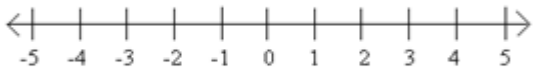
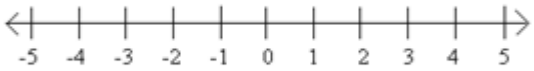
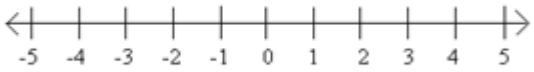
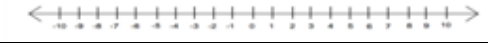
Honors PreCalculus

Unit 1 Building Functions Project

Instructions: All students will create a diversified portfolio of concepts using the lessons below. Students must accumulate **at least 85 points** for the Project grade. There is a maximum of 128 points that can be earned on this project. Yes, you will earn "extra" points if you go above and beyond the minimum.

Due Date: Hard copy to be turned in by **September 22nd** – NO EXCEPTIONS. Late: - 20 points

Concepts	Assignment	Points
1.1 Function Notation	1. If $f(x) = x^2 - 3x + 4$, $f(-3) = ?$ 2. If $h(x) = (x + 2)^3/5$, what is x when $h(x) = -25$ If g(x) is described by the table at right 3. Find g(8) - g(6) 4. If $g(x) + 2 = 14$, find x x: 4, 6, 8, 10 — g(x): 12, 6, 0, -6	5 points
1.2 Interval Notation	1. Inequality: $-6 \leq x < -4$ OR $-3 \leq x$  Interval notation: 2. Inequality:  Interval notation: $(-\infty, 4)$ 3. Inequality: $x > 0$ or $x < -2$  Interval notation:	4 points
1.3 Properties of Functions	Pick 2 parent functions of your choice. Graph them. Use your notes to identify and analyze the following concepts: end behavior, continuity vs. discontinuity, domain, range, bounded, asymptotes	12 points
1.4 Parent Functions	Draw all 9 parent functions on graph paper. Include at least 5 points for each graph.	27 points

<table>
<tr>
<td>1.5 Domain Restrictions</td>
<td>1. $f(x) = \sqrt{(x - 3)} / (x - 6)$
 
2. $f(x) = 1 / \sqrt{(4 - x^2)}$
  </td>
<td>9 points</td>
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<tr>
<td>1.6 Modeling</td>
<td>The number of Starbucks that existed over time is given below. Create a scatter plot of the data on your calculator. What type of regression might fit best?

Create an exponential regression model, E(x), of the data (round to the hundredths) where x is the years after 1980

Find E(21). What does it mean?

The actual number of Starbucks in 2001 was 4709. What might your model not be considering about business growth the real world?

Generally, business growth usually levels out in the long run. Find a logistic regression, L(x), of the data where x is years after 1980. Is L(21) closer to the actual number?
<table>
<tr><th>Year</th><th>Number of Locations</th></tr>
<tr><td>1987</td><td>17</td></tr>
<tr><td>1988</td><td>33</td></tr>
<tr><td>1989</td><td>55</td></tr>
<tr><td>1990</td><td>84</td></tr>
<tr><td>1991</td><td>116</td></tr>
<tr><td>1992</td><td>165</td></tr>
<tr><td>1993</td><td>272</td></tr>
<tr><td>1994</td><td>425</td></tr>
<tr><td>1995</td><td>676</td></tr>
<tr><td>1996</td><td>1015</td></tr>
<tr><td>1997</td><td>1412</td></tr>
<tr><td>1998</td><td>1886</td></tr>
<tr><td>1999</td><td>2498</td></tr>
</table></td>
<td>15 points</td>
</tr>
<tr>
<td>1.8 & 1.9 Transformations</td>
<td>PreCalculus Transformations Worksheet (even questions)</td>
<td>30 points</td>
</tr>
<tr>
<td>1.10 Piecewise Functions</td>
<td>Analyzing Tax Systems (obtain a copy from Ms. Grosse)</td>
<td>20 points</td>
</tr>
<tr>
<td>1.11 Composition & Combinations</td>
<td>Evaluate, given that $f(x) = -2x + 4$ and $g(x) = x^2$
a. $(g - f)(2a)$ =
b. $(f \circ g)(3)$ =</td>
<td>6 points</td>
</tr>
</table>

Unit 1 Building Functions Project – Real World Application: Income Tax

In the United States, we have a progressive income tax. This means that as you make more money, the percentage that goes to taxes increases. A simplified version of a progressive tax system is shown below.

If you annually earn:

- **$0 - 37,000** — **15% tax on this amount less than or equal to $37,000**
- **$37,001 - 90,000** — **25% tax on this amount above $37,000 but less than or equal to 90,000**
- **Over $90,000** — **28% tax on this amount above $90,000**

We can model this progressive tax based on a person's income ***i*** with the equation:

$$\boldsymbol{P(i)} = \begin{cases} \boldsymbol{.15i} & when\ i \leq 37{,}000 \\ \boldsymbol{.25i - 3700} & 37{,}000 < i \leq 90{,}000 \\ \boldsymbol{.28i - 6400} & when\ i > 90{,}000 \end{cases}$$

Some politicians argue that the United States should switch to a flat income tax. This means that everyone pays the same tax rate, no matter how much money they make.

A flat tax of 17% could be modeled by the equation:

$$\boldsymbol{F(i) = .17i} \qquad \boldsymbol{for\ all\ i} > 0$$

Part A

1) For both functions, what is the domain? [Hint: why was ***i*** chosen as the variable?]

2) What output is either function calculating?

3) Why do you think the function names *P(i)* and *F(i)* were chosen?

4) What are the two income levels where the tax rate changes in the progressive tax?

Fill in the following chart that shows how much tax an individual would have to pay, based on yearly salary, for both the progressive tax systems and the flat tax system.

Part B

Mean annual salary	Taxes due under progressive tax P(i)	Taxes due under flat tax F(i)
1) $9,000		
2) $30,000		
3) $40,000		
4) $70,000		
5) $85,000		
6) $120,000		
7) $215,000		

Part C

Based on the table above, write a minimum of 5 sentences comparing the two different tax structures. Be sure to address the following questions:

- Who benefits more from a progressive tax?
- Who benefits more from a flat tax?
- Which would you prefer to have?

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Below is a chart of various occupations and the average yearly salary for individuals with those jobs. For each one, calculate the amount of tax they would owe under the progressive system. Then on the graph below, graph the data using income as the x – coordinate and the taxes owed as y – coordinate.

Part D

Occupation	Annual mean wage	Taxes Owed
Software Publishers	$100,000	
Home Health Care Services	$25,000	
School Maintenance	$30,000	
Actuary	$125,000	
Pharmacist	$115,000	
Veterinarian	$95,000	
Registered Nurse	$65,000	
Computer Programmer	$75,000	

Occupation	Annual mean wage	Taxes Owed
Physician's Assistant	$90,000	
Radiology Technologist	$60,000	
Graphic Designer	$40,000	
Waiter/Waitress	$20,000	
Teacher	$55,000	
Civil Engineer	$85,000	
Construction Worker	$35,000	