

TEAM LOGIC TEST #2

The instructions for this test are as follows:

Groups of up to three students are allowed. You DO NOT need to be a member of the logic club to take the test and win.

Resources may be used to aid in the solving of a problem. For example, you may research Fibonacci numbers or ask a teacher about Boolean algebra. However, a teacher is not allowed to simply give you the answer. You may also use the internet to aid you. However, do not post questions on the internet for others to answer, instead of you researching it yourself. You are a Science Academy student, and we trust you not to cheat.

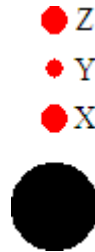
All answers must be written/typed on a separate sheet of paper and given to Mr. Grimaldo by 4:05 PM October 30th, 2009. This sheet should include your team name and the name of all team members. Work should be shown if possible (use your judgment). Results and solutions will be posted sometime during the first week of November.

The grading is as follows:

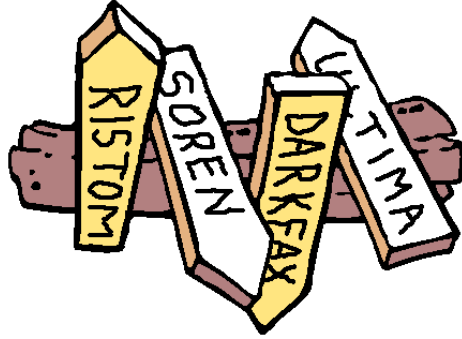
1. Points shall be given for every correct answer (the amount of points per question is written next to it); the exception to this rule is mentioned below (#3).
2. Ties shall be broken based on the tiebreaker questions (#s: 4, 6, 13, 16, and 20)
3. A question may have more than one answer (a mathematical, philosophical, et al); for example: a question may appear to be mathematics-related, and while the mathematical answer may be correct, it may only receive 1 point, while a more open-minded and creative philosophical answer could receive two points. As a result, you may want to mention two or three answers where appropriate. You be the judge. There is no penalty for incorrect answers. Extra points can be awarded for creative answers not specified in the solution.

Second Annual LTest

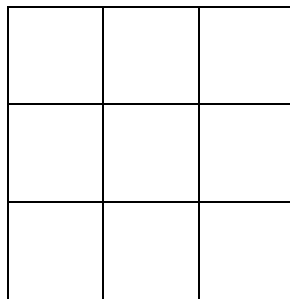
1. (2 pts) You are climbing one of three geometrically shaped ‘mountains,’ which are each 10,000 feet high. One is a cone with an incline angle of 20 degrees, another is a hemisphere, and the last is a cylinder with the same base radius as the hemisphere-shaped mountain. Roads are constructed on them so that you may walk to the summit of the mountain. All three roads are built so that you climb 2 vertical feet for every 10 feet traveled along the road. If you wish to travel the shortest distance from the base to the summit of the mountain, which mountain should you choose?
2. (2 pts) You have two 8 fluid ounces mugs; one is filled with root beer, and the other is filled with cola. You take 1 tablespoon of root beer and add it to the cola, and then stir the mixture. You then take 1 tablespoon of the mixture, add it to the root beer, and stir it. IS there more root beer in the cola or more cola in the root beer?
3. (2 pts) Three satellites are orbiting distant planet. Satellite X completes a revolution of the planet every 1.5 hours; Satellite Y completes a revolution of the planet every 3 hours; Satellite Z completes a revolution of the planet every 6 hours. At time $t=0$ hours, the satellites are lined up, as shown below. How long will it take for the satellites to line themselves again in a straight line (smallest time)?



