Elements of the Progression of Learning in Secondary School

Mathematics

Secondary 5

SN

March 2017

Adapted from the **Progression of Learning in Secondary School: Mathematics**
August 2016

Arithmetic

Understanding real numbers	SN
11. Represents and writes g. numbers using radicals or rational exponents	★
h. numbers in logarithmic notation using the equivalence $\log_a x = n \Leftrightarrow a^n = x$, if necessary	★
12. Estimates the value of the power of an exponential expression with respect to its components: base (between 0 and 1, greater than 1), exponent (positive or negative, integral or fractional) **Note:** The same applies for a logarithmic expression in TS and SN.	★

Operations involving real numbers	SN
14. Manipulates numerical expressions involving b. powers of bases (change of base), exponents, radicals (nth root), using their properties **Note**: In CST, radicals and their properties are not covered. For base changes in TS in Secondary IV, students use bases 2 and 10. In SN, students learn to deduce the properties of radicals.	★
c. logarithms i. definition and change of base	★
ii. properties	★
d. absolute values	★

Algebra

Understanding and manipulating algebraic expressions	SN
C. Analyzing situations using equations or inequalities	
11. Solves the following types of equations or an inequalities in one variable	
b. exponential, logarithmic or square root, using the properties of exponents, logarithms and radicals **Note**: In CST in Secondary V, students use the definitions of logarithm and change of base to solve exponential and logarithmic equations, but they are not required to solve square root equations or study the properties of radicals and logarithms. In TS, this is taught over two years, using the functional models under study.	★
c. rational	★
d. absolue value	★
f. trigonometric that can be expressed as a sine, cosine or tangent function	★
D. Analyzing situations using systems of equations or inequalities	
1. Determines whether a situation may be translated by a system of b. inequalities	★
2. Translates a situation algebraically or graphically using a system of b. inequalities	★
3. Solves a system	
d. of second-degree equations in relation to conics using changing variables, if applicable	★
4. Solves a system a. of first-degree inequalities in two variables	★
E. Linear programming	
1. Analyzes a situation to be optimized – mathematizing the situation using a system of first-degree inequalities in two variables – drawing a bounded or unbounded polygon of constraints to represent the situation – determining the coordinates of the vertices of the bounded polygon (feasible region) **Note**: In TS, the coordinates of points of intersection may be determined algebraically, using matrices, or approximated based on a graph. – recognizing and defining the function to be optimized	★
2. Optimizes a situation by taking into account different constraints and makes decisions with respect to this situation – determining the best solution(s) for a particular situation, given a set of possibilities – validating and interpreting the optimal solution, depending on the context – justifying the solution(s) chosen – changing certain conditions associated with the situation to provide a more optimal solution, if necessary	★

Understanding dependency relationships	SN
A. Relations, functions and inverses	
7. Performs operations on functions (including composition) **Note**: In TS, operations on functions can be approached intuitively as of Secondary IV. In Secondary V, they are studied using concrete situations.	★
B. Analyzing situations using real functions[1]	
Note: Statements 1 to 9 apply to the functions listed below 1. Models a situation verbally, algebraically, graphically, using a table of values or a scatter plot 2. Finds the rule of a function or its inverse, depending on the context 3. Represents and interprets the inverse 4. Interprets parameters (multiplicative or additive) and describes the effect of changing their value, if necessary 5. Describes the properties of real functions: domain, range, interval within which the function is increasing or decreasing, sign, extrema, *x*-intercept and *y*-intercept **Note**: In Secondary III, students are informally introduced to the study of properties, always in relation to a context. In CST, students use a graphical representation to describe the context. 6. Determines values or data by solving equations and inequalities 7. Interpolates and extrapolates data, if applicable 8. Compares situations or graphical representations 9. Makes decisions, if necessary, depending on the context	
c. Square root functions ii. $f(x) = a\sqrt{b(x-h)} + k$	★
d. Rational functions ii. $f(x) = a\left(\frac{1}{b(x-h)}\right) + k$ and $f(x) = \frac{ax+b}{cx+d}$	★
e. Exponential functions iii. $f(x) = ac^{b(x-h)+k}$ **Note:** The study of these functions should focus on bases 2, 10 and	★
f. Logarithmic functions iii. $f(x) = a\log_c b(x-h) + k$ **Note:** The study of these functions should focus on bases 2, 10 and e.	★
g. Piecewise functions **Note**: In Secondary III, students are introduced to this type of function informally.	★
h. Absolute value functions: $f(x) = a\lvert b(x-h)\rvert + k$ **Note**: In TS, this function is treated mainly as a piecewise function.	★
k. Functions i. Modelling periodic occurences (e.g. natural phenomena such as tides or sound, medical or electrical phenomena) **Note**: The analysis is based on a graphical representation. In this context, students are not required to determine the rule.	★
ii. sinusoidal: $f(x) = a\sin b(x-h) + k$, $f(x) = a\cos b(x-h) + k$	★
iii. tangent: $f(x) = a\tan b(x-h) + k$	★

