Math 130: Contemporary Mathematics
Math Puzzles Handout

**Numbers**

1. **Dividing Muffins Puzzle.** How do you divide up 5 muffins among 6 people so that they all get the same amount, and the smallest piece of muffin is as big as possible?

2. **Card Printing Puzzle.** You need to print cards for a game that has one 1, two 2s, three 3s, and so on up to twelve 12s. You print the same number of cards on each page, and you print each page a number of times equal to the smallest numbered card on it. Is this possible?

3. **Tip the Die Puzzle.** Start with a 6-sided die on a flat surface, with the 1 side up. Tip the die along an edge to an adjacent side, and add the result to your current total. Which totals can you get?

4. **Autobiographical Numbers Puzzle.** The number 1210 has the curious property that its first digit counts how many zeros it has, its second digit counts how many ones it has, its third digit counts how many twos it has, and its fourth digit counts how many threes it has. Can you find a 7-digit number like this?

5. **Averaging Averages Puzzle.** Starting with the numbers 1 through 10, take any two of them and replace them with their average. Repeat this until you have only one number left. Which whole numbers can you get via this process?

6. **Water Pouring Puzzle.** You have a 3-gallon jug and a 5-gallon jug, neither of which have any markings. Can you pour water between the two jugs to get exactly 4 gallons of water in the 5-gallon jug?

7. **Stone Weighing Puzzle.** You have 9 identical-looking stones. One of them is slightly heavier and contains a valuable jewel. You also have a balance scale. Can you figure out which stone contains the jewel using only two weighings on the scale?

8. **Chicken Nuggets Puzzle.** McDowell's fast food restaurants sell chicken nuggets in boxes of 5 and 8. Verify that you can't buy exactly 12 nuggets. What quantities of nuggets can you buy?

9. **Egg Drop Puzzle.** You live in a 15-story building, and you want to know which floors are safe to drop eggs from, and which floors will cause the eggs to break. You only have 2 eggs, and you can reuse any egg that doesn't break. If they both break before you figure it out, you've failed! What is the smallest number of egg-droppings that is guaranteed to work?

10. **Elevator Stops Puzzle.** An apartment building has 4 elevators which each stop at 3 different floors, and it's possible to travel from any floor to any other floor without switching elevators. How many floors can the building have?

11. **Stepping Stones Puzzle.** Starting with a 5x5 grid, write a number 1 in two spaces in the grid. Then write a 2 in a space next to the two 1s (diagonals count as adjacent). Then write a 3 next to the 2 and a 1 (so the sum of the numbers next to the 3 is 3). Then write a 4 next to some numbers that add up to 4. How many numbers can you write before you get stuck?

Shapes

12. **Mondrian Rectangles Puzzle.** Divide a 6×6 square into rectangles (or squares) of all different areas. Your score is the difference between the largest and smallest areas of your rectangles. What's the smallest score you can get?

13. **Patio Planting Puzzle.** What's the largest number of 1×1 gaps you can make (to plant flowers in) by arranging ten 2×1 patio bricks?

14. **Non-parallel Cycle Puzzle.** Start with a 4×4 grid of dots. Connect them in a closed cycle with 16 straight line segments so that no two of the line segments are parallel.

15. **Piling Dice Puzzle.** How many 6-sided dice can you arrange so that they all touch each other?

16. **Domino Tiling Puzzle.** Take a 4×4 chessboard, and remove the two opposite corner squares. Can you cover the remaining squares with dominoes that each cover two adjacent squares?

17. **Triangle Cutting Puzzle.** Fold this paper using straight folds, then make a single straight cut to exactly cut out this triangle.
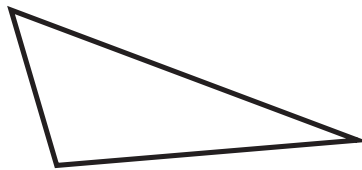
18. **Orchard Planting Puzzle.** Can you plant 8 trees so that you have 7 rows of three trees each? (Some of the rows can be diagonal.)

19. **Dissected L Puzzle.** Make an L-shape out of three squares, then cut the L-shape into four identical pieces.

