and range of an exponential function by looking through all the questions above?

Q8) Do you think exponential functions have an inverse function? Why or Why not? Justify your answer with a few sentences.

Extension:

Q9) The weight of bacteria in a culture is 100 grams. Under favorable conditions, the weight is increasing by 20% each hour.

Consider how the weight changes 1 hour later, 2 hours later, 5 hours later, and *n* hours later. Use Excel to examine your findings.

Note: Consider on what it is meant by the words '*increasing by 20%*' carefully when you conduct your approach.

- **After calculating your data with similar steps in the warm-up section, use the data you obtained, and INSERT a *Scatter Chart* on the Excel worksheet.**
- **Interpret the chart in terms of any outcomes of the previous questions. Evaluate whether the data express a function or not. If it expresses a function, then what kind of function it is.**

Your notes:

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....
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....
..

Compare your findings with the figure below:
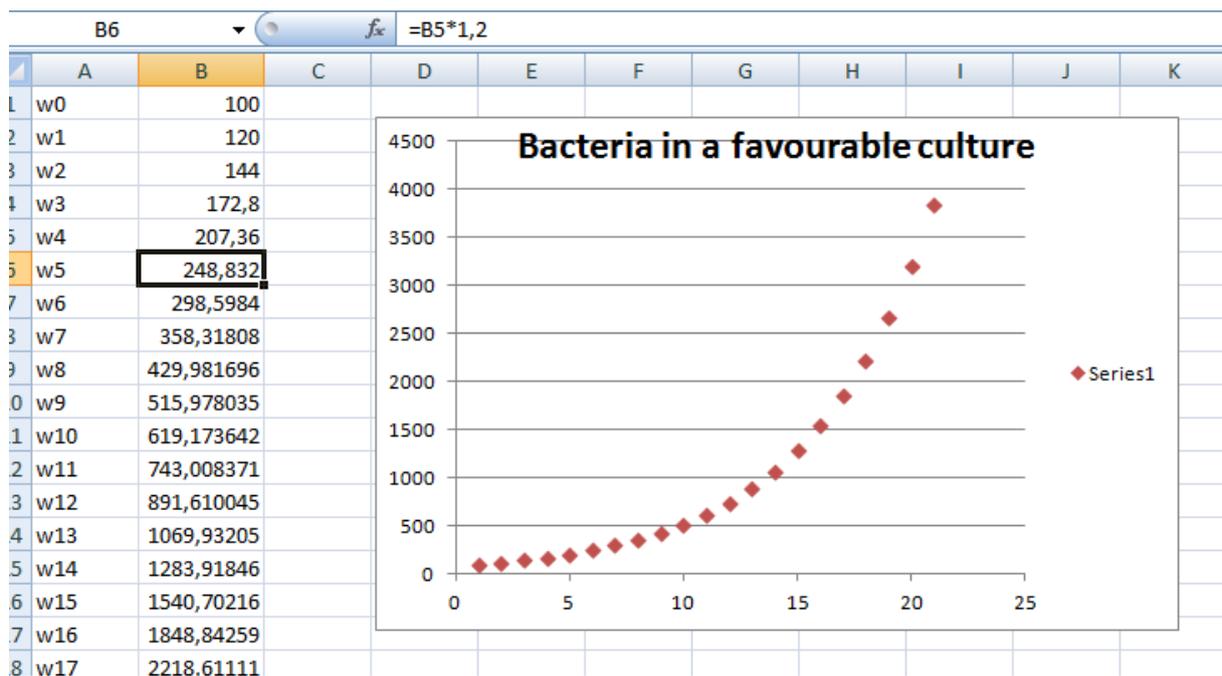
Q10) Consider Q9 again. What if the conditions were unfavorable and the weight is decreasing by 20% each hour? Interpret the new situation and give your reasons with a few sentences.

Reflection

The purpose of this worksheet was to provide 11^{th} grade students to investigate exponential functions by using spreadsheet and TI84 Plus Graphing Display Calculator. I aimed to meet the objectives of the topic by helping students to construct their own knowledge during the worksheet. At this point TI calculators were an important helper, I believe. Even if a student could not sketch a graph of an exponential function by hand, he/she will be able to sketch it by using technology and this will help him/her to go on within the interpretation parts.

To be able to provide the students clear and enough explanation is the challenging part for a teacher, I experienced. Many times I could not be sure whether my explanations or instructions are enough or not. This challenge could be coped more easily; when I, as a teacher, knew about the students' backgrounds- particularly on technology use for this worksheet study.

Besides, I paid attention to the following topic's (logarithm) objectives while I was preparing the questions. As I knew from my past experiences as a teacher in dershane, the part with exponential functions was usually pasted quickly-even suddenly- and logarithm took more time and place in the classes from the eyes of the students. So, I wanted to provide connections between these two topics especially with the questions before the extension part.

In addition, I tried to make connections with science issues such as the questions placed in extension part. However, it was again a challenging issue for me since I would prefer to collaborate with a science teacher to construct more realistic and meaningful questions for the students. This time I looked for such an example through IB books and tried to adjust one for the extension part of the worksheet.

As a conclusion, preparing such a worksheet was an interesting and helpful study for me since I have hardly ever used technology neither as a student nor a teacher candidate. I compared my past education life and today's needs from the eyes of a student and a future teacher. Once you learned about technology and know where and when it is suitable to utilize from the medium in teaching/learning activities, then technology becomes a quite effective way of teaching.