# Developing Mathematical Discussion

Nathan Burns
*Teacher Educator*

Mr Metacognition

# Contracting Session

- Will be utilising break-out rooms; so be ready to *discuss* with others!
- Putting ideas and feedback into the chat function
- Opportunity for a Q&A at the end of the session.

Mr Metacognition

# Session Aims

- Evaluate the importance of discussion
- Consider metacognitive components of discussion
- Explore multiple discussion strategies

Mr Metacognition

# Who Am I?

- Nathan Burns
- Former Head of Maths/Pastoral Lead/MAT Lead
- Metacognitive researcher and author
- Full time training provider and consultant




Mr Metacognition

# Discuss....

*Why is discussion so important in the Mathematics classroom?*

Mr Metacognition

# The Importance of Discussion

- Support the development of oracy in the classroom
- Increase student participation ratio
- Mathematics is a language – need an opportunity to discuss!
- Improve vocabulary and reasoning skills
- Support development of curriculum coherency and developing mental model
- Learn from experiences of others e.g. alternative approaches
- Tackle problems together

Mr Metacognition

# Silence = Good?

- Poor proxy for learning: silence = effective learning
- Silent strugglers?
- Limited feedback?
- Appearing to be busy?
- Cannot improve oracy in a silent environment
- Metacognitive development is reliant upon verbal communication

Mr Metacognition

# Discussion

- Discussion can be difficult – groups, behaviour, timings, evidencing learning…
- Metacognitive discussion requires two scaffolds:
  - Task understanding (e.g. time allotment; writing down or not?)
  - Cognitive understanding (*what* to discuss, with visible statements)

Mr Metacognition

# Goal Free Problems

What?

- Provide students with a longer problem question, but remove the question/task element
- Allow students to recall as much information as they can.

Why?

- 'Rich' Task
- Superb retrieval task
- Removes the barrier of a 'question'
- Improves student confidence; show them what they can do

Mr Metacognition

# Example

The diagram shows the floor plan of Mary's conservatory.

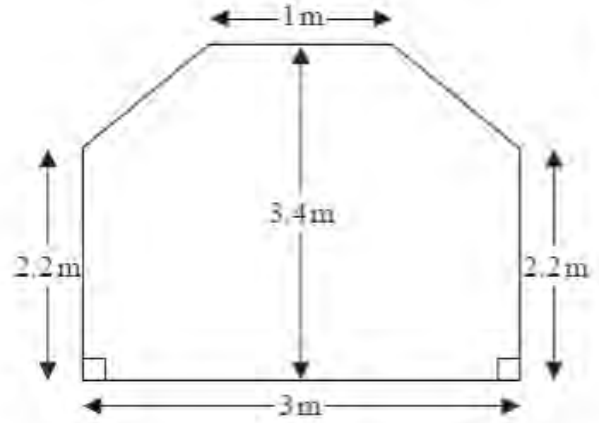



Diagram **NOT** accurately drawn

Mary is going to cover the floor with tiles.

The tiles are sold in packs.
One pack of tiles will cover $2m^2$
A pack of tiles normally costs £24.80
Mary gets a discount of 25% off the cost of the tiles.

Mary has £100

Work out what you can from this information.

Peter Mattock; Goal Free Problems

Mr Metacognition

# Example



potatoes
£1.50 per kg



carrots
£1.80 per kg

Jack buys $1\frac{1}{2}$ kg of potatoes and $\frac{1}{2}$ kg of carrots.

What can you calculate?

