

# Learning & Teaching

*Mathematics Teacher: Learning and Teaching PK-12*, is NCTM's newest journal that reflects the current practices of mathematics education, as well as maintains a knowledge base of practice and policy in looking at the future of the field. Content is aimed at preschool to 12th grade with peer-reviewed and invited articles. *MTLT* is published monthly.

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## Mission Statement

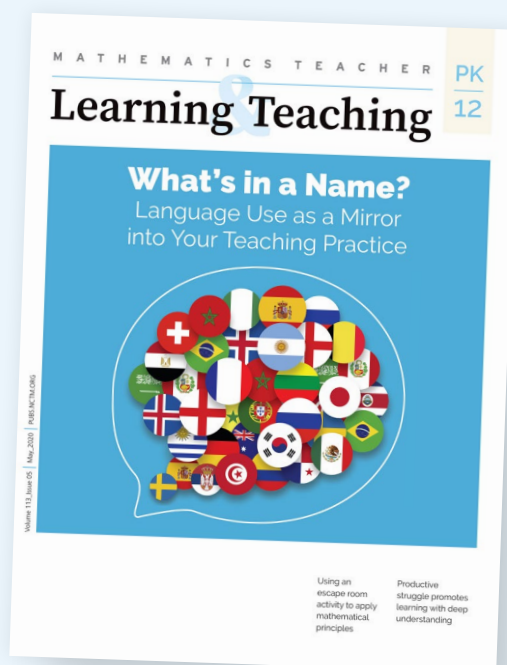
The National Council of Teachers of Mathematics advocates for high-quality mathematics teaching and learning for each and every student.

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# Problems to Ponder

Problems to Ponder provides 28 varying, classroom-ready mathematics problems that collectively span PK–12, arranged in the order of the grade level. Answers to the problems are available online. Individuals are encouraged to submit a problem or a collection of problems directly to [mtlt@nctm.org](mailto:mtlt@nctm.org). If published, the authors of problems will be acknowledged.

Sang Moo Lee

For problems 1 to 28, consider the following situation.

You have a piggy bank with a total of 120 coins: 40 quarters, 40 dimes, and 40 nickels. The following table provides the weight, diameter, and thickness of the 120 coins.

| Coin                      | Quarter                                                                             | Dime                                                                                | Nickel                                                                               |
|---------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Coin image (not to scale) |  |  |  |
| Quantity                  | 40                                                                                  | 40                                                                                  | 40                                                                                   |
| Weight                    | 5.67 g / quarter                                                                    | 2.268 g / dime                                                                      | 5 g / nickel                                                                         |
| Diameter                  | 24.26 mm                                                                            | 17.91 mm                                                                            | 21.21 mm                                                                             |
| Thickness                 | 1.75 mm                                                                             | 1.35 mm                                                                             | 1.95 mm                                                                              |

*Note.* A quarter is worth 25 cents; a dime is worth 10 cents; a nickel is worth 5 cents.

1

Which coin is the largest in size, and which is the smallest in size? Which is the greatest in value, and which is the least in value?

4

You and 3 friends want to share the total of 120 coins equally. Explain what “equally” could mean in this situation and give one possible sharing arrangement for each interpretation.

2

How much total money do you have?

3

If the public bus fare to your school is \$1, how many bus trips can you take using your coins?

5

You want to purchase an orange juice at a vending machine. If the drink costs \$2.25, what coins could you use to make this amount? Give two possible combinations of your coins that would give you the exact amount needed.

6

If you remove 2 coins, what is the greatest amount of money you would have left? What is the least amount of money you would have left? How did you figure it out?

7

What is the least number of coins needed to make \$10? What is the greatest number of coins needed to make \$10? Can you make \$10 from the same amount of each coin? Explain.

8

Find three different ways to make \$5 with the coins you have. Suppose you were challenged to use only a single type of coin to sum up to whole dollars. What is the largest amount of dollars you can make using only nickels? Can that amount also be made using only dimes or quarters?

