Celebrating π Week

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GOALS AND OBJECTIVES

The goal of celebrating π-Week is to engage students and teachers in fun, math-related activities.

SUNSHINE STATE STANDARDS

MA.A.1.4.1, MA.A.1.4.2	π Necklace
MA.C.1.4.1, MA.C.3.4.2, MA.B.3.4.1, MA.D.1.4.1	Circumference / Diameter Ratio
MA.B.4.4.1, MA.B.4.4.2, MA.D.1.4.1, MA.D.2.4.1	Linear Regression
MA.D.1.4.1, MA.D.1.4.2	Integral Activity

OVERVIEW

During the week that contains March 14th ("π-Week") students are engaged, through their Math classes and via school-wide announcements, in π-related activities, lessons, and competitions.

BEFORE π-WEEK:

1.) <u>Announcing the π-off competition</u>: A school-wide announcement was made during the morning announcements, via the Math classes, and was posted in the Math hallway bulletin board giving the details for the π-off competition to be held on March 14th. Since students would have to write down as many digits of π as they could remember, this announcement was made 1 month prior to π-Week.

2.) <u>Hallway Decorations:</u> Math teachers in the department were given strings of 50-100 digits of π so that their students could make the hallway decorations. These consisted of digits drawn on $8\frac{1}{2} \times 11$ unlined paper which students decorated and often times personalized. Since each digit was drawn on a separate paper, teachers had many of their students participate. In addition, the decimal point and ellipsis (…) at the "end" of π, the approximately equal to (≈), and the symbol π itself, also had to be drawn and decorated. Finally student volunteers from the Math and National Honor Societies helped cover the Math hallways' walls with as many digits of π as they could fit. (During π Week, many students stopped by to see "their" digits on the walls!)

3.) Other Decorations: Mathematics teachers were given π posters that they could put up in their classrooms in preparation for π-Week. The ceramics class made a beautiful plate with the π symbol inside it and a 3-dimensional paper weight in the shape of π. These and other π objects were displayed in the Media Center's display case along with their collection of π books. A Math student aide made bead "π-necklaces" for all the department teachers to wear during the week. Finally, the school's Art Silver Knight Nominee designed a poster to be used during the Week.

4.) Questions and Prizes: The π Week Daily Questions were written and the prizes decided upon and purchased. Since each Math teacher was given prizes for their own class competitions, a lot of "smaller" prizes had to be purchased (like pencils personalized with 20 – 30 digits of π). Some prizes were donated by community agencies, and contacting them to request and then thank for the prizes, was time consuming.

5.) Other Support: The school's webmaster was given π-Week information regarding the activities and competitions which was posted on the school's website.

π-WEEK:

1.) Daily Questions: Each morning at 7:00 AM a question was "revealed" in the Math Hallway Display Case. The same question was then shown during the televised morning announcements, and posted in all the Math classrooms. Students had to turn in their solution to my classroom where a time stamp kept track of when each solution was turned in. Each day, a

1st, 2nd, and 3rd place winner was selected, awarded a prize and a certificate, and then his/her name was posted along with the solution to the problem during the next day. (Because a Teacher Planning Day and *Spring Break* followed π-Week during the 2004-05 school year, there were only 4 days of competition). I also had additional donated prizes and was able to give two prizes for each place! In addition, the names of all the student participants were kept in a file so that at the end of the week a name was randomly chosen from among all the entries received to win a top prize: one of two TI-84+ Graphing Calculators.

2.) <u>π–off Competition</u>: Any student who wanted to participate was given 3 minutes 14 seconds to write as many digits of π as they could. The winner was the student who knew the most digits. This competition took place on π Day – March 14th, and the winner took home the second TI-84+ Graphing Calculator.

3.) <u>Math Class Activities / Competitions</u>: Math teachers were given a packet with lessons, activities and trivia questions that they could use in their classes during this week. They were also given prizes to award their students based on predetermined criteria such as correctness, completeness, and creativity. Since all teachers (from ESE Math through Calculus) were given content specific materials, most students were engaged during one or more days on these π-related tasks.

