

Key Features of Graphs and Rates of Change

Grade 9 – Algebra 1 math · Worksheet · Standards: F-IF.B.4, F-IF.B.6, F-IF.C.9

Name: _____ Date: _____ Class: _____

These problems train reading intercepts, intervals of increase and decrease, maximums and minimums, positive and negative intervals, end behavior and symmetry from graphs, tables and equations (F-IF.B.4). They also compute and interpret average rates of change (F-IF.B.6) and compare functions given in different forms (F-IF.C.9). The last six problems are multi-step contexts such as stock prices, phone plans and profit.

Standards: F-IF.B.4, F-IF.B.6, F-IF.C.9 · **Level:** Grade 9 Algebra 1

Problem 1 Intercepts of a line (easy)

Find the x- and y-intercepts of $y = 2x - 6$.

Problem 2 Intercepts with a negative slope (easy)

Find the intercepts of $y = -3x + 12$.

Problem 3 Increasing or decreasing (easy)

Is $f(x) = -4x + 1$ increasing or decreasing? Explain.

Problem 4 Rate from a table (easy)

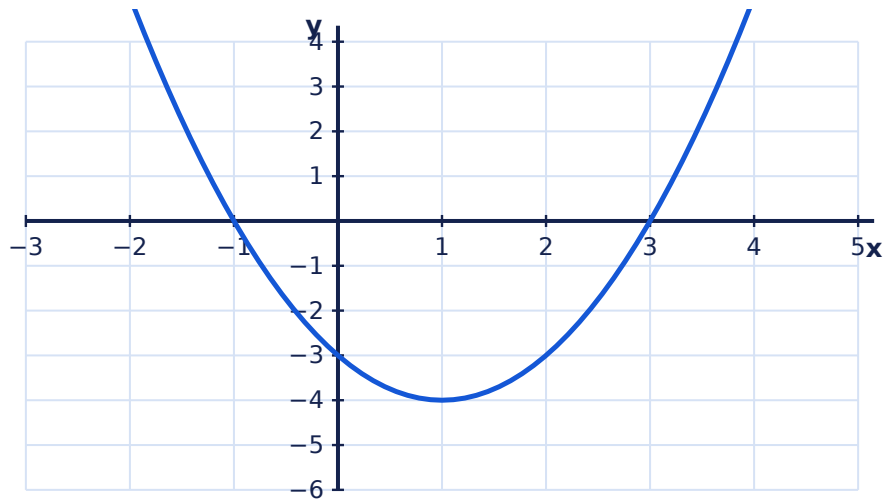
A function has this table:

x	0	2	4	6
f(x)	10	16	22	28

Is it increasing or decreasing? Find the average rate of change from $x = 2$ to $x = 6$.

Problem 5 Reading a parabola (easy)

Read off where the graph crosses each axis and where it is lowest.



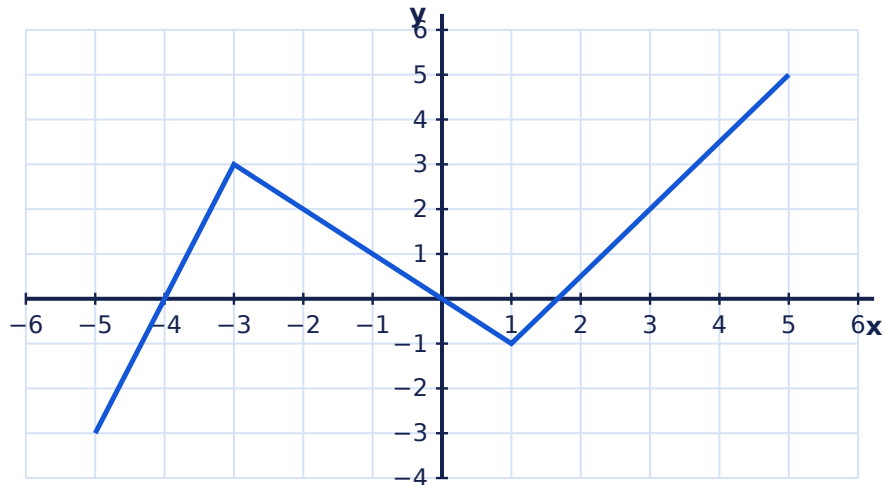
The graph of a function.

