European Schools

Office of the Secretary-General

Ref.: 2010-D-581-en-1

Orig.: EN

S4P4 MATHEMATICS SYLLABUS SECONDARY 4th YEAR

4 period/week course

JOINT TEACHING COMMITTEE

Meeting on 4 and 5 February 2010

Proposal: entry into force in September 2010

ALGEBRA (for guidance: 60 periods)

TOPIC	KNOWLEDGE & SKILLS	USE OF TECHNOLOGY
Basic Calculations	*Pupils must be able to and/or understand:* - do basic calculations $\left(+,\ -,\ x \text{ and }/\right)$ over the sets $\mathbb{N}, \mathbb{Z}$ and $\mathbb{Q}$ - verify calculation rules and properties established in years 1, 2 & 3 and use them in simple algebraic expressions	*Pupils must be able to and/or understand:* - handle basically a calculator - transform a fraction into a decimal and vice versa - manage approximate and exact mode calculation - calculate lcm and hcf - simplify and factorise numerical expressions - use the calculator for controlling results

Square Roots and a new set of numbers	*Pupils must be able to and/or understand:*
	
	- recognise problems leading to square roots
	- solve $x^2 = a$; $a \in \mathbb{N}$; $x \in \mathbb{N}$
	- give the definition of $\sqrt{a}$
	- understand the idea of roots
	- recognise that squaring and square rooting are inverse operations
	- calculate the square roots of perfect squares (between 1 and 400) without a calculator
	- understand that $\sqrt{2} \notin \mathbb{Q}$ and recognise other irrational numbers
	- understand that it is necessary to define the set of real numbers $\mathbb{R}$
	- realise that $\mathbb{N} \subset \mathbb{Z} \subset \mathbb{Q} \subset \mathbb{R}$
	- know that all arithmetic rules in $\mathbb{Q}$ apply in $\mathbb{R}$
	- apply the following:
	
	   • $\sqrt{a}\sqrt{b} = \sqrt{ab}$; $\dfrac{\sqrt{a}}{\sqrt{b}} = \sqrt{\dfrac{a}{b}}$ for $a \in \mathbb{R}^+$, $b \in \mathbb{R}^+$
	
	   $\sqrt{n^2 m} = n\sqrt{m}$ for $n \in \mathbb{N}$, $m \in \mathbb{N}$
		Pupils must be able to and/or understand:
		
		- solve by trial $x^2 = a$, $a \in \mathbb{R}^+$
		
		- calculate the square root of a number
		- approximate a number in the decimal form
		- approximate a number as a fraction
		
		- show properties of square roots
		
		- simplify expressions involving square roots

TOPIC	KNOWLEDGE & SKILLS	USE OF TECHNOLOGY
	• e.g. $\sqrt{12} = 2\sqrt{3}$ • $\sqrt{a^2} = |a|$ for $a \in \mathbb{R}$ - calculate also more difficult expressions like $$\left(3\sqrt{2} + \sqrt{12}\right)^2 ; \left(\sqrt{2} + 3\sqrt{5}\right)\left(-1 + \sqrt{2}\right)$$	
Linear dependency and proportionality: 1st degree functions and equations	*Pupils must be able to and/or understand:* - recognise that one value depends on another value and define a function accordingly - write the equation of and recognise a linear function $y = mx + p$ - transform an equation $ax + by = c, \left(b \neq 0\right)$ in the form $y = mx + p$ and the converse - recognise that the graphical representation of $ax + by = c$ is a straight line and the converse - understand the meaning of m and p - define geometrically m and p - find algebraically and geometrically the zero (root) of a linear function - recognise real problems which lead to such functions - make equations from simple problems - solve linear equations - understand that the equation $ax + by = c$, with a and b non-zero, has an infinite number of solutions - give a geometric interpretation of such equations - recognise real problems which lead to such equations and solve them without a calculator	*Pupils must be able to and/or understand:* - draw the graph of a linear function - operate the transformation $ax + by = c \Leftrightarrow y = mx + p$ - find the equation of a linear function given its graph - use sliders to vary m and p - find the intersection point with the x-axis given the graph and given the equation of a linear function - plot a set of (*x, y*) values and the graph of a linear function according to them - solve equations - solve equations step by step and check solutions - verify results by use of a calculator

Simultaneous equations of the type: $$\begin{cases} ax + by = c \\ dx + ey = f \end{cases}$$	*Pupils must be able to and/or understand:* - recognise real problems which lead to simultaneous equations - solve simultaneous equations geometrically - solve simultaneous equations by substitution and/or elimination methods - check solutions - solve real problems without a calculator	*Pupils must be able to and/or understand:* - draw the graph of two linear functions - solve simultaneous equations - solve simultaneous equations step by step - check solutions
Polynomials	*Pupils must be able to and/or understand:* - recognise polynomial expressions and calculate their value - handle algebraic expressions with powers and recognise equivalent expressions - add and multiply algebraic expressions with powers - simplify and order polynomial expressions - add and multiply polynomials in one variable - handle simple factorisation - apply the special identities: $(a \pm b)^2 = a^2 \pm 2ab + b^2$ $(a + b)(a - b) = a^2 - b^2$ $(a \pm b)^3 = a^3 \pm 3a^2b + 3ab^2 \pm b^3$	*Pupils must be able to and/or understand:* - calculate the numerical value of an algebraic expression by substituting given numerical values to the variables - simplify expressions involving powers - simplify algebraic expressions - factorise algebraic expressions - expand the expression $(a + b)^n$ and calculate coefficients of Pascal's triangle

