H Algebra II B Spring Project

You are required to complete 3 of the following mini projects. Each mini project is worth 30 points. There are eight options to choose from below. Each provides its own full explanation. For those projects that require a poster, use a standard size poster board (it does not have to be a tri-fold poster). For those requiring the use of PowerPoint, be sure to follow guidelines for good PowerPoint presentations (see http://writingcenter.gmu.edu/resources/Howtowritewithppoint.pdf for help). All work must be typed (with the exception of sketched graphs). You can type equations in Microsoft Word using the Equation Editor or MathType (available on school computers).

If using PowerPoint, your file must be available on a flash drive on the due date. You may also burn it to CD to submit. The CD will not be returned. Please name your PowerPoint files in the following manner *FirstName_LastName_Project#.ppt* (for example Jane_Smith_Project4.ppt)

For posters or other non-electronic submissions, please neatly write your first and last name on the back or bottom.

Your projects will be graded based on their neatness, creativity, and, of course, mathematical accuracy. If the project scenario places you in a certain position (i.e. making a presentation to a company), place yourself into that role and write to that audience.

You will also receive 10 presentation points. Select one of your projects for a 5 minute class presentation.

Late Projects: Projects are due at the bell beginning class on Monday, May 11, 2009. If you are working on the project when class starts, it will be counted late. Projects will be accepted until Wednesday, May 13th with a 6 point penalty per project. After the beginning of class on May 13th, the project will receive a zero.

Project 1: Build a Box

Create a box that has a base with an area of 448 from a piece of poster board measuring 24 centimeters by 36 centimeters by cutting congruent squares from the corners of the card stock and folding up the sides.

Procedure:

(a) Sketch a diagram of a piece of poster board that measures 24 centimeters by 36 centimeters. Draw congruent squares in each corner. Label the lengths of the sides of the squares as x.
(b) Write expressions to represent the width and length of the base being created.
(c) Write a polynomial to represent the area of the base of the box.
(d) Write an equation to solve for x. Determine the dimensions of the squares to cut from the corners of the poster board. Provide an explanation for your answer.
(e) What are the dimensions of the box you are creating?
(f) Cut the squares from the poster board. Tape the upturned sides together to form a box.
(g) Measure the dimensions of the box that you created. Verify that they match the dimensions in Step e.
(h) Show that the area of the original piece of poster board minus the four squares is equal to the surface area of the box that was created.
(i) Use the same process to create another box that has a base area of 220 square centimeters. What are the dimensions of this box?

Report your findings on a poster and include the boxes that you made.

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Project 2: Calculating Wind Chill

(a) Use local weather forecasts to record the overnight low temperatures and wind speeds for a three-day period. Organize your data in a table with four columns: Day, Overnight Low Temperature (˚F), Wind Speed (miles per hour) and Wind Chill (˚F). The fourth column will be calculated in a later step. (Note: Since we live in an area where the climate is warm and winds are relatively calm, use data from a another city, preferably a northern city, to make this more interesting)

(b) Convert the temperatures from degrees Fahrenheit to degrees Celsius. Round the temperatures to the nearest thousandth. You may want to add another column in your table to house the converted temperatures.

(c) The formula $= 13.12 + 0.6215 \quad +(0.3965 \quad - 11.37)$ · is used to calculate wind chill. In the formula, is the wind chill temperature in degrees Celsius, *t* is the current temperature in degrees Celsius, and *V* is the wind velocity in miles per hour. Use the formula to calculate the wind chills to the nearest thousandth.

(d) Convert each wind chill from degrees Celsius to degrees Fahrenheit. Round to the nearest tenth and complete the table.

(e) Compile a brief report including the following
   a. Your table
   b. A description of the significance of the wind chill factor for each day represented in the table.
   c. An answer to the question: How can you tell from looking only at the data in the table that the relationship between the temperature and the wind speed is not linear?

Project 3: Newton's Law of Cooling

One way to determine exponential decay is to conduct an experiment. Take an empty soda can and fill it with hot tap water. Put a thermometer in the can and let it sit at room temperature. Record the difference between the water temperature and the room temperature every two minutes for the first 10 minutes and then every five minutes afterwards until the water in the can is the same temperature as the air in the room.

Present the following results in a poster.

(a) Graph the data using time for the water to cool as the independent variable. Draw a smooth curve through the points.

