CATEGORY 2 - Supporting Standard 4.A

Calculate, using technology, the correlation coefficient between two quantitative variables and interpret this quantity as a measure of the strength of the linear association.

1. Find the correlation coefficient for each set of data, then circle the words that describe the correlation between the variables.

2. There are no scales on the graphs. What pattern should a scatterplot of data with a certain r-value show? In each scatterplot write the letter of the table it could represent.

A

Dosage (mg)	Mortality Rate (%)
0	79
50	64
75	47
100	39
150	22
200	9

r = -0.9918

weak positive
strong **negative** correlation
no

B

Height (in.)	Monthly Income ($)
66	2980
69	3570
73	3020
58	2130
67	1440
75	1690

r = 0.0711

weak positive
strong negative correlation
no

C

Height (cm)	Wingspan (cm)
172	172.3
154.4	159.4
178.2	182.1
168.6	169.6
167.6	164.5
169.4	165.5

r = 0.895

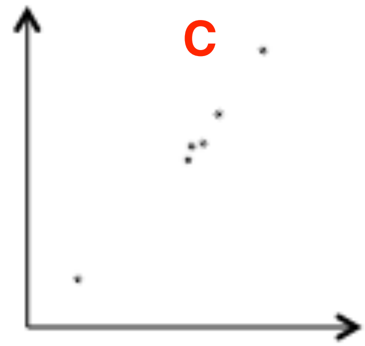
weak **positive**
strong negative correlation
no

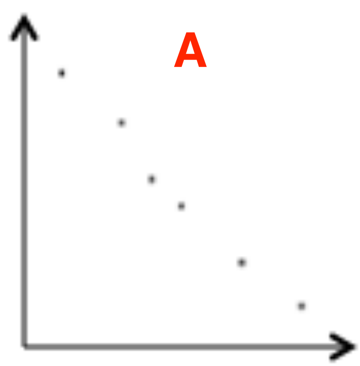
D

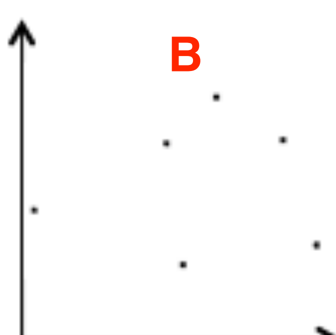
State	Land Area (1000's of sq. miles)	2015 Population (1000's)
HI	6	1432
MA	31	1329
NH	9	1330
WY	97	586
ND	71	757
VT	9	626
DE	2	946
MT	146	1033

r = -0.34

weak positive
strong **negative** correlation
no





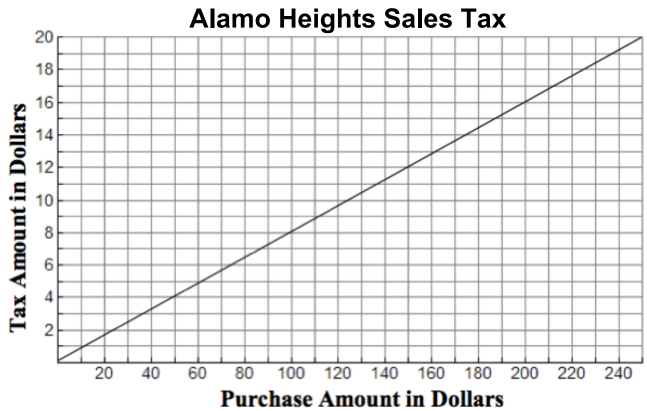


CATEGORY 2 - Readiness Standard 3.B

Calculate the rate of change of a linear function represented tabularly, graphically, or algebraically in context of mathematical and real-world problems.

Calculate the rate of change for each situation.

1



Rate of Change:

$0.08 per dollar of purchases.

2 The level of gas in a truck's tank depends on how many miles have been driven. The table shows the gas level during a trip.

miles driven	0	50	125	175	250
gallons of gas in tank	20	16	10	6	0

Rate of Change:

-0.08 gallons per mile

3 The function $f(x) = 15 + 40x$ describes the cost for a group of x people to park one vehicle and purchase tickets at a theme park.

