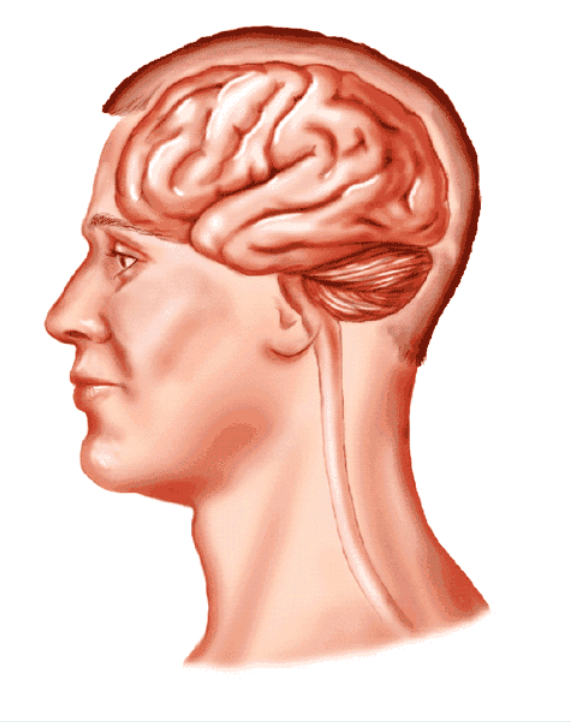
DEPARTMENT OF BASIC EDUCATION

MATHEMATICAL LITERACY TRAINING 2021

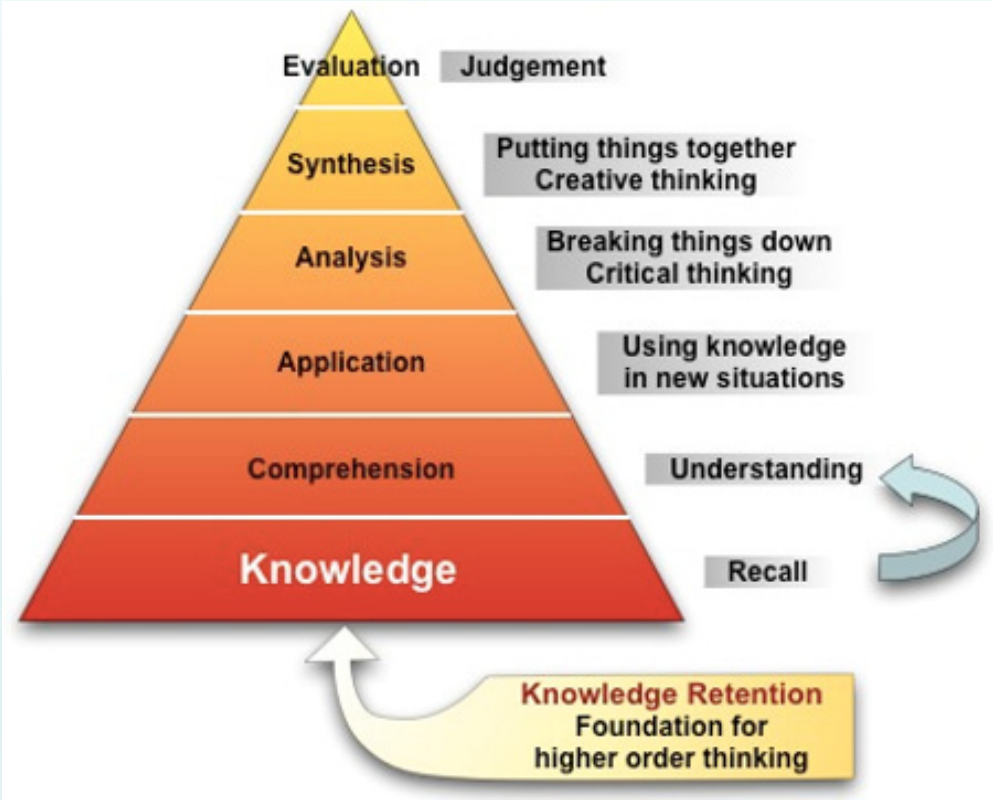
COGNITIVE LEVELS

What does your subject curriculum say about cognitive levels?

