

COGNITIVE LEVELS

**SENIOR PHASE
MATHS WEBINAR**



Host: Gretel Lampe

Presenter: Stephen Sproule

THURSDAY 14 MARCH 2024

SENIOR PHASE COGNITIVE LEVELS SKILLS

	COGNITIVE LEVELS	DESCRIPTION OF SKILLS TO BE DEMONSTRATED
LEVEL 1	KNOWLEDGE ~ 25%	<ul style="list-style-type: none"> • Straight recall • Identification and direct use of correct formula • Use of mathematical facts • Appropriate use of mathematical vocabulary
LEVEL 2	ROUTINE PROCEDURES ~ 45%	<ul style="list-style-type: none"> • Estimation and appropriate rounding of numbers • Perform well-known procedures • Simple applications and calculations which might involve many steps • Derivation from given information may be involved • Identification and use (after changing the subject) of correct formula • Generally similar to those encountered in class
LEVEL 3	COMPLEX PROCEDURES ~ 20%	<ul style="list-style-type: none"> • Problems involve complex calculations and/or higher-order reasoning • Investigate elementary axioms to generalize them into proofs for straight line geometry, congruence and similarity • No obvious route to the solution • Problems not necessarily based on real world contexts • Could involve making significant connections between different representations • Making significant connections between different representations • Require conceptual understanding
LEVEL 4	PROBLEM-SOLVING ~ 10%	<ul style="list-style-type: none"> • Unseen, non-routine problems (which are not necessarily difficult) • Higher-order reasoning and processes are involved • Might require the ability to break the problem down into its constituent parts

Assigning Cognitive Levels in Grades 7 - 9



Stephen Sproule, St John's College
Pi Day, 2024

Overview

- The four levels and how I see them
- Documenting the levels and examples
- Thoughts on classifying questions
- Let's try some classifying ...



Other frameworks

PISA, 2022

- Key understandings
- Formulate
 - Choose a method, choose a method
- Employ
 - Perform calculation or algorithm, generalize, manipulate
- Interpret and evaluate
 - Critique, real world consequence

TIMSS, 2023

- Knowing
 - Recall, order, compute
- Applying
 - Select operation, implement, represent
- Reasoning
 - Analyse, integrate, justify

The four cognitive levels

- Knowing (Kn)
- Performing routine procedures (RP)
- Performing complex procedures (CP)
- Solving problems (PS)

(TIMSS, 1999)

Why use *these* levels?

- Why do **you** want to use these levels?
- This is not about the matric exam (yet)
- Setting better and more balanced exams
- It's easier to use than Bloom's taxonomy
- Enables differentiation
- These are not "levels" 1 to 4

Mathematical demand and your learners

My rule of thumb:

Classifying the level of demand using:

- **your** teaching
- **your** learners
- the grade you are teaching
- interaction with colleagues

Knowing

Keywords:

- recall
- identify
- state
- estimate

- Recall or identify
- State definitions
- Estimation and rounding
- To think mathematically, learners must first remember and use :
 - mathematical facts,
 - appropriate mathematical vocabulary and symbols

... but is the question difficult?

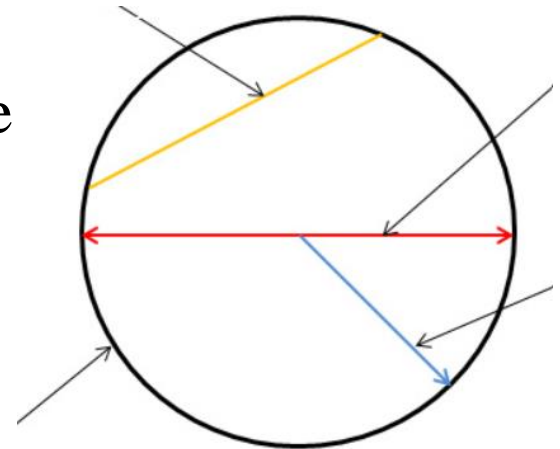
Knowing

Grade 7: Determine the 5th term of the sequence 7, 11, 15, ...