4.) <u>π-Songs</u>: Some of my 1st period students sang π songs to my class and other Math classes during the week.

5.) <u>Math Teachers / Staff Prizes</u>: Math resource books, "Math" Teddy Bears, pens, tote bags, puzzles, Math shirts, and other prizes were

raffled off among the Math teachers every lunch period during π–Week. At the end of the week 12 apple π's were raffled among the entire faculty!

6.) Miscellaneous Activities: Every teacher and/or staff member was sent a "Happy π-Week" e-card during the course of π-Week. The faculty, not just the Math Department, was sent informative e-mails about the number π and our week-long celebrations.

LESSONS AND ACTIVITIES

Some of the π-Week lessons follow. The resource books have other lessons that were used in the school by the Math teachers.

Math Teachers' Instructions

π Week

March 14th – 18th, 2005

"Probably no symbol in Mathematics has evoked as much mystery, romanticism, misconception, and human interest as the number π"

- William L. Schaaf, *Nature and History of π*

I am attaching activities and questions that you may choose to do with your kids during π–Week. Each of you will get 2-3 "π–Week" prizes to distribute to your subject "winners". What I am going to do for my classes, for example, is select one AP Stats winner and one Honors Geometry winner. Please do not give the kids the answers to the Trivia Questions as some of us will be using them to determine who our winners are.

I also need your help in promoting the Daily School-Wide Competition. Students are to look at the Display case in our area to get the daily question (Monday – Thursday). They will turn in their solution to me in room 138. Several daily winners will be selected – their names will also be posted as well as announced in the morning announcements.

The daily prizes for the students who answer the school-wide questions correctly are:

1st Prize:	$ 15.00 gift certificate to Barnes & Noble
2nd Prize:	A solar scientific calculator
3rd Prize:	A daily surprise!!

Two winners will be selected for each category based on the accuracy of their solutions and the time that they turned in their answer to me.

I would like to invite you on March 14th at 1:59 PM to be in tune to the fact that π–Week officially kicks off then. Either Millie or Caryl will be making an announcement.

If you have any questions or suggestions please let me know. I would also like some feedback via e-mail about the activities once they are completed. I would like for this to be a yearly event so I need your help and ideas!

Thanks a lot!!!!!!

Sandra

Faculty e-mail

π Week

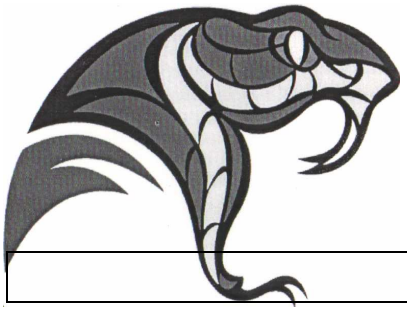
March 14th – 18th, 2005

Good Morning:

If you have noticed the signs around the school, the Display in the Media Center, and the TV announcements, the Math Department has been celebrating **π** "PI" **Week**. Students have been involved in Math activities and contests that celebrate this number ($\pi \approx 3.14$) since March 14th and the last day is today. We will be holding a raffle of miscellaneous "pies" during the luncheon this afternoon so that you too can be part of our celebration. After all, only 4 numbers in Math have been given their own "name": π, e, i, and ϕ. π baffled the Babylonians, the ancient Egyptians, and it is even mentioned in the Bible; today it is still a common and favorite topic among Mathematicians. It has a movie named after it (and about it) and a fragrance named after it. If you win a pie today, you too will have enjoyed a "Piece of π".

Thanks,

Sandra



π-Week Questions

CONFIDENTIAL!!!!

MONDAY:

Measure the circumference (C) and diameter (d) of a DVD. What is <u>EXACT</u> value of the ratio $\frac{C}{d}$?