20. **Sensor Beam Puzzle.** A hexagonal room has 6 exterior walls and 2 interior walls. Each interior wall is constructed from one corner of the hexagon to another, straight through the interior of the room. Your job is to determine where the interior walls are using sensor beams. You can project a sensor beam through the center of an exterior wall to the center of another exterior wall, and it will tell you how many interior walls it intersects along the way. How many sensor beams do you need to determine where the interior walls are? One example is shown below (the sensor beam is the dotted line).
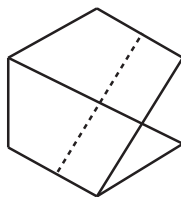
21. **Tetris Enclosing Puzzle.** Using one of each of the different Tetris pieces, what's the largest amount of empty area you can enclose?

22. **Considerate Roommate Puzzle.** You arrive home late and want to unlock your room without turning the light on and waking your roommate. You have 6 keys on a key ring, but you can't see them. How many different shapes of keys do you need to tell the keys apart by touch?

Networks

23. **Fire Station Placement Puzzle.** In an 8×8 city grid, we place a number of fire stations at the corners of the grid. What's the fewest fire stations we need to have every house in the city no more than 2 blocks away from a fire station?

24. **Snow Plowing Puzzle.** In a 4×4 city grid, a snow plow makes a path through the city, plowing the road in front of it as it goes. What's the smallest number of city blocks the plow needs to traverse more than once to plow all the streets?

25. **Airline Routing Puzzle.** You're working for a new airline company, and scheduling flights between eight cities in the U.S. You want a passenger to be able to get from any city to any other city with only two flights (one layover), and you want at least two different routes between any two cities in your network, in case an airport is inaccessible because of weather. How many flight connections do you need?

26. **Chaser and Runner Puzzle.** Two chasers and one runner are moving on a 5×5 city grid. On each turn, first each chaser moves along a single street to a neighboring corner, then the runner does. Players are allowed to stay still. The chasers win if either of them catches the runner. The runner wins if she can avoid getting caught indefinitely. Who can win the game?

27. **Peg Jumping Puzzle.** You have 15 pegs arranged in a 4×4 grid. You can jump a peg over an adjacent peg horizontally or vertically, and then remove the peg you jumped over. Can you get down to only one peg?

28. **Queens Domination Puzzle.** How many queens do you need place on an 8×8 chessboard to attack every square?

Logic

29. **Testing Batteries Puzzle.** Your TV remote takes two batteries, and you have four good batteries and four dead ones, but you don't know which is which. What's the fewest tests you need to find two that work?

30. **String Burning Puzzle.** You have two pieces of string, each of which will burn for exactly one minute, but not uniformly along its length. How can you use them to measure 45 seconds?

31. **Sitting and Standing Puzzle.** Four people are sitting in a row. They win the game if they all stand up. The following moves are allowed:

   - Person 1 can stand or sit at any time.
   - Person 2 can stand or sit only if person 1 is sitting.
   - Person 3 can stand or sit only if person 2 is sitting and person 1 is standing.
   - Person 4 can stand or sit only if person 3 is sitting and the others are standing.

   Can they win the game?

32. **Find the Leak Puzzle.** Three of the mayor's nine advisors are telling state secrets to the press. The mayor devises a list of false secrets to tell her advisors. She will tell different groups of advisors the false secrets, and use the information of which secrets get printed in the newspaper to figure out which of her advisors are leaking the information. The reporters won't print the stories unless they get confirmation from all three leakers (so if the mayor tells only two of them a false secret, it won't get printed). The goal is to find the leakers telling as few false secrets as possible, and printing as few as possible. How well can she do?

Games

33. **Sequence Solitaire Puzzle.** Start with one pile of six cards. On each turn take one card from all the piles, and make a new pile with them. Will you at some point during the game make six piles of one card each?

34. **Coloring Game Puzzle.** Aliyah and Bob alternately color the squares of a 3×3 chessboard red, blue, or green, with the rule that two adjacent squares can't be the same color. Aliyah wins if they finish coloring the board, and Bob wins if they get stuck and can't finish. Who will win if they both play perfectly?

35. **Nim Puzzle.** Alma and Basir take turns removing sticks from piles on the table. They start with three piles of 3, 5, and 7 sticks. Each player can take any number of sticks from one of the piles. A player loses if they are forced to take the last stick. Who will win if they both play perfectly?

36. **Coin Predictor Puzzle.** A robot coin flipper is programmed to flip a coin three times, and flip two heads and one tails, but in a random order. You are betting an unsuspecting friend that the coin will land heads each time. You start with $10, and you can decide how much to bet each time. What's the most profit you can guarantee yourself in your three bets?