Generic Tasks template

The template has to be able to describe different aspects of the task that is being described:
- the minimum scholar level,
- the concepts that are necessary to perform the task,
- the types of measures that are performed in the generic elements of solutions, especially when no direct mean is accessible,
- the type of quantity that is asked,
- the range of objects upon which the task can be applied.

Context and references can be added as optional elements.

Title	Scholar level	Main concepts	Measures	Result	Competencies	Objects	Context	References

For example:

Title	Scholar level	Main concepts	Measures	Result	Competencies	Objects
Recognizing a shape	2	Modeling shapes in the environment	Visual recognition	The name of the shape	Recognize and name a basic shape, model a real object	An object of a well defined form.
Number of rectangular things	2	Multiplication	The number of say windows horizontally, vertically, the number of missing windows	Their product minus the missing ones.	Recognize a multiplicative problem, count aligned objects, compute a multiplication	A rectangular arrangement such as a facade.
Slope	9	Slope as ratio of a height by a length	The height and horizontal length between start and end	Their ratio, in % or as the coefficient of a line.	Know what is a slope, identify suitable horizontal and vertical segments, measure them, compute	A constant slope with easy horizontal and vertical segments.
Long slope	9	Slope as an angle	The height between start and end not by direct mean, for example through an equivalent stair, & its length.	The angle given by its sine, ratio of height by length.	Relate two equal heights, measure two lengths, compute their ratio, know how to use sine.	A slope where start and end can not be easily compared.
Radius of a circular arc	9	Arc length proportional to radius and angle	The length of an arc and whether its chord, or the angles between its tangents. If the center is reachable, a direct estimation of the radius	The radius of a piece of circular arc	Understand a complex geometric figure, measure angles and lengths, determine tangent lines.	A piece of a large circular arc such as a curved building, a round square...

The long slope is a more complex generic task than the one where direct measures of a piece of length and its associated height are accessible, such as the following long slope:

Its length can be directly measured, but its height has to be inferred by other means (comparison with stairs for example). Moreover, some trigonometric identities are needed to get the horizontal.

We should try to address most of the entries in the curricula for different levels by defining specific generic tasks for each notion and each minimum level.

Description of notions and concepts at different scholar levels

Scholar level 1-3 :

Numbers & calculus
- Counting, enumeration, basic combinatorics
- Decimal numeration up to 10 thousands
- Addition, subtraction, multiplication

Geometry
- Qualitative basic 2D shapes: circle, square, rectangle, triangles, orthogonality
- Instrumented 2D shapes, circle, segment and polygon tracing
- Qualitative axial symmetry

Physical quantities and measures
- Measure of segments length, perimeter of polygons
- Time (year, month, week, day, hour…), calendar, duration
- Mass, volume (comparing or counting units)

Algorithmic, logics
- Orientation, maps, spatial awareness and location
- Instrumented 2D shapes, circle, segment and polygon tracing
- Geometric and numerical friezes and sequences

[Probability, combinatorics, statistics]

Scholar level 4-6 :

Numbers & calculus
- Counting, enumeration, basic combinatorics
- Decimal numeration up to 1 billion
- Algorithmic operations on decimals, Euclidean division
- Positioning fractions on an axis
- Proportionality of numbers

Geometry
- Basic 2D shapes and quadrilaterals, their properties
- Instrumented 2D shapes, circle, segment and polygon tracing
- Parallelism, lines, half-lines
- Basic 3D-shapes (right cuboid, prism, pyramid, cylinder, cone, sphere) and their nets
- Construction and properties of axial symmetry
- Proportionality of shapes, changes of scales

Physical quantities and measures
- Distance between shapes
- Proportionality, percentage
- Constant speed
- Scale, conversions between units
- Areas and decomposition of complex 2D-shapes
- Comparison between, operations on and measures of angles (protractors)
- Formulas for perimeters, areas (triangle, rectangle, disk) and volumes (right cuboid)