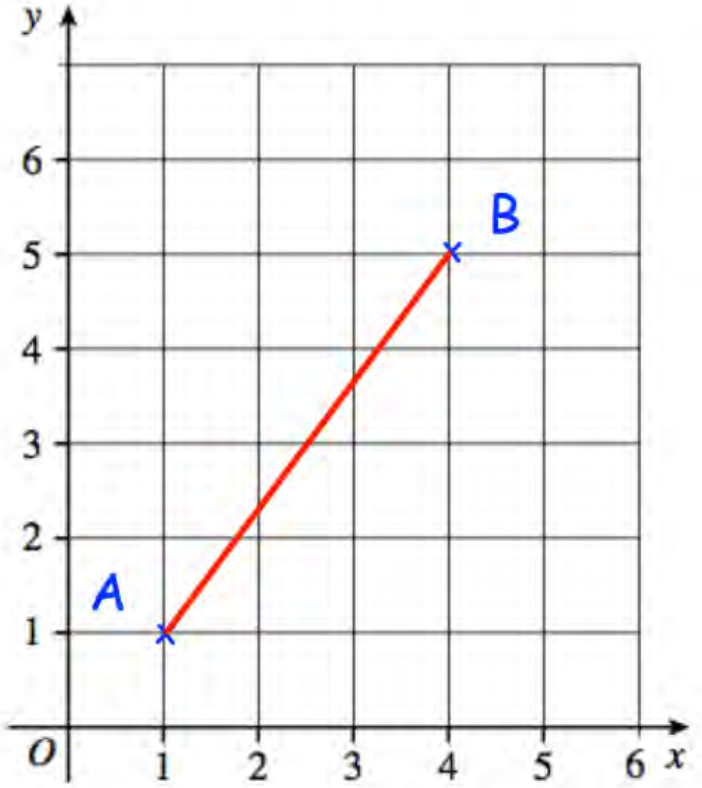
How many marks can you achieve?

List all potential questions

What units does the question link to?

Mr Metacognition

# Example




Corbett Maths

What might we/students be able to calculate here?

Mr Metacognition

# Talking Heads (Concept Cartoons)

What?

- Provide students with a question and several different responses
- These can be alternative answers, or often, answers with varied depth
- Students need to identify correct answer/most detailed answer

Why?

- Force consideration of depth of answers
- Develop understanding of effective answers
- Discuss subtlety in response
- Tease out misconceptions

Mr Metacognition

# Example

## Define a rectangle

A square is a rectangle

A rectangle has two pairs of opposite parallel sides

A rectangle has two pairs of equal sides

A rectangle has four sides

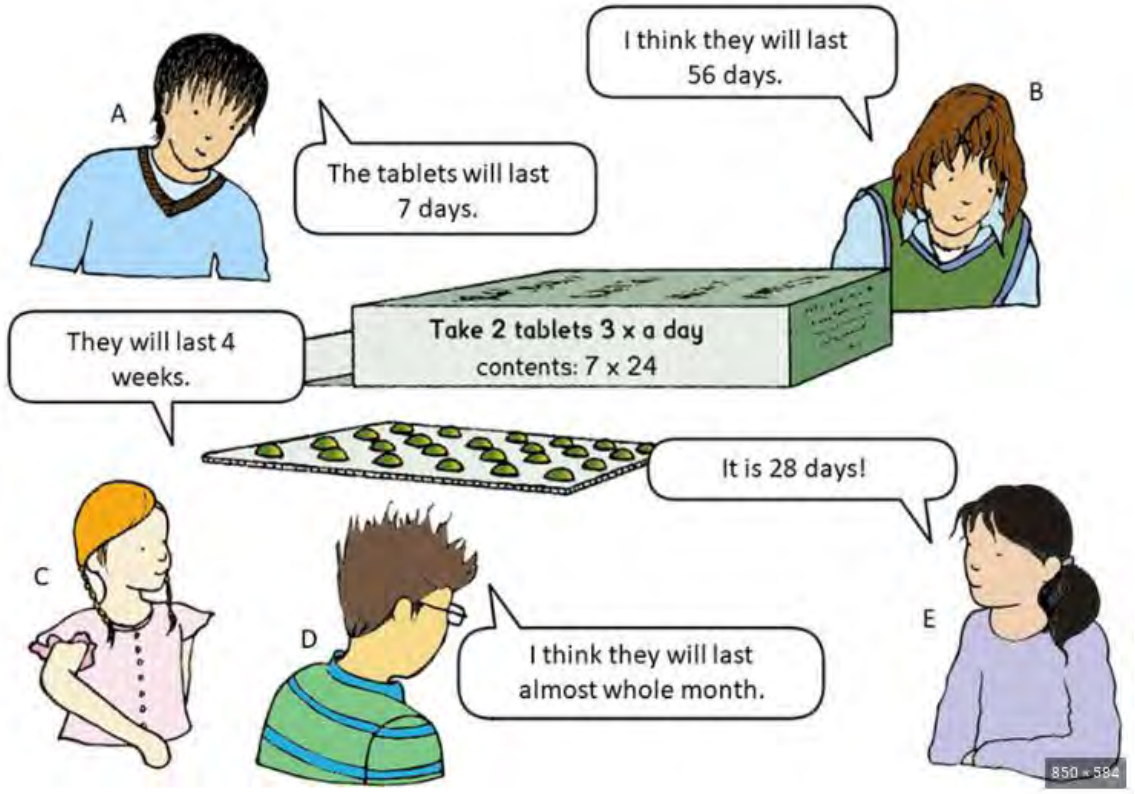
A rectangle is a quadrilateral with four right-angles