9

If you removed a third of the coins, what is the greatest amount of money you could have left? What is the least amount of money you could have left?

10

What percentage of your coins are quarters? Answer as a mixed number percentage and round the decimal percentage to the nearest hundredth.

11

If you have 25% of all the coins, what is the greatest amount of money you could have? What is the least amount of money you could have? Which coins would you have in each case?

12

You want to deposit \$10 of your coins into your savings account at the bank, but you have to walk to the bank, which is eight blocks away. Which coins would you bring for the lightest bag of coins? Which coins would you bring for the heaviest bag of coins? Explain how you know.

13

You decided to stack all your coins. What is the total height of your coins in centimeters? Is the stack more or less than six inches tall? (1 inch = 2.54 cm)

14

You decide to throw all your coins into a wishing well and wish for world peace and to end world hunger. The well is shaped like a cylinder and has a circumference of  $2\pi$  meters. After you throw your coins into the well, how much does the depth of water increase? Round your answer to the nearest hundredth in millimeters.

15

If you increase the number of coins by 5%, you have a 9.375% increase in money. Which coin type has been increased?

16

Which would increase your total money more: increasing the total value of money by 10.96%, or increasing the total weight of the coins by 10.96% using the coin type with the greatest value per gram? Explain.

17

Approximately 1,191,000,000 quarters were minted in 2025. Estimate the total monetary value and the total mass of these quarters. Express both answers in scientific notation, rounded to the nearest hundredth.

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18

You are interested in purchasing a small toy from Canada. The exchange rate of your US coins is 1.0 USD (US dollars) to 1.5 CAD (Canadian dollars). The cost of the toy is \$2.25 in Canada. Give three combinations of coins that you should take to pay for the toy.

19

Your nickels are from the 1940s. They each contain 35% silver by weight. How many grams of silver can you obtain from your nickels? If 1 gram of silver is worth \$1, how much are your nickels worth in terms of their silver content?

20

Every day, you exchange one nickel from your piggy bank for one quarter from a friend. Write an equation to represent the total amount of money  $A$  after  $d$  days (for up to 40 days) and graph the relationship. Why must the exchange be limited to 40 days or fewer? How much money do you have after 20 days? After 40 days?

21

Inflation decreases the purchasing power of your \$16 by 2% annually. Write an equation that models this phenomenon in  $t$  years. What will your money's purchasing value be in 5, 10, and 100 years?

22

If inflation decreases the purchasing power of your \$16 by 2% annually, will the purchasing power of your money ever decrease to \$0? Write an equation, graph the equation, and explain using the graph.

23

Your coins appreciate in collectible value by 1% annually. Write an equation to model this situation. How much would they be worth in 0, 10, 50, and 100 years?

24

You notice that your spending and saving habits have become sinusoidal with a period of 12 months. In January, you have \$9 saved. In April, your savings reach a maximum of \$18. In October, your savings reach a minimum of \$0. How much do you have in July? How much do you have in August?

25

You take out approximately 50% of the coins by weight. What is the least amount of money you could remove? What is the greatest amount of money you could remove? Justify your answer.

26

Every day, you exchange the least valuable coin in your piggy bank for a quarter from a friend. Write a piecewise equation to represent the total amount of money  $A$  after  $d$  days. Graph the relationship.

What are the domain, range, and maximum amount of money?

Is the graph discrete or continuous? Explain.

27

You randomly pick out 4 coins from your piggy bank. What is the probability, rounded to the nearest hundredth, that you took out more than \$0.50?

28

You and a friend decide to make a roller coaster track for your coins. Your friend provides you with the track layout using the equation  $h(d) = -4d^3 + 11d^2 - 6d + 1$ , where  $\{0 \leq d \leq 2\}$ ;  $d$  is horizontal distance in meters, and  $h$  is height in meters. The roller coaster will start at  $d = 0$  m. What is the highest point of the track? Assuming that friction and wind resistance are negligible, will the coin be able to go over the highest point?