UC IRVINE MATH CEO

Community Educational Outreach

Meeting 7 Student's Booklet

Geometry 2

May 24 2017 @ UCI

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STUDENT'S BOOKLET

UC IRVINE MATH CEO
http://www.math.uci.edu/mathceo/

1 CIRCULAR MOUNTAINS

In the Orange Mountain game, we use a carbot to climb a quarter of a mountain of height 100 meters, called "Orange Mountain". This mountain has the shape of a perfect half-orange, so the path to climb it is a quarter of a circle of radius 100m. The score of each carbot is equal to its height (distance to the ground). The maximum possible score is equal to 100, which means reaching the top (climbing 90° from the top).

A

Estimate the scores of different car-bots, depending on the angle that they climbed, by measuring the heights.

Note: Angle measured counterclockwise from the ground.

Note: for an angle x. the score divided by 100, is called sine of x: sin(x°)

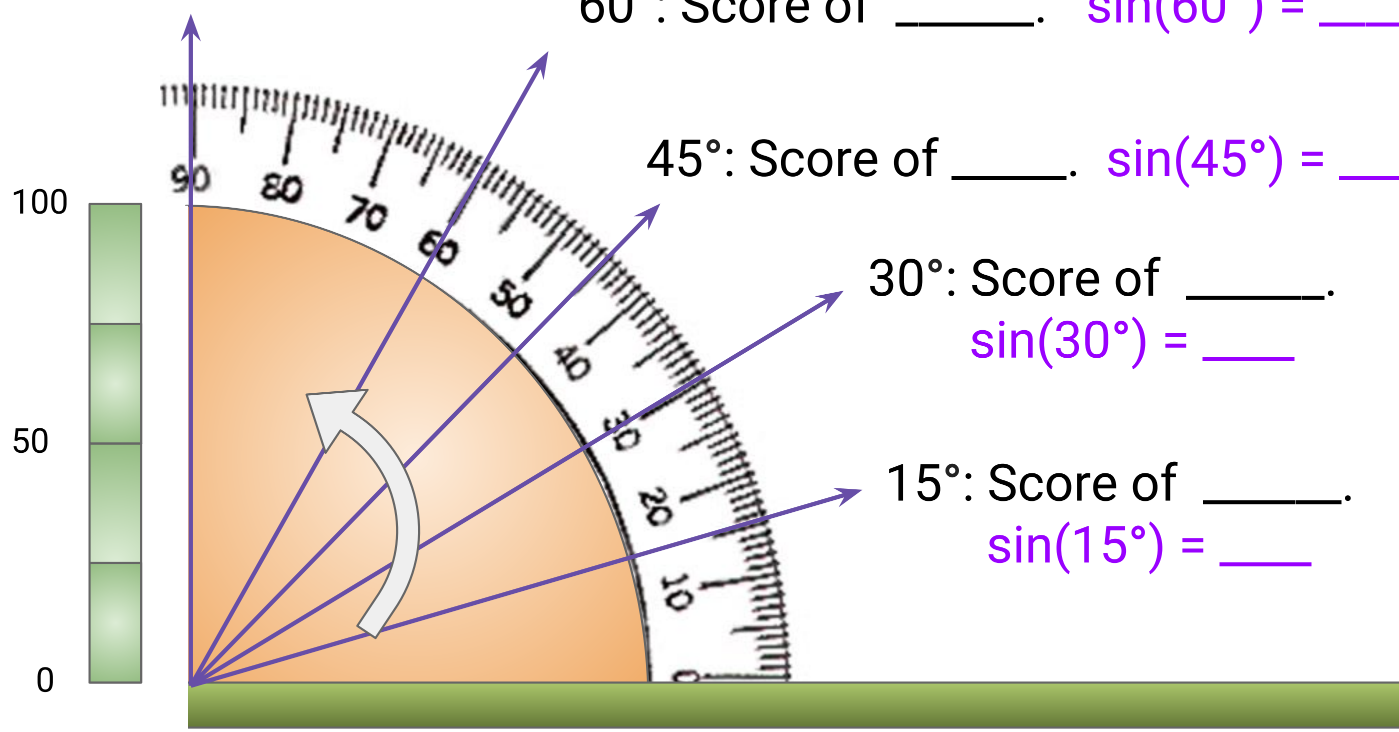
90°: Score of 100 . sin(90°) = 1.

