

Grade 7 & 8 Math Circles Pair-O'-Dice: The Game

APRIL 2/3, 2013

Instructions

Set Up

Get into a group of 3 to 5 players. Each group needs 2 *different* dice and 1 score card.

Choose 1 player to be the score-keeper, and write everyone's name on the blank above each column on the score sheet.

Designate 1 die to be the *tens die* and the other to be the *ones die*.

Playing the Game

Choose 1 player to be the reader for this round. He/she will roll both dice. Multiply the value shown on the *tens die* by 10 and add the value shown on the *ones die*. This is the question you will answer this round.

The reader will read the question aloud to the group. Once finished if any group member has a question about the problem it must be answered by the group *before* anyone may begin writing their solution. When the writer says 'go' everyone may pick up their pencils and begin solving the problem.

Make sure you write your final answer for each question on the blank beside each question. Once you have done this, set your pencil down and say 'done.' After you say done you **cannot** pick up your pencil or change the answer you have written down! Remember the

order in which everyone in the group says done. It is possible to tie (2 people finish at the same time). Everyone in the group gets to finish the question, saying ‘done’ once finished and remembering the order in which they finish.

After counting and recording scores (see below) the player to the left of the reader becomes the new reader for the next round, and the process above repeats. If you roll a question which you’ve already answered, roll again or go to the next question you have not answered.

Scoring

The first person to say ‘done’ reads out the answer they have **written down** on their page, followed by the second and so on. Then the reader will go to the teacher to get the correct answer and announce it to the group.

Beside each question there is a score listed in brackets. **Every** player who answered the question correctly will receive that number of points. Anyone who wrote down the incorrect answer will receive 0 points.

The player who said ‘done’ the earliest **and** had the correct answer will receive 1 additional point. So if the first 3 people done wrote down the wrong answer but the fourth player had the correct answer, he/she would get the extra point. If 2 players tie and both have the correct answer written down, both receive 1 extra point.

Problems

11. What is the 12th Fibonacci number? (1 pt) _____

12/13. NOTE: Questions 12 & 13 use the following set up:

Greg, Sylvia and Caitlin are siblings. Today the product of their ages is 36.

12. Read the set up first (12/13)!

Greg was 7 when Sylvia was born. How old is Caitlin today? (2 pts) _____

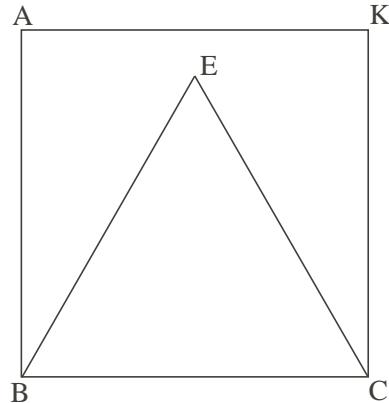
13. Read the set up first (12/13)!

In 6 years, Greg's father's age will be 3 times greater than Greg's age in 6 years. (Greg's age will be 21 in 12 years). How old is Greg's father today? (2 pts) _____

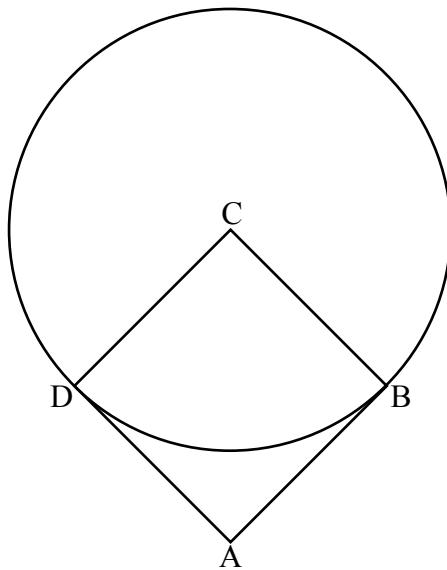
14. Pascal's Triangle normally has a 1 in the upper circle (i.e. the first row contains only a 1) then all lower circles are the sum of the one or two circles directly above it. If 7 is in the upper circle, what value is in the fifth circle of the sixth row? (2 pts) _____

15. When 25 cylindrical crackers are stacked on top of one another, they have a volume of 502.4cm^3 . The company that creates the crackers wants to sell a single stack of 42 crackers packaged in a box. The crackers touch all 4 sides of the box, and the first and last crackers touch either end of the box. Knowing that the base of the box has side lengths of 8cm, what is the volume of this box when empty? Use 3.14 as the value of π . (7 pts) _____ cm^3

16. Given that BAKC is a square and BEC is an equilateral triangle, what is the degree of angle AEK? (2 pts) _____°



21. ABCD is a quadrilateral with C being the centre of the circle with radius 9cm. Lines AB and AD are tangent to the circle at points B and D. If angle BAD equals 80° , what is the length of arc BD which is inside quadrilateral ABCD? See the diagram on the next page. Your answer should have π in it. (8 pts) _____cm.



