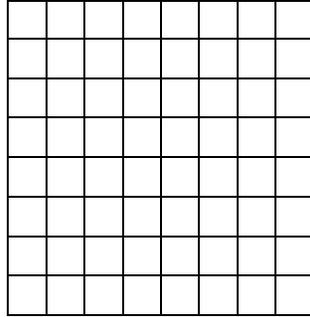


PUZZLES

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1. A gregarious IE undergraduate named Javier living in Arlington Hall gave a party during the time that UTA was closed this semester from weather conditions. Javier told his IE 3301 professor Dr. Maria Savant that everyone at the party shook hands with everybody else exactly once and that there were 66 handshakes. Immediately Dr. Savant correctly told Javier the number of people who attended. What was her answer?
2. Weather.com predicts that the Arlington temperature on the night of February 26 will reach 0 degrees Fahrenheit. EE Professor Dr. Max Short tells his students that he will save energy by turning his home thermostat down from 70 to 60 degrees at 8 p.m. that night until noon the next day, at which time he will turn it back up to 70. By noon the temperature is forecast to be 40 degrees. One student, however, states that if the house cools down to 60 at night, then the next day the same amount of energy saved by lowering the temperature to 60 will be needed to take the temperature back to 70. Dr. Short hesitates and states that he will give his idea further thought. Select the correct statement for this situation from the multiple choices below. State your answer as the corresponding letter.
 - (a) It makes no difference.
 - (b) Turning the thermostat down to 60 uses less energy.
 - (c) Leaving the thermostat at 70 uses less energy.
 - (d) There is not enough information to select (a) – (c) with certainty.
3. An ME named Kuan gets a spam email offer from www.luxxar.com. According to the email, if Kuan simply visits this website, he will be given \$100 worth of free merchandise, with free shipping and no taxes. There are restrictions, however. Kuan may only select from items A, B, C sold on that website. Item A costs \$0.25 per unit, item B costs \$1 per unit, and item C costs \$15 per unit. Moreover, Kuan is required to spend all \$100 and not spend any of his own money. In addition, he must buy exactly 100 items, including at least one each of A, B, and C. Suppose Kuan visits the website and follows the above directions. Also assume the offer as stated is valid. Then how many of each type of item will Kuan receive for free? Express your answer in the form (x,y,z) , where x is the integer number of A items received, y is the integer number of B items, and z is the integer number of C items.
4. The nation of Griddonesia consists of 81 equally-spaced islands represented by intersections of the lines in the grid below. Each island is connected to all its adjacent islands by horizontal and vertical bridges. There are no diagonal bridges.



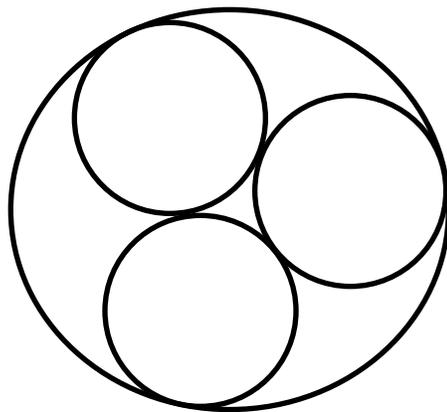
In the nation's presidential elections, by law there are exactly two candidates - one each from the Yin and the Yang parties. Griddonesia has a presidential election this year with the Yin incumbent female president running against a Yang candidate chosen by his party. In a Griddonesian presidential election, each voter splits exactly 5 points between the Yin and the Yang candidate, giving each candidate a nonnegative integer number of points. A vote is thus one of the ordered pair of points $(5,0)$, $(4,1)$, $(3,2)$, $(2,3)$, $(1,4)$, or $(0,5)$. The first number represents the points a voter gives to the Yang candidate and the second the points the voter gives to the Yin candidate. The rationale is that a Griddonesian election allows a voter to express the degree to which the voter prefers one candidate over another. On the other hand, it does not allow a voter to evenly divide the 5 points between the two candidates.

Another interesting feature of a Griddonesian election is that when an incumbent president runs, the incumbent remains in office for another term if both candidates receive the same total number of points from voters. To two decimal places, determine the smallest possible percentage of total votes cast in which the Yang candidate receives more points than the Yin incumbent - for example, $(4,1)$ - but in which the Yin incumbent will remain in office.