60°: Score of _____. sin(60°) = ____

45°: Score of _____. sin(45°) = ____

30°: Score of _____. sin(30°) = ____

15°: Score of _____. sin(15°) = ____



The Orange Mountain Game

The goal of the game is to score points according to the height that your cars reach at the end of the game in 6 different "circular" mountains of the same height 1 unit (or 100, however you want).

The game is played as follows: There are 6 different mountains, numerated 1 to 6. Place those mountains in the center of the table, reachable to all players. Each player controls six different cars (coins or tokens), one per mountain. All cars start at the ground (zero degrees).

The game consists of 4 rounds, and in each round every player plays one turn, clockwise.

Each turn: Roll 2 dice. Let X be your smaller value and Y be your larger value (or X=Y if they are equal). Choose exactly one:

- Your car climbs 15Y degrees in one mountain of your choice.
- Separate X as a sum of two numbers A+B; climb 15A degrees in one mountain, and 15B degrees in another mountain.

Example 1: rolled X=2 and Y=6. You decide use Y=6 to advance 90 in Mountain 1, reaching the top since your car was in the ground.
Example 2: rolled X=4 and Y=5. You decide to separate X as 3+1, and advance 45d in Mountain 2 and 14 degrees in mountain 6.
Example 3: rolled X=3 and Y=3. You decide to separate X as 2+1, and advance 30d in Mountain 4 and 15d in mountain 1.

Note: if you advance more than the top, it is fine, you just stay on the top of the mountain. For example, if your car is at 60 degrees in Mountain 1 and you advance 45 degrees, you move your car to the top (90 degrees). You "waste" 15 degrees.

End of the game: each player collects their score. The score is the sum of the heights (not the angles, but the heights!) reached in each mountain. There is a catch, though: in order to win, you need to have won (or tie first place) in at least one mountain. In case of a tie, whoever dominated more mountains wins the game. If tie persist, tied players share the victory.

After playing the game...

B

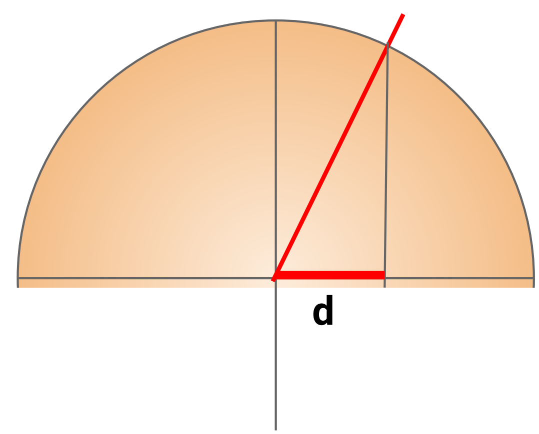
Reflecting on the game: What was your strategy to play this game? Would you change your strategy? Why?

C

If you have a total of 6x15=90 degrees to distribute however you wish to make your cars advance in the 6 mountains, how would you choose to do this in order to maximize your total score? What would that score be equal to?

D

Suppose that you now play the following variant of the game: for each mountain, you measure your horizontal distance **d** to the "vertical axis" of the mountain, and that gives you negative points. Whoever gets the highest score wins (so the one closest to zero). So for example, if you move 60 degrees in one mountain, your score is -50, and if you move 90 degrees in a mountain, your score in that mountain is 0.



Answer question C with this game in mind, after trying various distributions of degrees.

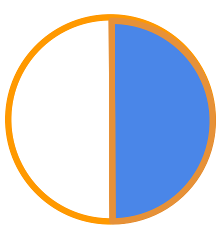
2 ROTATIONS

We associate a fraction with a fraction of a turn. 1/1 is a complete turn (360 degrees), 1/2 is *one half of a turn*, 1/3 is *one third of a turn*, etc.