A rectangle has four sides, with two pairs of congruent parallel sides

A rectangle has parallel sides



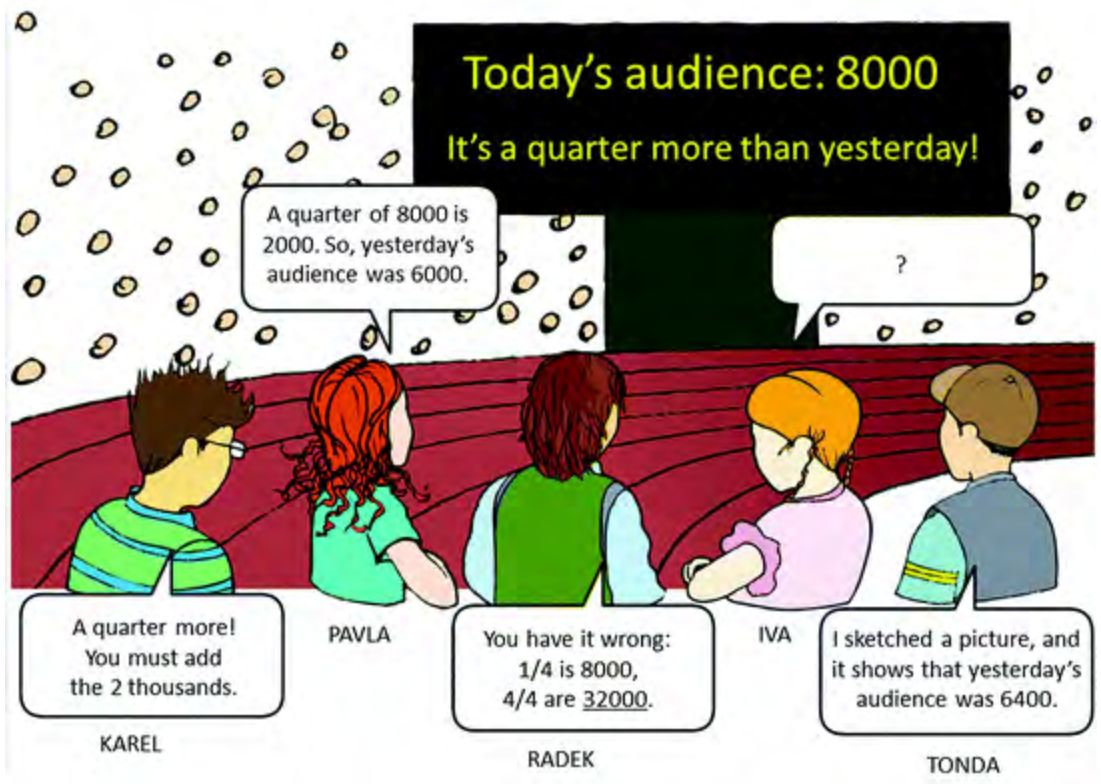
# Example




Via Research Gate

Mr Metacognition

# Example




Via Springer Link

Mr Metacognition

# Misconception Discussion

What?

- Provide students with a misconception answer, or a range of answers containing at least one misconception
- Students need to identify the error, correct it, understand why it has come about

Why?