5. By tradition in Griddonesia, each person continues to have children until he/she has a daughter. In other words, if the Griddonesian national bioengineer ᄡᆞᆯᆞᆯᆞᆯ has a son, ᄡᆞᆯᆞᆯᆞᆯ has another child. If ᄡᆞᆯᆞᆯᆞᆯ has a daughter, she has no further children. To model the effects of this tradition, assume unrealistically that this practice has been precisely followed forever. Also assume unrealistically that no Griddonesian boys and girls under 18 die. What is the current proportion of boys to girls under 18 in Griddonesia?
6. Suppose that an ant is trapped inside the face of the office clock in the CE administrative office. The ant starts crawling upwards from the central axis of the minute hand at exactly noon. The ant crawls at a constant speed along the hand and reaches the end of the hand in 15 minutes. To the nearest minute, at what time was the ant at its highest position?
7. A tourist attraction in Desperado, Colorado, is a railroad ride on an old coal-burning train once used in settling the western United States. Luke is an ME undergraduate from Colorado who drives the train engineer during the summer. He knows that the consumption of coal by the locomotive varies as the square of the speed. Excluding

coal and workers' salaries, the other operating expenses are only \$72 per hour. If the price of coal is \$10 per ton and if at a speed of 25 mph, the locomotive uses 5 tons per hour, to the nearest dollar, what is the minimum cost of a trip of 100 miles?

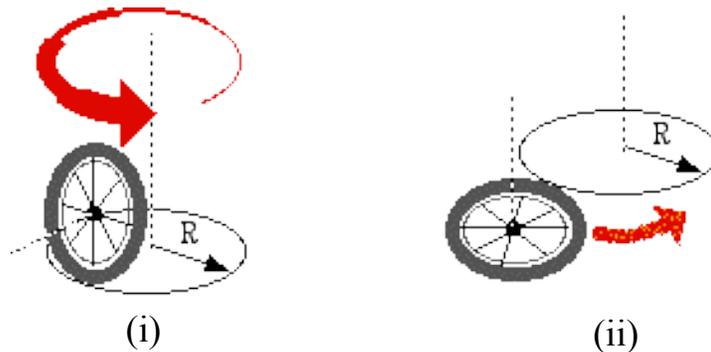
8. An ME graduate student named Aaron has been assigned the following homework question in his fluid flow class. He is given the following information. An open barrel can be filled with water from the top through a faucet and emptied through a hole in the bottom. With the faucet closed, a full barrel is emptied in 9 minutes. With the hole closed, an empty barrel is filled in 8 minutes by the open faucet. The barrel is positioned vertically on a metal frame exactly a foot above a flat concrete surface in such a way that the inflow and outflow of water are not affected. How long does it take an empty barrel to fill if both the hole and faucet are open? Aaron has come up with four possible answers, one of which is correct. As your answer, give the letter corresponding to the correct answer.
- (a) The barrel will be filled in 72 minutes.
 - (b) The barrel can only be filled to $81/256$ of its height.
 - (c) All water will flow out as fast as it enters the barrel.
 - (d) There is not enough information to select (a) – (c) with certainty.
9. A Korean systems engineering graduate student named Sun Lee wants to use the notion of fractal dimensions to characterize the complexity of a network model of a system. To understand the concept, she goes to http://en.wikipedia.org/wiki/Fractal_dimension, where the fractal dimension of the Sierpinski triangle is calculated. For practice, she then devises an example of her own and calculates the fractal dimension of the object formed by recursively dividing the figure below in a manner similar to obtaining the Sierpinski triangle. In each iteration, the part of a larger circle not in one of its three inner circles is removed and regarded as a hole. To the nearest two decimal places, calculate the fractal dimension of the object that may eventually be called the Sun circle despite [Stigler's Law of Eponymy](#).



