European Schools

Office of the Secretary-General
Pedagogical Development Unit

Ref.: 2011-01-D-27-en-2

Orig.: EN

S5P4 MATHEMATICS SYLLABUS SECONDARY 5th YEAR

4 period/week course

APPROVED BY THE JOINT TEACHING COMMITTEE ON 9, 10 AND 11 FEBRUARY 2011 IN BRUSSELS

Entry into force in September 2011

ALGEBRA (for guidance: 55 periods)

TOPIC	KNOWLEDGE & SKILLS	USE OF TECHNOLOGY
Powers	*Pupils must be able to and/or understand :* ▪ recognise that some numbers can be expressed as a positive power of another number ▪ use the formulae concerning powers and show that they work with negative powers ▪ define $\sqrt{x} = x^{\frac{1}{2}},\ x \geq 0$ ▪ simplify expressions like: $3^{-2} \times 9^2,\ \frac{16^{\frac{1}{2}}}{4},\ \frac{21a^2b}{7ab^2},\ 3a^{-\frac{1}{2}}b \times 18ab$ ▪ express a number in scientific notation and include rounding ▪ perform calculations with numbers in scientific notation	*Pupils must be able to and/or understand :* ▪ simplify numerical expressions containing powers ▪ simplify algebraic expressions containing powers ▪ perform calculations with numbers in scientific notation
Expressing growth with powers	*Pupils must be able to and/or understand :* ▪ distinguish between linear and exponential growth and decay ▪ recognise problems of exponential growth and decay like cell division, compound interest, depreciation of an investment ▪ give the expression of the nth year	*Pupils must be able to and/or understand :* ▪ use a spreadsheet to represent an exponential growth and decay problem such as cell division, compound interest, depreciation of an investment ▪ represent the problem graphically using scatter plot or histogram ▪ solve exponential growth and decay problems ▪ find out the year when a certain value of the dependent variable is reached by trial and error (use of logs is not required)

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Quadratic dependency: 2nd degree functions and equations	*Pupils must be able to and/or understand :* ▪ recognise problems leading to quadratic proportionality $y = ax^2$ ▪ draw parabolas of the types: $y = ax^2$ ▪ graphically compare $y = (x-p)^2$ and $y = (x-p)^2 + q$ with $y = x^2$ ▪ identify given the graph of a parabola ○ the axis of symmetry ○ the coordinates of the vertex ○ the zeros ○ the y intercept ▪ solve equations $x^2 = a$; *for* $a \geq 0$ ▪ factorise an expression of the kind $x^2 + bx + c$ ▪ calculate the discriminant $\Delta = b^2 - 4ac$ for the expression $ax^2 + bx + c$ ▪ understand the meaning of the discriminant ▪ solve quadratic equations $ax^2 + bx + c = 0$ by using ○ factorisation when possible ○ the general solution formula ▪ find from the equation of the quadratic function ○ whether the graph is convex or concave ○ the axis of symmetry ○ the coordinates of the vertex ○ the zeros, when appropriate ○ the y intercept ▪ interpret geometrically the solutions of a 2nd degree equation ▪ determine algebraically, and graphically, the points	*Pupils must be able to and/or understand :* ▪ verify that their graphs have been successfully drawn ▪ investigate the effect of changing coefficients in functions of the form: $y = a(x-p)^2 + q$ ▪ verify the solutions to a variety of quadratic equations ▪ factorise and solve equations ▪ verify algebraically and geometrically the intersection of a straight line and a parabola

