The CST option in Secondary IV
Update

Examples of problems
Changes to the way in which the properties of functions are taught

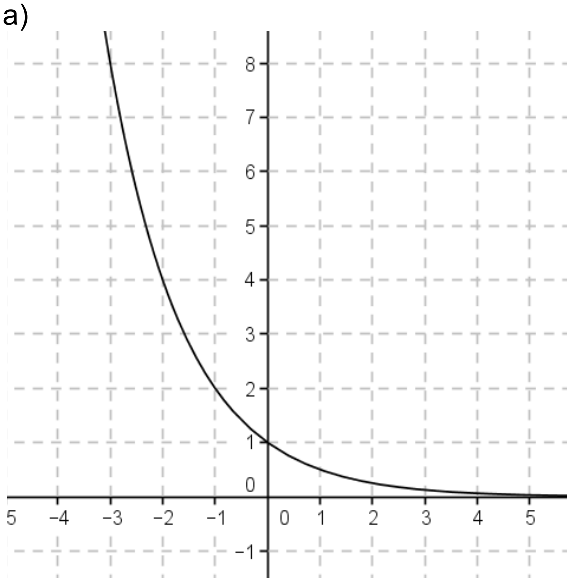
In the updated version of the CST option in Secondary IV, the approach to teaching the properties of functions in *arithmetic and algebra* has been modified; they must now be taught in relation to a context.

This document uses concrete examples to illustrate the desired changes to the way that these concepts are taught. The examples should make it possible to understand how existing instructional materials can be adapted to bring them into line with the suggested update, without having to revamp everything.

Example 1 - Changes to be made

Analyze the functions represented below.

a)



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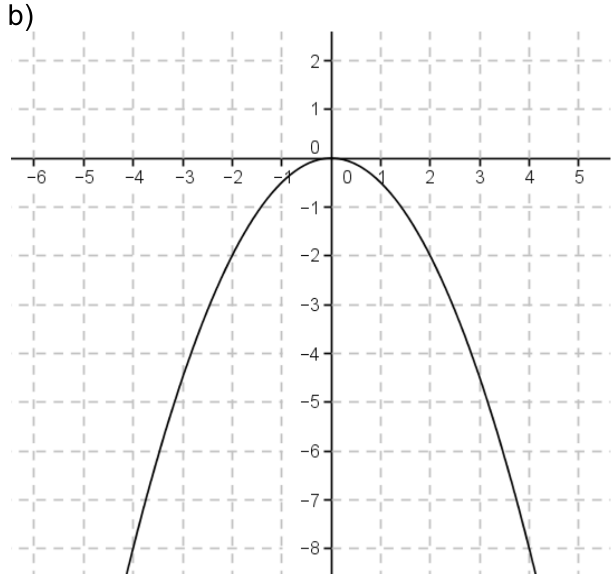


This type of question calls for certain changes. A context must be provided for the functions and properties that students are asked to name.

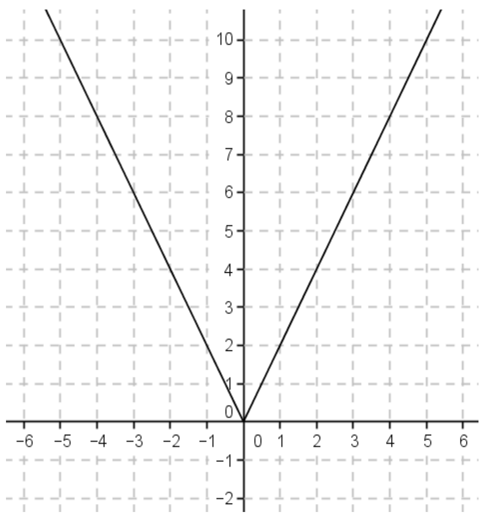
Example 2 - Changes to be made

Find the domain, range, sign, intervals within which the function is increasing or decreasing and the *x*- and *y*-intercepts of the following functions.