(b) Another way of stating the formula for Newton's Law of Cooling is $- \quad = \quad$, where *T* is the temperature at any given time, is the room temperature (assumed to be constant), *A* is the difference between the object's temperature and the room temperature when cooling starts, and *k* is the cooling constant for the room.

(c) Prepare a table of values of *t* and $\ln[\quad - \quad]$. Graph this data with *t* on the x-axis.

(d) Use the graph from part b to establish the value of the cooling constant for the room where you conducted the experiment.

(e) Substitute the values that you know for , *A* and *k* into original formula. Graph this on the same graph as part a. Does it pass through your data points?

(f) What would you expect to happen if you put this same empty soda can in a sauna at 100˚F?

Project 4: Even and Odd Functions

A function can be either even or odd. A function *f(x)* is even if $( ) = \quad (- \quad)$ for all real numbers *x*. The graph of an even function is symmetrical about the y-axis. A function *f(x)* is odd if $- \quad ( ) = \quad (- \quad)$ for all real numbers *x*. The graph of an odd function is the same if it is rotated 180 degrees around the origin.

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This activity involves randomly creating coefficients and their signs for a polynomial. In this activity you will create several polynomials of various degrees and graph them. Roll a number cube (die) to determine the coefficient of each term. Flip a coin to determine the sign of each term using "+" for heads and "-" for tails.

Procedure:

(a) Create a polynomial of degree 4 with two terms. It should be in the form, $(\ ) =$ $+$. To determine the coefficient *a*, roll the number cube. To determine if *a* is positive or negative, flip a coin. Do the same to determine the coefficient *b*.
(b) Determine if the function is even or odd (or neither). Then graph the function to verify that the function is even or odd. If the function is neither, then repeat Step a until you create an even or odd function.
(c) Create a polynomial of degree 6 with three terms. It should be in the form, $(\ ) =$ $+$ $+$. Use the number cube and coin to determine the coefficients *a*, *b*, and *c*.
(d) Determine if the function is even or odd (or neither). Then graph the function to verify that the function is even or odd. If the function is neither, then repeat step c until you create an even or odd function.
(e) Create a polynomial of degree 5 with three terms. It should be in the form, $(\ ) =$ $+$ $+$. Use the number cube and coin to determine the coefficients *a*, *b*, and *c*.
(f) Determine if the function is even or odd (or neither). Then graph the function to verify that the function is even or odd. If the function is neither, then repeat step e until you create an even or odd function.

Report your results in a poster. Include any failed polynomials that you tried.

Project 5: The Richter Scale

The Richter scale is used to measure the magnitude of an earthquake, using the formula $= \log -$ where *E* is the intensity of the earthquake being measured and is the intensity of a standard earthquake unit. If we call 1 unit, then the formula reduces to $= \log$.

(a) Write the formula in exponential form.
(b) The San Francisco earthquake of 1989 registered a magnitude of 6.9 on the Richter scale. The death toll was 62. In this same city in 1906, an earthquake measured 8.3 on the Richter scale. The death toll was 503. Calculate how much more powerful (intense) the 1906 earthquake was than the 1989 earthquake.
(c) In 2003 there was an earthquake in southern Iran that registered 6.6 on the Richter scale. The death toll was a tragic 31,000. How much less powerful was this earthquake than the one in San Francisco in 1989? Why do you think the death toll was so much higher? What factors could have contributed to the huge difference in fatalities?
(d) Suppose an earthquake in Los Angeles is only half as powerful as the 2005 earthquake in Indonesia, which measured 8.7 on the Richter scale. What would the Los Angeles earthquake measure on the Richter scale?

Present your results in poster or PowerPoint form.

Project 6: How Loud is Too Loud?

Use the equation $= 10 \log -$ where $=$ ———— for calculating the decibel (dB) rating of sounds to answer each of the following:

(a) How much louder is a 60 dB sound than a 40 dB sound?

