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Project: Water bill: Residential Rates

Company: The Town of Cary, NC Public Utilities

<https://www.carync.gov/home/showpublisheddocument/29251/638109458552570000>

Objectives:

- (a.) Calculate the water bill of the residents of the Town of Cary, NC for single household use of 2”-meter size within each tier using the arithmetic method.
 - (b.) Write a piecewise function of the rates.
 - (c.) Recalculate the same water bill of the residents of the Town of Cary, NC for single household use of 2”-meter size within each tier using the piecewise function method.
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Information:

Service Locations inside Cary, Morrisville, and Research Triangle Park

Corporate Limits

Monthly Base Charge:

Meter Size: 2”

Each Water, Irrigation, and Sewer Service: \$29.95

Tier 1	1 - 5000 gallons	\$5.25 per 1000 gallons
Tier 2	5001 – 8000 gallons	\$5.89 per 1000 gallons
Tier 3	8001 – 23000 gallons or up to water budget	\$7.44 per 1000 gallons

Conversions:

$\frac{\$5.25}{1000}$	\$0.00525 for one gallon
$\frac{\$5.89}{1000}$	\$0.00589 for one gallon
$\frac{\$7.44}{1000}$	\$0.00744 for one gallon

Test Numbers:

- (1.) 0 gallons
- (2.) 2000 gallons
- (3.) 3563 gallons
- (4.) 7500 gallons
- (5.) 15237 gallons
- (6.) 21674 gallons

Arithmetic Method:

(1.) 0 gallons a month

Monthly charge: \$29.95

$$0(0.00525) + 29.95$$

$$0 + 29.95$$

$$29.95$$

Total Cost: 29.95

(2.) 2000 gallons a month

Monthly charge: \$29.95

$$2000(0.00525) + 29.95$$

$$10.50 + 29.95$$

$$40.45$$

Total Cost: \$40.45

(3.) 3563 gallons a month

Monthly charge: \$29.95

$$3563(0.00525) + 29.95$$

$$18.70575 + 29.95$$

$$48.65575$$

Total Cost: \$48.66

(4.) 7500 gallons a month

Monthly charge: \$29.95

$$7500 - 5000 = 2500$$

$$5000(0.00525) + 2500(0.00589) + 29.95$$

$$26.25 + 14.725 + 29.95$$

$$70.925$$

Total Cost: \$70.93

(5.) 15237 gallons a month

Monthly charge: \$29.95

$$15237 - 8000 = 7237$$

$$8000 - 5000 = 3000$$

$$7237(0.00744) + 3000(0.00589) + 5000(0.00525)$$

$$53.84328 + 17.67 + 26.25$$

$$97.76328 + 29.95$$

$$127.71328$$

Total Cost: \$127.71

(6.) 21674 gallons a month

Monthly charge: \$29.95

$$21674 - 8000 = 13674$$

$$8000 - 5000 = 3000$$

$$13674(0.00744) + 3000(0.00589) + 5000(0.00525)$$

$$101.73456 + 17.67 + 26.25$$

$$145.65456 + 29.95$$

$$175.60456$$

Total Cost: \$175.60

Piecewise Function:

Let c = cost of water consumed per gallon (in \$)

Let g = gallons of water consumed

First piece:

When the usage of water is less than or equal to 5000, we multiply the amount by the cost for that specific tier. Then we also include the additional monthly add-on fee which is \$29.95.

$$c(g) = 0.00525$$

$$c(g) = 0.00525g + 29.95$$

Second Piece:

Now that we know the information for the function, we multiply the cost by the maximum amount of gallons used in that specific tier.

Monthly Base Charge: \$29.95

$$c(g) = 0.00525(5000) + 29.95$$

$$c(g) = 26.25 + 29.95$$

$$c(g) = 56.20$$

$$c(g) = 56.20 + 0.00589(g - 5000)$$

$$c(g) = 56.20 + 0.00589g - 29.45$$

$$c(g) = 0.00589g + 26.75$$

Third Piece:

Now we must finish solving the end of the second piece.

Monthly Base Charge: \$29.95

$$c(g) = 0.00525(5000) + 0.00589(8000 - 5000) + 0.00744(g - 8000)$$

$$c(g) = 26.25 + 0.00589(3000) + 0.00744g - 59.52$$

$$c(g) = 26.25 + 17.67 + 0.00744g - 59.52$$

Add in the monthly base charge of \$29.95

$$c(g) = 29.95 + 26.25 + 17.67 + 0.00744g - 59.52$$

$$c(g) = 73.87 + 0.00744g - 59.52$$

$$c(g) = 0.00744g + 14.35$$

Piecewise Function:

$$c(g) = \begin{cases} 0.00525g + 29.95; & 0 \leq g \leq 5000 \\ 0.00589g + 26.75; & 5000 < g \leq 8000 \\ 0.00744g + 14.35; & 8000 < g \leq 23000 \end{cases}$$

Piecewise Function Method:

(1.) 0 gallons a month

Monthly charge: \$29.95

$$c(g) = 0.00525g + 29.95$$

$$c(0) = 0.00525(0) + 29.95$$

$$c(0) = 0 + 29.95$$

$$c(0) = 29.95$$

Total Cost: \$29.95

(2.) 2000 gallons a month

Monthly charge: \$29.95

$$c(g) = 0.00525g + 29.95$$

$$c(2000) = 0.00525(2000) + 29.95$$

$$c(2000) = 10.50 + 29.95$$

$$c(2000) = 40.45$$

Total Cost: \$40.45

(3.) 3563 gallons a month

Monthly charge: \$29.95

$$c(g) = 0.00525g + 29.95$$

$$c(3563) = 0.00525(3563) + 29.95$$

$$c(3563) = 18.70575 + 29.95$$

$$c(3563) = 48.65575$$

Total Cost: \$48.66

(4.) 7500 gallons a month

Monthly charge: \$29.95

$$c(g) = 0.00589g + 26.75$$

$$c(7500) = 0.00589(7500) + 26.75$$

$$c(7500) = 44.175 + 26.75$$

$$c(7500) = 70.925$$

Total Cost: \$70.93

(5.) 15237 gallons a month

Monthly charge: \$29.95

$$c(g) = 0.00589g + 26.75$$

$$c(15237) = 0.00744(15237) + 14.35$$

$$c(15237) = 113.36328 + 14.35$$

$$c(15237) = 127.71328$$

Total Cost: \$127.71

(6.) 21674 gallons a month

Monthly charge: \$29.95

$$c(g) = 0.00744g + 14.35$$

$$c(21674) = 0.00744(21674) + 14.35$$

$$c(21674) = 161.25456 + 14.35$$

$$c(21674) = 175.60456$$

Total Cost: \$175.60

MLA Citations:

Chukwuemeka, Samuel D. “Piecewise Functions - Water Bill.” *Piecewise Functions*,

<https://conferencepresentations.appspot.com/Projects/PreCalculus/PiecewiseFunctions/WaterBill.html>, Accessed 6 June 2024.

“Utility Fees and Charges.” *Town of Cary, NC*,

<https://www.carync.gov/home/showpublisheddocument/29251/638109458552570000>, Accessed 21 June 2024