Grade 8: Plot the points on the given axes:
(3; -4), (-2; 0)

Grade 9: Simplify $\frac{2}{3^{-1}}$

Grade 7: Name the parts of a circle



How many steps does it take?

Routine procedures

Keywords:

- solve
- simplify
- calculate
- apply
- determine
- show that

- Perform well-known procedures (Questions practised in class and for homework.)
- Simple applications and calculations which involve a number of steps.
- Identify and use correct formula.
- Derivation from given information

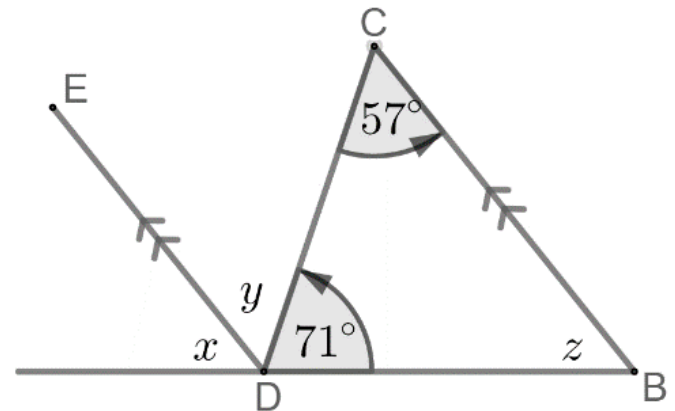
Performing routine procedures

Grade 8: Simplify $4xy - 7x^2y + 2xy + 4x^2y$

Grade 7: Calculate $\frac{5}{4} + \frac{1}{6}$

Grade 9: Draw a sketch graph of $y = 3x - 2$

Grade 8: Determine, giving reasons, the size of angles x , y and z



Complex procedures

- Complex calculations and/or higher order reasoning
- Often **no obvious route** to the solution
 - Try something before you can see a route
 - Break down the question to find a starting point
- Requires deeper conceptual understanding
- **Connect** different representations or topics

Complex procedures

Grade 9: Simplify $2(x + 1)^2 - 3(x - 3)(x + 2)$

Grade 7: Express the ratio $3\frac{2}{3} : 7\frac{1}{5}$ in its simplest form.

Grade 8: Simplify
$$\frac{(4a^2b)^3(3abc^3)^2}{6a^5b^2c \cdot 3bc^2}$$

Grade 9: A class of 28 students averaged 63% for a maths test. Karibo joined the class from another class. She had 78% for the test. Determine the new class average.

Problem solving

Keywords:

- conjecture
- analyse
- evaluate
- generalise
- justify

- **Non-routine** problems – likely to be unfamiliar to learners.
- Higher order reasoning and processes are often involved.
- Might require the ability to break a problem down into its constituent parts.
- (Transfer knowledge and thinking to a new situation.)