Rate of Change:

$40 per person

4 The table shows a bank's monthly service fee as a function of the number of transactions.

# of transactions	0	10	15	20	30
monthly fee ($)	5.00	6.50	7.25	8.00	9.50

Rate of Change:

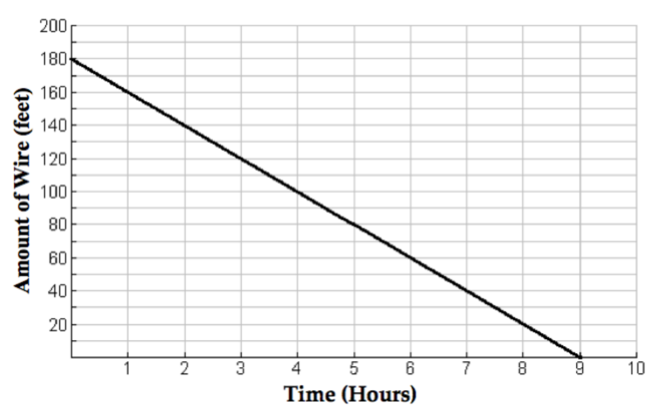
$0.15 per transaction

5 The function $f(x) = \frac{1}{4}x + 2$ represents the number of cups of frosting needed to decorate x cupcakes and a layer cake.

Rate of Change:

1/4 cup of frosting per cupcake

6 A machine takes soldering wire from a spool and uses it to make electronic components. The graph shows the amount of wire left on the spool during a work shift.



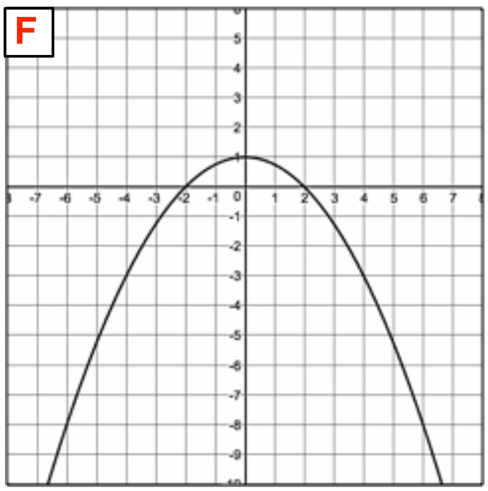
Rate of Change:

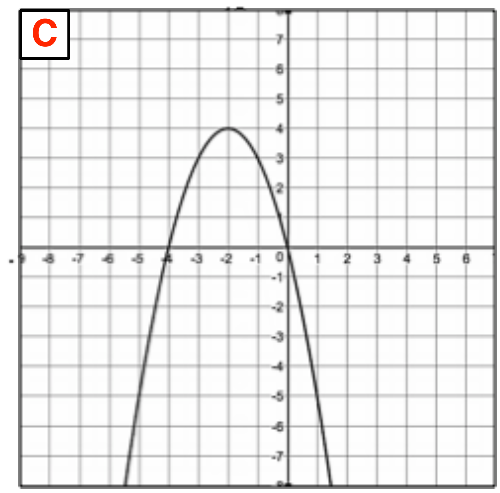
-20 feet per hour

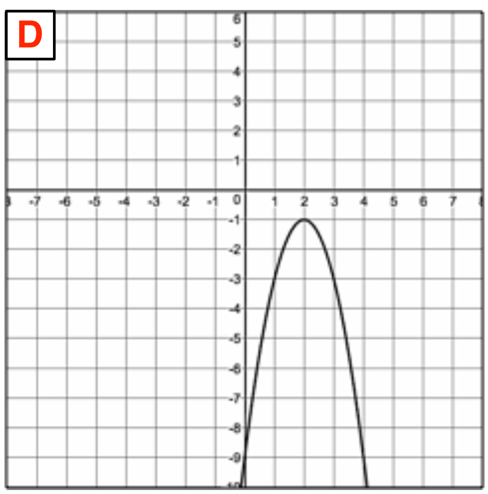
CATEGORY 4 - Readiness Standard 7.A

Graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possible, including x-intercept, y-intercept, zeros, maximum value, minimum value, vertex, and the equation of the axis of symmetry.