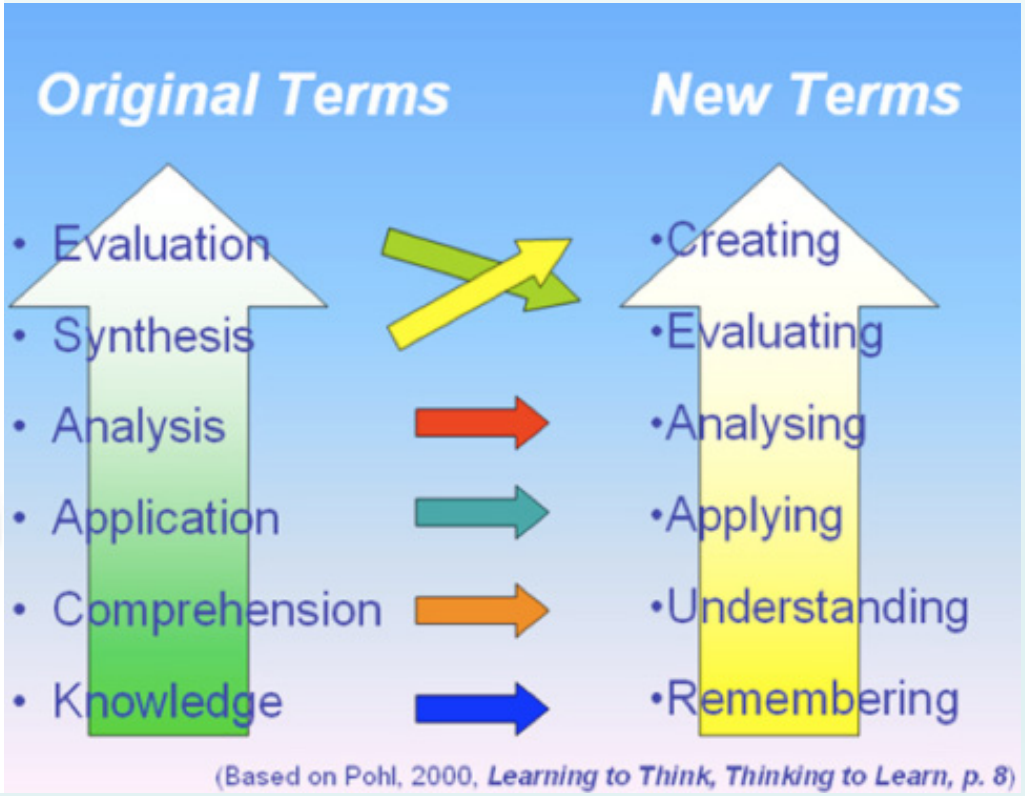


BLOOM'S TAXONOMY

Original taxonomy



Revised taxonomy



Remembering: Recognizing, recalling, labelling, naming

Understanding: Interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining

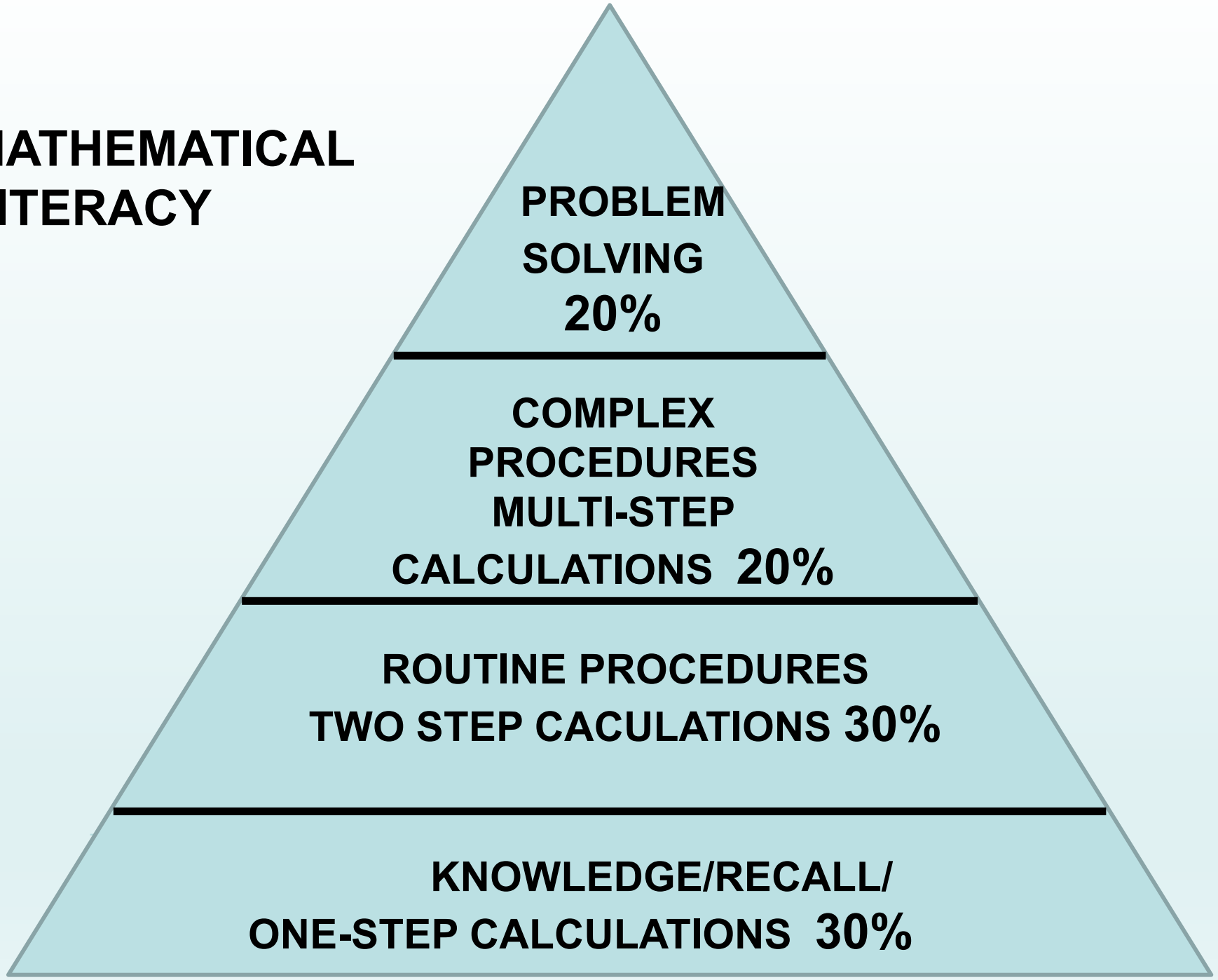
Applying: Executing, implementing, preparing, using

Analyzing: Differentiating, organizing, attributing, solving

Evaluating: Critiquing, judging, justifying, recommending

Create: Generating, planning, producing

MATHEMATICAL LITERACY



MATHEMATICAL LITERACY COGNITIVE LEVELS

AS PREPARED BY
MA HENDRICKS

LEVEL 1

TOOL FOR CLASSIFYING GRADE 12 QUESTIONS ACCORDING TO TAXONOMY LEVELS

MATHEMATICAL LITERACY developed by MA HENDRICKS 2014

TAXONOMY LEVEL 1 KNOWING

KNOWING questions serve TWO FUNCTIONS

FUNCTION 1: To ask questions about the context

FUNCTION 2: To test the ability to:

- Interpret contextualized information
- Use familiar techniques
- Perform basic calculations
- Explain common terms

READ off information directly from GIVEN:

- Bills / payslips/ budgets / statements
- Measurements from Plan/ Model /Drawing.
- Clock (time)
- Questionnaire/ Graphs

LEVEL 1

IDENTIFY:
• Exchange rates between TWO currencies from a table.
• Interest rate
• Name of employee / Monthly salary
• Appropriate Formulae (measurement) from a list
• Names of national roads or towns on route between two locations .
• Scale on map or plan or model
• Mode for arranged data
• Median for arranged odd data
• Maximum or minimum values
EXPLAIN (DEFINE) meaning of terms/words / vocabulary to a particular topic:
• "Break-even" in context
• Interest / Interest Rate/ Inflation
• Gross Pay/Net Pay/ Deductions / Taxable income
• Area/ Perimeter/ Volume/ Radius, etc.
• Given Scale on plan or actual measurement.
• Floor plan / Elevation plan/ Layout Plan
• Difference between (Categorical/ numerical/ discrete/ continuous data)
• Event/ Outcome etc.