Algorithmic, logics
- Organization of data
- Movements on a map, doing and coding.
- Instrumented 2D shapes, circle, segment and polygon tracing

Scholar level 7-9 :

Numbers & calculus
- Algebraic expressions, variable, unknown, 1st degree equation
- Powers, square root of a number (Pythagorean theorem)

- Orders of magnitude, engineer notation, comparison, choice of units
- Basic divisibility, primality
- Proportions, percentage, frequencies
- Random processes, basic probabilities, equiprobability, statistics, mean, median, spread
- Data and functions: definition, use, graphical or tabular representations, interpretation
- Proportional dependency, linear or affine functions, slope, constant rate of change
- Piecewise affine functions, basic non linear functions, area of a disk

Geometry
- Proportionality in geometry, Thales theorem
- Formulae for areas, volumes, effect of change of scale, symmetries
- Properties of 2D shapes to prove statements
- Orthogonality, Pythagorean theorem, perpendicular bisector
- Angles in triangles, parallelism, sine, cosine, tangent in a triangle, angular bisector,
- System of axis for 2D and 3D coordinates, abscissa, ordinate, height, longitude, latitude
- Symmetries, friezes, pavings, rosettes

Physical quantities and measures
- Mean speed
- Formulae for perimeters, areas and volumes, density

Algorithmic, logics
- Decompose a task in sub-tasks
- Basic coding and decoding, information

Scholar level 10-12 :

Numbers & calculus
- 2nd degree equation, slope, rational fractions
- Continuity, derivation, variations, maxima, minima, intermediate value theorem
- Arithmetic and geometric sequences
- Exponential growth or decay, logarithm, trigonometric functions
- Limits and comparison of sequences, of functions, bounds
- Integration, primitives
- Divisibility, congruences, Gauss and Bézout theorems, decomposition in prime numbers

Probability and statistics
- Dispersion, variance, quartile
- Statistical test, fluctuation interval, confidence interval
- Probability law, events, dependency, conditioning, random variable, expected value
- Discrete laws (Poisson, Bernoulli, binomial)
- Weighted probability tree
- Continuous laws (uniform, exponential, normal), density, Moivre-Laplace theorem
- Markov processes, matrices and their powers