Match each equation with its graph by writing its letter in the boxes at the left upper corner of the graphs.







A $y = \frac{1}{2}x^2 - 7$

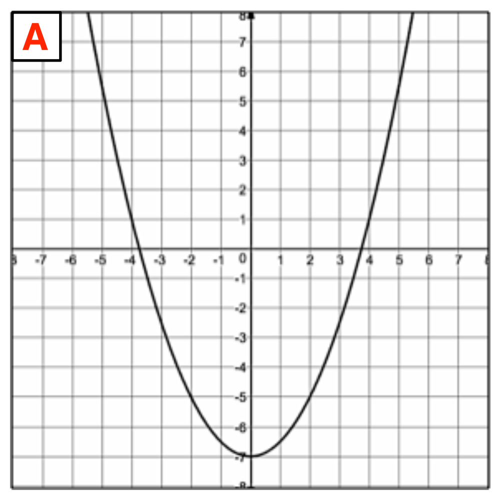
B $f(x) = 2x^2 - 4x + 3$

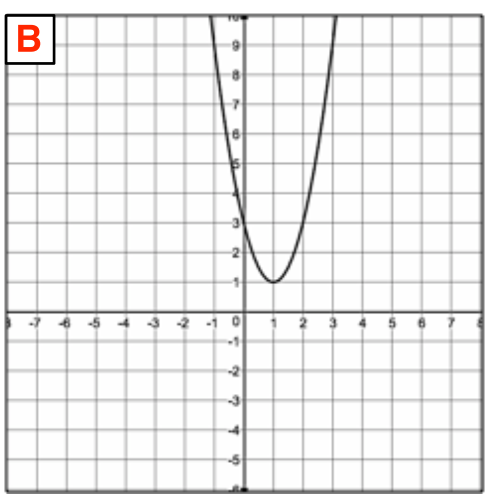
C $y = -(x + 2)^2 + 4$

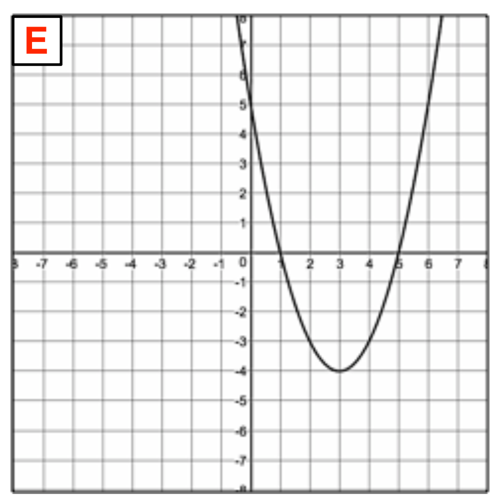
D $y = -2x^2 + 8x - 9$

E $y = (x - 3)^2 - 4$

F $y = -\frac{1}{4}x^2 + 1$







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CATEGORY 4 - Readiness Standard 7.A

Graph quadratic functions on the coordinate plane and use the graph to identify key attributes, if possible, including x-intercept, y-intercept, zeros, maximum value, minimum value, vertex, and the equation of the axis of symmetry.