- Supports monitoring and evaluation abilities (i.e. identifying 'red flags')
- Significant subject knowledge benefits
- Develops students criticality

Mr Metacognition

# Example

'Mr Woolaston's Mistakes'…

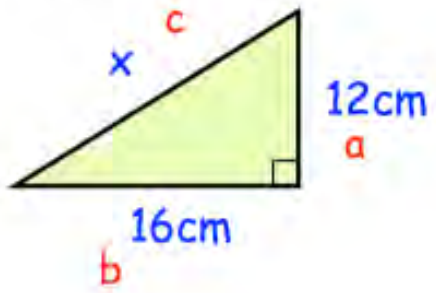
*Four prompts:*

1. What is the error?
2. What should I have done?
3. Why do you think I made the mistake?
4. Mistake or misconception?

Mr Metacognition

# Example

Benjamin has completed this question.
Can you spot any mistakes?




$a^2 + b^2 = c^2$

$12^2 + 16^2 = x^2$

$144 + 256 = x^2$

$400 = x^2$

$x^2 = 400$

$x = 200\text{cm}$

Corbett Maths

Mr Metacognition

# Example

**Question 7:** Duncan has answered the questions below.
Can you spot any mistakes?

Write down the value of

(a) $3^2$

$3 \times 2 = 6$

6 ..... (1)

(b) seven squared

$7 \times 2 = 14$

14 ..... (1)

(c) $8^2$

$8 \times 2 = 16$

16 ..... (1)

Corbett Maths

Mr Metacognition

# Frayer Model

What?

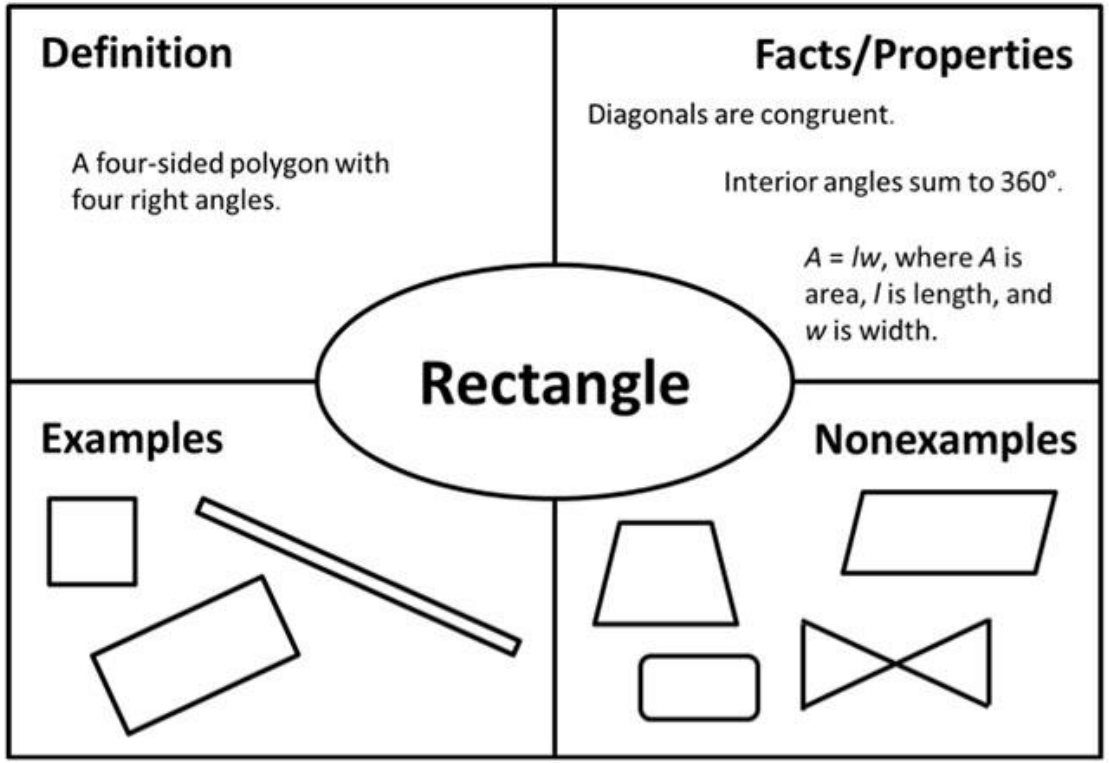
- A 2x2 grid, headed with 'definition'; 'characteristics'; 'examples'; 'non-examples'
- Can swap out headings to better suit the topic area

Why?