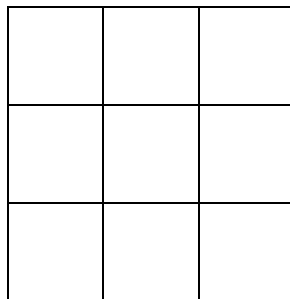
4. (10 pts) Transposition cipher:
I S E L S V Q T N H I H I I W D D O O L N Y E H P A A N A A N T T U F T O E U I
S A S E S N O A W L S Y C P D I H S S A G M L I I S U O L E A O W T T M S G R N
H O E E R T T S R E A N R I A N
5. (2 pts) Suppose you have 4 pairs of black socks, 3 pairs of white socks, and 2 pairs of gray socks in your drawer. It is nighttime, and you cannot see the color of the socks. You need to select one pair of matching socks of any color. What is the least number of socks you must remove from the drawer to be certain you have at least one matching pair?
6. (4 pts) You and your friends are hiking in a remote countryside. Your final destiny is the town of Darkfax. You leave the town of Soren and follow the trail to an important intersection. Unfortunately, the signpost showing which way to go at the intersection has been knocked down. How can you figure out what is the right direction to go. (See signpost diagram, next page)



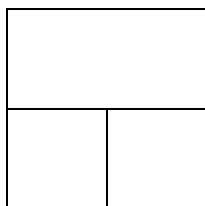
7. (2 pts) Create a magic square, 3 by 3 square with the numbers 1-9, arranged so that each row, column, or diagonal of 3 numbers adds up to the same number.



8. (2 pts) Create an anti-magic square, a 3 by 3 square with the numbers 1-9, arranged so that each row, column, or diagonal of 3 numbers adds up to different numbers



9. (4 pts) You cut a chocolate square cake into half, and then cut one of the halves into half again. You are then suddenly joined by two friends. What is the minimum number of cuts you must make so that all of you will eat the same amount of cake? (see the diagram below)



10. (4 pts) Boolean Algebra – simplify the Boolean expression below.

$$A \cdot \neg(A \cdot B) + B \cdot C + A \cdot A + B \cdot C \cdot D$$

11. (2 pts) While visiting a mental asylum, you ask the Director what measure determines if a patient should be institutionalized. "Well," the Director says, "we fill up a bathtub and ask the individual to empty the bathtub with a tablespoon, teacup, or bucket." What do you use?

12. (4 pts) You take two identical containers filled with water, one at 35 °C and the other at 100 °C, and put them into a freezer. Which one will freeze first and why?

13. (6pts) What is the 6-digit number with these properties:

- a. the digits are all different
- b. the sum of the digits matches the number formed by the last two digits
- c. the sum of the first two digits equals the sum of the last two digits
- d. the three numbers formed by the digit pairs are prime
- e. take the sum of the number, the number rotated one to the left, the number rotated one to the right, the number with the first three and last three digits swapped, the number with the digit pairs rotated to the left, and the number with the digit pairs rotated to the right. The first and last digits of this sum match the last two digits of the number, in some order.

Note:

- The sum of all the digits of 247 is $2+4+7 = 13$;
- The digit pairs in 125690 are 12 56 90;
- Rotating 123456 one to the left = 234561; Rotating 123456 one to the right = 612345;
- Rotating the digit pairs in 567890 to the left = 789056; Rotating the digit pairs in 567890 to the right = 905678;

14. (4 pts) Which does not belong?

- 4-Cell
- 5-Cell
- 8-Cell
- 24-Cell
- 16-Cell
- 120-Cell
- 600-Cell

15. (6 pts) The FBI discovers a ring of domestic spies in Texas with the code names Alpha, Bravo, Charlie, Delta, and Echo. The names of the spies are also known, but the agents do not know the individual spies' code names. Cody Diemen is an engineer working for NASA. His wife works for a bank and apparently knows nothing of his espionage activities. Eric Beauford works as a janitor at the same firm and is single. Neil Ronald is

