

MATHCOUNTS[®] Problem of the Week Archive

Geometry of Gift Giving– December 17, 2018

Problems & Solutions

Vanessa bought some round holiday dessert plates to give as a gift to her friend. However, the store only had 5 of the 8 plates she wanted. (All of the plates are the same.) The stack of five plates measured 1.5 inches tall, and when two plates were removed from the stack the remaining stack of three plates had a height of 1 inch. When Vanessa finally has all 8 of the plates she wants, how tall will the stack of 8 plates be, in inches? Express your answer as a decimal to the nearest hundredth.

We need to remember that most plates are not flat, so when they are stacked, the bottom plate takes up more height-space than the plate that is stacked on top of it. That's why we can't add the height of a 5-plate stack to a 3-plate stack to get an 8-plate stack of 2.5 inches. Notice that when the two plates were removed, the stack's height decreased by 0.5 inches. This means that adding a plate to the stack will add 0.25 inches to the stack. If we then add three plates to the 5-plate stack of 1.5 inches, we will have an 8-plate stack measuring $1.5 + 3(0.25) = \mathbf{2.25}$ inches.

What is the height of just one of these plates, in inches? Express your answer as a decimal to the nearest tenth.

We can also see that if removing two plates reduced the stack by 0.5 inches, then removing 0.5 inches from the stack of three plates that measures 1 inch will result in one plate that has a height of $\mathbf{0.5}$ inches.

The circumference of each of these plates measures 25 inches. What is the number of inches in the diameter of each plate? Express your answer as a decimal to the nearest hundredth.

The circumference of a circle is the result of the diameter of the circle multiplied by π . Since the circumference is 25 inches, the diameter is $25 \div \pi = \mathbf{7.96}$ inches. (This is the answer whether we use the π key on the calculator or the approximation of 3.14 for π .)

Once Vanessa has all eight plates, she wants to put them into a box that she will then wrap and give as a present. The store has boxes (rectangular prisms) of all sizes. What is the volume, in cubic inches, of the smallest box Vanessa can buy that has integer dimensions and will hold this stack of eight plates?

We know from the last problem that the plates are slightly less than 8 inches across, so a box that is 8 by 8 on the bottom will hold a plate. The stack of 8 plates is 2.25 inches, so we're going to have to go with a box that is 3 inches tall in order to keep an integral height and fit the entire stack. Therefore, the smallest possible box Vanessa can buy has dimensions 8 inches by 8 inches by 3 inches and has volume $8 \times 8 \times 3 = \mathbf{192}$ in³.

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