(b) How much louder is a 75 dB sound than a 70 dB sound?
(c) The school safety committee requires that the sound intensity in the gym during a dance does not exceed 80 dB. When the dance begins, the sound is measured using a sound level meter at 90 dB. The students in charge don't think this is a big difference in the intensity of the sound. How many times louder is the music than it ought to be? Is the teacher in charge justified in asking the DJ to lower the volume of the music?
(d) At a rock concert the sound level is measured to be 110 dB. How much louder is this than the level allowed at the dance (80 dB)?
(e) The Occupational Safety and Health Act (OSHA) states that continued exposure to sound levels of 90 dB and above will lead to hearing loss. How loud do you play your stereo? If the level of your personal stereo is 88 dB and you move it up to 91 dB, how much more intense is the sound?
(f) Report the results of the problems above in a brief report. Then, make a poster or brief PowerPoint advising teenagers about the importance of using care with the volume of their iPods and mp3 players. Be specific with the numbers and potential dangers (there is a lot of information available online).

Project 7: Toss in the Can

(You will need someone to help you with this experiment)

When an object is thrown into the air along a path similar to a parabola, the maximum height it reaches is represented by the function $h(\ ) =\quad +\quad +$, where *r* is half of the restraining force, *v* is the initial upward velocity, *t* is the time in seconds, and *c* is the initial height.

In this lab you will shoot a "free throw" and take measurements to determine the maximum height of the ball during the shot. Use a trash can that is between 75 centimeters and 100 centimeters tall as the basketball hoop and a paper wad as the basketball. When you shoot the free throw, you need to sit on the floor so that you are about the same height as the trash can. Find the maximum height your paper wad free throw reaches.

Procedure

(a) Sit on the floor and act like you are going to shoot a free throw with a paper wad. Your partner needs to measure to get a value for *c*, the height at which you will release the shot. Trade roles so that you can measure your helper. Record the height in meters.
(b) Use masking tape to create a line that is 1.5 meters from the trash can.
(c) Sit on the free throw line and shoot a free throw. Your partner should use a stopwatch to measure the time it takes for the paper wad to leave your hand and hit the trash can or go into it. Complete 5 free throws.
(d) Repeat step c and time your partner's 5 free throws.
(e) Assuming the path the paper wad follows models a parabola, at what time during the flight would the paper have reached its maximum height? How do you find the value you use for *t* to find the maximum height of your free throw?
(f) Use the formula to find the maximum height that your free throw shot reaches. For *r*, use -4.9 ——, which represents half of the restraining force, gravity. For *v* use 3.0 ——. Round the calculated height to the nearest hundredth.
(g) Sketch a graph of your free throw. The x-axis should show time (in seconds) and the y-axis should show height (in meters).

Report your results in a lab report or poster.

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Project 8: Measuring an Umbrella

Use an open umbrella as a model of a parabolic curve. Determine an equation for a parabola that when rotated about a line, modeled by the handle of the umbrella, forms the domed part of the umbrella.

Procedure:

(a) Open an umbrella, turn it upside down, and set it on the ground. Have a helper hold the handle of the umbrella so that it is perpendicular to the ground. Measure the maximum diameter of the umbrella in inches.
(b) Measure the height in inches that the outer edge of the umbrella is above the ground.
(c) Consider the time of the umbrella to be the point of origin on a coordinate plane. Use the measurements from steps a and b to determine three points on a parabolic curve that model a "straight on" view of the umbrella. The tip of the umbrella will model the vertex of the parabola, and the handle of the umbrella will model the axis of symmetry.
(d) The standard equation for a parabola is $\quad = \quad + \quad +$. Substitute the three points from step c into this equation for *x* and *y* to generate a system of three equations.
(e) Use this system to solve for *a*, *b*, and *c (Hint: how did we solve systems of equations with three variables last semester?)*, and substitute these values for *a*, *b*, and *c* into the equation $\quad = \quad + \quad +$ to write the equation for the parabolic curve that represents the shape of the umbrella.
(f) Use the equation for the parabolic curve that you found in Step e to find additional points on the parabolic curve. For the values of *x*, include both negative values and positive values.
(g) Graph the parabolic curve that, when rotated around its axis of symmetry, forms the shape of the umbrella.
(h) Test the points that you plotted in step g by measuring the actual umbrella. For example, if one of your points is (10,2.5), measure the height that the umbrella rises above the ground in inches at a horizontal distance of 10 inches from the tip of the umbrella. In this case, it should rise 2.5 inches above the ground.
(i) Does it matter in which direction from the tip of the umbrella the horizontal distance is measured when determining the height that the umbrella rises above the ground?

Extra Credit

There are 3 extra credit project options each worth 10 points. You may select one to submit as extra credit. Projects must be impeccable to receive full credit.