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	of intersection of a line and a parabola ▪ form quadratic equations from worded problems and solve them	
Inverse proportionality and hyperbolas	*Pupils must be able to and/or understand :* ▪ recognise problems leading to inverse proportionality $y = \frac{a}{x}$ ▪ sketch the hyperbolas $y = \frac{a}{x}$; $y = \frac{a}{x+c}$; $y = \frac{ax+b}{x+c}$ ▪ identify, given the graph or the equation of a hyperbola ○ domain ○ the equations of the asymptotes ○ the centre of symmetry ○ the zero, when appropriate ○ the y intercept, , when appropriate ▪ determine algebraically, and graphically, the points of intersection of a line and a hyperbola ▪ know the behaviour of the graph close to the asymptotes ▪ solve inverse proportionality , $y = \frac{a}{x}$, problems	*Pupils must be able to and/or understand :* ▪ verify that their graphs have been successfully drawn ▪ investigate the effect on the graphs of the hyperbolas by changing coefficients in functions of the form: $y = \frac{a}{x}$; $y = \frac{a}{x+c}$; $y = \frac{ax+b}{x+c}$; $y = \frac{ax+b}{cx+d}$ ▪ verify algebraically and geometrically the intersection of a straight line and a hyperbola ▪ verify the solutions to inverse proportionality , $y = \frac{a}{x}$, problems

STATISTICS & PROBABILITY (for guidance: 23 periods)

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Probability	*Pupils must be able to and/or understand :* ▪ determine the universal set Ω of possible outcomes of a random trial ▪ define an event *A* as sub-set of Ω (containing one or more elements) ▪ show the universal set in the form of a Venn diagram ▪ understand the idea of probability leading on from relative frequency ▪ list the set of all possible outcomes in an experiment ▪ describe some sample sets of possible outcomes with the help of a tree diagram and a total possibility space diagram ▪ calculate the probability of an event ▪ define the complement of an event, independent events, mutually exclusive events and exhaustive events ▪ use tree diagrams for independent and conditional (dependent) probability (limit up to three sets of branches)	*Pupils must be able to and/or understand :* ▪ use the random number generator ▪ create by using a spreadsheet, the relative frequency of a virtual generated experiment and compare with the theoretical probabilities (e.g. dice simulation) ▪ calculate a probability as a fraction and as a decimal

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Probability Laws	*Pupils must be able to and/or understand :* ▪ apply the formulas: ○ $P(\overline{A}) = 1 - P(A)$ ○ $P(A \cap B) = 0$ for mutually exclusive events ○ $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ ○ $P(A \cup B) = 1$ for exhaustive events ○ $P(A \cap B) = P(A) \cdot P(B)$ for independent events	*Pupils must be able to and/or understand :* ▪ use the tool in probability problems
Analysis of data	*Pupils must be able to and/or understand :* ▪ understand that the variance and the standard deviation are a measure of spread ▪ calculate, for a small size sample $(n \leq 6)$, variance and standard deviation, using one of the following $\sigma^2 = \frac{\sum (x - \bar{x})^2}{n} = \frac{\sum x^2}{n} - (\bar{x})^2$	*Pupils must be able to and/or understand :* ▪ calculate from frequency distributions or histograms the variance and the standard deviation ▪ calculate an estimate of the variance and the standard deviation for raw and grouped data $\sigma^2 = \frac{\sum (x - \bar{x})^2}{n} = \frac{\sum x^2}{n} - (\bar{x})^2$ $\sigma^2 = \frac{\sum a(x - \bar{x})^2}{\sum a} = \frac{\sum ax^2}{\sum a} - (\bar{x})^2$ ▪ calculate the variance and the standard deviation for raw and grouped data using the spreadsheet

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Interpretation and comparison of data	*Pupils must be able to and/or understand :* ▪ compare and interpret distributions with respect to their: ○ means and variances/standard deviations ○ given histograms	*Pupils must be able to and/or understand :* ▪ calculate an estimate of the mean, variance and the standard deviation ▪ construct a histogram for interpretation and comparison

GEOMETRY (for guidance: 50 periods)