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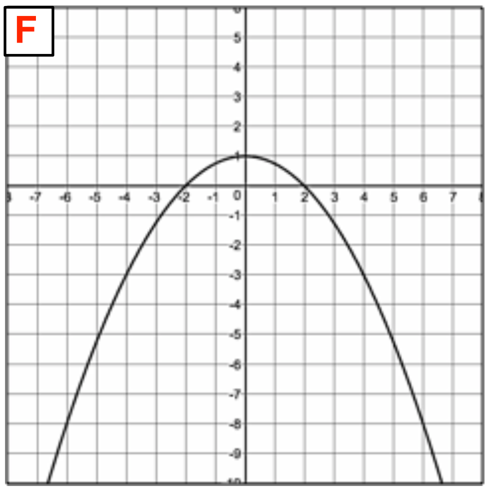
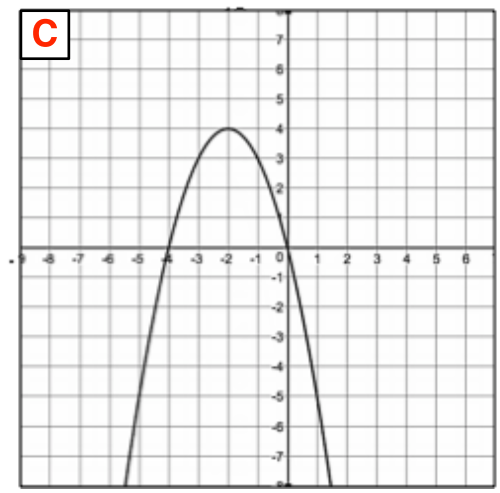
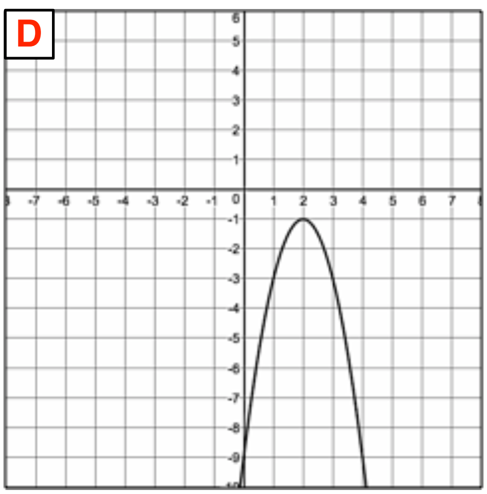






A $y = \frac{1}{2}x^2 - 7$

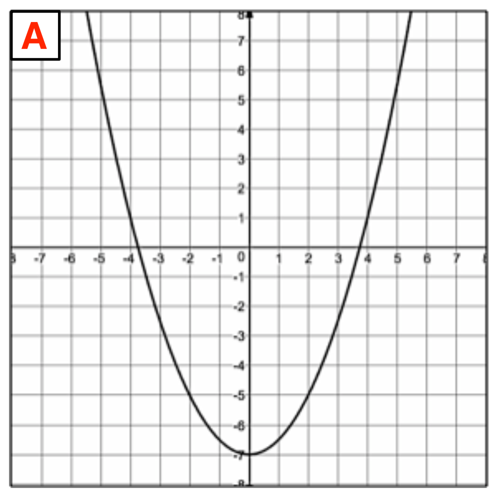
B $f(x) = 2x^2 - 4x + 3$

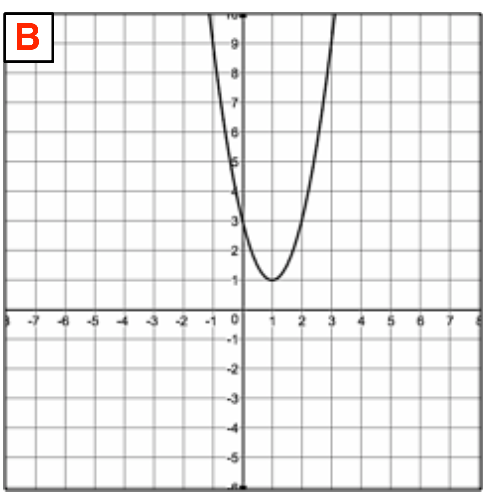
C $y = -(x + 2)^2 + 4$

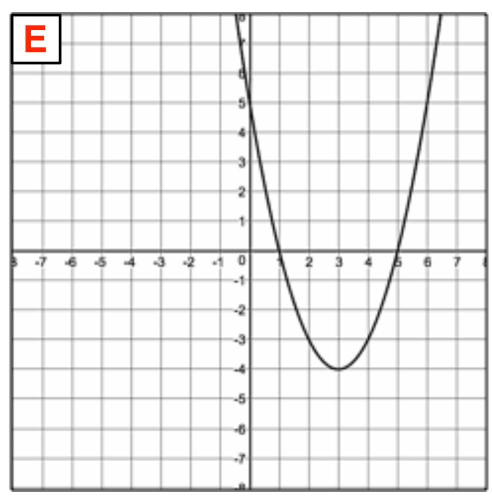
D $y = -2x^2 + 8x - 9$

E $y = (x - 3)^2 - 4$

F $y = -\frac{1}{4}x^2 + 1$







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CATEGORY 4 - Supporting Standard 8.B

Write, using technology, quadratic functions that provide a reasonable fit to data to estimate solutions and make predictions for real-world problems.