- 22.** A rhombicosidodecahedron is a solid with 20 equilateral triangles, 30 squares, and 12 regular pentagons as faces. The number of edges is 10 times greater than the number of edges in a cube. How many vertices are there in a rhombicosidodecahedron? (2 pts)
_____ vertices.

23/24/25. NOTE: Questions 23, 24 & 25 use the following set up:

At Bob's school lockers 1 through 100 are empty. One day at lunch Bob and his friend Tina are bored, so they decide to play a game. In the first round Bob walks along and opens every locker.

In the second round Tina leaves the locker 1 alone, closes 2, and continues to close every second locker.

Tina and Bob continue skipping one extra locker each time. When they stop at a locker, they will close it if it's open or open it if it's closed. In the final (100^{th}) round, one of the two friends skips the first 99 lockers and stops at locker 100. He/she opens or closes the locker, and the game ends.

23. Read the set up first (23/24/25)!

How many times did someone stop at locker 12? (1 pt) _____

24. Read the set up first (23/24/25)!

Who was the last person to stop at locker 63 & did he/she open or close the locker?

(2 pts) _____

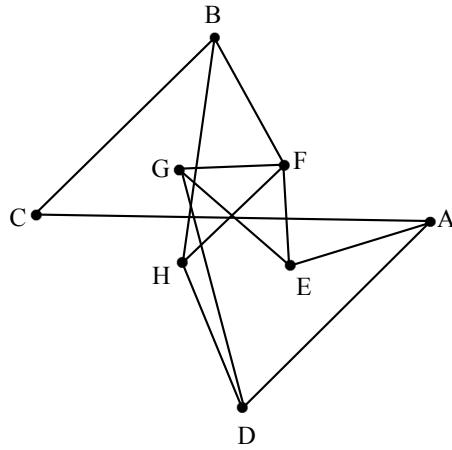
25. Read the set up first (23/24/25)!

How many lockers are open at the end of the game? (4 pts) _____

26. What are the next three terms in the following sequence? 3, 5, 8, 16, 29,...

(2 pts) _____

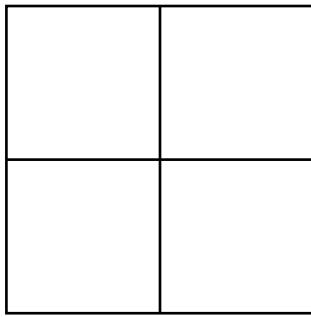
31. Find a Hamilton cycle in the following graph.



(3 pts) List your cycle here: _____.

32. If the shorter side length of a golden rectangle is 3.14159cm, what is the length of the longer side (to 4 decimal places)? Approximate φ with 1.618034. (1 pt) _____cm

33. Given the following figure, how many polygons do you see of each type? Note that we will consider squares to be different from rectangles.

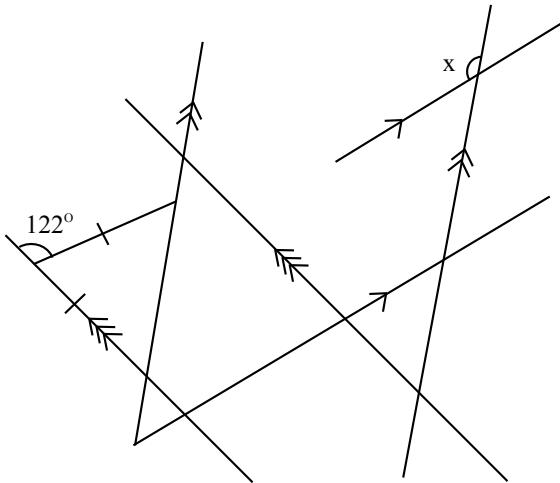


_____ squares, _____ rectangles, _____ hexagons, and _____ circles. (1 pt for each correct answer, all answers must be correct to get the ‘done’ bonus)

34. A cylindrical cake has a diameter of 50cm. The cutter is not so good with math and so instead of cutting the cake into 8 equal slices, 7 slices each have a 49° angle between cuts. Knowing the height of the cake is 12cm, what volume of cake does the eighth slice contain? Leave π in your equation, but round your final answer to 1 decimal place. (8 pts)