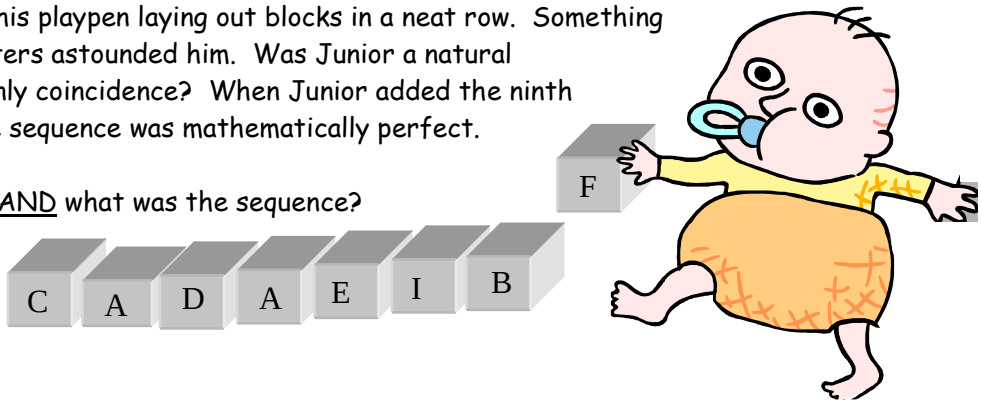
TUESDAY:

Move ONE stick to make π (approximately!) $\frac{\text{XXIII}}{\text{VII}} = \text{II}$

WEDNESDAY:

Father watched Junior in his playpen laying out blocks in a neat row. Something about the sequence of letters astounded him. Was Junior a natural Mathematician or was it only coincidence? When Junior added the ninth block, Father gasped! The sequence was mathematically perfect.

What was the ninth block <u>AND</u> what was the sequence?



(From ***The History of PI***)

THURSDAY:

Look at the Math Mural in one of the Math hallways and find the equation that uses π ⇒
Write it down!

MONDAY's QUESTION:

Measure the circumference (C) & diameter (d) of a DVD.

What is <u>EXACT</u> value of the ratio $\frac{C}{d}$?

SOLUTION:

Given the circumference and diameter of ANY circle,

the ratio $\frac{C}{d} = \frac{\pi d}{d} = \boxed{\pi}$

MONDAY's QUESTION WINNERS:

1st Place - Alejandro M. / Pamela D.
2nd Place - Shayna H. / Leili A.
3rd Place - Danial A. / Birjees K.

π – off competition winners:

1st Place – **Yukari H.** (165 correct decimal places of π !)
2nd Place – **Adriana de la F.**
3rd Place – **Andrick L.**

Please come by room 138 to claim your prize!

TUESDAY's QUESTION:

Move ONE stick to make π (approximately!)

$$\frac{\text{XXIII}}{\text{VII}} = \text{II}$$

SOLUTION:

$$\frac{\text{XXIII}}{\text{VII}} = \text{II} \qquad \frac{\text{XXII}}{\text{VII}} = \Pi$$

$$\text{because } \pi \approx \frac{22}{7}$$

TUESDAY's QUESTION WINNERS:

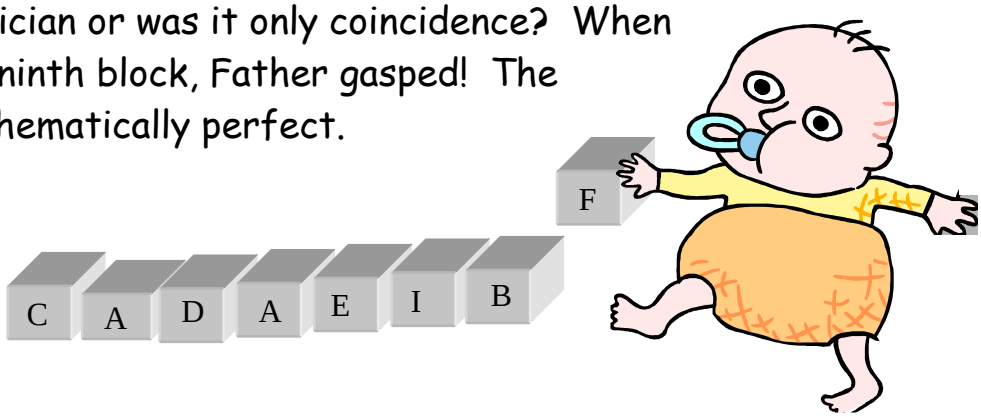
1st Place - Victoria V. / Jeremy S.
2nd Place - Daniela S. / Vanessa P.
3rd Place - Alvaro A. / Estefania N.

