

Name:	Quinn [REDACTED]							
Date:	04-24-2024							
Instructor:	Samuel Chukwuemeka							
Project:	Water Bill: Single-Family Residential Rates							
Company:	The City of Richmond Department of Public Utilities (https://www.rva.gov/index.php/public-utilities/utility-rates)							
Objectives:	<p>(1) Use the arithmetic method to find the water bill for single-family residential buildings of Richmond, Virginia within the specified ranges of water consumption using 5/8" water meters.</p> <p>(2) Write a piecewise function for the water rates.</p> <p>(3) Use the piecewise function to recalculate the water bill for single-family residential buildings of Richmond, Virginia within the specified ranges of water consumption using 5/8" water meters.</p>							
Information:	<p style="text-align: center;">Richmond Water Rates</p> <p>Volume charges are charges for each Ccf of water used by the customer.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">Tier 1</td> <td style="text-align: center;">Between 0 and 4 Ccfs (lifeline rate)</td> <td style="text-align: center;">\$2.96</td> </tr> <tr> <td style="text-align: center;">Tier 2</td> <td style="text-align: center;">Above 4 Ccfs</td> <td style="text-align: center;">\$5.86</td> </tr> </table> <p style="text-align: center;">5/8" Meter Monthly Service Charge: \$16.70</p>		Tier 1	Between 0 and 4 Ccfs (lifeline rate)	\$2.96	Tier 2	Above 4 Ccfs	\$5.86
Tier 1	Between 0 and 4 Ccfs (lifeline rate)	\$2.96						
Tier 2	Above 4 Ccfs	\$5.86						
Test Cases:	<p>(1) 0 Ccf</p> <p>(2) 2 Ccf</p>							

	<p>(3) 4 Ccf</p> <p>(4) 16 Ccf</p>
Arithmetic Method:	<p>(1) 0 Ccf</p> <p>Monthly Charge: \$16.70</p> <p>Tier 1 Water Rate: \$2.96</p> $2.96 * 0 = 0$ $16.7 + 0 = 16.7$ <p>The total cost for 0 Ccf is \$16.70</p> <p>(2) 2 Ccf</p> <p>Monthly Charge: \$16.70</p> <p>Tier 1 Water Rate: \$2.96</p> $2.96 * 2 = 5.92$ $16.7 + 5.92 = 22.62$ <p>The total cost for 2 Ccf is \$22.62</p> <p>(3) 4 Ccf</p> <p>Monthly Charge: \$16.70</p> <p>Tier 1 Water Rate: \$2.96</p> $2.96 * 4 = 11.84$ $16.7 + 11.84 = 28.54$ <p>The total cost for 4 Ccf is \$28.54</p>

	<p>(4) 16 Ccf</p> <p>Monthly Charge: \$16.70</p> <p>Tier 1 Water Rate: \$2.96</p> <p>Tier 2 Water Rate: \$5.86</p> $2.96 * 4 = 11.84$ $5.86(16 - 4) = 5.86(12) = 70.32$ $16.7 + (11.84 + 70.32) = 16.7 + 82.16 = 98.86$ <p>The total cost for 16 Ccf is \$98.86</p>
<p>Piecewise Function:</p>	<p>Let c equal the cost per Ccf</p> <p>Let w equal the amount of water used in Ccf</p> <p>For the first piece, take the rate for usage less than or equal to 4 Ccf and multiply by the amount used:</p> $2.96 * w = 2.96w$ <p>Then, add the constant of \$16.70, the base monthly charge, onto the cost:</p> $c(w) = 2.96w + 16.7$ <p>For the second piece, take the first piece and calculate it for 4 Ccf:</p> $2.96(4) + 16.7 = 11.86 + 16.7 = 28.54$ <p>Then, multiply rate for more than 4 Ccf by the water used past 4</p>

	<p>Ccf:</p> $5.86(w - 4) = 5.86w + 5.86(-4) = 5.86w - 23.44$ <p>Finally, add on the cost from the first piece:</p> $c(w) = 5.86w - 23.44 + 28.54 = 5.86w + 5.1$ <p>The Piecewise Function:</p> $c(w) = \begin{cases} 2.96w + 16.7; & 0 \leq w \leq 4 \\ 5.86w + 5.1; & w > 4 \end{cases}$
Algebraic Method:	<p>(1) 0 Ccf</p> <p>Use the first piece:</p> $c(w) = 2.96w + 16.7$ $c(0) = 2.96(0) + 16.7$ $c(0) = 0 + 16.7$ <p>The total cost for 0 Ccf is \$16.70</p> <p>(2) 2 Ccf</p> <p>Use the first piece:</p> $c(w) = 2.96w + 16.7$ $c(2) = 2.96(2) + 16.7$ $c(2) = 5.92 + 16.7$ $c(2) = 22.62$ <p>The total cost for 2 Ccf is \$22.62</p>

(3) 4 Ccf

Use the first piece:

$$c(w) = 2.96w + 16.7$$

$$c(4) = 2.96(4) + 16.7$$

$$c(4) = 11.84 + 16.7$$

$$c(4) = 28.54$$

The total cost for 4 Ccf is \$28.54

(4) 16 Ccf

Use the second piece:

$$c(w) = 5.86w + 5.1$$

$$c(16) = 5.86(16) + 5.1$$

$$c(16) = 93.76 + 5.1$$

$$c(16) = 98.86$$

The total cost for 4 Ccf is \$98.86

Citation:

MLA Style Citation

Chukwuemeka, Samuel D. "Piecewise Function." *Piecewise Functions*, [https://precalculus.appspot.com/Piecewise Functions/piecewise-functions.html](https://precalculus.appspot.com/Piecewise-Functions/piecewise-functions.html). Accessed 23 April 2024.

"Utility Rates: Richmond." *Utility Rates | Richmond*, The City of Richmond Department of Public Utilities, www.rva.gov/index.php/public-utilities/utility-rates. Accessed 23 Apr. 2024.