2011 Excellence in Mathematics Contest
Team Project

CHANDLER-GILBERT COMMUNITY COLLEGE

School Name:

Group Members:

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Reference Sheet

Formulas and Facts

You may need to use some of the following formulas and facts in working through this project. You may not need to use every formula or each fact.

$A = bh$ Area of a rectangle	$C = 2l + 2w$ Perimeter of a rectangle	$A = \pi r^2$ Area of a circle
$C = 2\pi r$ Circumference of a circle	$A = \frac{1}{2}bh$ Area of a triangle	$m = \frac{y_2 - y_1}{x_2 - x_1}$ Slope
$\frac{\text{change in amount}}{\text{original amount}} \cdot 100\%$ Percent Increase/Decrease	5280 feet = 1 mile	3 feet = 1 yard
16 ounces = 1 pound	2.54 centimeters = 1 inch	$a^2 + b^2 = c^2$ Pythagorean Theorem
1 kilogram = 2.2 pounds	1 ton = 2000 pounds	1 gigabyte = 1000 megabytes
1 mile = 1609 meters	1 gallon = 3.8 liters	1 square mile = 640 acres
1 sq. yd. = 9 sq. ft	1 cu. ft. of water = 7.48 gallons	1 ml = 1 cu. cm.
$V = \pi r^2 h$ Volume of cylinder	$V = lwh$ Volume of rectangular prism	$V = \frac{4}{3}\pi r^3$ Volume of a sphere
Lateral SA = $2\pi \cdot r \cdot h$ Lateral surface area of cylinder	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ Quadratic Formula	$\tan\theta = \frac{\sin\theta}{\cos\theta}$

TEAM PROJECT
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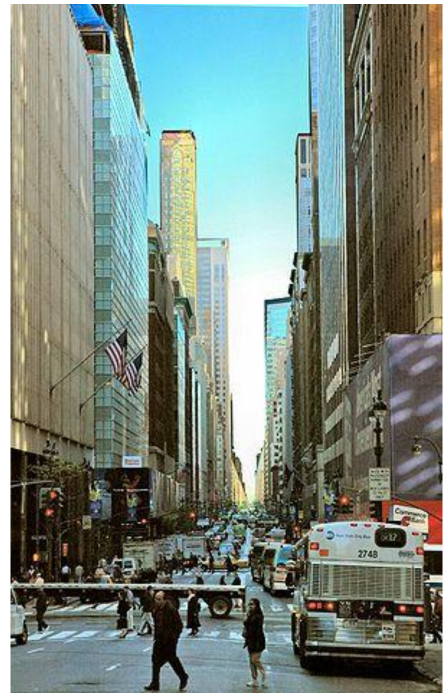
The Team Project is a group activity in which the students are presented an open ended, problem situation relating to a specific theme. The team members are to solve the problems and write a narrative about the theme which answers all the mathematical questions posed. Teams are graded on accuracy of mathematical content, clarity of explanations, and creativity in their narrative.

Part 1 – Introduction



Madison Avenue, in the borough (suburb/town) of Manhattan in New York City, is often associated with the advertising industry. Starting in the 1860's and up until the 1970's or later, many advertising agencies were located on Madison Avenue. In recent decades, these agencies have moved off of Madison Avenue and only a few remain but it is still common to hear of "Madison Avenue" when referring to any activity related to the advertising industry.

Advertising plays a very large role in our American culture. From billboards to television and radio to sports stadiums and to product placement in movies, companies work to get their product visible and known to the American people. We are all so familiar with company logos since they are made visible to us thousands and thousands of times each day.

We can learn to analyze advertisements to better understand the purpose of the ad and to learn how to respond to it. Is the advertisement designed to make us aware of a new product? Is it intended to persuade us to switch from one product to another? Who is the intended audience for the ad? Is that ad trying to convince us that their product is the best and that we really need to purchase the product?