Please come by room 138 WITH YOUR ID to claim your prize!

Remember that non-winners who participate are entered in the grand prize drawing of another TI-84+ to be raffled off on Thursday March 17th!

WEDNESDAY's QUESTION:

Father watched Junior in his playpen laying out blocks in a neat row. Something about the sequence of letters astounded him. Was Junior a natural Mathematician or was it only coincidence? When Junior added the ninth block, Father gasped! The sequence was mathematically perfect.



What was the **ninth** block AND what was the sequence?

(*From* ***The History of PI***)

SOLUTION:

1ST Block	2nd Block	3rd Block	4th Block	5th Block	6th Block	7th Block	8th Block	9th Block
C	A	D	A	E	I	B	F	E
3	1	4	1	5	9	2	6	5

The ninth block was E and the sequence was π

WEDNESDAY's WINNERS:

1st Place - Andrick L. / Michael V.
2nd Place - Jessica C. / Paul D.
3rd Place - Alexis M. / Alejandro M.

Please come by room 138 BEFORE 10:40 AM on Thursday WITH YOUR ID to claim your prize!

Remember that non-winners who participate are entered in the grand prize drawing of the TI-84+!

FELIX VARELA SENIOR HIGH SCHOOL

π WEEK

Sample Certificate Awardee

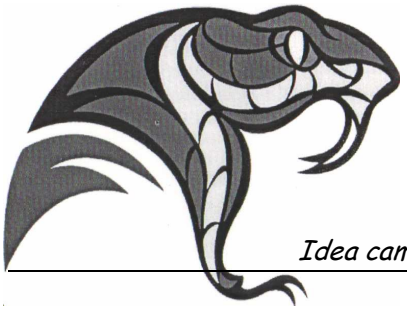
is recognized as a

π Week Daily Contest Winner – WEDNESDAY / 1st PLACE

March 14th – 17th, 2005

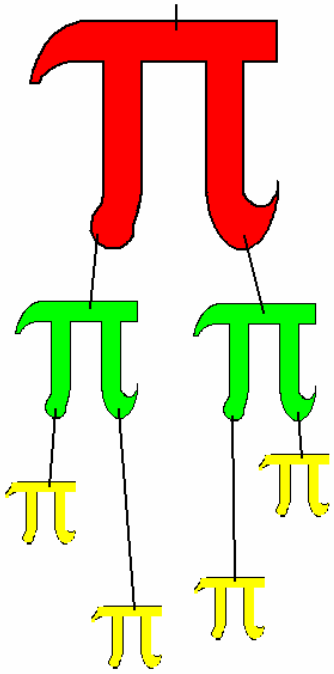
_____

Math Department Co-Chair