1. Functions are introduced using contexts adapted to Secondary III and the various options, with or without the use of technological tools.

Statistics

Analyzing and making decisions about one- or two-variable distributions, using statistical tools	SN
B. Two-variable distributions	
9. Interpolates or extrapolates values using b. the functional model best suited to the situation	★

Geometry

Analyzing situations involving measurements[1]	SN
C. Angles	
6. Defines the concept of radian	★
7. Determines the correspondence between degrees and radians	★
G. Metric or trigonometric relations	
4. Proves trigonometric identities by using algebraic properties, definitions (sine, cosine, tangent, cosecant, secant, cotangent), Pythagorean identities, and the properties of periodicity and symmetry **Note**: Formulas for finding the sum or difference of angles are compulsory in SN only.	★
H. Vectors in the Cartesian or Euclidian plane	
1. Defines a vector: magnitude (length or norm), direction, sense **Note**: In Secondary Cycle One, vectors are used in translations.	★
2. Represents a vector graphically (arrow in a plane or pair in a Cartesian plane) **Note**: In TS, students may use a matrix with geometric transformations	★
3. Identifies properties of vectors	★
4. Performs operations on vectors **Note**: In TS, operations on vectors are performed in context. a. determination of the resultant or projection of a vector	★
b. addition and subtraction of vectors	★
c. multiplication of a vector by a scalar	★
d. scalar product of two vectors	★
e. linear combination of vectors	★
f. application of Chasles relation	★
5. Justifies statements using properties associated with vectors	★
6. Analyzes and models situations using vectors (e.g. displacements, forces, speeds or velocities)	★

1. Depending on the context, measurement prefixes (e.g. *nano*, *micro*, *milli*, *deca*, *kilo*, *mega*, *giga*) are introduced.

Analytic Geometry

Analyzing situations using analytic geometry	SN
B. Straight lines and half-planes	
1. Uses the concept of change to b. determine the coordinates of a point of division using a given ratio (including the coordinates of a midpoint) **Note**: In SN, students can also determine the coordinates of a point of division using the product of a vector and a scalar.	★
D. Geometric loci	
1. Describes, represents and constructs geometric loci in the Euclidian and Cartesian planes, with or without technological tools **Note**: In SN, the study of geometric loci is limited to conics.	★
2. Analyzes and models situations involving geometric loci in the in the Euclidian and Cartesian plane **Note**: In TS, geometric loci also include plane loci, i.e. geometric loci involving lines or circles only. In SN, the study of geometric loci is limited to conics.	★
3. Analyzes and models situations using conics – describing the elements of a conic: radius, axes, directrix, vertices, foci, asymptotes, regions – graphing a conic and its internal and external region – constructing the rule of a conic based on its definition – finding the rule (standard form) of a conic and its internal and external region – validating and interpreting the solution, if necessary	
a. parabola centred at the origin and resulting from a translation	★
b. circle, ellipse and hyperbola centred at the origin	★
4. Determines the coordinates of points of intersection between a. a line and a conic **Note**: In TS, this is associated with solving systems involving the functional models under study and entails mostly graphical solutions (with or without the use of technological tools).	★
b. two conics (a parabola and a conic)	★
E. Standard unit circle	
1. Establishes the relationship between trigonometric ratios and the standard unit circle (trigonometric ratios and lines)	★
2. Determines the coordinates of points associated with significant angles using metric relations in right triangles (Pythagorean relation, properties of angles: 30°, 45°, 60°)	★
3. Analyzes and uses periodicity and symmetry to determine coordinates of points associated with significant angles in the standard unit circle	★
4. Proves Pythagorean identities	★