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## Appendix B: Illustration of the cognitive domain for mathematics

**Content validation study: 2016 key stage 2 reading and mathematics tests**



## Introduction

- The following slides formed part of the training materials for our mathematics experts.
- For each strand, the first slide is a definition/description taken from the *test framework* document; the second slide provides an example of a question that seems worthy of a low rating and an example of a question that seems worthy of a high rating.
- These questions were selected to be as uncontroversial as possible, in terms of their 'high' or 'low' rating, as agreed with STA test development officials

# DEPTH OF UNDERSTANDING

## Depth of Understanding (as defined by STA)

- This strand is used to assess the demand associated with **recalling facts and using procedures to solve problems**.
  - Questions requiring less depth of understanding require simple procedural knowledge, such as the quick and accurate recall of mathematical facts or the application of a single procedure to solve a problem.
  - At intermediate levels of demand, a question may require the interpretation of a problem or application of facts and procedures. However, the component parts of these questions are simple and the links between the parts and processes are clear.
  - At a high level of demand, a greater depth of understanding is expected. Questions may require that facts and procedures will need to be used flexibly and creatively to find a solution to the problem.

# Depth of Understanding

## Lowest Level of (DoU) Demand

3

Calculate  $735 + 2669$

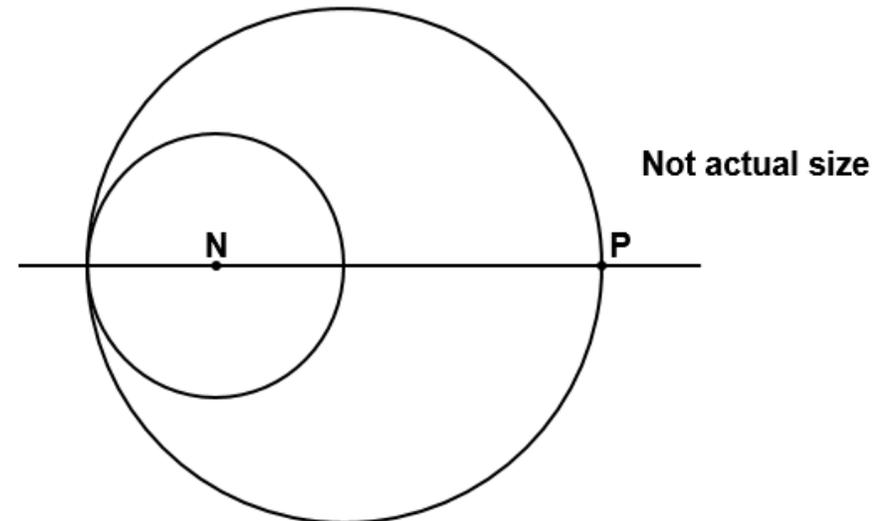


$\frac{3}{1 \text{ mark}}$

**LOWEST = SOME (not none)**

## High Level of (DoU) Demand

Two circles have their centres on a straight line.  
The diameters of the circles are 18cm and 6 cm.



Calculate the distance from the centre N to P, in cm.

# COMPUTATIONAL COMPLEXITY

## Computational Complexity (as defined by STA)

- This strand is used to assess the **computational** demand of problems.
  - In questions with low complexity, there will be no numeric operation.
  - In questions with lower complexity, it is likely that a one-step process such as recalling a mathematical fact or the application of a simple procedure will be sufficient to solve the problem.
  - At an intermediate level of complexity, more than one numeric step or computation will be needed to solve the problem.
  - At a high level of complexity, questions will have multiple numeric steps or computations and the links between them within the problem will be complex.

# Computational Complexity

## Lowest Level of (CC) Demand

12

Circle the approximate measurement.

The length of a banana is about ...



2 cm

20 cm

2 mm

2 m

20 m

The mass of an apple is about ...



2 g

20 kg

200 kg

200 g

2 kg

A glass of fruit juice is about ...



2 ml

2 l

20 ml

200 ml

20 l

121

\_\_\_\_\_

121

2 marks

## High Level of (CC) Demand

The area of a rugby pitch is 6,108 square metres.

A football pitch measures 112 metres long and 82 metres wide.

How much larger is the area of the football pitch than the area of the rugby pitch?

**LOWEST = NONE**

# SPATIAL REASONING AND DATA INTERPRETATION

## Spatial Reasoning and Data Interpretation (as defined by STA)

- This strand is used to assess the demand associated with the **representation of geometrical problems** involving 2–dimensional and 3–dimensional shapes and position and movement. This strand is also used to assess the demand associated with **interpreting data** presented in tables, pictograms, charts and graphs.
  - There is a low level of demand when all of the resources or information required to answer the question are presented within the problem (e.g. finding the perimeter of a shape by adding the length of the sides).
  - At intermediate levels of demand, spatial reasoning will be needed to manipulate the information presented in the question to solve the problem (e.g. reflect a polygon in a mirror line). Pupils may need to select the appropriate information in order to complete the problem (e.g. from a table, chart or graph).
  - At the highest level of demand there may be the need to use complex spatial reasoning to interpret, infer or generate new information from that given before the problem can be completed (such as identifying 3–dimensional characteristics from 2–dimensional representations or making inferences from the given information).

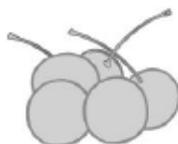
# Spatial Reasoning and Data Interpretation

## Lowest Level of (SR) Demand

12 Seb had some cherries.

Every day he ate 10 cherries and gave 5 away.

