Name I.D. Number

Project 2

Evaluation 32
Second Year Algebra 2 (MTHH 040 059)

Be sure to include ALL pages of this project (including the directions and the assignment) when you send the project to your teacher for grading. Don't forget to put your name and I.D. number at the top of this page!

This project will count for 8% of your overall grade for this course and contains a possible 100 points total. Be sure to read all the instructions and assemble all the necessary materials before you begin. You will need to print this document and complete it on paper. Feel free to attach extra pages if you need them.

When you have completed this project you may submit it electronically through the online course management system by scanning the pages into either .pdf (Portable Document Format), or .doc (Microsoft Word document) format. If you scan your project as images, embed them in a Word document in .gif image format. Using .gif images that are smaller than 8 x 10 inches, or 600 x 800 pixels, will help ensure that the project is small enough to upload. Remember that a file that is larger than 5,000 K will NOT go through the online system. Make sure your pages are legible before you upload them. Check the instructions in the online course for more information.

Part A – Exploring Conic Sections in Everyday Life (possible 22 points)

Activity: Your job is to locate pictures of Circles, Parabolas, Ellipses, and Hyperbolas in the real world around you. These conics can be man-made or something found in nature *but* you **can't** make or draw them yourself in order to get the desired shape. If you chose to use pictures from the Internet you MUST cite the URL for each picture – if not, you will lose points.

You will create a collage of pictures illustrating all four conic sections (circles, parabolas, ellipses, and hyperbolas) found in **nature** (leaves, flowers, body parts, etc.), **architecture** (bridges, doorways, etc.), and **everyday items** (appliances, logos, furniture, etc.).

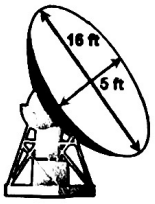
Requirements: Your Picture Collage must contain:

1. Pictures of the entire objects where the conic section is found.
   a. cut from magazines, uploaded images taken from a smart phone, or downloaded from the Internet with URL source sited.
2. Three different examples for each of the four conic sections: circles, parabolas, ellipses, and hyperbolas (no repeat pictures are allowed). **1 pt each**
3. Trace in marker (or use an editing tool), the conic in each picture. **5 pts**
4. A title for the Picture Collage. **1 pt**
5. Creativity! **4 pts**

Part B – Applications of Parabolas & Ellipses (possible 30 points)

Activity: You will answer the following questions. Clearly label the questions and show ALL necessary steps.

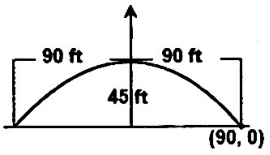
1. A satellite dish is shaped like a parabola. The signals that originate from a satellite strike the surface of the dish and are reflected to a single point, where the receiver is located. If the dish is 16 feet across at its opening and 5 feet deep at its center, at what position should the receiver be placed? **(4 pts)**



2. A searchlight is shaped like a parabola. If the light source is located 3 feet from the base along the axis of symmetry and the depth of the searchlight is 4 feet, what should the width of the opening of the searchlight be? **(4 pts)**

3. The towers of a suspension bridge are 450 feet apart and 150 feet high from the roadway. Cables are at a height of 25 feet above the roadway, midway between the towers, but gradually get taller toward each end. Assume the *x*-axis is the roadway and the *y*-axis is the center of the bridge, write an equation for the parabola. What is the height of the cable at a point 50 feet from one of the towers? Round to the nearest whole number. **(4 pts)**

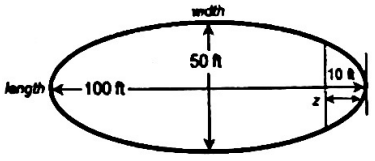
4. The parabolic arch shown in the figure is 45 feet above the water at the center and 180 feet wide at the base. Will a boat that is 30 feet tall clear the arch 30 feet from the center? (Use water as the *x*-axis.) **(4 pts)**



5. The Whispering Gallery in the Museum of Science and Industry in Chicago is 47.3 feet long and is in the shape of an ellipse. The distance from the center of the room to the foci is 20.3 feet. Find an equation that describes the shape of the room. How high is the room at its center? **(4 pts)**

6. A racetrack is in the shape of an ellipse, 100 feet long and 50 feet wide. **(6 pts)**

a. Write the standard form of the elliptical track.



b. What is the width of the line z, which is 10 feet in from the right vertex, assuming your new

ellipse is proportional?

c. Identify both endpoints of the new width.