- Formative assessment opportunity
- Retrieval task
- Deeper and strengthen Mathematical understanding (e.g. non-concepts)

Mr Metacognition

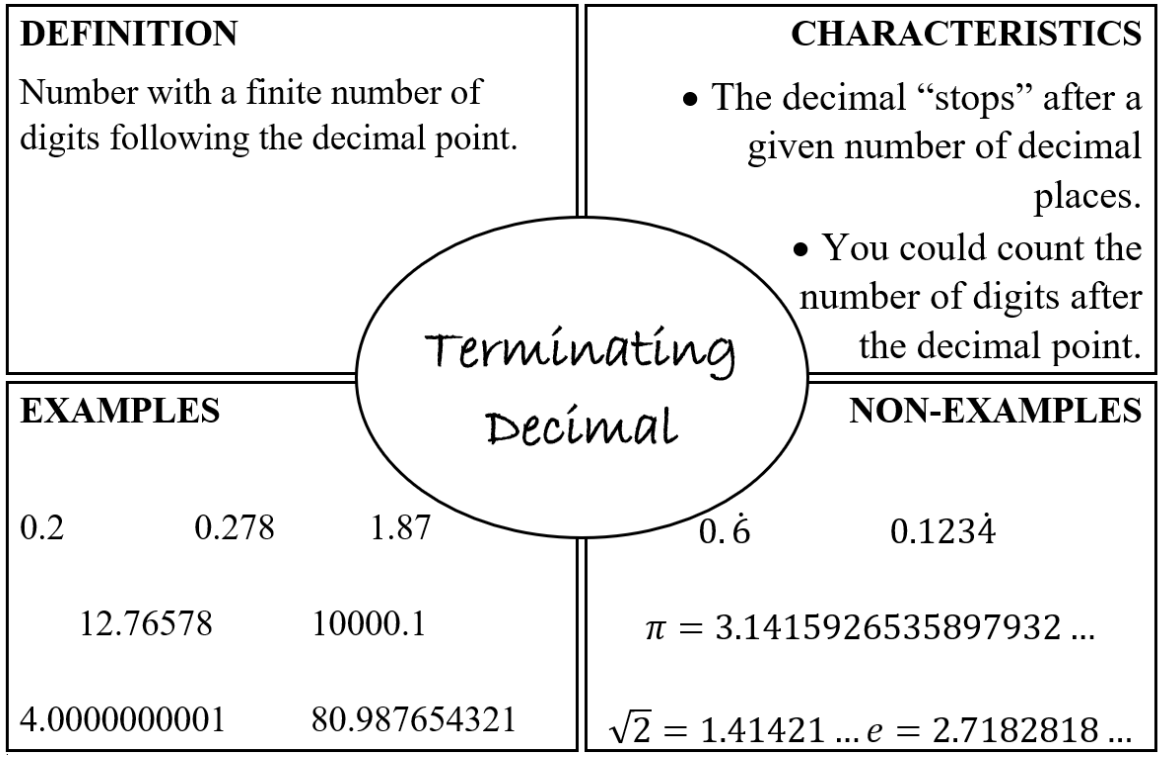
# Example




OPEPP

Mr Metacognition

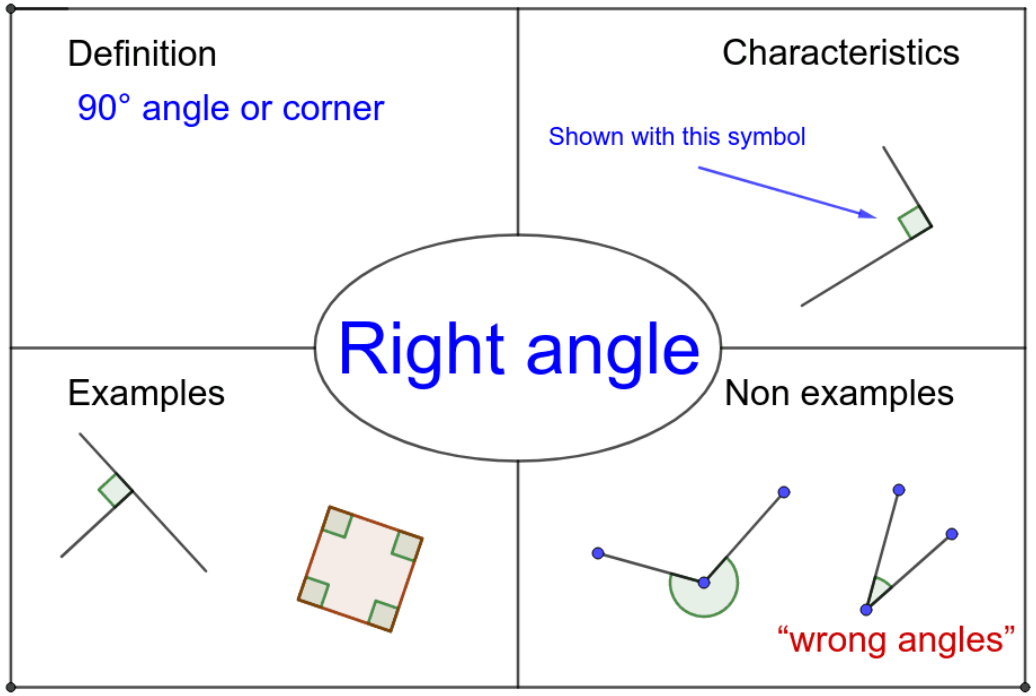
# Example




Resourceaholic

Mr Metacognition

# Example




Geogebra

Mr Metacognition

# Odd One Out

What?

- Provide students with at least three options, where there is at least one 'odd one out'.