1 Farmers in states where wheat is grown get different yields per acre. The average yield was correlated with the average summer temperature for a particular region. The data suggests a quadratic pattern.

Average Summer Temp (°C)	Yield (tons per acre)
10	5.3
13	13.1
15	13.6
16	14.3
20	14.8
22	12.7
24	10.4
25	8.4
26	6.4

a. Use your graphing calculator to find the quadratic regression equation.

$y = -0.144x^2 + 5.209x - 31.748$

b. Use the equation to determine what average summer temperature (to the nearest degree) would result in the highest yield. What is the highest yield?

18 degrees Celsius -

15.3 tons per acre

c. Farmers cannot make a profit on wheat unless their yield is at least 2 tons per acre. If the average summer temperature in a region is always above 28°C, would it be profitable to plant wheat there? Why or why not?

No, because the model equation predicts yields of less than 2 tons per acre for all temperatures above 27.6°C.

2 The table shows a correlation between the age of a tree in a particular forest and the amount of lumber that can be cut from it. The relationship can be modeled with a quadratic function.

Age of Tree	20	40	80	100	120	160	200
100s of Board Feet	1	6	33	56	88	182	320

a. Use your graphing calculator to find the quadratic equation of best fit.

$y = 0.011x^2 - 0.681x + 13.313$

b. Use the equation to estimate how old a tree of this type would have to be to produce at least 10,000 board feet of lumber.

125 years or older

c. Assuming the model continues to be a good predictor for trees over 200 years old, about how much lumber could a 300-year old tree of this kind produce?

(round to the nearest 10,000 board feet)

80,000 board feet

CATEGORY 5 - Supporting Standard 9.B

Interpret the meaning of the values of a and b in exponential functions of the form $f(x) = ab^x$ in real-world problems.

For each situation, explain the significance of each number in the equation as in the example.

Example: *The function $f(x) = 340(1.07)^x$ describes the dollar value of an acre of land that Mrs. Brown purchased 50 years ago. If x represents the number of years since Mrs. Brown acquired the land, then what do the numbers 340 and 1.07 signify?*

The land was purchased for $340.

1.07 is the growth factor. The rate of increase is .07, or 7% per year. Each year the value of the land is 100% + 7% = 107% of what it was the previous year.

1 Mr. Gilligan purchased a new tractor. The function $f(x) = 35{,}000(0.87)^x$ describes the value of the tractor x years from the date of purchase.

35,000: **The tractor cost $35,000.**

0.87: **decay factor**

rate of decrease: 13%

Each year the tractor is worth 100% - 13% = 87% of what it was the previous year.

2 The profit of a business for its first month in operation can be estimated using the function $f(x) = 4{,}034(1.1)^x$, where x is the number of months after the business was started.

4,034: **The first month's profit was $4034.**

1.1: **growth factor**

rate of increase: 10%

Each month the profit is expedted to be 100% + 10% = 110% of what it was the previous month.

3 The function $f(x) = 180(1.03)^x$ describes the balance in a savings account x years from the date the only deposit was made.

180: **$180 was deposited when the account was opened.**

1.03: **growth factor**

rate of increase: 3%

Each year the balance in the account is 100% + 3% = 103% of what it was the previous year.

4 A radioactive isotope has a half-life of one day. The function $f(x) = 850(0.5)^x$ describes the mass, in grams, of a sample of the isotope x days after it was first measured.

850: **The sample had an initial mass of 850 g**

0.5: **decay factor**

rate of decrease: 50%

Each day the mass is 100% - 50% = 50% of what is was the previous day.

CATEGORY 5 - Readiness Standard 9.C

Write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay.