10. In the chemical engineering department, an administrative assistant named Susan edits the department chairman Dr. Han Wright's important letters. He gives her a handwritten draft that she must edit for clarity, grammar, and punctuation. Randomly during the day, Dr. Wright puts one of his letters in Susan's in-box. When there is free time between her other duties, she takes the top letter, edits it, and creates a Word document, finishing all his letters the same day he wrote them. One day Dr. Wright writes five letters labeled 1,2,3,4,5 according to the order in which he put a letter into her box. In other words, letter 1 is the first (and lowest) letter that he put in her box during the day, and letter 5 is the last. Which of the following could NOT be the order from left to right in which Susan edits them? State your answer as the letter corresponding to the order correctly answering the above question.

- (a) 1 2 3 4 5.
- (b) 5 4 3 2 1.
- (c) 3 2 4 1 5.
- (d) 4 5 2 3 1.

11. An AE undergraduate named Timothy is an avid biker. During the time that UTA was closed this semester from weather conditions recent, he repaired replaced his rear wheel in the UTA parking garage. In doing so, Timothy imagined the following two scenarios depicted in the drawings below. In (i) a wheel of radius R vertical to the plane of a circle of radius R makes exactly one revolution around its axis moving along the circumference of the circle. In (ii) the same wheel makes exactly one revolution around its axis moving along the same circle but horizontal to the plane of the circle.



With regard to scenarios (i) and (ii), give as your answer to this problem the letter below corresponding to the correct statement.

- (a) The wheel goes further around the circumference in (i) than in (ii).
- (b) The wheel goes further around the circumference in (ii) than in (i).
- (c) The wheel goes the same distance in (i) and (ii).
- (d) There is not enough information to select (a) – (c) with certainty.

12. Dr. Frank N. Stein of the CSE faculty has a grant to test the decision-making skills of students. For one experiment as part of this research, the eminent AI writes a computer program to randomly generate three different integers from 1 to 1000. In

the experiment, a participant hits * on the keyboard of a laptop, and the value of one of the three numbers randomly appears on the screen. If the participant believes that this first number is the largest of the three, he/she stops the experiment and receives an amount in dollars equal to the number. Otherwise, he/she hits the * key again, the first number disappears, and one of the remaining two integers randomly appears on the screen. Again, if the participant believes that this second number is the larger of the remaining two numbers, he/she stops the experiment and gets its value in dollars. Otherwise, he/she hits * again, the second number disappears, and the participant receives its value in dollars.

A female ME undergraduate participant name Devina will participate in this study and has formulate the following strategy. She will ALWAYS hit * after the first number appears. If the second number is larger than the first, she will stop. If it is smaller than the first, she will hit * again and take the third number. To the nearest two decimals, what is the probability that Devina will receive the largest possible amount of money with this strategy?

13. (Remember, it's a dirty dozen.) A materials science graduate student named Farzad has developed a buckyball (<https://www.planetseed.com/node/19769>) constructed from the newly discovered and extremely expensive element unobtainium. Farzad takes two identical such buckyballs to a 100-floor building in Dubai. From chaos theory Farzad knows that the two identical buckyballs can break from being dropped from dramatically different heights. However, his goal is to determine the highest floor of this 100-story building from which at least one of his buckyballs can be dropped without breaking. What is the minimum number of drops to determine if the highest floor is the 49th, as determined by computer simulation, if Farzad is willing to break both buckyballs in the process?

ANSWERS

1. 12.
2. (b)
3. (56,41,3)
4. 0 (Question said "smallest".)
5. 1:1 (Simulate if you don't believe the answer.)
6. 12:08 p.m. (Finding the height via convergence using a calculator is easiest.)
7. \$480

8. (d) (The weight of the water above the hole as water flows into an EMPTY barrel, plus the shape of barrel, affect the instantaneous rate of outflow. A cylindrical barrel reaches an equilibrium at $81/256$ of its height and never fills completely. But a different barrel shape would change this answer.)
9. 1.43 (See <http://mathworld.wolfram.com/CirclePacking.html> for magnification factor).
10. (d)
11. (b) (Try with a quarter and a tracing of a quarter on paper.)
12. 0.5 (Simulate if you don't believe the answer. Also see http://en.wikipedia.org/wiki/Monty_Hall_problem for a similar paradox.)
13. 3 (Worst case: If the first one dropped from the 49th floor doesn't break, you have two to drop from the 50th floor. That leads to 3 drops if the first drop from the 50th floor breaks. The 50th floor is the obvious floor to try next.)