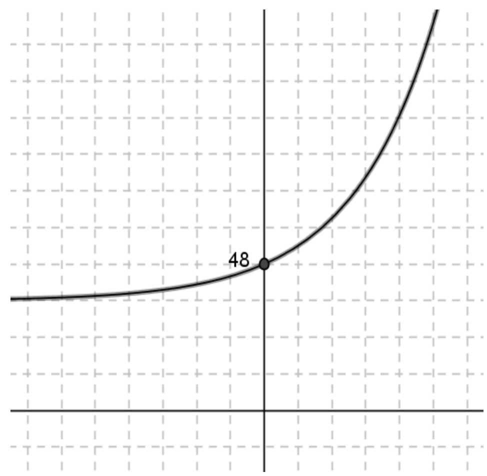
a) $h(x) = -\frac{x}{3} - 5$

b) $f = \{\ldots, (-2, 1), (-1, 1), (0, 1), (1, 1), (2, 1), \ldots\}$

c)



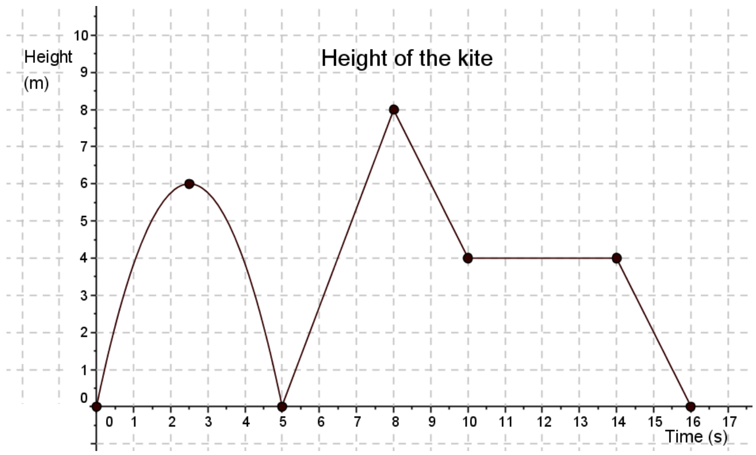
d)



This type of question calls for certain changes. A context must be provided for the functions and properties that students are asked to name.

Example 3 - Minor changes to be made

The graph below shows the height of a kite in relation to the amount of time elapsed since it was released.

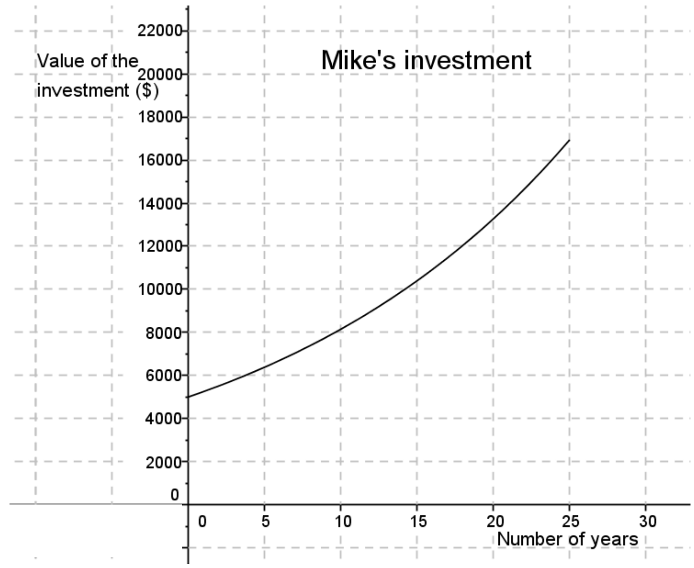


BEFORE THE UPDATE Examples of questions you may have asked students before the update:	AFTER THE UPDATE The questions could be reworded as follows:
For this function: a) Find the domain.	a) Find the domain of the function and indicate what it means in concrete terms. OR For how long was the kite observed?
b) Find the range.	b) What is the range of the function and what does it mean in concrete terms?
c) Find the zero(s)	c) Find the zero(s) of the function and indicate its/their meaning in the context. OR At what times was the kite on the ground?
d) Find the extrema of the function.	d) What was the maximum height reached by the kite? What was the minimum height?
e) Find the interval over which the function is constant.	e) In concrete terms, what does the interval [10, 14] represent?
f) Find the interval over which the function is increasing.	f) What is the interval over which the altitude of the kite increases? OR What is the total amount of time during which the altitude of the kite increases?

The names of the properties can still be used in the updated version of the program, but it is important that the properties be related to a context.

Example 4 – Minor changes to be made

Mike has invested money in a financial institution offering an annual interest rate of 5%, compounded once a year. The graph to the right shows how much his investment has grown.



BEFORE THE UPDATE Examples of questions you may have asked students before the update:	AFTER THE UPDATE The questions could be reworded as follows:
a) What rule represents this function?	a) What rule represents this function?
b) What is the domain of the function?	b) What is the domain of the function and what does it mean in concrete terms? OR How long has Mike had the investment?
c) What is the range of the function?	c) What is the range of the function and what does it mean in concrete terms?
d) What are the extrema of the function?	d) What is the maximum value of the investment?
e) Find the *y*-intercept?	e) What does the *y*-intercept mean in this context? OR What was the amount of Mike's initial investment?