LEVEL 1

EXPLAIN/ SHOW how the following has been calculated:
• Total due/ VAT/ Total income/ Profit/ Loss/
CLASSIFY ING items from:
• Statements/ budgets / payslips (as fixed or variable)
MEASURE:
• Accurately Using instruments.
• The dimensions of a structure for which model/2D drawing will be constructed.
DETERMINE / CALCULATE:
• Cost price by adding. • Income generated (based on sale price and volume).
• Radius from given diameter • Distance / Mass/ Volume/Time
SORT /ARRANGE / COUNT data .
COMPLETE a questionnaire.
ROUNDING OFF answers approximately as per given instruction
CONVERSION of metric units- one dimensional

LEVEL 2

TOOL FOR CLASSIFYING GRADE 12 QUESTIONS ACCORDING TO TAXONOMY LEVELS

MATHEMATICAL LITERACY **developed by MA HENDRICKS 2014**

TAXONOMY LEVEL 2

Applying ROUTINE PROCEDURES in familiar contexts.

Questions requiring performing WELL-KNOWN procedures / common tasks.
The procedure/ task to be performed is clear from the way the problem is posed.
All the necessary information to solve the problem is immediately available.
Routine procedure questions commonly involve:

- Single step calculations.
- Repeating the same calculation several times.
- Completing a familiar task.

READ OFF:

- **Break-even values from two given graphs.**
- **Values from graphs showing simple and compound interest scenarios.**
- **Appropriate tax values from GIVEN tax deduction tables.**
- **Time values AND perform calculations with time.**
- **Estimated values from a graph.**

LEVEL 2

IDENTIFY:
• Income tax bracket based on GIVEN salary (monthly or annual).
• On which plan (elevation) a particular structure is shown.
• Number of items on a plan by USING a given key.
• All possible outcomes of an event.
CONSTRUCT / DRAW/ COMPLETE / CONDUCT:
• Income expenditure statement/ budget for individual OR household.
• A Table to show how cost price changes depending on the number of items made.
• A given Frequency table.
• A Survey / Questionnaire
• A Table of values.
• Graphs from GIVEN table of values.
SOLVING EQUATIONS BY:
• Trial-and-error / Algebraically

LEVEL 2

SUBSTITUTING VALUES INTO GIVEN:
• Equations / Formula
EXPLAIN:
• Whether a particular event is more or less likely to occur.
ESTIMATE:
• Values from GIVEN graphs
CONVERSION of units of measure:
• Temperature using given formulae (^{o}F and ^{o}C).
• Between different systems using conversion factors (e.g. cubic m to litres)- 2D and 3D
SORT DATA:
• According to two categories

LEVEL 2

TAXONOMY LEVEL 2 Applying ROUTINE PROCEDURES in familiar contexts.
DETERMINE / CALCULATE / PROVIDE:
• How an amount was calculated USING a given formula. • Value of one currency USING a given exchange rate. • % Increase or Decrease of an amount/ value. • % Mark-up to compare Selling and Cost price of an item. • Simple Interest (MANUALLY) over multiple time periods. • How the Price of an item is affected by Inflation. • Tax to be deducted from salary USING tax deduction tables. • Break-even point from a TABLE.
• Distance between the two locations by IDENTIFYING the position of TWO locations USING given distance values. • Perimeter, area and volume USING given formulae. • Number of running meters of carpet needed by measuring USING the dimensions of floor

LEVEL 2

- Travelling distance between two locating by identifying locations USING given distance values on the map.
- Set of directions to travel between two points on a map USING street names /places.
- Location by INTERPRETING a GIVEN set of directions.
- The number of a specific structure from a GIVEN key of a plan.
- Actual measurements USING given OR Measured values USING a given scale.
- % values to represent relative size (Relative Frequencies).
- Mean /Range of data values.
- Mode of data values NOT arranged.
- Median EVEN number of data values.
- Median of ODD number of data values NOT arranged.
- Quartile values for arranged data values.
- Inter-quartile range from GIVEN quartile values.
- Probability of an event (% or Decimal or Fraction form).

LEVEL 3

TOOL FOR CLASSIFYING GRADE 12 EXAMINATION QUESTIONS ACCORDING TO TAXONOMY LEVELS
MATHEMATICAL LITERACY developed by MA HENDRICKS 2014

TAXONOMY LEVEL 3
APPLYING MULT-STEP PROCEDURES IN A VARIETY OF CONTEXTS

- At **GRADE 12** level it is expected that learners will be able to perform multi-step calculations involving **NUMEROUS** (**more than THREE steps**) and **COMPLEX** calculations **WITHOUT** guidance or scaffolding.
- The procedure or method is **NOT** immediately obvious from the way the problem is posed.
- Learners may have to decide on the most appropriate procedure/ method to find a solution to the question/ task.