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Right angles triangles	*Pupils must be able to and/or understand :* ▪ define, recognise and apply the definitions of Sine (sin), Cosine (cos) and Tangent (tan) of an angle φ in right-angled triangles	*Pupils must be able to and/or understand :* ▪ do simple calculations with the basic trigonometric functions $0^\circ \le \varphi \le 90^\circ$
Angle measure	*Pupils must be able to and/or understand :* ▪ define radians in relation to the arc length of sectors ▪ convert radians to degrees and vice versa ▪ estimate the size of an angle in radians and degrees	*Pupils must be able to and/or understand :* ▪ convert radians to degrees and vice versa ▪ use constructions and measurements to verify their estimation
Circle Trigonometry	*Pupils must be able to and/or understand :* ▪ define the unit circle ▪ define trigonometric functions on the unit circle to generate their graphs in both degrees and radians for $0^\circ \le \varphi \le 360^\circ$ and $0 \le \varphi \le 2\pi$ ▪ sketch the graphs of sine, cosine and tangent	*Pupils must be able to and/or understand :* ▪ use of constructions, measurement and trace function of the unit circle to generate a list of values of trigonometric numbers. These numbers are then used to sketch trigonometric function graphs

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Trigonometric Ratios	*Pupils must be able to and/or understand :* ▪ deduce and know by heart values of $\sin\varphi$, $\cos\varphi$ and $\tan\varphi$ for standard angles : $\varphi = 0^\circ, 30^\circ, 45^\circ, 60^\circ, 90^\circ$ and also in radians ▪ know by heart values of $\sin^{-1}(a)$ and $\cos^{-1}(a)$ for $a = 0; \frac{1}{2}; \frac{\sqrt{2}}{2}; \frac{\sqrt{3}}{2}; 1$ with $0 \le \varphi \le \frac{\pi}{2}$ ▪ deduce $\tan^{-1}(a)$ for standard values with $0 \le x \le \frac{\pi}{2}$ ▪ use the graphs to understand that other angles will give the same trigonometric ratios as the standard angles ▪ solve simple equations of the kind $\sin\varphi = \pm\frac{1}{2}$, $\cos\varphi = \pm\frac{\sqrt{2}}{2}$ by only using graphs in both degrees and radians	*Pupils must be able to and/or understand :* ▪ calculate $\sin\varphi$, $\cos\varphi$ and $\tan\varphi$ for $0^\circ \le \varphi \le 360^\circ$ and $0 \le \varphi \le 2\pi$ ▪ calculate, for a given *a*, $\sin^{-1}(a)$, $\cos^{-1}(a)$, $\tan^{-1}(a)$ ▪ use the graphs to see that other angles will give the same trigonometric ratios as the standard angles ▪ solve equations to check solutions ▪ read and interpret correctly results obtained from the calculator ▪ do simple calculations with the basic trigonometric functions $0^\circ \le \varphi \le 360^\circ$ ▪ solve equations
Trigonometric Formulae	*Pupils must be able to and/or understand :* ▪ know and apply the fundamental formulae $\sin^2\varphi + \cos^2\varphi = 1$ $\tan\varphi = \frac{\sin\varphi}{\cos\varphi}$	*Pupils must be able to and/or understand :* ▪ do calculations to verify and use these results ▪ use of construction and shape, use of variable and data capture, use of measurements of angles and lengths to verify these formulae

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Applied Trigonometry	*Pupils must be able to and/or understand :* ▪ calculate lengths and angles in right-angled triangles ▪ use trigonometry and Pythagoras' theorem to solve problems	*Pupils must be able to and/or understand :* ▪ use trigonometric functions in calculations ▪ solve problems using a variety of angles and lengths ▪ use of construction and shape, use of variable and data capture, use of measurements of angles and lengths to solve problems and check solutions
Solid Geometry	*Pupils must be able to and/or understand :* ▪ sketch objects and their plane sections ▪ calculate lengths and angles in right-angled triangles found in plane sections of prisms, pyramids and cones ▪ determine the volume for the following objects: cube, cuboid, triangular right prism, triangular and square based pyramids, cylinder, cone ▪ recognise the nets for the following objects: cube, cuboid, triangular right prism, triangular and square based pyramids, cylinder, cone ▪ construct a net for a cube and for a triangular prism, given measurements ▪ calculate surface areas for the following objects: cube, cuboid, triangular right prism, triangular and square based pyramids, cylinder ▪ apply the formulae for volume and surface area of a sphere	*Pupils must be able to and/or understand :* ▪ use the tool for calculations ▪ use the calculator to store results needed for calculating volumes and surface areas of solids