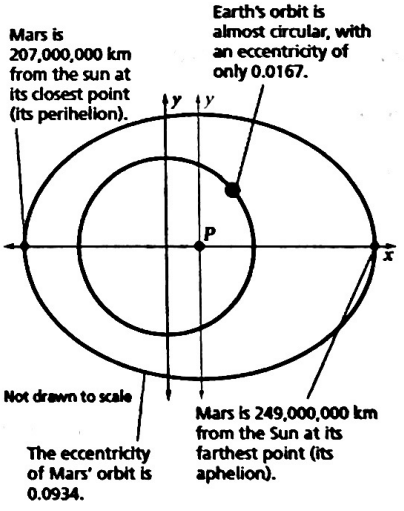
7. A bridge is to be built in the shape of a parabola and is to have a span of 140 feet. The height of the arch at a distance of 50 feet from the center is to be 20 feet. Find the height of the arch at its center. **(4 pts)**

Part C – Martian Math (possible 12 points)

Activity: Even life has not yet been discovered on Mars, today we know a lot of other things about the planet. Mars has a day about 25 hours long, a pattern of seasons similar to Earth's, and polar icecaps. Mars also has surface temperatures that rarely rise above freezing and almost no oxygen in its atmosphere. Mars is often called the Red Planet because red deserts cover its surface.

1. Mars travels in an elliptical orbit with the Sun at one of its foci. Use the data from the diagram to calculate *a*, *b*, and *c* of this *elliptical* orbit. **(4 pts)**

2. Point *P* is the midpoint between Mars' closest and farthest distances to the Sun. Use your values of *a* and *b* to write an equation of the elliptical orbit of Mars relative to a coordinate system drawn through point *P* (*y*-axis in gray). Use distances in millions of kilometers. **(3 pts)**

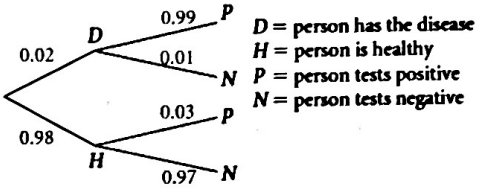


3. It is also useful to define Mars' motion relative to the Sun. Imagine a new coordinate system (*y*-axis in black) with its origin at the center of the Sun. Rewrite your equation for the ellipse in this new coordinate system. **(3 pts)**

4. Explain how the eccentricity of a planet's orbit can affect its annual weather cycle. **(2 pts)**

Part D – Comparing Conditional Probability (possible 24 points)

Activity: You learned about Conditional Probability in Lesson 8. Use your knowledge to answer the following questions using the given tree diagram. For example to find $P(P \mid D)$, which is the probability that a person with a disease will test positive for it will be $P(P \mid D) = 0.99$.



D = person has the disease
H = person is healthy
P = person tests positive
N = person tests negative

Example: Find $P(H \mid P)$.

Since $P(H \mid P) = \dfrac{P(H \text{ and } P)}{P(P)}$, find $P(H \text{ and } P)$ and $P(P)$.

$P(H \text{ and } P) = 0.98 \cdot 0.03$

$= 0.0294$

$P(P) = P(D \text{ and } P) \text{ or } P(H \text{ and } P)$

$= 0.02 \cdot 0.99 + 0.98 \cdot 0.03 = 0.0492$

So $P(H \mid P) = \dfrac{P(H \text{ and } P)}{P(P)} = \dfrac{0.0294}{0.0492}$ Substitute.

≈ 0.598 Simplify.

About 60% of the people who test positive do not actually have the disease.