The names of the properties can still be used in the updated version of the program, but it is important that the properties be related to a context.

Example 5 – Minor changes to be made

The rise of a hot-air balloon can be modelled using a second-degree polynomial function. The following table of values provides information on the altitude reached by the balloon in relation to the time elapsed since it began its ascent.

Height reached by a hot-air balloon

Time (min)	0	2	4	6	8	10
Altitude (m)	0	6	24	54	96	150

BEFORE THE UPDATE Examples of questions you may have asked students before the update:	**AFTER THE UPDATE** The questions could be reworded as follows:
a) Use a graph to represent this situation for the first 10 minutes of observation.	a) Use a graph to represent this situation for the first 10 minutes of observation.
b) What is the rule corresponding to this situation?	b) What is the rule corresponding to this situation?
c) What is the range of the function you have represented?	c) What is the range of the function and what does it mean in concrete terms? OR What interval represents the change in altitude of the balloon during the first 10 minutes?
d) Find the *x*- and *y*-intercepts?	d) What are the *x*- and *y*-intercepts and what do they mean in this context?

The names of the properties can still be used in the updated version of the program, but it is important that the properties be related to a context.

Example 6 – No changes to be made

A house located in a small Québec municipality sold for $150 000. It is estimated that the value of houses in this municipality will increase at an average rate of 2% per year over the next 10 years. The situation is represented by the following rule: $f(x) = 150\ 000\ (1 + 0.02)^x$ where $f(x)$ represents the value of the house after x years.

a) Represent this situation by means of a graph.

b) Determine the properties of the function (domain, range, intervals within which the function is increasing or decreasing, sign, extrema and *x*- and *y*-intercepts) and indicate what they mean in this context.

c) What will the value of the house be in 10 years?

This is a good example of a contextualized situation: the requested properties are related to the context.

Example 7 - No changes to be made

The graph below provides information on the height a spring has reached in relation to its initial position as a function of the time elapsed since it was set in motion.

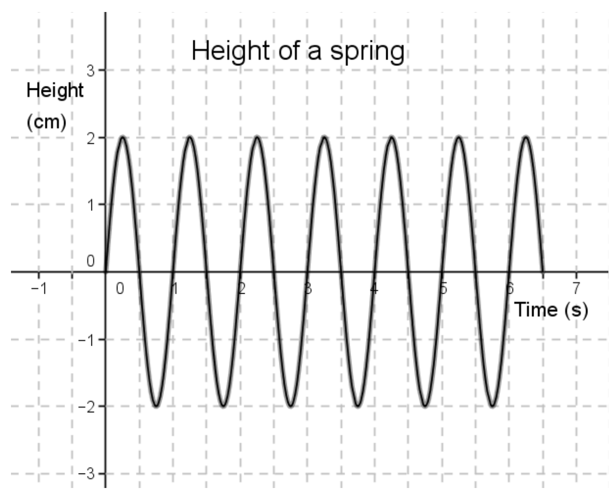
a) What type of function can be used to model this situation?

b) What is the height of the spring at the beginning of the observation period?

c) What is the maximum height the spring can reach?

d) What do the zeros of the function mean in concrete terms?

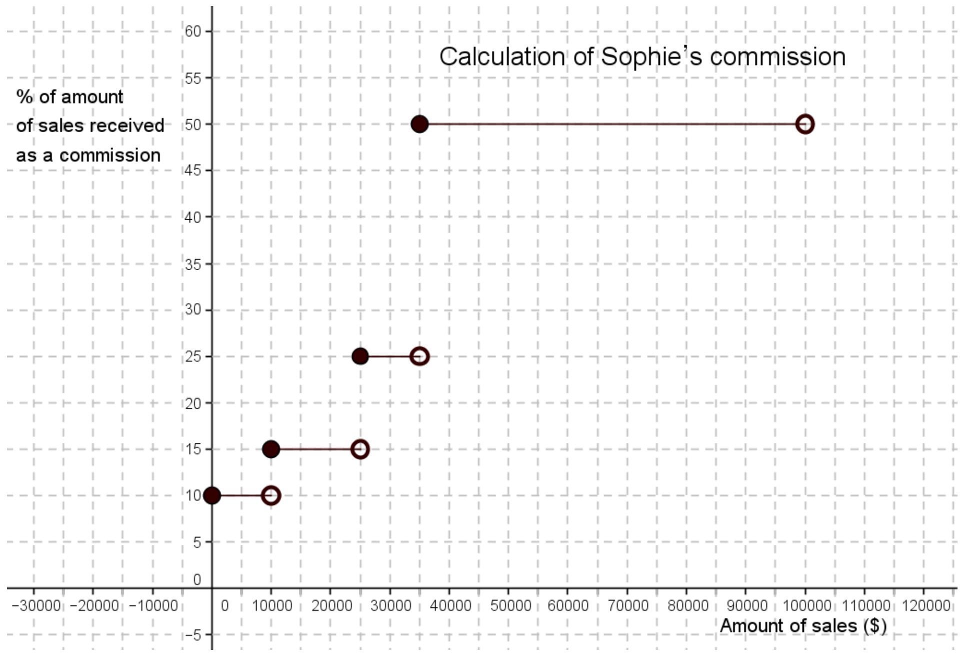
e) How much time is needed for the spring to return to its initial position?