We can also learn to analyze advertisements mathematically. This is the focus of this project. On the following pages, you will study a particular advertisement and respond to questions intended to allow you to think mathematically about the situation.

Have fun!

Part I – Shrinking Twinkies
(taken from The Mathematics Teacher –Media Clips – Vol. 103, No. 2, September 2009 – National Council of Teachers of Mathematics)

Associated Press
updated 11/3/2008 8:25:52 AM ET

MILWAUKEE — Hostess Twinkies are becoming the latest product remade and repackaged into 100-calorie snack packs, a product some analysts say could do well given that more people are packing their own lunches in the slumping economy. The maker of the golden yellow, creme-filled cake is launching "Twinkie Bites" nationwide in stores on Monday…Some 500 million Twinkies are sold every year.

And while Leavitt notes that the original Twinkie come in at 150 calories, people asked for a lightened version and the company got to work. They didn't want to just shrink the Twinkie, known for its elongated shape, Leavitt said, so they created three, miniature round versions. Leavitt said people enjoy having multiple bites rather than just the one product.

"It's not some impostor like some portion control products would be," Leavitt said. "From that standpoint it eats like a Twinkie, it smells like a Twinkie, it tastes like a Twinkie." …

For this part of the project, you will need to refer to the following tables of nutritional facts.

Nutrition Facts for One Traditional Twinkie

Nutrition Facts

Serving Size 1 twinkie (42.0 g)

Amount Per Serving	
Calories 150	Calories from Fat 40
	% Daily Value*
Total Fat 4.5g	**7%**
Saturated Fat 2.5g	**12%**
Cholesterol 20mg	**7%**
Sodium 220mg	**9%**
Total Carbohydrates 27.0g	**9%**
Sugars 19.0g	
Protein 1.0g	
Vitamin A 0% •	Vitamin C 0%
Calcium 2% •	Iron 0%

* Based on a 2000 calorie diet

Nutrition Facts for New Twinkie Bites (Three-Pack)

Nutrition Facts
Serv. Size 3 Cakes (29g)
Servings Per Container 1
Calories 100
Calories from Fat 25

Amount/Serving	%DV*	Amount/Serving	%DV*
Total Fat 2.5g	4%	**Total Carb.** 18g	6%
Sat. Fat 1g	5%	Dietary Fiber <1g	2%
Trans Fat 0g		Sugars 11g	
Cholest. 10mg	3%	**Protein** 1g	
Sodium 160mg	7%		

Vitamin A 0% • Vitamin C 0% • Calcium 0% • Iron 2%

*Percent Daily Values (DV) are based on a 2,000 calorie diet.

Part I – continued…

1. Calculate the percent decrease of mass in one serving of the new product compared with the mass (in grams) of the traditional product.

The percent decrease of the grams in the new product compared with the grams in the traditional product is

$$(42\ g - 29\ g)/42\ g \cdot 100\% = 31\%$$

2. Calculate the percent decrease of calories in the new product compared with the calories of the traditional product.

The percent decrease of the calories in the new product compared with the calories in the traditional product is

$$(150\ cal - 100\ cal)/150\ cal \cdot 100\% = 33\frac{1}{3}\%$$

3. Calculate the percent decrease of calories/gram in the new product compared with the calories/gram of the traditional product.

The percent decrease of the calories/gram in the new product compared with the calories/gram in the traditional product is

$$(3.57\ cal/g - 3.45\ cal/g)/3.57\ cal/g \cdot 100\% = 3.4\%$$

4. Use your results to determine which Twinkie is the healthier snack.

Answers will vary. The decrease in calories is mostly due to the decrease in grams. The 3% decrease in calories/gram is not high. Many other snacks have a much lower calories/graph ratio. And there are other factors to consider beyond this ratio.

Part I – continued…

5. a) Complete the table.