_____ cm^3

35. Given the following diagram, what is the measure of angle x ? (3 pts) _____ $^\circ$



36. An ice cream shop has a scoop which gives the perfect amount of ice cream per cone (in fact it results in a perfectly spherical scoop of ice cream). The radius of the scoop is the same as the radius of the cone. If you let all the ice cream melt, it would all perfectly fit inside the cone. If the radius of one scoop of ice cream is 3cm, how tall is the conical ice cream cone? (5 pts) _____ cm

41/42. NOTE: Questions 41 & 42 use the following set up:

Sir Cumference owns a vast property and is worried his dog, Pi, will get lost. So he puts an 8 meter leash on Pi so she can still play outside. The other end is attached to a hook which is drilled into the outside wall of Pi's rather large, square doghouse. There is only one entrance to the doghouse and the leash cannot run through the walls of the doghouse.

41. Read the set up first (41/42)!

If the leash is tethered halfway between the 4m walls, how much area outside the doghouse does Pi have to play? Keep π in your answer. (5 pts) _____ m²

42. Read the set up first (41/42)!

If the leash is tethered 1m in from a corner of the doghouse, how much area outside the doghouse does Pi have to play? Keep π in your answer. (6 pts) _____ m²

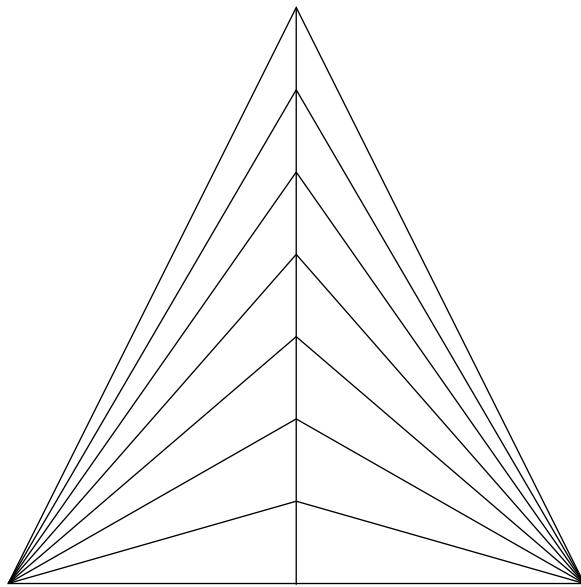
43. If a tree has 24 vertices, how many edges does this tree have? (1 pt) _____

44. If the longer side of a golden rectangle is 1.974cm, what is the area of the rectangle? Round all your calculations to the nearest thousandth. Use 1.618034 for φ . (3 pts)

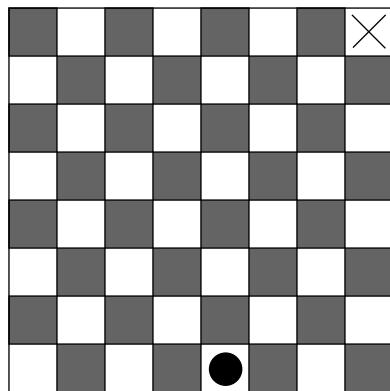
_____ cm²

45. 2009-G7-21: Lara ate $\frac{1}{4}$ of a pie and Ryan ate $\frac{3}{10}$ of the same pie. The next day Cassie ate $\frac{2}{3}$ of the pie that was left. What fraction of the original pie was not eaten?
(2 pts) _____

46. How many triangles are in the following figure? (6 pts) _____

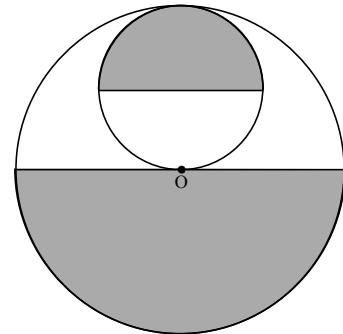


51. Checkers can only move diagonally forward. How many different combinations of moves will lead to the black checker piece landing on the 'X' square? (2 pts) _____

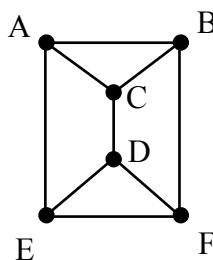


52. 2009-G8-20: A piece of string fits exactly once around the perimeter of a square whose area is 144cm^2 . Rounded to the nearest whole number, what is the area of the largest circle that can be formed from the piece of string? (3 pts) _____ cm^2