Extra Credit Project 1: Educational Contributions

An educational foundation offers to give the Cobb County School System money in January 2010 to improve its access to technology. There are two plans possible to distribute the money.

> Plan A: The school system will receive $20 million outright.
>
> Plan B: The school system will be allocated a penny for the first day of the month, two pennies for the second day, four pennies for the third day, eight pennies for the fourth day, and so on. This pattern will continue for all of January. At the end of the month, the school system will be given the sum that has accumulated.

In February 2011, the school system has the opportunity to get more money from the same educational foundation. For this second installment, there are also two plans to distribute the money.

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Plan A: The school system will receive $5 million outright.

Plan B: The school system will be allocated a penny for the first day of the month, two pennies for the second day, four pennies for the third day, eight pennies for the fourth day, and so on. This pattern will continue for all of January. At the end of the month, the school system will be given the sum that has accumulated.

You are the leader of a student group chosen to given a recommendation to the Board of Education of which plans to accept. Prepare a brief presentation indicating which plan your group believes will be most beneficial to the school system. Remember that the School Board loves facts and figures, so be sure to show your reasoning clearly within your presentation.

This presentation should be completed in Microsoft Powerpoint.

Extra Credit Project 2: Gravitational Force

The gravitational force between an object with mass *m*, and an object with mass *m*, separated by a distance *r* is given by the formula $=$ ——— . In the formula, the force, *F*, is measured in Newtons, the masses are measured in Kilograms, and the distance is measures in meters. *G* is the constant of gravitation, which is approximately 6.67×10 .

(a) Solve the formula for *r*. Be sure to rationalize the denominator.
(b) Two satellites are orbiting Earth. One satellite has a mass of 12,000 kilograms, and the other satellite has a mass of 15,000 kilograms. The gravitational force between the satellites is 4.0×10 Newtons. About how far apart are the two satellites?
(c) The mass of the Earth is about 6×10 kilograms. The gravitational force between the Earth and a skydiver with a mass of 80 kilograms is approximately 2.2×10 Newtons. About how far from the Earth is the skydiver?

Present your results for this problem in a poster.

Extra Credit Project 3: Carbon Dating

C-14 is a radioactive isotope of carbon that exists in a fixed percentage in nature. Living tissue, which constantly has its carbon content renewed through normal metabolic processes, also contains this same percentage of C-14. When death occurs, however, the issue no longer takes on new carbon and the C-14 decays with a half-life equal to approximately 5700 years. The fraction of C-14 (N) left after t years of decay is given by $= -$ ——.

(a) If the measured C-14 content of an animal fossil is 0.05 of the concentration in a living organism, about how long ago did the animal die?
(b) Some explorers find a document written on parchment. They think they may have stumbled on the original version of the Bible, which would be worth millions of dollars. The explorers bring the document to you for testing. You measure the C-14 concentration in the paper to be 0.72 of the concentration found in living plants. Could this document be what the explorers think it is? Prepare a poster or brief PowerPoint to present your findings to the explorers.

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General Scoring Rubric

Understanding the Problem	0: Complete misunderstanding of the problem 1: Part of the problem misunderstood or misinterpreted 2: Complete understanding of the problem
Planning a Solution	0: No attempt, or totally inappropriate plan 1: Partially correct plan based on part of the problem being interpreted correctly 2: Plan could have led to a correct solution if implemented properly
Getting an Answer	0: No answer, or wrong answer based on inappropriate plan 1: Copying error; computational error; partial answer for a problem with multiple answers; answer missing label 2: Correct answer and correct label for the answer
Reporting the Answer	0: Omits significant parts or all of the response; missing diagrams; major errors 1: Incomplete response; ambiguous response; incomplete or unclear explanation; diagrams are unclear 2: Contains a complete response with clear, coherent unambiguous and elegant explanation; diagrams are clear and simple; communicates effectively to the intended audience; gives strong supporting arguments
Visual Presentation	0: Presentation is sloppy or unorganized or cannot be followed by the viewer 1: Presentation is moderately appealing to the viewer or contains visual distractions 2: Presentation is attractive and visually appealing to the viewer

Presentation Rubric

10 points	Student knows the material to be presented and presents it fluidly; responds appropriately to any questions
5 points	Student delivers material with hesitation; unable to respond appropriately to any questions
1 point	Student hesitates throughout the presentation; understanding is unclear
0 points	Student refuses or is unprepared to present