Pizza Problems – August 2, 2021

Problems & Solutions

Tony's Pizzeria sells three sizes of pizzas: small, medium and large. The standard crust size is 1 inch wide, no matter what size pizza you get. At Tony's, a small pizza is 10 inches, has four slices and costs $9.95; a medium is 14 inches, has six slices and costs $12.95; and a large is 16 inches, has eight slices and costs $15.95. What is the absolute difference in price per square inch between the small and the large pizzas?

*The large pizza is 16 inches in diameter and has an area of $\pi \times 8^2 = 64\pi$ in². The cost per square inch for a large pizza is, therefore, $15.95 \div 64\pi$ in² $\approx$ \$0.08/in². The small pizza is 10 inches in diameter and has an area of $\pi \times 5^2 = 25\pi$ in². The cost per square inch for a small pizza is, therefore, $9.95 \div 25\pi$ in² $\approx$ \$0.13/in². The difference in price per square inch between the large and the small is, therefore, \$0.13 – \$0.08 = ***\$0.05***.*

Mrs. Smith is ordering pizza for her class. She asks each student how many pieces of pizza they will eat and discovers a total of 35 slices are needed to feed the entire class. She decides to call and order from Tony's Pizzeria. She must order enough to have at least 35 slices, but having extra slices is fine. How many pizzas of each size should she order in order to minimize cost?

*In order to minimize the cost of her order, Mrs. Smith should first figure out which pizza has the lowest cost per slice. The cost per slice of a small pizza is $9.95 \div 4 \approx$ \$2.49; the cost per slice of a medium pizza is $12.95 \div 6 \approx$ \$2.16; and the cost per slice of a large pizza is $15.95 \div 8 \approx$ \$1.99. The large pizza has the lowest cost per slice of the three size options. If Mrs. Smith orders only large pizzas, she will need to order 5 pizzas. The total cost will be $15.95 \times 5 =$ \$79.75, and she will have $5 \times 8 – 35 = 5$ extra slices. If Mrs. Smith orders only medium pizzas instead, she will have to order 6 pizzas. The total cost will be $12.95 \times 6 =$ \$77.70, and she will have $6 \times 6 – 35 = 1$ extra slice. If she orders 4 large pizzas, she will have $4 \times 8 = 32$ slices, and also orders 1 small pizza, which has four slices, she will be left with $32 + 4 – 35 = 1$ extra slice. The total cost will be $15.95 \times 4 +$ \$9.95 $=$ \$63.80 $+$ \$9.95 $=$ \$73.75. This is the cheapest option to feed all her students, so the order Mrs. Smith should place to minimize her cost and still feed the whole class is: **1 small, 0 medium, 4 large** pizzas.*

A very greedy restaurant manager at Tony's Pizzeria tells a very clever employee to maximize the number of slices he makes with six straight cuts through a large circular pizza. The manager only cares about selling more slices and making more money. The employee asks, "Do they need to be equally sized slices?" The manager responds, "Any size is fine! Just get more slices!"

What is the maximum number of slices the employee can make to satisfy his demanding boss?

Let's start with the first straight cut. For one straight cut through a circular pizza, you can create two slices and no more (see diagram). For the second cut, the most you can create is two more slices, four in total. You do this by intersecting the one already existing cut. For the third cut, the most you can create is three additional slices, seven in total. This is done by intersecting the third cut with each of the two existing cuts (not at an already existing point of intersection).

1 cut   2 cuts   3 cuts
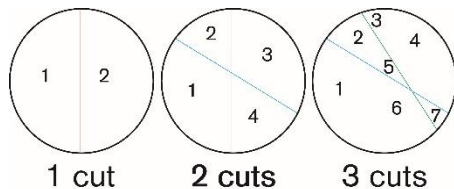
From here, you may be able to notice a pattern emerging. At zero cuts, we have one slice; at one cut, we add one slice for a total of two; at two cuts, we add two slices for a total of four; at three cuts, we add three slices for a total of seven. Let's write this out in a table and see how many slices we will have after six cuts if this pattern continues.

Cut	Pieces
0	1
1	1 + 1 = 2
2	2 + 2 = 4
3	4 + 3 = 7
4	7 + 4 = 11
5	11 + 5 = 16
6	16 + 6 = 22

*We get a maximum of **22** slices of pizza possible with six straight cuts. The diagram below shows one way of making these six cuts to obtain 22 slices.*
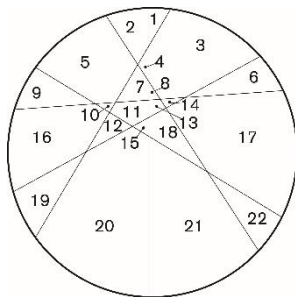
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