Answers

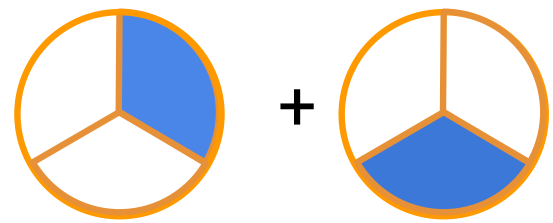
MORE THAN HALF?

For each of these rotations, determine if it is more than one half of a turn, one half of a turn, or less than one half of a turn. Then, write the rotation as a single fraction.

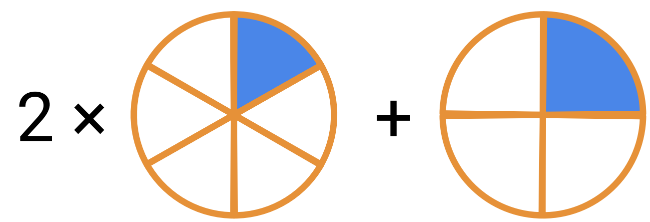


Half of a turn (1/2)

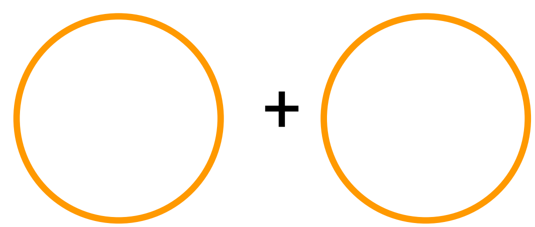
A Two thirds of a turn



B Two sixths of a turn plus one fourth of a turn



C Three eighths of a turn plus one ninth of a turn.



Draw the corresponding rotation

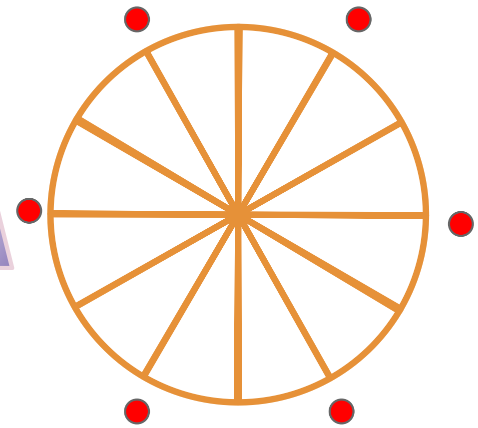
FIVE CONFIGURATIONS

Discuss:
For each configuration of "coins", describe it in your own words. Use mathematical words: turn, angles, adjacent, etc.

Note: these configurations do not change if you rotate the wheel.

