MTH 261, Piecewise Functions Mini-Project, Spring 2019

Instructions: This project uses online graphing technology (specifically at GraphFree.com, although you may use any website that can graph piecewise functions that you prefer) to explore piecewise functions, their limits and continuity. Follow the directions below using a provided example. Submit a Word document with screenshot/images and your explanations to Blackboard by the posted due date.

For this project, we will be using the piecewise graphing program at <u>GraphFree.com</u>. Select the **Start Graphing** button, and you will find a graphing input screen somewhat similar to a graphing calculator. In the dropdown menu in the middle of the screen, select Piecewise.

| CLR CLR PLOT 1 CLR ALL | | | Plot 1: | Plot 2: Plo | t 3: Plot | 4: Plot 5: | Plot 6: | | | | | | |
|--|----------|------------------------|---------|-------------|--------------------------------------|---------------------------------------|---------------------|-----------------|-------------------|--|--|--|--|
| BACK | DEL | CUR ┥ | CUR► | Plot Type | Function 🔹 | f(x) = | | | | | | | |
| 1 | 2 | 3 | + | Color | Function Implicit | Show arro | ows at edges of gra | ph | | | | | |
| 4 | 5 | 6 | _ | Width | Polar Parametri | | | | | | | | |
| 7 | 8 | 9 | * | Line style | Piecewise Asymptote XY Scatter | | | | | | | | |
| 0 | | [-] | / | Grid type | Slope Field Number Line | Gridlines | Full grid lines 🔹 | Plot width | 30 | | | | |
| X ² | √() | X ⁻¹ | ^ | xMin | -10 | Tick labels | No labels 🔹 | Plot height | 30 | | | | |
| sin() | cos() | tan() | п | xMax | 10 | Grid color | Light Gray 🔹 🔻 | | pixels and do not | | | | |
| sin ⁻¹ () | cos=1() | tan=1() | e | xTick | 1 | Background | White v | include caption | n or legend.) | | | | |
| ln() | log() | e^() | abs() | yMin | -10 | X-axis label | | Point size | Medium | | | | |
| X | Y | θ | Т | yMax | 10 | Y-axis label | | Angle unit | Radians | | | | |
| = | EE | (|) | yTick | 1 | | | Cros | ate Plot | | | | |
| Other (| select): | sec | • | Standard | Zoom In Zoom Out | | | | | | | | |
| Set Shading Options Set Caption & Legend Set Custom Note Texts | | | | | | | | | | | | | |
| Apply Quickset (select): All plot & grid styles to defaults Create custom Quickset | | | | | | | | | | | | | |
| t 3: Plot 4: Plot 5: Plot 6: | | | | | | | | | | | | | |
| | | | | | n will update | f(x) = | | if | ≤ X ≤ ▼ | | | | |
| • | • | • | | | g the pieces | | | if [| (≤ x ≤ ▼) | | | | |
| • | • | - | • | ong with t | | | | | | | | | |
| • | | | | e each pi | | | | | | | | | |
| tetined | 3. Ityo | u need | more | than thre | e pieces, you | Show open and closed endpoint symbols | | | | | | | |

additional pieces. They will all graph on the same screen.

To graph the function

 $f(x) = \begin{cases} 2x + 1, \text{ for } x < 1 \\ x, \text{ for } x \ge 1 \end{cases}$ we enter the pieces and select the appropriate inequalities from the dropdown menu. In the middle of the screen, you can adjust the display options such as the maximum and minimum values for each axis, the color and tick labels and other features. Then select **Create Plot**.

| f(x) = | | | lif | | ≤ x | ≤ ▼ | | | | | | | |
|---------------------------------------|-----------|-----------|-----|-------------|------|--------------------|----|--|--|--|--|--|--|
| | | | lif | | ≤ x | ≤ ▼ | | | | | | | |
| | | | if | | ≤ X | ≤ ▼ | | | | | | | |
| Show open and closed endpoint symbols | | | | | | | | | | | | | |
| f(x) = | 2x+1 | | lif | | x < | • • 1 | | | | | | | |
| | x | | lif | | x ≥ | • • 1 | | | | | | | |
| | | | lif | | ≤ × | . ≤ ▼ | | | | | | | |
| Show open and closed endpoint symbols | | | | | | | | | | | | | |
| | Grid type | Cartesian | Ŧ | Gridlines | | Full grid lines | • | | | | | | |
| | xMin | -5 | | Tick labels | | Every other line 🔻 | | | | | | | |
| an | xMax | 5 | | Tick label | size | | 11 | | | | | | |
| un | xTick | 1 | | Grid color | | Light Gray | • | | | | | | |
| | | | _ | 1 | | | _ | | | | | | |

yMin 5 Background yMax 5 X-axis label yTick 1 Y-axis label Standard Zoom In Zoom Out When the screen reloads, it will display the graph at the top of the screen. This function produces the following graph.

From this graph, you will then be able to answer questions like $\lim_{x\to 1^-} f(x) = 3$ and $\lim_{x\to 1^+} f(x) = 1$, f(1) = 1, $\lim_{x\to 1} f(x)$ is undefined since the one-sided limits don't agree, the graph is discontinuous at x = 1since the limit doesn't exist, and this is a jump discontinuity and is, therefore, not removable.

For each of the piecewise functions below, construct a graph and then use the graph to answer the following questions for each function.

For each value *c* where a piece of the graph changes find:

- a. $\lim_{x \to \infty} f(x)$
- b. $\lim_{x \to c^+} f(x)$
- c. f(c)
- d. $\lim f(x)$
- e. Is the function continuous at x = c?
- f. If f(x) is discontinuous at x = c, what kind of discontinuity is it? Removable or a jump? If the discontinuity is removable, what value should f(c) be defined to be to repair the discontinuity?

Some of the graphs will have more than one break, and so you may need to answer each of these questions at two values.

- 1. $f(x) = \begin{cases} -x + 4, \text{ for } x < 3\\ x 3, \text{ for } x \ge 3 \end{cases}$ 2. $f(x) = \begin{cases} x^2, \text{ for } x < -1\\ x + 2, \text{ for } x \ge -1 \end{cases}$ 3. $f(x) = \begin{cases} x + 1, \text{ for } x < 0\\ 2, \text{ for } 0 \le x < 1\\ 3 - x, \text{ for } x \ge 1 \end{cases}$
- 4. $f(x) = \begin{cases} \frac{1}{2}x + 1, & \text{for } x < 4 \\ -x + 7, & \text{for } x \ge 4 \end{cases}$

5.
$$f(x) = \begin{cases} \frac{1}{x-3}, & \text{for } x \neq 3\\ 2, & \text{for } x = 3 \end{cases}$$