Use the tree diagram in the Example above to find each probability for 1–4. **(2 pts each)**

1. $P(N)$ 2. $P(H \text{ and } N)$ 3. $P(H \mid N)$ 4. $P(D \mid N)$

5. Explain the difference in the meaning between $P(P \mid D)$ and $P(D \mid P)$ for the test in the opening example. Compare the values of $P(P \mid D)$ and $P(D \mid P)$. What is the best use for this test? Explain. **(2 pts)**

6. You can take Bus 65 or Bus 79 to get to work. You take the first bus that arrives. The probability that Bus 65 arrives first is 75%. There is a 40% chance that Bus 65 picks up passengers along the way.

There is a 60% chance that Bus 79 picks up passengers. Your bus picked up passengers. What is the probability that it was Bus 65? **(2 pts)**

7. According to estimates from the federal government's 2003 National Health Interview Survey, based on face-to-face interviews in 16,677 households, about 58.2% of U.S. adults have both a landline and a mobile phone, 2.8% have only a mobile phone service, but no landline, and 1.6% have no telephone service at all.

   a. Make a Venn diagram to help visualize the following probabilities: **(2 pts)**

   b. What proportion of U.S. households can be reached by a landline call? **(2 pts)**

   c. Are having a mobile phone and having a landline independent events? Explain. **(2 pts)**

8. Make a tree diagram based on the survey results below. **(2 pts)** Find *P*(a female respondent is left-handed) and *P*(a respondent is both male and right-handed). **(2 pts each)**

   - Of all the respondents, 17% are male.
   - Of the male respondents, 33% are left-handed.
   - Of female respondents, 90% are right-handed.

Part E – Area Under the Curve **(possible 12 points)**

Activity: In the field of statistics the function $f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$ is used to model data like birth weight or height. In Lesson 8, you learned how to calculate z-scores, which then those scores related to the number of standard deviations that specific value was from the mean. Now, you will extend that knowledge of z-scores and find the area under the graph of the function, $f(x)$, to find probabilities.

Ex. In a given population, the weights of babies are normally distributed about the mean, 3250 g. The standard deviation is 500 g. Find the probability that a baby chosen at random weighs from 2250 g to 4250 g.

Step 1 Find the z-scores of the lower and upper limits.

Step 2 Enter $f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{x^2}{2}}$ as Y_1.

Adjust window values if needed.

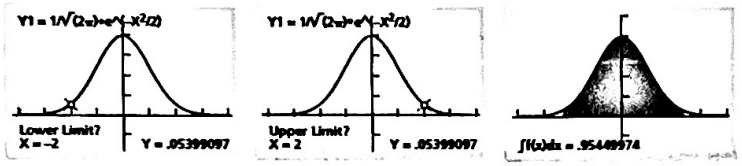
$$\text{z-score} = \frac{\text{value} - \text{mean}}{\text{std. dev.}}$$

WINDOW
Xmin = –4.7
Xmax = 4.7
Xscl = 1
Ymin = –.2
Ymax = .5
Yscl = .1
Xres = 1

$$z_1 = \frac{2250 - 3250}{500} = \frac{-1000}{500} = -2$$

$$z_2 = \frac{4250 - 3250}{500} = \frac{1000}{500} = 2$$

Step 3 Use the CALC button and press 7 to access the $\int f(x)dx$ feature. Move the cursor until the lower limit is $x = -2$. Press ENTER. Then repeat steps with the cursor to find the upper limit $x = 2$. Press ENTER.



The area under the curve from $x = -2$ to $x = 2$ is about 0.95. Therefore, the probability that a baby weighs from 2250 g to 4250 g is about 95%.

Use the data and the function in the example above. Find the probability that the weight of a baby chosen at random falls within each interval 1–4. **(1 pt each)**

1. 3150–4150 g 2. 4300–4500 g 3. less than 1800 g 4. more than 4550 g

5. For questions 1–4, estimate the number of babies within each interval from a population of 2400 babies. Round to nearest whole number. You will have 4 answers total. **(1 pt each)**

answer for question 1 _____

answer for question 2 _____

answer for question 3 _____

answer for question 4 _____

6. A battery company manufactures batteries having life spans that are normally distributed, with a mean of 45 months and a standard deviation of 5 months. Find the probability that a battery chosen at random will have each life span. **(2 pts each)**

a. 45–52 months

b. 48–50 months