Problem 6 Positive and negative intervals (medium)

For the graph in Problem 5, state where the function is positive and where it is negative.

Problem 7 Increasing, decreasing, extremes (medium)

Find the intervals of rise and fall, and each relative maximum and minimum point.



A piecewise linear function.

Problem 8 Rate of change of a quadratic (medium)

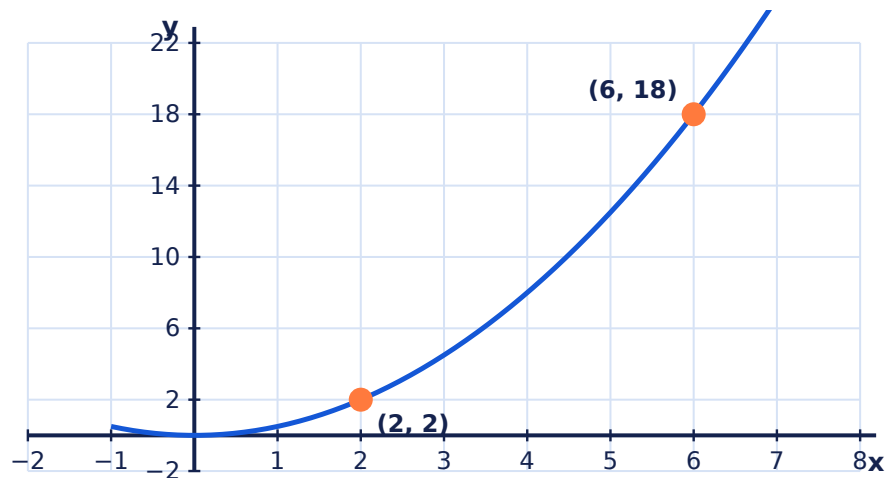
Compute how fast $f(x) = x^2 - 6x + 5$ changes on average as x moves from 2 to 6.

Problem 9 Rate with a negative input (medium)

Starting at an input of -4 and ending at an input of 3 , what is the average rate of change of $f(x) = x^2 - 11$?

Problem 10 Rate from a graph (medium)

The graph shows $g(x) = 0.5x^2$. Use the two marked points to find the slope of the secant line between them.



Two points on the graph of g .

Problem 11 End behavior (medium)

Describe the end behavior of (a) $f(x) = -7x + 3$ and (b) $g(x) = -x^2 + 10$.

Problem 12 Symmetry of a parabola (medium)

The graph of $f(x) = (x - 3)^2 - 2$ is symmetric about the vertical line $x = 3$. If $(0, 7)$ is on the graph, which point at the same height is its mirror image? Verify with the equation.

Problem 13 Compare an equation and a table (medium)