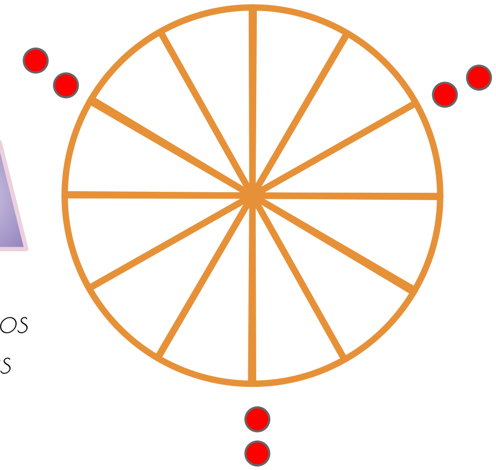
1

Perfect Balance



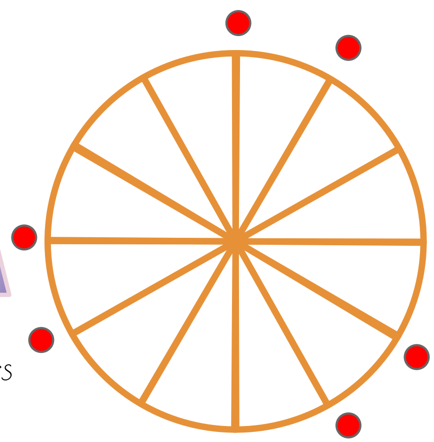
2

Kangaroos & Babies



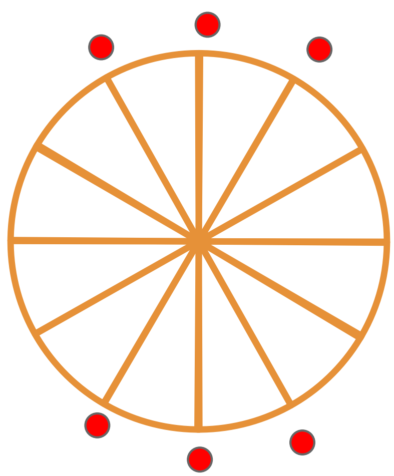
3

3 couples



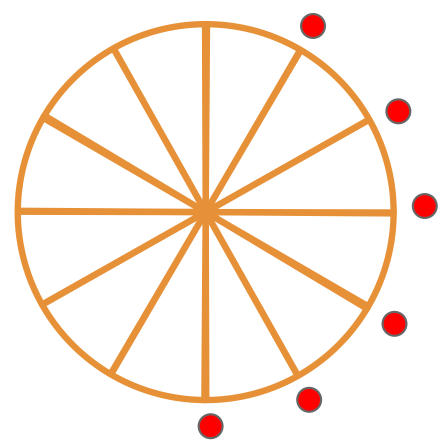
4

2 teams



5

Watching a movie



The Six Coins Game

The goal of this cooperative game is to complete the 5 different configurations (see previous activity) of the game in less than 30 turns, each turn corresponding to the movement of one of the 6 coins along the circle according to the roll of the dice. The 5 configurations can be completed in any order.

Start: Place the big circle in the center of the table and 6 coins all in the same place at angle 0. (Equivalently, you may start at any angle you want). Place the 5 configuration cards, visible. Remember that orientation does not matter The game lasts 30 turns at most.

Each turn: a player rolls 2 dice. Let X and Y be the results. Players agree to form a fraction (either X/Y or Y/X) and move ONE coin counterclockwise by that fraction of a turn. You can choose any fraction except 1/5, 2/5, 3/5, 4/5 or 6/5. This guarantees that any rotation of a coin is a multiple of 30 degrees (since 1/12 turn equals to 30 degrees). One player (each turn a different one) computes the number of degrees to rotate and writes the following: “x/y of a turn = z degrees ” (example: 2/4 of a turn = 180 degrees).

Example 1: rolled X=2 and Y=3. You form the fraction 3/2 and move a coin 3/2 of a turn (that is, 180 degrees).
Example 2: rolled X=4 and Y=5. You have to form 5/4, and so you move any coin you choose 5/4 of a turn (that is, 90 degrees)
Example 3: rolled X=3 and Y=3. This turn is essentially lost, since you will move any coin 1 turn (that is 360 degrees)

Completing configurations: At the end of any turn, if you complete any configuration, grab the corresponding card. You have completed that configuration. Note that each configuration is not rigid and is independent of the labeling of the angles, meaning that there are several ways to achieve it. Do not reset the game, play continues.

End of the game: If players conquer all 5 configurations before of by turn #30, they win the game. Otherwise they lose.
Mentor’s Help: The mentor has 6 special cards. At any time he can offer one of the cards to the players, specially if it seems unlikely that they will be able to win. Players can keep the cards and use them. Playing a card does not count as a round. A card played is burned, and so it cannot be reused.