Geometry
- Analytic 2D and 3D, lines, planes, intersections, orthogonality, parallelism
- Vectors, trigonometry, scalar product, vector product
- Complex numbers, algebraic and exponential notations
- Areas with primitives
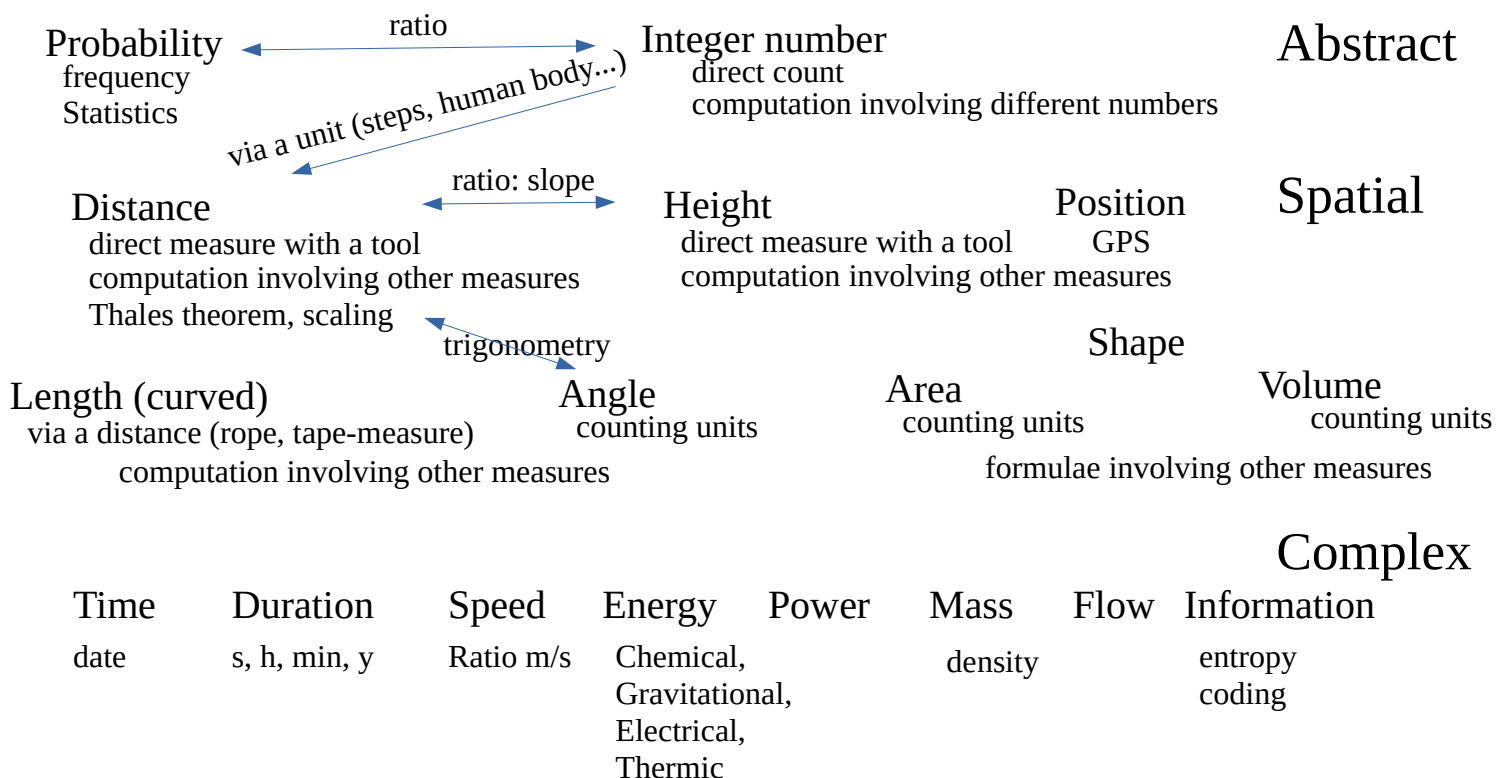
Physical quantities and measures
- Instant speed
- Mean value of an experiment

Algorithmic, logics
- Dichotomy algorithm
- Iterative algorithm
- Boolean expressions, basic quantification
- Direct proof, contraposition, reciprocal, negation
- Coding and decoding using arithmetic

Physical quantities and measures

Physical quantities can be measured directly or be built upon more basic measurements. This section is here to objectify the complexity of a physical quantity asked in a task. Which physical quantity is the solution of the task, based on which measures, sum, product or ratio?

Probability
frequency
Statistics

ratio

via a unit (steps, human body...)

Integer number
direct count
computation involving different numbers

Abstract

ratio: slope

Distance
direct measure with a tool
computation involving other measures
Thales theorem, scaling

Height
direct measure with a tool
computation involving other measures

Position
GPS

Spatial

trigonometry

Shape

Length (curved)
via a distance (rope, tape-measure)
computation involving other measures

Angle
counting units

Area
counting units

Volume
counting units

formulae involving other measures

Complex

Time	Duration	Speed	Energy	Power	Mass	Flow	Information
date	s, h, min, y	Ratio m/s	Chemical, Gravitational, Electrical, Thermic		density		entropy coding

For example, if the result is a length, the path could be, starting from the modeling of the situation with basic shape recognition:
- direct **measure**, reading a tool, for an accessible length
- direct **measure** of a pattern/unit (like steps or arm spans) and **counting** an integer (or rational) number of it then **multiplying**,
- estimating through direct **measures** and **scaling** using Thales theorem,
- computing through indirect **lengths** using Pythagorean theorem with a right **angle**
- or more involved **trigonometric** identities after the measure of an **angle**
- combining those.