π Mobile

Idea came from mathwithmrherte.com/pi_mobile.htm

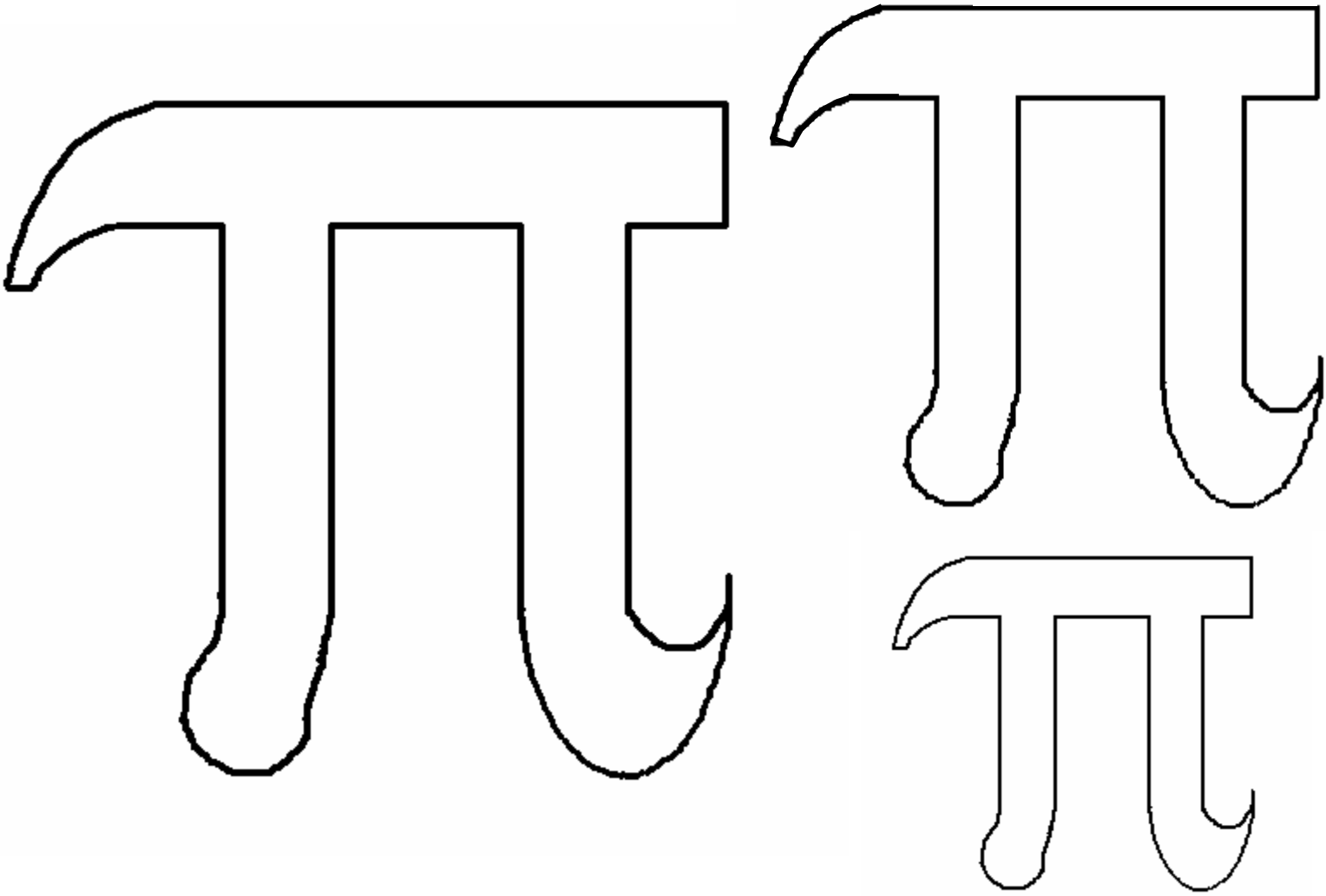


MATERIALS NEEDED:

- Yarn
- Construction paper of different colors
- Hole puncher
- "π" stencils

DIRECTIONS:

Use the π stencils below to cut out ONE large π, 2 medium π & 4 small π.
Attach the center top of each π symbol to the bottom of the π leg of the next larger one as shown to the right.



ALGEBRA I and GEOMETRY π-Week Questions

Some questions were taken from edHelper.com

Answer the following questions to the best of your knowledge.
Return your answer sheet to your teacher by Wednesday 3/16 at 7:30 AM for the chance to win a **π-Week** prize.

1.) Measure the circumference of a DVD and divide it by its diameter.
What do you get as an answer?

2.) Devin made seven pepperoni pizzas for a party. He cut the pepperoni himself from a sausage that was 13 inches long and $1\frac{3}{4}$ inches in diameter. The pizzas were each 14 inches in diameter. His friend Taylor is a real math whiz and took the opportunity to calculate what percent of the total pizza surface area was covered by pepperoni. The pepperoni was cut into slices $\frac{1}{4}$ of an inch thick. Each pizza has the same number of whole pepperoni slices (he ate any extra pepperoni!). What percent of the total pizza surface area was covered by the pepperoni? Round your answer to the nearest hundredth.