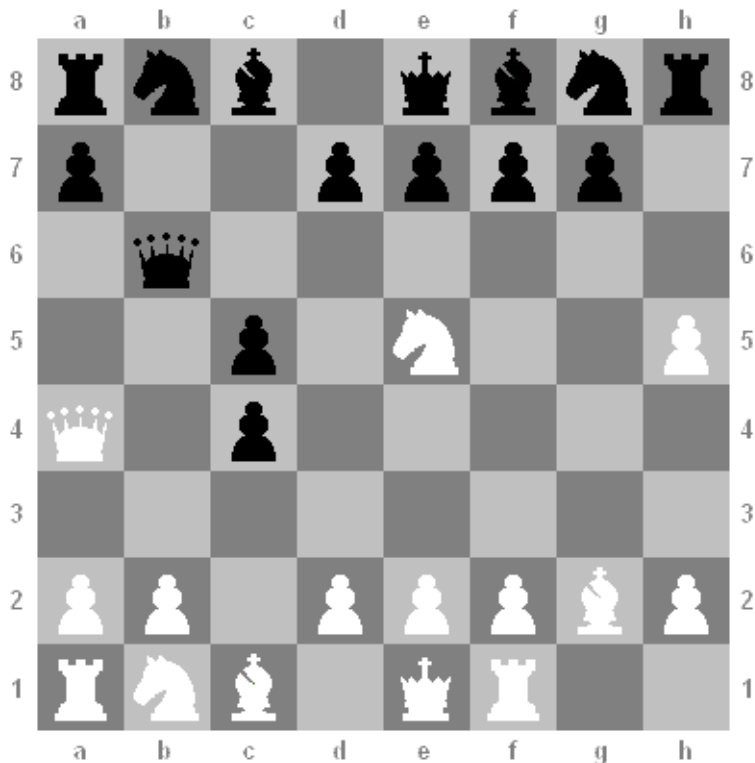
the vice president of AeroCorp. He and his wife share a condo with his sister. Nelson Winland, unmarried, is a communications expert with the same firm. The fifth member is Lance Shelby, a retired Foreign Service Officer and former ambassador. He is married and has no siblings. The FBI has these clues:

- Alpha and Bravo and their wives occasionally take vacations together
- Charlie is dissatisfied with his job
- Mrs. Diemen regularly corresponds with ‘Mrs. Delta’
- Mrs. Diemen was once engaged to the brother of Delta.
- Neither Echo nor Bravo has ever been outside the state
- Finally, Beauford makes monthly trips to Mexico.

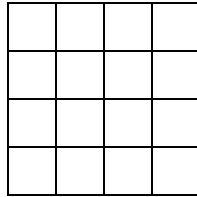
Who has which code name?

16. (6 pts) Dr. Cooper has just invented an invisibility potion which turns whoever drinks a sip of the potion completely invisible for 24 hours. The bad news is that someone has stolen a bottle of it from his lab. Dr. Lovelace, was worried that the thief might have drank the potion and spied on his confidential engineering drawings, but Dr. Cooper reassured him that the thief would not do so. Given that Dr. Cooper and Dr. Lovelace do not know who the thief was, how can Dr. Cooper be certain that the thief will not see Dr. Lovelace’s confidential drawings while invisible?

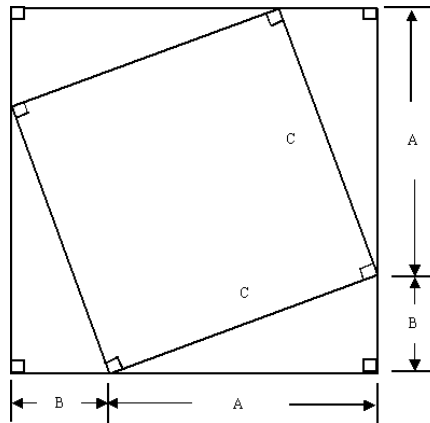
17. (4 pts) What is impossible in this game of monochromatic chess?



18. (2 pts) Place 4 circles in such a way so that no two circles are in the same row, column, or diagonal.



19. (4 pts) Prove the Pythagorean theorem given:



20. (10 pts) Show and explain the relationship between the Pythagorean Theorem, the distance formula, the equation of conic sections, and a trigonometric identity.