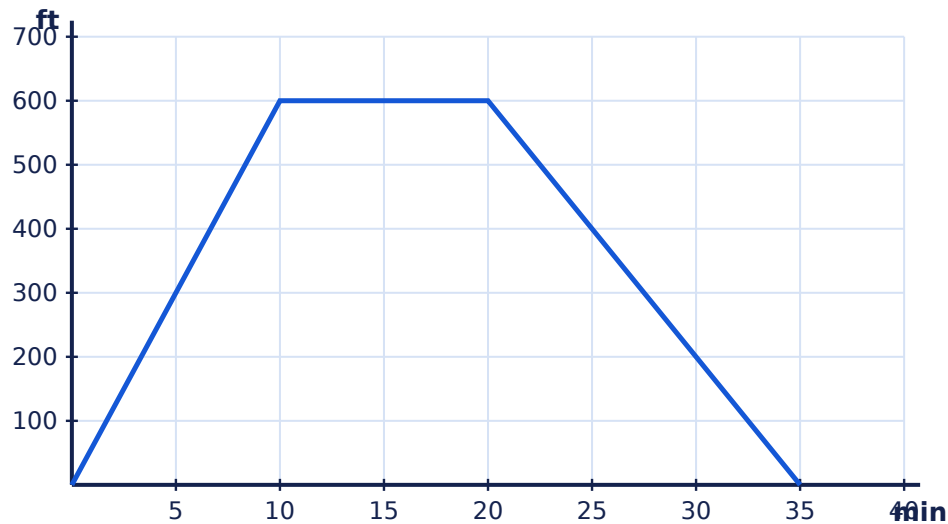
Function $f(x) = 4x + 1$. Function g has the table:

x	1	2	3
$g(x)$	6	11	16

Which function climbs faster per unit of x ? Write a rule for g .

Problem 14 Balloon flight (medium)

The graph shows a balloon's altitude. State when it is increasing, constant and decreasing, the greatest altitude, and the average rate of change from 0 to 10 minutes and from 20 to 35 minutes.



Altitude of a hot-air balloon (feet) over time (minutes).

Problem 15 Bike trip table (hard)

The table shows the distance of a cyclist from the start.

Hours	0	1	2	3	4
Miles	0	14	30	44	60

Find the average rate of change on 0 to 2 hours, 2 to 4 hours and 1 to 3 hours, and then on 0 to 1 hour. Is the rate constant?

Problem 16 Stock price (hard)

A stock's price $P(t)$ in dollars at week t has $P(0) = 48$, $P(4) = 60$ and $P(10) = 42$. Find the average rate of change from week 0 to 4, from 4 to 10 and from 0 to 10, and interpret each.

Problem 17 Two phone plans (hard)

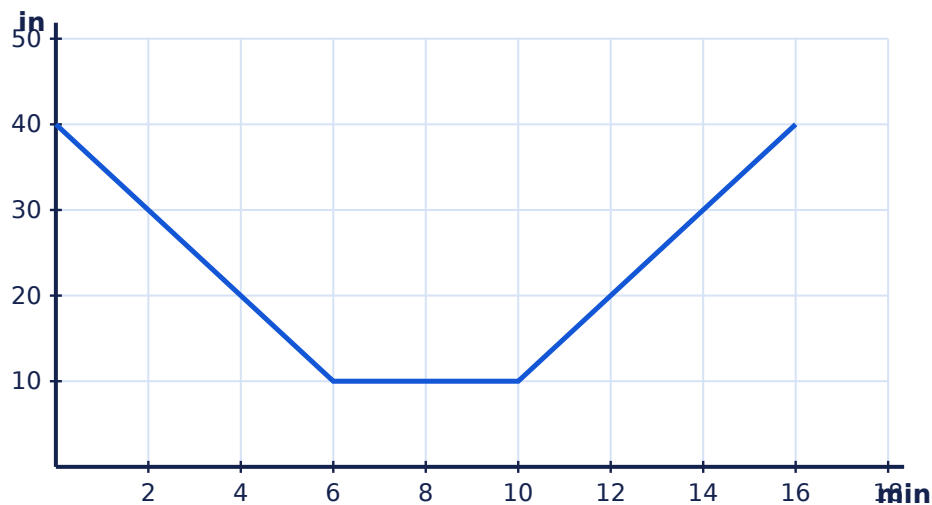
Plan A: $C(m) = 18 + 0.12m$ dollars for m minutes. Plan B has this table:

Minutes	100	200	300
Cost (dollars)	28	36	44

Which plan grows faster? Find each cost at 500 minutes and the number of minutes where the plans cost the same.