Problem solving

Grade 7: List the possible remainders when $n \times (n+1)$ is divided by 3

Grade 9: If $i^2 = -1$, determine the value of i^{2024}

Grade 8: $21999999999978 \times 4 =$

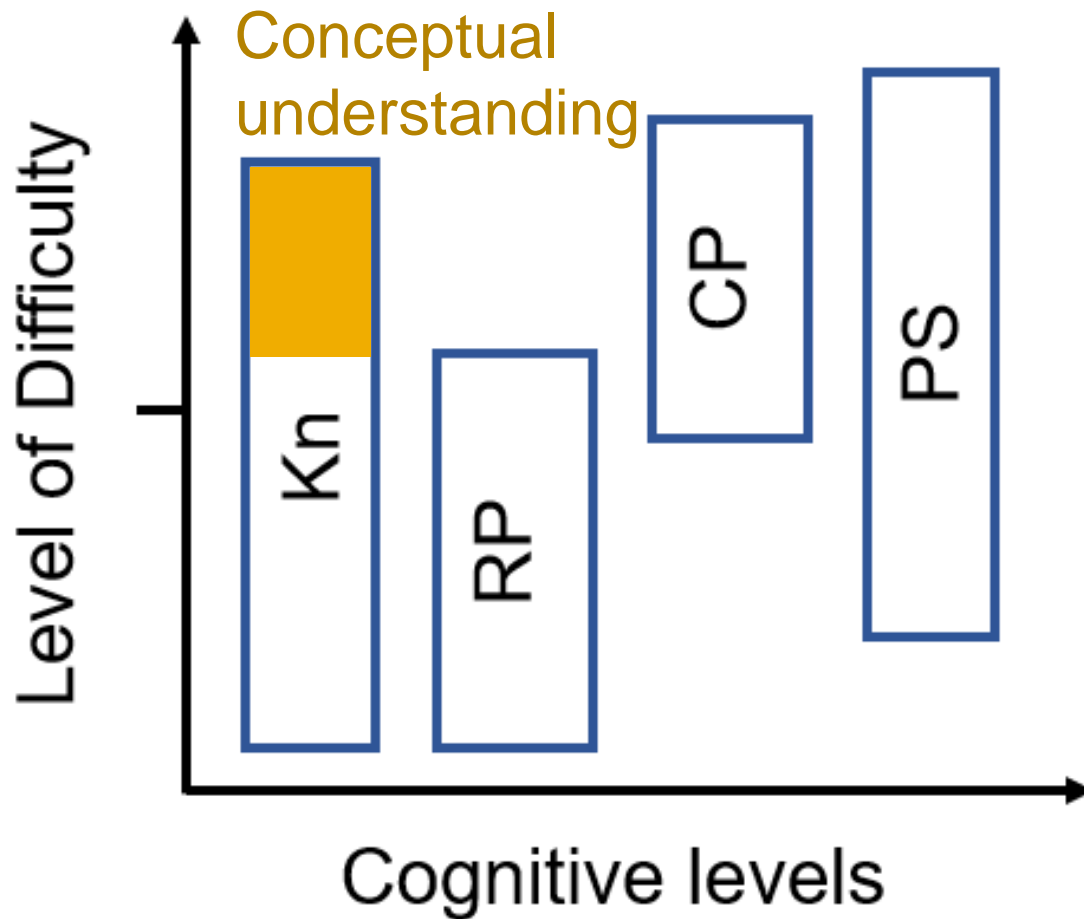
Grade 7: If 6 chickens lay 36 eggs in 3 days, how long will it take 3 chickens to lay 12 eggs?

Grade 9: Find an equation for the route walked by an ant, if the ant is always that same distance from the points $(2; 2)$ and $(-2; 0)$.

Thoughts on classifying questions

- Different levels in the same question?
- Prototypical examples to remember
 - CP: $x^2(x-4) + 3x(x-4) - 2(4-x)$
- Lowering the demand
- It's about your class and your school
- In a DBE exam, ... 25 - 45 - 20 - 10

Also ... levels of difficulty



Let's classify some questions together ...

- Knowledge (K):
- Routine procedure (RP)
- Complex procedure (CP)
- Solving problems (PS)

7 (c)

In a discus-throwing competition, the winning throw was 61,60 m. The second-place throw was 59,72 m. How much longer was the winning throw than the second-place throw?

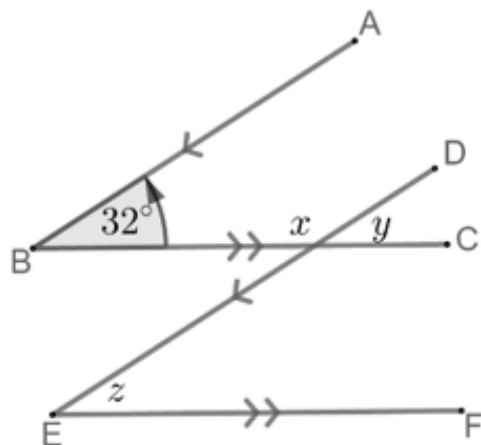
8 (b)

How many shaded triangles are there in the n -th stage?