This is a good example of a contextualized situation: the requested properties are related to the context and students are required to analyze the graph.

Example 8 – No changes to be made

An electronic appliance saleswoman receives an annual salary of $35 000 in addition to a commission on sales. The graph below shows how her commission is calculated.



a) What type of function is associated with this situation?

b) What is the minimum and maximum commission that the saleswoman can receive in percentage terms?

c) The amount of the sales for which the saleswoman can receive a commission corresponds to what interval?

d) If the saleswoman's total sales amount to $25 000, how much commission will she receive?

This is a good example of a contextualized situation: the requested properties are related to the context and students are required to analyze the graph.

Examples of problems
The general form of the linear equation

In *analytic geometry*, all content related to the general form of the linear equation has been removed from the compulsory component of the updated CST option for Secondary IV. **Teaching this content is therefore optional**. As a result, students will not be required to deal with the general form of the linear equation on the year-end uniform examination.

The following examples explain this aspect of the update in concrete terms. They also indicate different ways of easily adapting instructional materials, particularly if a teacher decides to no longer teach content relating to the general form of the linear equation.

Example 1 – Minor changes to be made

Three lines are described using the general form of their equations:

A. $2x + 3y - 12 = 0$ B. $x + 5y + 25 = 0$ C. $-4x - 2y + 6 = 0$

a) Draw each line in a Cartesian plane.

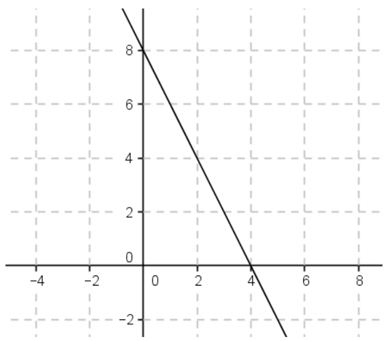
b) Find the x- and y-intercept of each line.

This question requires very little modification. It would be better to avoid specifying that it involves the general form of the equations because students are not expected to know or recognize the different forms of a linear equation. On the other hand, **students should be able to perform the algebraic operations needed to work with these equations so that they can, for example, draw the graph or find the *x*- and *y*-intercept**.

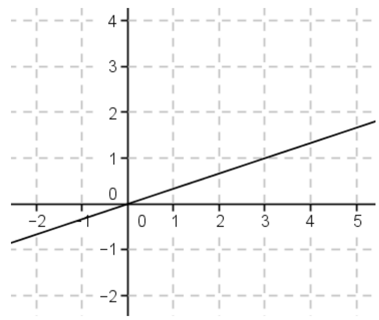
Example 2 – Minor changes to be made

Find the general form of the equation for each of the following straight lines.

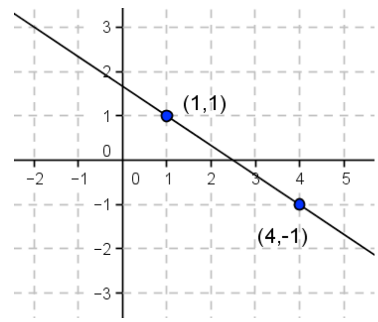
a)



b)



c)



This question needs only a minor adjustment. Without specifying the form of the equation, simply ask students to find the equation of each straight line.

Example 3 – Optional questions

a) Write the equations of the following straight lines in functional form.

I. $x - 4y + 6 = 0$

II. $-2x + 3y - 10 = 0$

III. $3x - y + 3 = 0$

b) Write the following linear equations in general form.

I. $y = 2x - 5$

II. $y = -0.5x + 12$

III. $y = \frac{3}{2}x - \frac{7}{3}$

These questions become optional in the updated version of the program. Students are not required to know or recognize the different forms of linear equations and therefore do not have to convert equations from one form to another.