3.) A cylinder can approximate the shape of a snake. Which snake would have the most volume, one that is 48 cm long and 10 cm in diameter, or one that is 34 cm long and 13 cm in diameter?

4.) Simplify the following expression: $-2\frac{1}{2}\pi + 2(\pi - \frac{1}{2}) - \frac{1}{2}\pi + 14$

5.) $\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\sqrt{\pi}}}}}}}}}\ldots$

6.) The world's biggest pizza was made in Norwood, South Africa in 1990. The diameter of the pizza was 37.3 meters. What was the area of the pizza?

7.) What is the 32nd decimal place of the number π?

8.) Angles can be measured in degrees or in radians. $1^\circ = \frac{\pi}{180}$ radians.
Convert 45° to radian measure.

9.) Let $\mathbf{x} = \frac{\pi}{2}$, $\mathbf{y} = 3\pi\mathbf{x}$, $\mathbf{z} = \frac{2\mathbf{y}}{\pi}$, and $\mathbf{w} = \frac{1}{3}\mathbf{z}$. What is **w** equal to?

10.) The Americans celebrate π-Day on March 14th (3/14). When do the Europeans celebrate it?

ALGEBRA I and GEOMETRY π–Week Answers

ANSWERS

1.) π

2.) There are 52 pepperoni slices to be divided evenly by 7 pizzas – Each pizza gets 7 pepperonis (he eats the remaining 3!). Each pizza has an area of 153.938 and each pepperoni has an area of 2.405. Since each pizza has 7 pepperonis, the percent of the area covered is $\frac{(7)(2.405)}{153.938}(100) = 10.94\%$

3.) The snake that is 34 cm long and 13 cm in diameter has more volume.

4.) $-\pi + 13$

5.) 1

6.) 1092.163 m^2

7.) 0

8.) $\frac{\pi}{4}$ radians

9.) π

10.) On July 22nd (7/22) ($\pi \approx \frac{22}{7}$)

WHAT DO YOU HAVE LEFT?

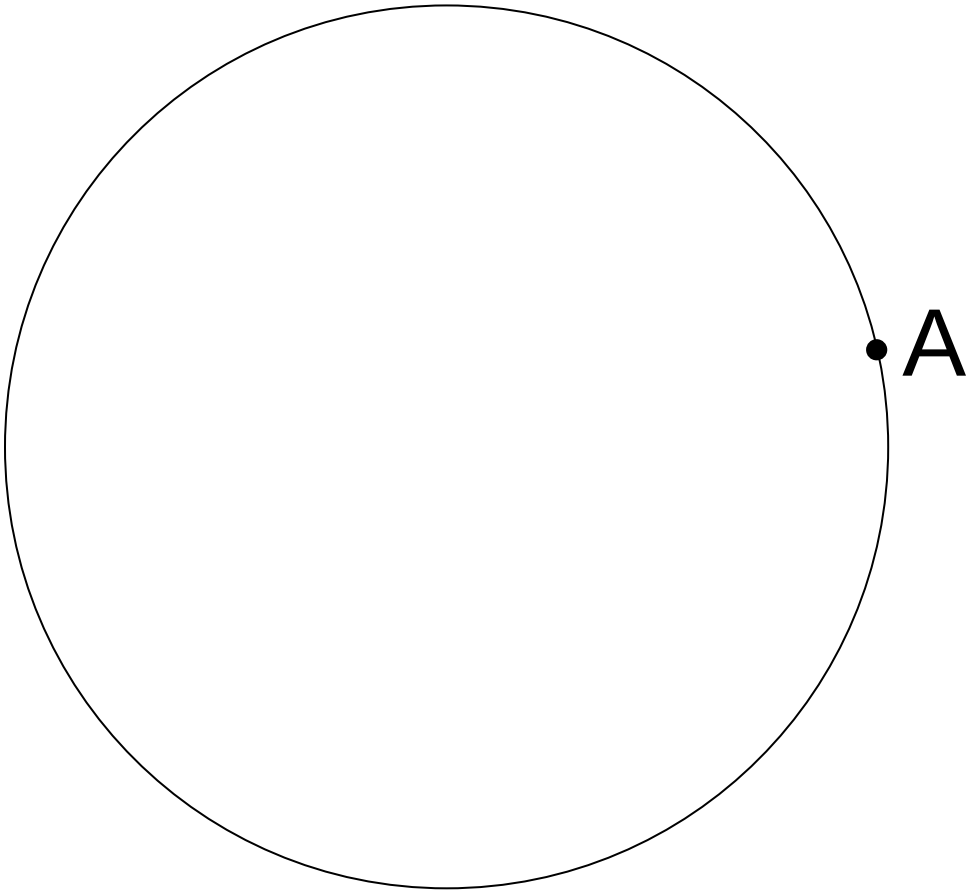
(Idea comes from "A Piece of PI")