	1 Traditional Twinkie (Old Twinkie)	1 Three-pack Twinkie Bites (New Twinkie)	Percent Decrease (–) or Increase (+)
Calories from Fat	40	25	$(25-40)/40\cdot100\%=-37.5\%$
Total Fat (g)	4.5	2.5	$(2.5-4.5)/4.5\cdot100\%=-44\%$
Saturated Fat (g)	2.5	1.0	$(1.0-2.5)/2.5\cdot100\%=-60\%$
Cholesterol (g)	20	10	$(10-20)/20\cdot100\%=-50\%$
Sodium (g)	220	160	$(160-220)/220\cdot100\%=-27\%$
Total Carbohydrates (g)	27	18	$(18-27)/27\cdot100\%=-33\frac{1}{3}\%$
Sugars (g)	09	11	$(11-19)/19\cdot100\%=-42\%$

b) If the Hostess Company used the same recipe for the new three-pack Twinkie and for the traditional Twinkie, what number should have filled each cell of the percent decrease/increase column?

Around 30%,since the new three-pack has a mass around 30% less than the traditional Twinkie.

c) Use the data from the table to support your conclusion in deciding whether the recipe for the new three-pack Twinkie differs significantly from the recipe for t he traditional Twinkie.

The Hostess Company may have added salt to hide the fact that the new three-pack has less sugar and fat. These percent decrease (particularly the 43% decrease in saturated fat) support the claim that Hostess has made the new product significantly healthier.

Part II – Does this ad make sense?

(taken from The Mathematics Teacher –Media Clips – Vol. 100, No. 9, May 2007 – National Council of Teachers of Mathematics)

1. How is the claim that the Hanging Mosquito Lantern can "Protect an Area 15 times Greater Than Citronella Buckets or Candles" inconsistent with the picture? How might the ad be reworded to be mathematically accurate?

The claim refers to the area, but the illustration shows two people being protected up to a radius of 15 feet from the lantern and 1 foot from the bucket, respectively. The ad might have more accurately read "Protects up to a Radius 15 times Greater that Citronella Buckets or Candles."

Part II – continued…

2. Suppose that any mosquito repellent devise can protect a circular area. What area would be protected by each device? How might the ad be reworded to be mathematically accurate about areas?

The lantern would protect an area of about 700, or 225π, square feet:

π

The bucket would protect a area of about 3, or π, square feet:

π

Since 225π/π = 225, the ad might have read “Protects an Area More Than 200 Times Greater Than Citronella Buckets or Candles.”

3. Suppose that the mosquito repellent devices protect hemispherical regions with bases on the ground. What volume would be protected by each device? How might the ad be reworded to be mathematically accurate about volumes?

The lantern would protect a volume of about 7000, or 2250π, cubic feet:

$$\frac{1}{2}\cdot\frac{4}{3}\cdot\pi\cdot 15^3 \approx 7068.58$$

The bucket would protect a volume of about 2, or 2π/3, cubic feet:

$$\frac{1}{2}\cdot\frac{4}{3}\cdot\pi\cdot 1^3 \approx 2.09$$

Since , the ad might have read “Protects a Volume More Than 3000 Times Greater Than Citronella Buckets or Candles.”

Part II – continued…

4. Did the advertiser understate or overstate the relative benefits of its product? Why do you think the advertiser might have done that?

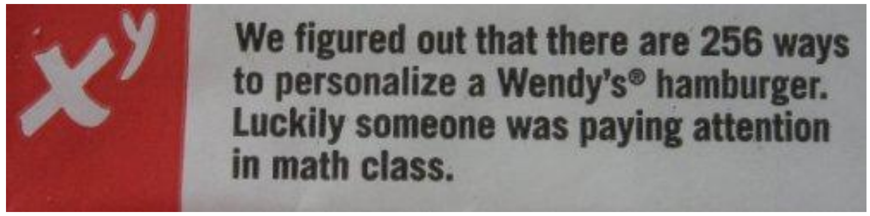
The advertiser understated the relative benefits of the product. Possible reasons for this are varied. For example, the advertiser may have wanted to express the relationship in simplest terms for consumers, and it may have considered linear measurements the easiest to understand. However, it should not have used the term area when referring to a radius!