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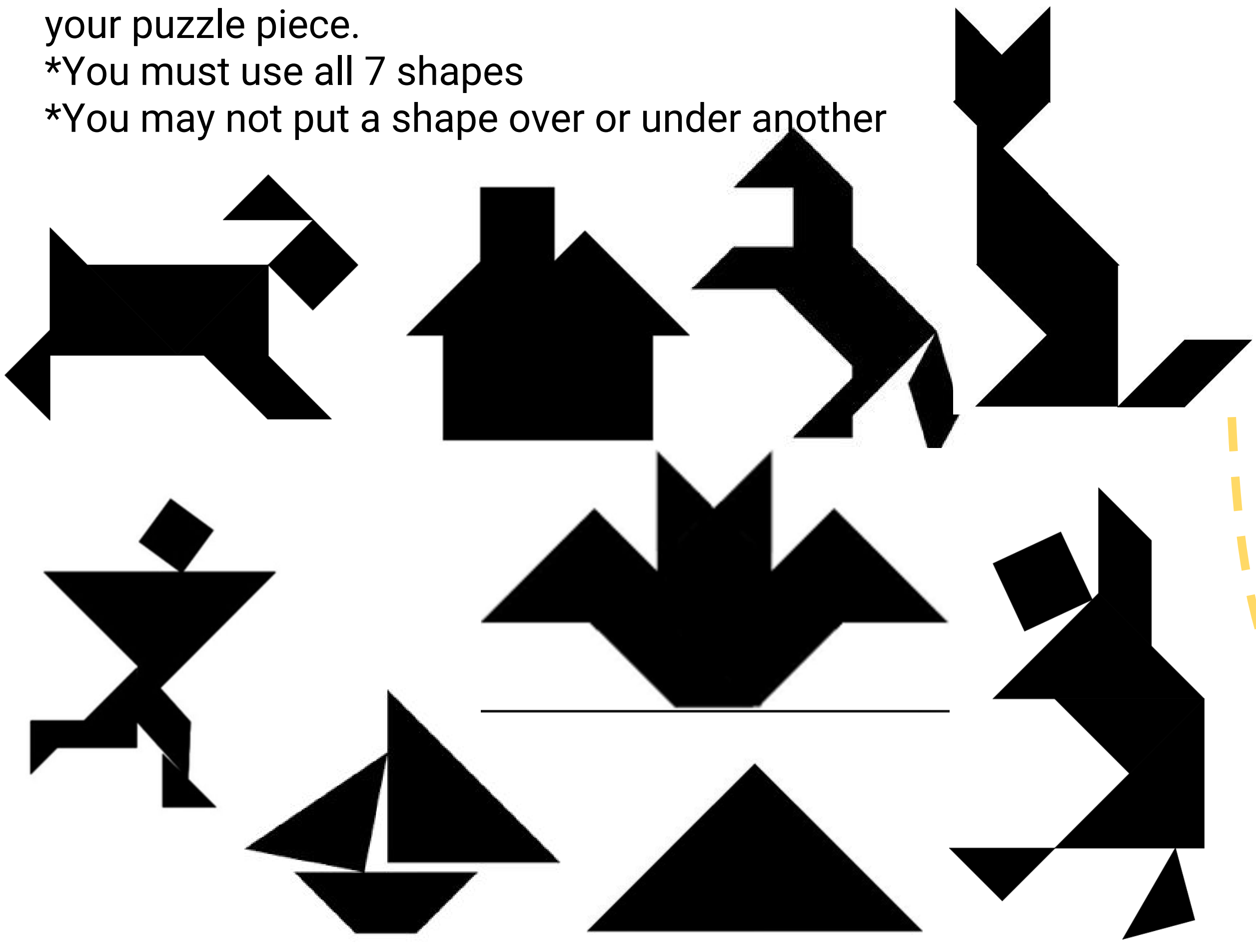
Spring 2017 FAMILY PROJECT: Math is everywhere□

My name: ___________________________

This week's family project is a **Tangram**!!!

Cut out the shapes on the other page, those 7 shapes would be your puzzle piece.
*You must use all 7 shapes
*You may not put a shape over or under another



How many puzzles did you complete? ________/9

Each week, you will interview a family or friend about how they use math in their everyday life!

This week, I interviewed:

____

Q1: What is your favorite shape? What everyday item has that shape?

A1: _____________________________________

____

Q2: How can you calculate the area of this shape? (if it's a complicated shape, maybe break it into smaller areas)

A2: ______________________________

____

____