After he gave the last 5 cherries away, he had eaten 40 cherries altogether.



How many cherries did Seb have at the start?

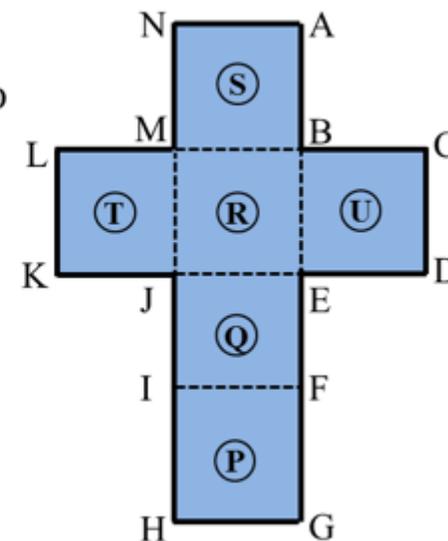
Show your working

121  
121  
2 marks

## High Level of (SR) Demand

A cube is made by folding the net on the right.

- ① Which points will match up with point A?
- ② Which faces will be perpendicular to face T?
- ③ Which face will be parallel to face R?



**LOWEST = NONE**

# Spatial Reasoning and Data Interpretation

## Lowest Level of (DI) Demand

12 Seb had some cherries.

Every day he ate 10 cherries and gave 5 away.

After he gave the last 5 cherries away, he had eaten 40 cherries altogether.



How many cherries did Seb have at the start?

Show your working

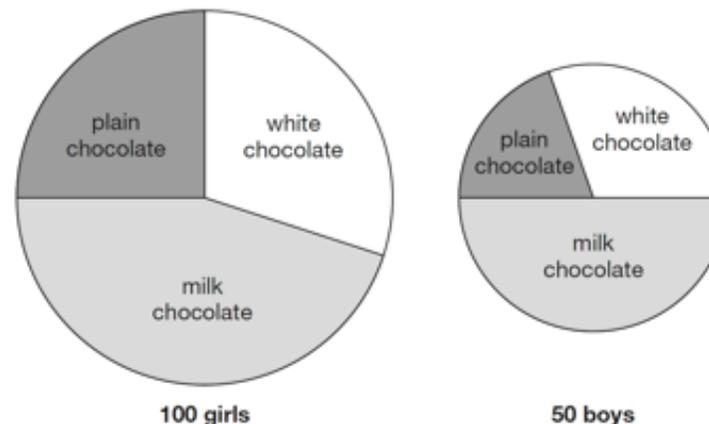
121  
121  
2 marks

**LOWEST = NONE**

## High Level of (DI) Demand

100 girls and 50 boys were asked which kind of chocolate they like best.

These two pie charts show the results.



Dev says,

*"The pie charts show that more girls than boys liked milk chocolate best."*

Dev is correct.

Explain how you know.

# RESPONSE STRATEGY

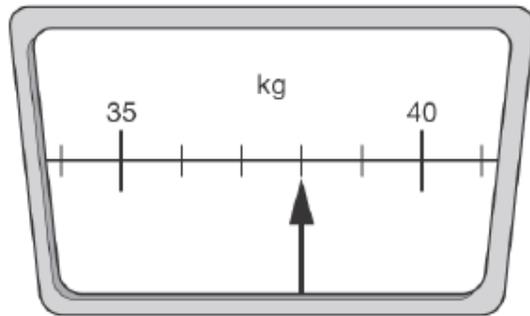
## Response Strategy (as defined by STA)

- This strand describes the demand associated with **constructing a response** to a question.
  - At a low level of demand, the strategy for solving a problem is given as part of the presentation of the problem.
  - At a lower intermediate level of demand, the strategy for answering a problem is clear and following simple steps will lead to completion of the problem. Some reasoned construction may be associated with organising appropriate working.
  - At an upper intermediate level of demand there may be the need to construct a straightforward response. Some reasoned construction may be associated with organising more complex working.
  - At a high level of demand, the question will require that a strategy is developed and monitored to complete the task. The answer may need to be constructed, organised and reasoned.

# Response Strategy

## Lowest Level of (RS) Demand

1 This scale shows how much Chen weighs.



How much does Chen weigh?

kg

1 mark

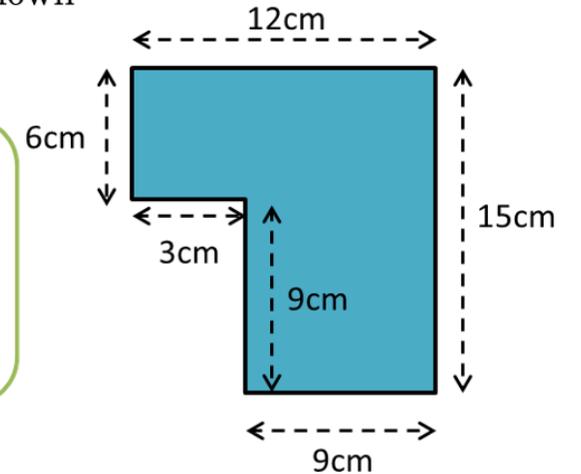
## High Level of (RS) Demand

We are going to think about how to calculate the area of the shape shown on the right.



$$6 \times 12 + 9 \times 9 = 72 + 81 \\ = 153$$

Answer = 153cm<sup>2</sup>



① Explain Ben's way of calculating the area.

**LOWEST = SOME (not none)**