Name: _____

Honors Precalculus - Summer Work
Part I

Precalculus neophytes:

Welcome to your final year of high school algebra! The following questions are designed to keep your math skills sharp over the languid summer months. The summer work is divided into four parts, and each part will require about 2 hrs to complete.

In addition to providing you with practice while away from school, this review will help me assess your strengths and weaknesses coming into the class. While you are free to use any notes or texts from previous Wooster classes, please do not ask anyone else for assistance. Further expectations for the work's completion are outlined below.

I encourage you to take note of the problems with which you have trouble and ask me about them over the first few days of class. I further urge you to take a look through the Prerequisite chapter of the textbook (Chapter P). We will do a very brief review of this chapter once the year starts; the test for this preliminary material will be held within the first two weeks of classes. Appendix A in the back of the book is also a good review of some basic algebra skills you will need this year.

Best of luck, and enjoy your summer!

Directions:

1. All parts of the summer work must be submitted on the first day of class.
2. Each part is divided into four separate sections. Be aware of the restrictions placed on each section by the heading in **bold** at the top of the page.
3. All work must be done in **pencil** in the space provided – please **do not** use separate sheets of paper.
4. Please box or circle your answers.
5. **Show your work!** I am interested in both accuracy and process.
6. You may use any written resources available to you, but please do not ask another person for assistance.
7. Calculators are legal where stated, but should not be used at all otherwise.
8. **Grades are based on effort, not correctness.**
9. The grade you earn will play a significant role in your first marking period grade and effort grade.
10. Some of the questions may cover topics you are unsure about. That is expected. Just make your **best written attempt on each problem** and you'll get a high grade!

Section I: Algebra Skill Review – NO CALCULATOR!

1. Subtract and simplify: $\dfrac{x}{x^2-7x+6}-\dfrac{x}{x^2-2x-24}$

2. Use synthetic division to determine if $x-2$ is a factor of $f(x)=4x^3-3x^2-8x+4$.

Section I: Algebra Skill Review – NO CALCULATOR!

3. Solve: $(x+7)(x-1)=(x+1)^2$

4. Rationalize the numerator: $\dfrac{\sqrt{x+h}-\sqrt{x}}{h}$

Section II: Applied Problems – Show all necessary work. Calculators are permitted.

1. A total of $20, 000 is to be invested, some in bonds and some in certificates of deposits (CDs). If the amount invested in bonds is to exceed that in CDs by $300, how much will be invested in each type of investment?

2. An open box is to be constructed from a square piece of sheet metal by removing a square of side 1 foot from each corner and turning up the edges. If the box is to hold 4 cubic feet, what should be the dimensions of the sheet metal?

Section III: Concepts & Writing – Do not perform any calculations for these questions!

1. Is there a positive real number "closest" to 0? Explain your answer.

2. Describe three ways you might solve a quadratic equation. State your preferred method and explain why you chose it.

Section IV: Activity

Acceleration Due to Gravity: The function $t = \sqrt{\frac{2d}{g}}$ models the time t in seconds it takes for any object at rest to fall a distance d in meters neglecting air resistance and friction. Enter this equation into your TI calculator next to $\mathbf{Y_1}$ in the "Y=" window. Replace t with y and d with x, and set $g = 9.81$ m/s^2. Press the "ZOOM" Button and select **ZStandard** to view the graph.

Questions:

What restrictions should be placed on the function $y = \sqrt{\frac{2x}{9.81}}$ given its real context?

Using the graph, press the "TRACE" button and move the cursor back and forth on the graph. How much time will elapse for the fall of an object being dropped from a height of 200 meters above the ground?

Is there a maximum value for this function? Explain your reasoning.

Section IV: Activity

A comparison of acceleration due to gravity for various celestial bodies is provided to the right.

Body	Acceleration Due to Gravity (in m/s^2)
Sun	274.13
Mercury	3.59
Venus	8.87
Earth	9.81
Moon	1.62
Mars	3.77
Jupiter	25.95
Saturn	11.08
Uranus	10.67
Neptune	14.07
Pluto	0.42

Go back to the "Y=" screen and again graph $t = \sqrt{\frac{2d}{g}}$, only this time let $d = 20$ meters, and let x replace g. Observe the times required for an object to fall from a height of 20 meters.

Use the "TRACE" function to answer the following questions.

Questions:

On which of the given bodies will the 20 meter fall require the **most** time?

On which of the given bodies will the 20 meter fall require the **least** time?

How much time will the fall of the object from a 20 meter height require on Earth?

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Honors Precalculus - Summer Work
Part Two

Directions:

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9. The grade you earn will play a significant role in your first marking period grade and effort grade.
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Section I: Algebra Skill Review – NO CALCULATOR!

1. Solve: $4x^2 - x + 2 = 0$

2. Rationalize the denominator: $\dfrac{\sqrt{2}}{\sqrt{7}+2}$

Section I: Algebra Skill Review – NO CALCULATOR!