Part III – Wendy's Burger Variations

(taken from The Mathematics Teacher –Media Clips – Vol. 103, No. 3, October 2009 – National Council of Teachers of Mathematics)

Several years ago, a Wendy's fast-food bag had an interesting mathematical claim.

In case you can't read the claim, it says,



At the time this advertisement appeared, Wendy's nutrition information indicated that a hamburger could have 8 possible toppings.

1. With 8 available toppings, in how many ways can you personalize a hamburger by using exactly 2 toppings (not plain or only one topping are allowed)?

   Using exactly 2 of 8 toppings, you can personalize a hamburger in 28 ways.

2. With 8 available toppings, in how many ways can you personalize a hamburger by using exactly 5 toppings?

   Using exactly 5 of 8 toppings, you can personalize a hamburger in 56 ways.

3. Determine the total number of ways you can personalize a Wendy's hamburger using any combination of the 8 available toppings. Is the claim on the bag correct?

   One solution is to recognize that there are 2 possible decisions to be made for each of the 8 toppings: include the topping or not. We have 2 choices for mayonnaise, 2 for ketchup, 2 for mustard, etc. for each of the 8 toppings. So the total number of possible choices is 2^8=256.

Part III – continued…

4. Consider 4 additional toppings. With just these 4 additional choices, in how many ways can you personalize a Wendy's burger?

The additional 4 toppings bring the total number of toppings to 12. Repeating the method from #3, there are $2^{12}=4096$ ways.

5. Consider the possibility of requesting double toppings. In how many ways can you personalize a hamburger with the option of doubling any of the 8 toppings? That is, you may or may not include any of the 8 toppings in this case.

One way to think about this is to think that there are now 3 decisions to make for each topping: include it as a single topping, as a double topping, or excluding that topping. Therefore, there are a total of $3^8=6561$ ways.

6. In how many ways can you personalize a burger with the option of doubling any of the 12 toppings? Again, you may or may not include any of the 12 toppings in this case.

Now we have 3 choices for each of 12 toppings. Therefore, there are $3^{12}=531,441$ ways.

Part III – continued…

7. Create a new advertisement for the number of ways to personalize a Wendy's burger. Be creative. What suggestions would you make to Wendy's regarding its ad?

Answers will vary. Suggestions to Wendy's might include making the statement more general to allow for all 12 toppings and for the possibility of double toppings, thus making the number of ways to personalize a Wendy's bugger more impressive to the consumer.

Part IV – Analyze This Advertiser's Claim

(taken from The Mathematics Teacher –Media Clips – Vol. 99, No. 8, April 2006 – National Council of Teachers of Mathematics)

Source: Target advertising circular, February 20, 2005

Without knowing the base, height, or area of either screen, use the following steps to determine if the area of the larger screen is twice (2X) the area of the smaller screen.

1. Write an equation relating the base *b* and height *h* of a rectangular screen with a 7-inch diagonal.

$$b^2 + h^2 = 49$$

2. Write an equation relating the base *B* and height *H* of a rectangular screen with a 10-inch diagonal.

$$B^2 + H^2 = 100$$

Part IV – continued…

3. Assume that these screens are geometrically similar in shape: that is $B = kh$ and $H = kh$. Rewrite your equation in answer 2, relating B and H in terms of b and h.

$$k^2 b^2 + k^2 h^2 = 100$$

4. Find the value of k.

Solve the system of equations and to get .

5. Determine the ratio of the area of the 10-inch screen to the area of the 7-inch screen.

Using the previous answers,

Area of 7-inch screen =

Area of 10-inch screen = =

$$\frac{Area\ of\ 10-inch\ screen}{Area\ of\ 7-inch\ screen} = \frac{\frac{100}{49}bh}{bh} = \frac{2}{1}$$

So the advertisement is accurate.