

Build a Rule and Graph

Find the amount at zero even when it is not shown

A linear rule can be written $y = mx + b$. x is input; y is output; m is change per input unit. b is the rule's value at $x = 0$. If zero is an allowed input, b is the modeled output there. Two distinct input points determine one line when the relationship is explicitly assumed linear; two observations alone do not establish a physical linear rule.

Model from two nonzero points

For $0 \leq t \leq 6$, a supplied linear model of total water V has points $(2, 10)$ and $(4, 13)$. Minutes come first and liters second.

$m = (13 - 10) \div (4 - 2) = 3 \div 2 = 1.5$ liters per minute. At $t = 2$, the changing part is $1.5 \times 2 = 3$ liters. Subtract it from the observed total: $b = 10 - 3 = 7$ liters. So $V = 1.5t + 7$. Check both points: $1.5 \times 2 + 7 = 10$ and $1.5 \times 4 + 7 = 13$.

The 10 liters is the total after two minutes; it is not the start. m has liters-per-minute units. b has liters units. At zero time, the modeled total is 7 liters, so this total is linear but not proportional to time.

1 Guided rule

A supplied linear model on $0 \leq t \leq 6$ has points $(1, 7)$ and $(4, 13)$, in minutes and liters. Find m , recover b , write a rule and verify both points.

Your rate, initial value and checks

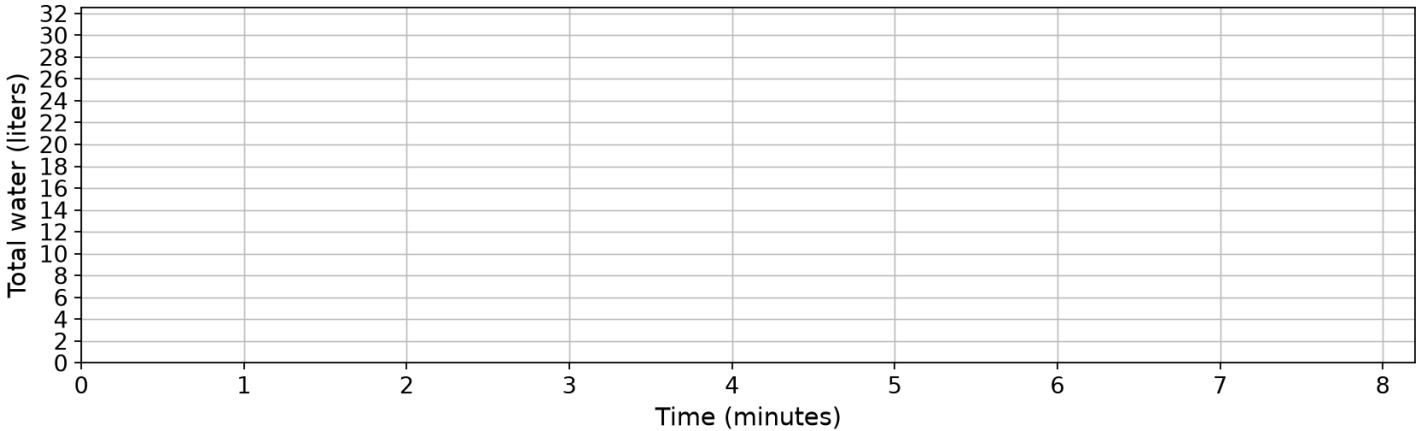
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Connect the rule, points and axes

2 A new linear model

For $0 \leq t \leq 8$, a supplied linear total-water model has points (2, 8) and (6, 18). Find its change rate and value at zero. Complete the table. Write a rule, then plot or describe its graph over the allowed domain.

Time t (minutes)	Total water V (liters)
0	
2	8
4	
6	18
8	



Rule, units and what the zero point means

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Check the rule and the stated domain

3 Recover a negative-rate start

For $0 \leq t \leq 6$, a supplied linear model of water remaining has points (2, 13) and (4, 8), with minutes first. Find m and b , write a rule, and predict the amount at five minutes. Check both original points.

Your signed rate, start and prediction

4 A zero input outside the model

A supplied linear model is valid only for $2 \leq t \leq 8$ minutes. Its points are (2, 11) and (5, 17) liters. Find a matching linear expression. Does its algebraic value at $t = 0$ establish an actual amount at zero minutes under these stated conditions? Explain.

Expression and model-boundary explanation

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Signed reference values and a zero start

Model a temperature below zero

A constructed continuous linear Celsius-temperature model is valid for $0 \leq t \leq 6$ minutes. Its points are (2, -3) and (4, 1). Rate = $[1 - (-3)] \div (4 - 2) = 4 \div 2 = 2$ degrees Celsius per minute. Recover $b = -3 - 2 \times 2 = -7$ degrees Celsius. $C = 2t - 7$ gives -3 at minute 2 and 1 at minute 4. The start is negative while the rate is positive; their signs describe different quantities.

5 Your signed-reference practice

Another supplied continuous linear Celsius-temperature model on $0 \leq t \leq 6$ gives (1, -2) and (4, 7). Find its rate, value at zero and rule. Verify both observations. Explain what the two signs mean.

Rate, reference value and explanation

6 Your zero-start practice

A supplied continuous linear total-water model on $0 \leq t \leq 6$ has points (2, 6) and (5, 15). Find its rate and value at zero. Write and verify a rule. Is this total proportional to elapsed time? Compare it with the constant 9-liter model.

Rule and proportionality comparison