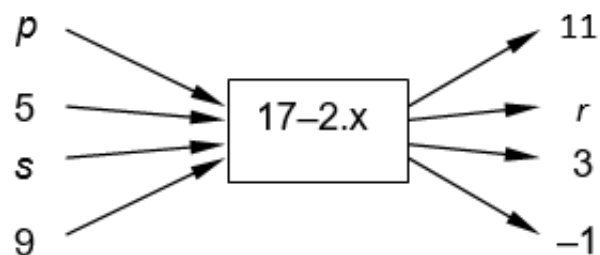
9 (c)

Find the magnitude of angles x , y , z , with reasons.



7 (b)

Determine the value of p , t and s



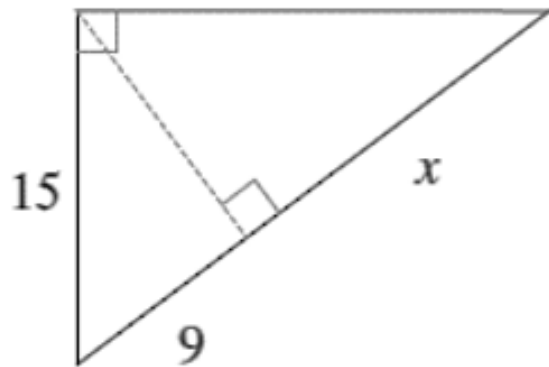
7 (a)

24 ; 9 ; 15

Determine the LCM

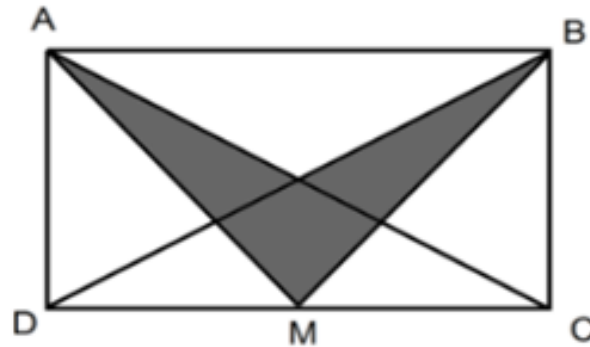
9 (d)

Calculate the value of x



8 (d)

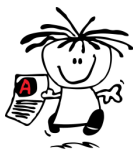
M is the midpoint of the side DC of rectangle ABCD. What fraction of the rectangle is shaded?



8 (c)

In each case, list all the quads that have the given property:

- Diagonals bisect each other.
- Diagonals are of equal length



8 (a)

Simplify:

$$7(x - 1) - 2(x + 1)$$

7 (d)

Determine the length of the pencil:



9 (b)

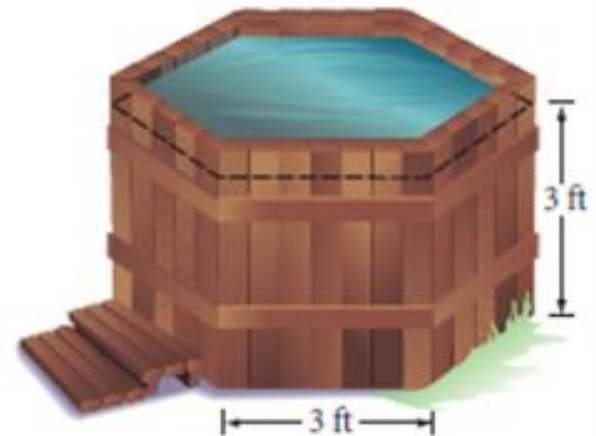
If mosquito travels at 1,9 km/h, how far (in metres) will it travel in 1 second?