Problem 18 Fish tank (hard)

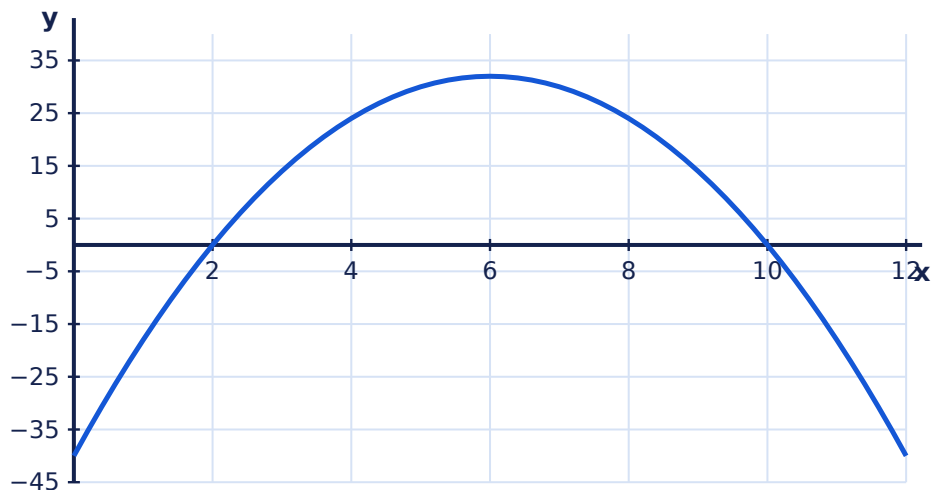
Here is a graph of a tank water level in inches. Tell when the level falls, stays flat and rises, give the lowest level, and the average rate of change from 0 to 6 minutes and from 10 to 16 minutes.



Water level in a fish tank (inches) over time (minutes).

Problem 19 Cupcake profit (hard)

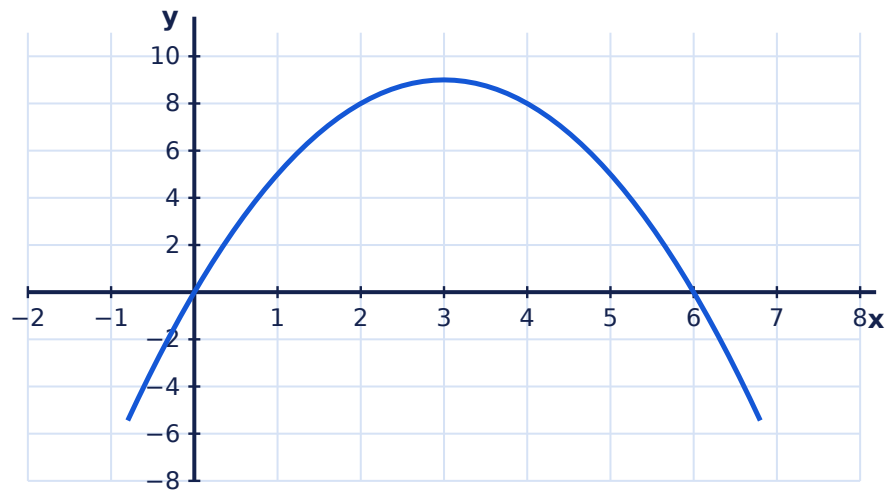
The profit in hundreds of dollars from selling x hundred cupcakes is $P(x) = -2x^2 + 24x - 40$. Use the graph to find the zeros, the maximum, the y-intercept and the interval where the profit is positive, then interpret them.



Profit $P(x)$, in hundreds of dollars, when x hundred cupcakes are sold.

Problem 20 Compare two functions (hard)

Function f is graphed. Function $g(x) = -x^2 + 4x + 8$. Which has the larger maximum value? Which is positive over the wider interval? (Use $\sqrt{12} \approx 3.46$.)



The graph of function f .