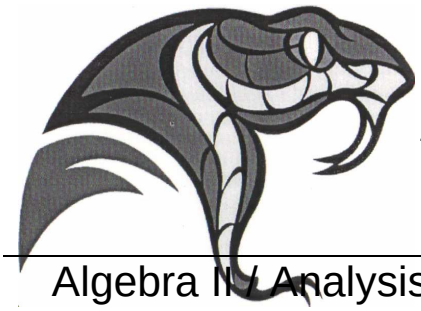
A letter has vertical symmetry if it can be divided into right and left halves that are reflections of each other.

Examples: M Y

Write all the letters of the alphabet around a circle using capital block letters.

Cross out the letters with vertical symmetry. What do you have left?





π-Week Trivia Quiz

Algebra II / Analysis Of Functions / Pacesetter / Pre-Calculus

Answer the following questions to the best of your knowledge.

Return your answer sheet to your teacher by Wednesday 3/16 at 7:30 AM for the chance to win a **π Week** prize.

1.) Who,in 1706, first gave the Greek letter π its current mathematical definition?
   a.) Albert Einstein
   b.) William Jones
   c.) Attila the Hun
   d.) Archimedes
   e.) Napoleon Bonaparte

2.) π is *transcendental*. What does this mean in mathematics?
   a.) it is equal to the ratio of two integers
   b.) its square root is imaginary
   c.) it cannot be expressed as an integer, or as a root, or as a quotient of integers
   d.) it was Ralph Waldo Emerson's favorite number

3.) If you calculated the circumference of a circle the size of the known universe, requiring that the answer be accurate to within the radius of one proton, how many decimal places of π would you need to use?
   a.) two million
   b.) 39
   c.) 48,000
   d.) 6 billion

4.) What is the earliest known reference to π in history?
   a.) The Rosetta Stone, approx. 200 BC
   b.) The Bible
   c.) An Egyptian papyrus scroll, written approximately 1650 BC by Ahmes the Scribe
   d.) Euclid's *Elements*, written in the 3rd century BC

5.) What is the current world record for the memorization of the decimal places of π?
   a.) 1000 places, by Alexander Craig Aitkin
   b.) 4096 places, by Simon Plouffe
   c.) 31,811 places, by Rajan Mahadevan
   d.) 42,000 places, by Alfred E. Neuman
   e.) None of the above

6.) Among the digits of π currently known, the concentration of each of the digits 0 – 9 are pretty close to equal. However, in the first 30 places of π 's decimal expansion, which digit is completely missing?

a.) 7 b.) 2 c.) 0 d.) 8

7.) What is the "formal" definition of π?

a.) the surface area of a sphere of diameter $\frac{22}{7}$

b.) 3.1415926

c.) the radius of a circle

d.) the ratio of a circle's circumference to its diameter

8.) Imagine that you wrapped a rope tightly around the earth at the Equator. How much longer would you have to make the rope if you wanted to be exactly one foot above the surface all the way around? (Assume that the Equator is a perfect circle.)