1 Write the exponential function that represents the table.

x	0	1	2	3	4
y	4	12	36	108	324

$y = 4(3)^x$

2 The population of a small town in Texas is 6500. It is growing at the rate of 6% per year. Write the exponential function that an be used to estimate the population *x* years after 6890.

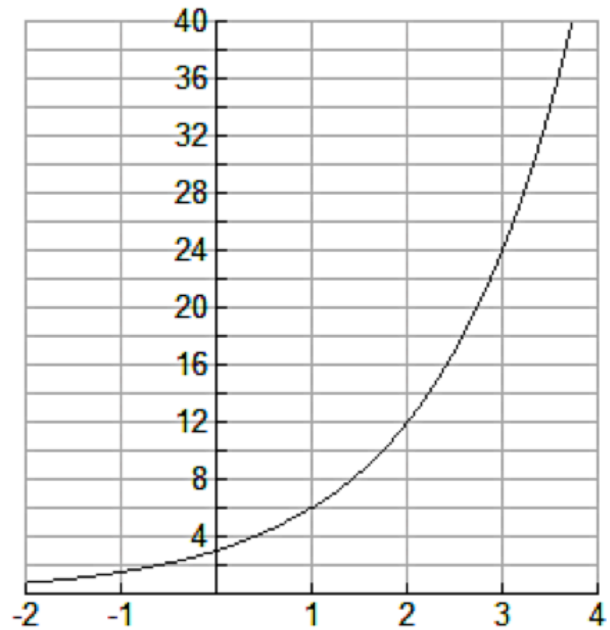
$f(x) = 6500(1.06)^x$

3 Write the exponential function that represents the geometric sequence

480, 360, 270, 202.5, . . .

$f(x) = 640(3/4)^x$

4 Write the equation that represents the graph.



$y = 3(2)^x$

5 A scientist starts with 200 bacteria in a petri dish with growth medium. Every day he measures 4 times as many bacteria as the day before. Write an exponential function that can be used to predict the number of bacteria x days after the scientist put the bacteria in the dish.

$f(x) = 200(4)^x$

cont'd →

CATEGORY 5 - Readiness Standard 9.C (cont'd)

Write exponential functions in the form $f(x) = ab^x$ (where b is a rational number) to describe problems arising from mathematical and real-world situations, including growth and decay.

6 The value of a small airplane that was purchased for $59,000 has been depreciating by 9% per year. Write an exponential function that describes the value of the plane t years after purchase.

$v = 59000(0.91)^t$

7 A scientist monitors a radioactive element over several days. The table below shows his data for the first few days. Write an exponential function that can be used to predict the mass after *d* days.

day # (d)	0	1	2	3
mass (m)	720	540	405	303.75

$m = 720(3/4)^d$

or

$m = 720(0.75)^d$

8 Brian is a collector of classic cars. He bought a Mercedes Benz 1981 Jaguar for $16,050. He expects its value to increase at the rate of 7% per year. Write the exponential function that can be used to estimate the car's value, *v*, *t* years after purchase.

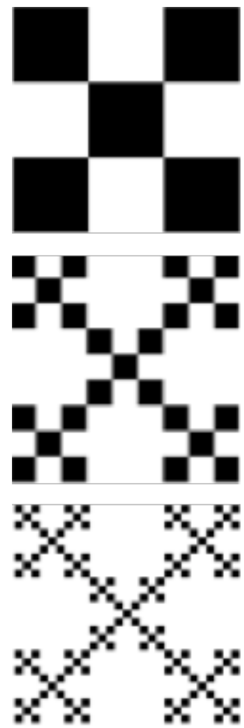
$v = 16050(1.07)^t$

9 Diane is drawing a simple box fractal. Steps 1 - 3 are shown.

step 1
5 squares

step 2
25 squares

step 3
125 squares



Write the exponential function that describes the relationship between *s*, the step number, and *n*, the number of black squares in the figure.

$n = 5^s$

10 When a non-native type of invasive plant was accidentally introduced in an island, its numbers started increasing at the rate of 500% per year. If there were 2 plants at the beginning, write a function that represents the number of plants, N, after *t* years.

$N = 2(6^t)$