STATISTICS (for guidance: 18 periods)

TOPIC	KNOWLEDGE & SKILLS	USE OF TECHNOLOGY
Collect, organise and analyse data	*Pupils must be able to and/or understand:* - recognise populations and samples in everyday life situations - recognise discrete and continuous data - determine frequencies from collected raw data - establish a table of frequencies - convert frequencies into percentages and the converse - establish the range of a set of data - form equal classes intervals - establish a table of cumulative frequencies - calculate the arithmetic mean and the median	*Pupils must be able to and/or understand:* - insert data into a spreadsheet - order data in a table of frequencies - use a calculator to convert frequencies into percentages and the converse - find the minimum and the maximum value of a numerical set of data - define and name a variable - calculate cumulative frequencies - calculate the arithmetic mean and the median
Representation of data	*Pupils must be able to and/or understand:* - draw a frequency graph - represent data by bar charts and histograms	*Pupils must be able to and/or understand:* - use a calculator to plot a graph - represent data on pie charts, by bar charts and histograms
Interpret and compare data	*Pupils must be able to and/or understand:* - read off data from a diagram - interpret a data diagram and determine the arithmetic mean , median, mode, interquartile range (IQR) from a frequency graph - use percentages to compare data - develop caution in interpreting data and misuse of statistics	*Pupils must be able to and/or understand:* - calculate the IQR - discuss dispersion by comparing graphs

GEOMETRY (for guidance: 50 periods)

TOPIC	KNOWLEDGE & SKILLS	USE OF TECHNOLOGY
Basic Geometry	*Pupils must be able to and/or understand:* - draw geometric figures such as triangles, quadrilaterals and regular polygons on paper - verify that the perpendicular bisectors of a triangle meet in one point - show the same for the altitudes (heights), the angle bisectors and the medians of a triangle - verify the expected sum of the angles of a triangle, a quadrilateral and a polygon	*Pupils must be able to and/or understand:* - draw geometric figures on the calculator - measure lengths and angles - define a variable - construct perpendicular and parallel lines - verify properties in specific geometric situations

Right-Angled Triangles	Pupils must be able to and/or understand:
	
	- recognise the following 4 properties of right-angled triangles:
	  a) they possess two complementary angles
	  b) the length of the median line extended from the right-angle is equal to half the hypotenuse
	  c) the centre of the hypotenuse is the centre of the circumscribed circle of the triangle
	  d) the hypotenuse is the diameter of the circumscribed circle
		Pupils must be able to and/or understand:
		
		- verify these properties using construction and measurements

Pythagoras Theorem	Pupils must be able to and/or understand:
	
	- recognise Pythagoras' Theorem
	- prove Pythagoras' Theorem
	- understand that there are different ways to prove Pythagoras' Theorem
	- apply Pythagoras' Theorem to problems in two dimensions
	- recognise real problems and apply Pythagoras' Theorem
		Pupils must be able to and/or understand:
		
		- verify the theorem using
		  • sides length measurements
		  • area measurements

Circles	Pupils must be able to and/or understand: - give the definition of a circle - draw a circle, a sector, an arc, a chord - define the sector of a disc, the arc of a circle and a chord - apply the formulae to calculate the circumference of a circle and the length of an arc - apply the formulae to calculate the area of a disc and of a sector of a disc - recognise tangents to circles and how lines intersect or completely avoid circles - recognise properties of right-angled triangles inscribed in a circle - recognise that the angle from a chord to the centre of a circle is double than the angle made at the circumference - recognise that all angles made from a chord to the circumference of a circle are equal	Pupils must be able to and/or understand: - calculate the length of a circle - calculate the area of a disc - find out by dynamical procedure some properties of triangles inscribed in a circle - verify by measuring angles - verify by measuring angles

Enlargement	Pupils must be able to and/or understand: - enlarge (and reduce) geometrically - determine the scale factor of an enlargement - explain and recognise invariants of enlargements - determine the effect of enlargement on angles	Pupils must be able to and/or understand: - draw simple enlargements - find out the scale factor using variables and sliders - verify invariants by measurements
Similar triangles	Pupils must be able to and/or understand: - recognise congruent and similar triangles - recognise the connection between parallel lines and the constant ratio of the segments of all lines cutting these parallel lines (intercept Theorem) - recognise the intercept theorem when working with triangles - link the intercept theorem with enlargements - recognise the converse of the intercept theorem - apply the intercept theorem to calculate lengths and to prove lines are parallel	Pupils must be able to and/or understand: - use constructions and measurements to verify lengths - use dynamical procedures to prove the theorem using variables and sliders - use constructions and measurements to verify lengths
Plane Sections of Solids	Pupils must be able to and/or understand: - apply Pythagoras' Theorem and the intercept theorem to plane sections of solids - calculate the internal diagonal of a cube or cuboid, the edges of a pyramid or the height of a cone with particular angles - recognise and solve real problems	