Water Cooler

A trainer for a professional football team keeps track of the amount of water players consume throughout practice. The trainer observes that the amount of water consumed is a linear function of the temperature on a given day. The trainer finds that when it is 90°F the players consume about 220 gallons of water, and when it is 76°F the players consume about 178 gallons of water.

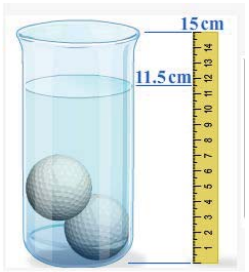
Part A: Write a linear function to model the relationship between the gallons of water consumed and the temperature.

Part B: Explain the meaning of the slope in the context of the problem.

Golf Balls - A PARCC Prototype

Tom is doing an experiment adding golf balls to a glass jar containing water. The picture and the table show what happens to the height of the water as Tom adds golf balls.

Number of golf balls x	Height of water in centimeters y
0	9.0
1	10.2
2	11.5
3	12.7
4	13.8



Which captions complete the sentences and the equation below based on the results of Tom's experiment.

golf balls	change	water height	1.16	glass jars
1.2	1.3	9.0	12.0	13.8

The height of the water changes at an average rate of about _____ centimeters per golf ball.

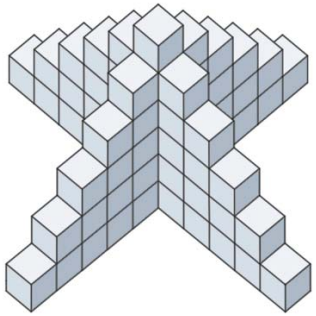
If these data were graphed with the number of golf balls as the independent variable, the y-intercept for the graph would be about_____ centimeter.

This means that for zero____, the ___ is 9 centimeters.

Tom's table and graph can be represented by the trend line with the equation y= ____x+_____

Illustrative Mathematics

Skeleton Tower



a. How many cubes are needed to build this tower?

b. How many cubes are needed to build a tower like this, but 12 cubes high? Justify your reasoning.

c. How would you calculate the number of cubes needed for a tower n cubes high?

Illustrative Mathematics

Parking Lot

A parking lot charges $0.50 for each half hour or fraction thereof, up to a daily maximum of $10.00. Let C(t) be the cost in dollrs of parking for t minutes. $10.00.

a. Complete the table below.

t (minutes)	$C(t)$ (dollars)
0	
15	
20	
35	
75	
125	

b. Sketch a graph of C for $0 \leq t \leq 480$.

c. Is C a function of t? Explain your reasoning.

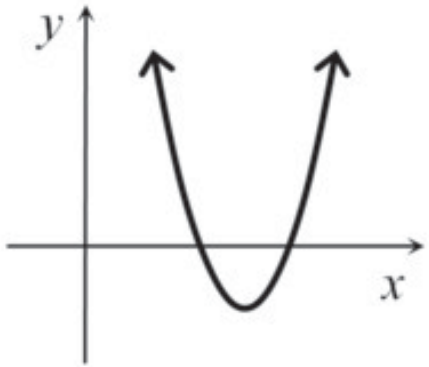
d. Is t a function of C? Explain your reasoning.

Illustrative Mathematics

Which Function?

Which of the following could be the function of a real variable x whose graph is shown below? Explain.

$f_1(x) = (x+12)^2 + 4$
$f_2(x) = -(x-2)^2 - 1$
$f_3(x) = (x+18)^2 - 40$
$f_4(x) = (x-12)^2 - 9$
$f_5(x) = -4(x+2)(x+3)$
$f_6(x) = (x+4)(x-6)$
$f_7(x) = (x-12)(-x+18)$
$f_8(x) = (24-x)(40-x)$



Illustrative Mathematics

Influenza Epidemic

An epidemic of influenza spreads through a city. The figure below is the graph of $I = f(w)$, where I is the number of individuals (in thousands) infected w weeks after the epidemic begins.