a.) 2π feet

b.) $2\pi r$ feet, where r is the radius of the Earth

c.) πr^2 feet, where r is the radius of the Earth

d.) $2\pi + 1$ feet

9.) How many hours did it take a supercomputer to calculate π to 51.5 billion digits, in 1997?

a.) 3 hours

b.) 29 hours

c.) 50 hours

d.) 78 hours

10.) π is an *irrational* number. What does that really mean?

a.) If we divided π by the number of students enrolled at Varela today we will get no remainder

b.) π is a real number, but it cannot be expressed as a ratio of two integers

c.) π is not a real number because $e^{\pi i} = -1$

d.) a crazy mathematician was the first to compute π to 10,000 decimal places

"Probably no symbol in Mathematics has evoked as much mystery, romanticism, misconception, and human interest as the number π"

- William L. Schaaf, *Nature and History of π*

π-Week Trivia Quiz Answers

Algebra II / Analysis Of Functions / Pacesetter / Pre-Calculus

ANSWERS

1.) b

2.) c

3.) b

4.) c

5.) e

6.) c

7.) d

8.) a

9.) b

10.) b

π-Week 2005 – Statistics

("Idea comes from PI Makes the World Go Around")

Linear Regression Activity / TEACHER NOTES

OBJECTIVE: Students will calculate π by finding the slope of the line $C = \pi d$. Students will discover the line of best fit (or regression line) is actually the formula for the circumference of a circle.

MATERIALS NEEDED: Circular objects, measuring tapes, rulers, graphing calculators.

METHOD: Divide students into groups. Each group will choose at least 5 circular objects and will measure the diameter and circumference of each. Each group will record their measurements in a table. Students will need to name their independent and dependent variables (explanatory & response variables). Next, students will enter the data into their graphing calculators and create a scatter plot of the data. Students will use the linear regression capability of the graphing calculator to find an equation of best fit.

EXTENSIONS: Construct a residual plot and examine if the relationship is really linear; combine the class data and do a regression on it. Look at r^2 and what it tells you about the strength of the association between the variables.

QUESTIONS TO ASK:

1.) What is the slope of the line that you found to represent your data?
2.) What does the slope represent?
3.) Does the equation of the line you found look familiar?
4.) If the diameter of a circle is d, what is the circumference of the circle? What is the circumference if the diameter is $d + 1$? What is the difference between the circumferences of these two circles?

CALCULUS

π Week 2005

(Idea comes from "PI Makes the World Go Around")

Come up with a definite integral that yields the number π, and turn it in to your teacher by Thursday March 17th.

The most creative and/or challenging definite integral will win a π week prize.

EXAMPLES:

$$\frac{3\pi}{152}\int_{4}^{6} x^2\,dx$$

$$\int_{\frac{\pi}{2}}^{\frac{3\pi}{2}} (1 - \sin x)\,dx$$

$$2\int_{\frac{\sqrt{2}}{2}}^{\frac{-\sqrt{2}}{2}} \frac{-1}{\sqrt{1 - x^2}}\,dx$$

PRINTED RESOURCES

Beckman, Petr. *A History of π (PI).* St. Martin's Press, 1971.

Bokhari, Naila. *Piece of Pi: Wit-Sharpening, Brain-Bruising, Number-Crunching Activities with Pi.* Dandy Lion Publications, 2001.

DeVoss, Angie. "PI Makes the World Go Around", 52nd FCTM Annual State Conference, Miami, Florida, October 2004.

Neuschwander, Cindy. *Sir Circumference and the Dragon of Pi: a math adventure.* Charlesbridge, 1999.

WEBSITES

www.123Greetings.com

http://mathwithmrherte.com/pi

http://www.edhelper.com/PiDayMath1.htm

www.exploratorium.edu/learning_studio/pi

CATALOG RESOURCES

D & H. (800) 340-1006

Instructional Images. (877) 221-4444

MindWare: brainy toys for kids of all ages. (800) 999-0398

Nasco. (800) 558-9595

NCTM Resources for the Mathematics Educator. (800) 235-7566

Oriental Trading Company, Inc. (800) 228-2269