3. Simplify: $\sqrt[4]{\dfrac{3x^8y^2}{8x^2}}$

4. Solve: $\left(4x+2\right)^{-1} < 0$

Section II: Applied Problems – Show all necessary work. Calculators are permitted.

1. For a certain ideal gas, the volume V (in cm^3) equals 20 times the temperature T (in °C). If the temperature varies from 80° to 120°C inclusive, what is the corresponding range of the volume of the gas?

2. The Village of Oak Lawn charges homeowners $21.60 per quarter-year plus $1.70 per 1,000 gallons or water usage in excess of 12,000 gallons. In 2000, one homeowner's quarterly bill ranged from a high of $65.75 to a low of $28.40. Over what range did water usage vary?

Section III: Concepts & Writing – Do not perform any calculations for these questions!

1. Without solving, explain what is wrong with the following problem: How many liters of 25% ethanol should be added to 20 liters of 48% ethanol to obtain a solution of 58% ethanol?

2. Can every line be written in *slope-intercept* form? Explain.

Section IV: Activity

<u>Mo' Money Problem:</u> Imagine you've been asked to compete on the game show *Mo' Money!* The premise of the show is simple: contestants are given a choice between prizes, and if they can correctly guess which among the options is the most valuable before time runs out, they get to take it home. Today is the series finale, and they've pulled out all the stops. You have been given thirty seconds to choose between two prizes: Prize #1 is a check for $1,000,000; Prize #2 consists of daily payments starting at one penny and doubling every day for thirty days. Remember, you only get to keep the prize if you correctly guess which of the two options is more valuable.

Before doing any calculations, ask at least 10 people you know which of the two prizes they would take. Time them to see how quickly they make their decision. How many would take Prize #1? Prize #2? Pick two people and write a short description of the reasoning that led them to their choice.

Then, complete the table to the right to determine how much money you will be paid on each day if you choose Prize #2. Amounts for the first four days are already listed.

Describe what happens to the daily payments as the days progress. What kind of growth does this represent?

Day	Amount of $
1	$0.01
2	$0.02
3	$0.04
4	$0.08
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
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Section IV: Activity

To find out how much total money Prize #2 is worth, you need to sum all the daily payments. You could add all the numbers together one by one on your calculator, or you can **find the sum using the following formula**

$$\frac{A_1\left(1-r^n\right)}{1-r}$$

where A_1 is the amount paid on the first day, r is the growth rate (the number you multiply by to find the next day's amount), and n is the total number of days. **How much is Prize #2 worth in total?**

Which prize is more valuable? How many times more valuable? How many of the people you asked at the beginning guessed correctly? Did they respond quickly enough?

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Honors Precalculus - Summer Work
Part Three

Directions:

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Section I: Algebra Skill Review – NO CALCULATOR!

1. Solve: $|2x-1| \le 1$

2. Factor: $(x+2)^2 - 5(x+2)$

Section I: Algebra Skill Review – NO CALCULATOR!

3. Solve: $e^{1-2x} = 4$

4. Solve: $\log_3 \sqrt{x-2} = 2$

Section II: Applied Problems – Show all necessary work. Calculators are permitted.

1. The layout of a softball field is a square, 60 feet on a side. How far is it directly from home plate to second base?

2. A Dodge Intrepid and a Mack truck leave an intersection at the same time. The Intrepid heads east at an average speed of 30 mph, while the truck heads south at an average speed of 40 mph.

   a) Sketch a picture illustrating this situation.

   b) Find an expression for their distance d apart (in miles) at the end of t hours.

Section III: Concepts & Writing – Do not perform any calculations for these questions!

1. The inequality $x^2 + 1 < -5$ has no real solution. Explain why, without solving.

2. Are the functions $f(x) = x - 1$ and $g(x) = \dfrac{x^2 - 1}{x + 1}$ the same? Explain.

Section IV: Activity

Arm Span: In this activity, we are going to compare a person's arm span to their height and find a function that relates the two using our calculators. You will need your TI graphing calculator and a measuring device such as a tape measure or yardstick.

Step 1: First, have someone measure your height. Then, spread your arms as wide as you can. Have someone measure the length, in inches, of your arm span from the tip of your fingers on one hand, across your back, to the tip of your fingers on your other hand. Record this information in the first row of the table below.

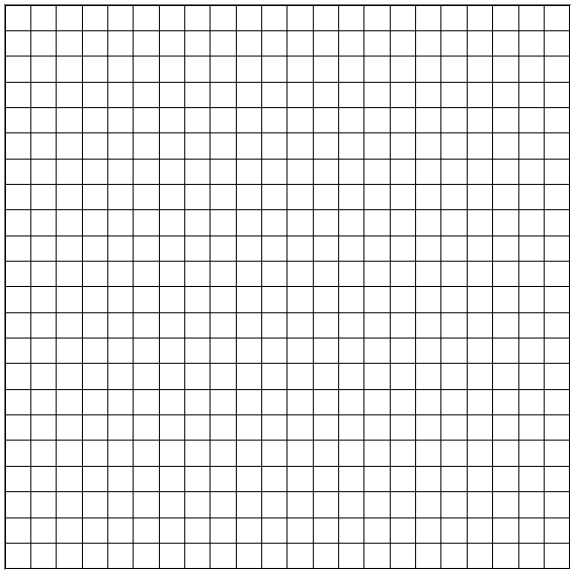
Step 2: Now, measure the arm spans and heights of five other people. Try to find subjects with a range of varying heights. Record that information in the table as well.