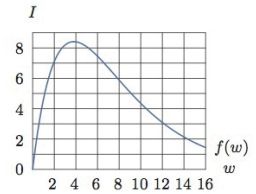
a. Estimate $f(2)$ and explain its meaning in terms of the epidemic.

b. Approximately how many people were infected at the height of the epidemic? When did that occur? Write your answer in the form $f(a) = b$.

c. For approximately which w is $f(w) = 4.5$

Explain what the estimates mean in terms of the epidemic.

d. An equation for the function used to plot the image above is $f(w) = 6w(1.3)^{-w}$. Use the graph to estimate the solution of the inequality $6w(1.3)^{-w} \geq 6$. Explain what the solution means in terms of the epidemic.



(Task from *Functions Modeling Change: A Preparation for Calculus, Connally et al., Wiley 2010.*)

Illustrative Mathematics

Linear or Exponential

In (a)–(e), say whether the quantity is changing in a linear or exponential fashion.

a. A savings account, which earns no interest, receives a deposit of $723 per month.

b. The value of a machine depreciates by 17% per year.

c. Every week, 9/10 of a radioactive substance remians from the beginning of the week.

d. A liter of water evaporates from a swimming pool every day.

e. Every 124 minutes, 1/2 of adrug dosage remains in the body.

Rabbit Population

Part a

A rabbit population can increase at a rapid rate if left unchecked. Assume that 10 rabbits (males and females) are put in an enclosed wildlife ranch, and that the rabbit population triples each year for the next five years, as shown in the table.

Year	Rabbit Population
0	10
1	30
2	90
3	270
4	810
5	2430

Let y represent the number of rabbits after x years. Drag the tiles to the appropriate slots to build a function rule that could be used to model y as a function of x.

$3x$	3^x	x^3	0	3	10	30	•	+

Part b

1. ____ The base of the exponent will change from 3 to 2.
2. ____ The coefficient will become 2.
3. ____ The y-intercept of the graph of the line for this function will be different.
4. ____ As the number of years increases, the graph of this model will be less steep than the graph of the original model.
5. ____ As the number of years increases, the graph of this model will be steeper than the graph of the original model.

Illustrative Mathematics

Analyzing Graphs

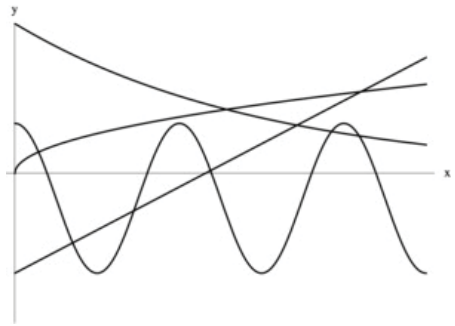
Pictured below are the graphs of four different functi ons, defined in terms of eight constants: $a,b,c,k,m,p,q,$ and r. The equations of the functions are:

$y = mx + b$

$y = a\cos(x) + c$

$y = qr^x$

$y = kx^p$



a. Match each equation with its graph.

b. Use the graphs to answer the following questions.

Justify your answers with appropriate explanations.

i. Which of the 8 constants are definitely negative?

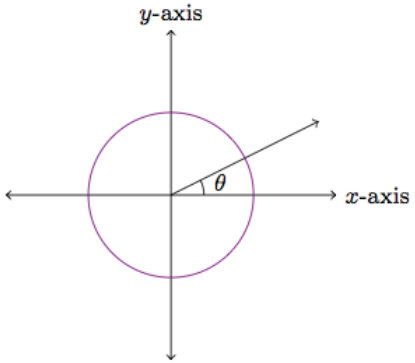
ii. Which of the 8 constants are definitely positive?

iii. Which of the 8 constants are definitely greater than zero but less than one?

iv. Which of the 8 constants are definitely greater than one?

Illustrative Mathematics

Trig Functions



a. Explain why $\sin(-\theta) = -\sin\theta$ and $\cos(-\theta) = \cos\theta$.

Do these equations hold for any angle θ? Explain your thinking.

b. Explain why $\sin(2\pi + \theta) = \sin\theta$ and $\cos(2\pi + \theta) = \cos\theta$.

Do these equations hold for any angle of ? Explain your thinking. Explain your thinking.