9 (a)

Madeleine's hot tub has the shape of a regular hexagonal prism. The chart on the hot-tub heater tells how long it takes to warm different amounts of water by 10°F . Help Madeleine determine how long it will take to raise the water temperature from 93°F to 103°F . **13 min**

Minutes to Raise Temperature 10°F

Gallons	350	400	450	500	550	600	650	700
Minutes	9	10	11	12	14	15	16	18

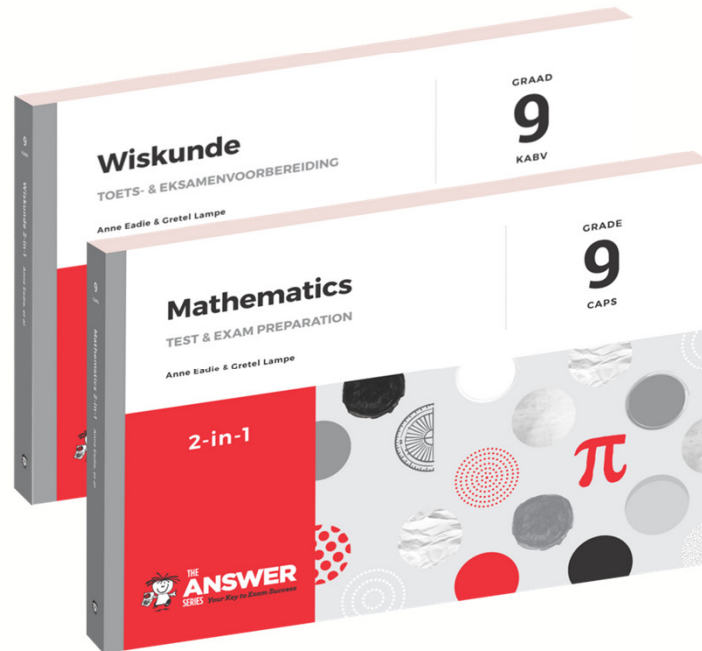
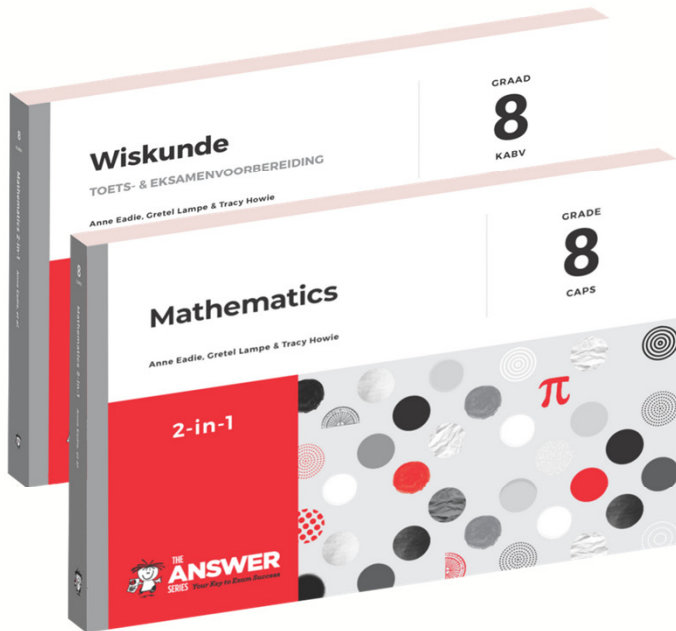


THANK YOU

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TAS SENIOR PHASE MATHS STUDY GUIDES

WWW.THEANSWER.CO.ZA



STILL IN PUBLICATION

TAS SENIOR PHASE MATHS COMMUNITY

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Tools for Senior Phase Teachers
(relevant teaching docs)

2023 Weekly Teaching Plans

- Grade 7 ATP
- Grade 8 ATP
- Grade 9 ATP

ASSESSMENT PAGES FROM CAPS MATHS: GRADES 7 – 9

AFTER PROPOSAL 2023 SUBJECT WEIGHTINGS FOR MATHS: GRADES 7 – 9

SP ACCEPTABLE REASONS FOR EUCLIDEAN GEOMETRY (ENG. & AFR.)

Problem solving

- Grade 7 Problem Solving AMESA 2023
- Grade 7 – 9 Problem Solving AMESA 2022
- SAMO – South African Maths Olympiads: Mathematics Challenge Question Papers

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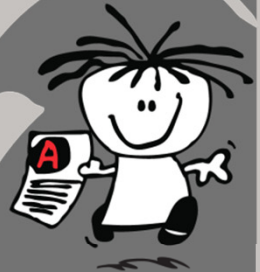
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THANK YOU!

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