  AND

  Learners may have to perform or complete one or more preliminary calculations/tasks before determining a solution to the question/task.
- Situations in which a variety of mathematical or non-mathematical content/ skills **AND /OR** considerations should be utilized from different topics **IN ORDER TO** make sense of the problem.

LEVEL 3

CALCULATE / DETERMINE:
• Compound interest MANUALY (without formulae) over multiple time periods. • Change of price/ value of an item due to inflation rate over MULTIPLE time periods. • Annual and Monthly income tax for an individual USING formulae provided on Income tax bracket tables. • How the tax rebate value is calculated. • Currency conversions taking into account currency exchange fees / commission.
• Perimeter/ Area/ Volume by FIRST performing calculations from plans to determine the dimensions. • Quantity of a substance required for performing a task BY determining the required measurement of the surface/ volume USING a given conversion ratio AND ROUNDING up AND then make a DECISION about the most appropriate quantity required based on available sizes.
• Dimensions on plan/ map USING given scale in conjunction with measurement. • Dimensions in which to draw a plan (make a model or 2D drawing) USING given scale in conjunction with other skills AND then draw the plan. • Scale of a map or plan • The shortest route between two locations on a map USING a distance chart. • Actual dimensions on a plan by MEASURING dimensions and USING given scale.

LEVEL 3

- Mean / median and mode for a set of data and DECIDE with reasons which average provides the most accurate representation of the data.
- Mean / median and mode USING data represented on a graph.
- Most appropriate graph to represent data by ORGANISING data USING an appropriate table and DECIDING on the most appropriate format (actual or %) for representing the data .
- The probability of an event by IDENTIFYING appropriate values from a given table of data values.

COMPLETE :

- A table of values that models a loan scenario AND include consideration of monthly Interest calculation/ monthly Repayment and monthly Outstanding amount on the loan.
- A project / task USING plans and other content, skills or applications.

CONVERT:

- Between different systems using conversion tables by first identifying and then USING the appropriate conversion factor.

LEVEL 3

TAXONOMY LEVEL 3 (BOTH PAPERS) APPLYING MULT-STEP PROCEDURES IN A VARIETY OF CONTEXTS
INTERPRET:
• Time values from timetables to determine departure/ arrival and travelling times.
ESTIMATE:
• The distance between two locations on a map by first IDENTIFYING possible route and USING a given scale. • The travelling times between TWO or MORE locations USING estimated travelling speed AND known/calculated distances.
PLANNING:
• A trip USING maps, distance charts, weather reports and other travel resources GIVING consideration to where to stop for petrol, estimated travelling distance, time and travelling costs
REPLICATE:
• The given calculations/ values shown on a bill for a different consumption value.

LEVEL 3

CONSTRUCT:
• An income / expenditure statement (OVER TWO YEARS) for a business OR budget for fundraising event .
• Frequency table by USING given set of raw data by first SORTING data and DECIDING on intervals.
DRAW GRAPH(S) without scaffolding or guiding questions to represent:
• Consumption costs. • Production Costs and Income generated from the sale of an item. • From a GIVEN table of values to represent loan scenarios.
• Data by using GIVEN set of raw data by first SORTING data then CONSTRUCTING Frequency table.
DRAW A PLAN:
• According to the scaled dimensions by DETERMINING the most appropriate scale in which a plan must be drawn and DETERMINING the dimensions according to that scale .
COMPARE DIFFERENT OPTIONS BY:
• DRAWING TWO or MORE graphs and IDENTIFYING intersection point(s).

LEVEL 4

TOOL FOR CLASSIFYING GRADE 12 QUESTIONS ACCORDING TO TAXONOMY LEVELS
MATHEMATICAL LITERACY developed by MA HENDRICKS 2014

TAXONOMY LEVEL 4
REASONING AND REFLECTING

REASONING AND REFLECTION questions can be divided into TWO groups

GROUP 1:

Requiring a DECISION, OPINION or PREDICTION about particular scenario BASED on calculations in previous questions (or given information),

Example:

- Analysing calculations performed in a previous question AND making a decision about the most suitable option for a person with particular needs.
- Critiquing a statement regarding some statistics reported in a newspaper article.
- Predicting a projected income for a business based on available financial data.
- Explaining which of TWO groups performed better by comparing provided data.
- Providing an opinion on possible reaction to a particular set of statistics.
- Suggesting how a household could change their expenditure to improve their financial position by analysing a completed income-and expenditure statement.