Name	Height (in inches)	Arm Span (in inches)

Question: Based on the data collected in the table, what kind of relationship do you think exists between a person's arm span and his/her height?

Step 3: Enter the information in the table into two lists on your calculator. To get to the lists, first hit the "STAT" button, then select "Edit." Under the "L1" column, enter the heights, in inches, of all of the participants. Under "L2," enter the arm span, in inches, of all of the participants.

Step 4: Make a scatter plot of the data where the independent variable is height, in inches, and the dependent variable is arm span, in inches. You can do this on your calculator by hitting "2nd" followed by "Y=", which takes you to the "STAT PLOT" screen. Hit "Enter" to select Plot1. In the Plot1 screen, you should see options that let you change the TYPE of plot (select the option in the upper left corner for scatter plot), the data you use in the plot (should be "Xlist: L1; Ylist: L2"), and the mark used to indicate a point on the graph (whichever you prefer). Turn Plot1 on by scrolling to the top and selecting "On," then press the "GRAPH" button to generate the scatter plot. Press the "WINDOW" button to customize your viewing window or "ZOOM" to zoom in or out. Reproduce the plot on your calculator on the graph to the right, making sure you scale and label your axes.



Question: What type of function would best model this data? Explain.

Section IV: Activity

Step 5: Find an equation modeling the data you've collected by running a linear regression on your calculator. Select the "STAT" button, then use the right arrow to scroll over to the "CALC" menu. Scroll down the menu to select "LinReg(ax+b)." Once selected, hit "ENTER" to run the regression.

The "LinReg" function runs a linear regression, finding values for the constants a and b for the linear function $y = ax + b$ that best mimics the behavior of your data. Write the function resulting from your regression below.

Step 6: Using your regression equation relating arm span to height, estimate the arm span of a person who is 5 feet tall.

Now, using your regression equation, extrapolate the arm span of a person who is 8 feet tall. How reliable is this prediction, do you think? Explain your reasoning.

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Honors Precalculus - Summer Work
Part Four

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Section I: Algebra Skill Review – NO CALCULATOR!

1. Factor: $x^4 - x^3 + x - 1$

2. Solve: $150e^{-0.04t} = 90$

Section I: Algebra Skill Review – NO CALCULATOR!

3. Solve: $\left(\frac{2x^{\frac{1}{2}}}{y^{\frac{2}{3}}}\right)^{-4}\left(\frac{3x^{-\frac{2}{3}}}{y^{\frac{1}{2}}}\right)$

4. Solve: $3\log_3 x - \log_3 8 = 3$

Section II: Applied Problems – Show all necessary work. Calculators are permitted.

1. An object is propelled vertically upward with an initial velocity of 20 m/s. The distance *s* (in meters) of the object from the ground after *t* seconds is given by $s(t) = -4.9t^2 + 20t$.

   a) When will the object be 15 meters above the ground?

   b) When will it strike the ground?

   c) Will the object reach a height of 100 meters?

   d) What is the maximum height the object will reach?

Section III: Concepts & Writing – Do not perform any calculations for these questions!

1. Describe how you would proceed to find the domain and range of a function if you were given its graph.

2. How many x-intercepts can the graph of a function have? How many y-intercepts can it have? Explain your answers.

Section IV: Activity

Scavenger Hunt: Use any written resources you like to answer the following math-oriented questions. If you choose to use the Internet, be selective in your choice of references: web pages associated with schools, universities, or science/math organizations are great tools, whereas personal web pages can have unverified or incorrect information. Wikipedia is acceptable, but don't rely on it alone, and pay attention to the notes regarding the veracity of the information provided; if it is called into question, don't use it. In addition to the Internet, you may also collect answers from books, encyclopedias, journals, or periodicals.

Your answers to the following items should be brief, but be sure to include short descriptions where necessary. Cite the reference you used to answer each question. If it's a web page, include the URL.

Find the following:

1. The name and nationality of the man widely considered the "Father of Algebra," as well as the name and nationality of the *other* man who has a claim to that title.

2. Two real life examples of exponential growth or decay functions.

3. The mathematician who first used the symbol *e* to represent that particular natural constant.

4. Two examples of the use of scientific notation and a brief description of the context in which you found them.

Section IV: Activity

5. The meanings of the words *abscissa* and *ordinate* and their mathematical relevance.

6. Two real life examples or applications of ellipses or ellipsoids.

7. The algebra topic that John Napier is famous for introducing.

8. The definition of a tessellation.

9. The two famous mathematicians independently credited with inventing calculus.

10. The name of any mathematician you choose (cannot be any of those listed above) and a brief description of his or her contributions to the world of mathematics.