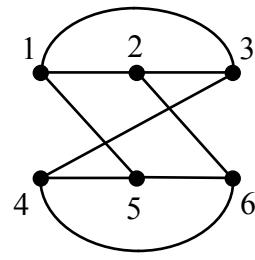
- 53.** 2008-G8-23: In the diagram, each circle is divided into two equal areas and O is the centre of the larger circle. The area of the larger circle is $64\pi\text{m}^2$. What is the total area of the shaded regions? Leave π in your answer. (4 pts) _____ m^2



- 54.** Show that these graphs are isomorphic by renaming the following graphs using ' $f()$ ' notation. There may be many correct answers. (5 pts)



Graph L



Graph N

- 55/56.** NOTE: Questions 55 & 56 use the following set up:

A wind turbine has blades that are 17.5m long, and a slug is stuck to the end of one of these blades. A rotation is when a blade begins at one position, gets blown around the turbine and returns to that same position. Yesterday, the wind was blowing at a constant speed causing the windmill to spin so that every minute the blades would make exactly 11 rotations.

- 55.** Read the set up first (55/56)!

If the circumference of the earth is about 40 060km, how many days and hours at the same speed, would it take for the slug to travel the same distance? Round your answer to the nearest hour and use 3.14 as the value for π . (7 pts)

_____ days and _____ hours

56. Read the set up first (55/56)!

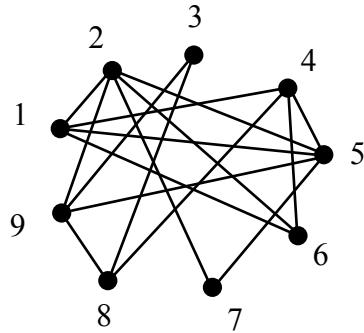
A snail also got stuck to the same windmill blade. However it is much closer to the center of the blade, being 11.5m away from the slug. What percentage of the slug's distance does the snail cover in the same amount of time? Your answer should have 3 digits. (2 pts)

_____ %

61. In the third row of a Pascal-like triangle the numbers are 3, 8, 5 in that order. (Note that the rows above this one do not exist, which does not affect the solution to this problem). What number is in the fourth position from the left in the ninth row of this triangle? (3 pts)

62. 2007-G7-19: The whole numbers from 1 to 1000 are written. How many of these numbers have at least two 7's appearing side-by-side? (3 pts) _____

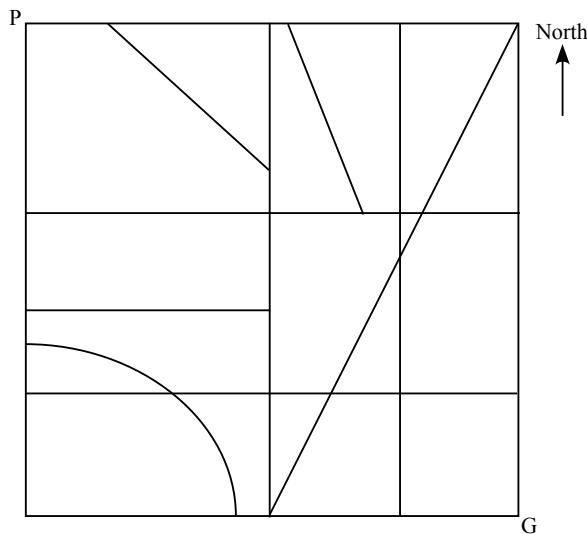
63. A planar graph is a graph which can be drawn so that no edges cross. Redraw the graph below so no edges are crossing one another. Your answer must be drawn in the space provided below. (4 pts)



64. Assume that the Fibonacci Spiral is divided into sections by each square that makes up the Fibonacci Rectangle and that every section is an arc centred at a vertex of the square. In cm, how long is the Fibonacci Spiral that starts in the first square with area 1cm^2 and ends after going through the square with area 64cm^2 ? Leave π in your final answer. (5 pts)

_____ cm^2

65. Canals in Venice (shown by lines below) separate many different islands (shown by white space). If Giovanni needs to steer his gondola (a boat) from *Giuseppe's Gondola Garage* (shown by G) to *Papa's Pizzeria* (shown by P), how many different paths can he take if he can never move in a southward or eastward direction? (5 pts) _____



66. A regular hexagon has a perimeter of 24cm. What is the area of the hexagon? (Hint: Pythagorean Theorem comes in handy; $a^2 + b^2 = c^2$). You can round your answer to 3 decimal places. (6 pts) _____ cm²