LEVEL 4

GROUP 2:

POSING and ANSWERING questions about which mathematics are required to solve a problem , select and use the mathematical content , recognize the limitations and consider other non-mathematical techniques and factors that may define or determine a solution to the problem.

Example:

- Decide on the most appropriate method to compare costs between TWO service contracts by deciding whether to use tables or graphs or equations AND then perform the necessary calculations and then make sense of the calculation in order to make a decision..
- Determine whether a business is in a healthy position by using calculations to compare income and expenditure values.
- Make a decision about the most suitable bank account by comparing bank charges of TWO different accounts for various transactions.
- Constructing a table to model a loan scenario taking into account the interest calculated, the monthly repayment and monthly closing balance on the loan.
- Investigate the effect on changes in the interest rate on a loan OR the impact of increasing monthly repayments on a loan by USING a given model of the loan scenario.
- Making a decision about the most cost-effective box for packaging an item by designing two different boxes AND comparing the boxes in terms of wasted space (volume) and materials (surface area).

LEVEL 4

MAKE A DECISION ABOUT:
• The most cost-effective Electricity/ water charge systems for the user by CHOOSING an appropriate strategy to COMPARE the costs for TWO different systems. • A business by INTERPETING and USING the cost and income graphs of an item.
• Which unit is the most appropriate or useful for a particular context by COMPARING solutions to a problem expressed in different units. • The need for accuracy when performing measurement in a particular context. • An interpreted measured value in context.
• Appropriate stopping points during a journey based on considerations of fatigue, petrol consumption, travelling time, etc. • The most cost-effective box for packaging an item by designing (constructing) two different boxes (models) AND comparing the boxes (models) in terms of wasted space (volume) and materials (surface area).

LEVEL 4

TAXONOMY LEVEL 4 REASONING AND REFLECTING
MAKE A DEDUCTION(S) ABOUT:
• The IMPLICATIONS for consumers to the proposed increases to consumption tariffs by ANALYSING newspaper articles.
• Whether collected data is BIASED or VALID based on the structure of the instrument used to collect the data OR the way in which the data was collected. • TRENDS (or PREDICTIONS for the future) in the data by ANALYSING data organised in tables / measures of central tendency and spread / graphs
• The fairness of a game by ANALYSING a game involving probability.
DESCRIBE THE DIFFERENCES/ IMPACT:
• By COMPARING income and expenditure values for a business over a TWO-year period. • Of INCREASING monthly repayments on the total cost of a loan/investment by investigation. • Of making a lump sum payment (during the first half) into a loan/ investment on the total cost of the loan/investment. • Projected versus Actual budget value. • In income tax over different time periods by ANALYSING graphs.

LEVEL 4

- Differences between data sets by COMPARING measures of central tendency and spread calculated for TWO or MORE sets of data.

ANALYSE / EXPLAIN / JUSTIFY / DEFEND / INTERPRET/ CRITIQUE/ INVESTIGATE:

- The relevance the break-even point of two graphs in relation to the context.
- The meaning of different regions (between different intersection points) on a graph in relation to the context.
- How an individual's tax may have changed by COMPARING income tax tables over different tax periods.
- A particular selling price by USING results of a market research.
- A particular salary by using knowledge of inflation rates.
- The effect that an increase in salary has on increased tax payments.
- How indexes provides a tool for determining the worth of on currency in relation to another.
- Why it is not necessarily true that the cost of an item in one country is much cheaper than in another.

LEVEL 4

- The scale in which an object has been drawn and offer an OPINION as to a more appropriate scale.
- A proposed travel route in relation to distance, estimated travelling time ,etc. And SUGGEST and JUSTIFY alternative routes.
- A model and critique the layout of the structure shown of the model.
- With justification whether data is discrete or continuous.
- What percentile/ quartile values represent in relation to the scenario represented in the table/chart by INTERPRETING the tables / charts.
- Whether a probability statement makes sense.
- The use of references to probability in newspaper articles.
- Classification of risk profiles of different groups by analysing a table showing risk assessment profiles of people in different age groups.

MAKE RECOMMENDATIONS as to how:

- Expenditure should be changed to improve the finances of a household/ business by ANALYSING a budget.