- High-quality Odd One Out questions contain multiple answers to deepen discussion and contestation

Why?

- Develops reasoning skills
- Strengthens and broadens Mathematical knowledge
- Contestation supports deeper and more varied discussion and debate

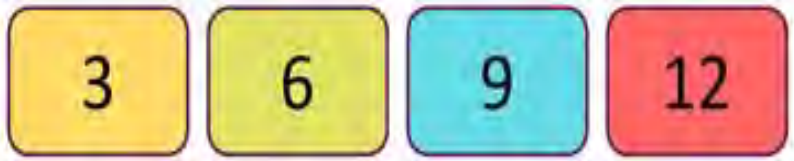
Mr Metacognition

# Example

EXCCEd

Odd One Out 1

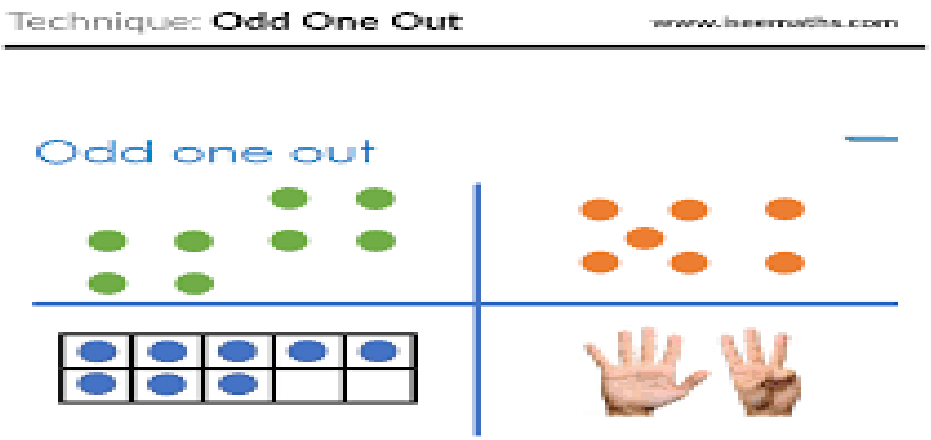
Which one of these is the 'odd one out'? Why?




**Note:**
Any of them could be the odd one out. You must be able to justify your choices.

Mr Metacognition

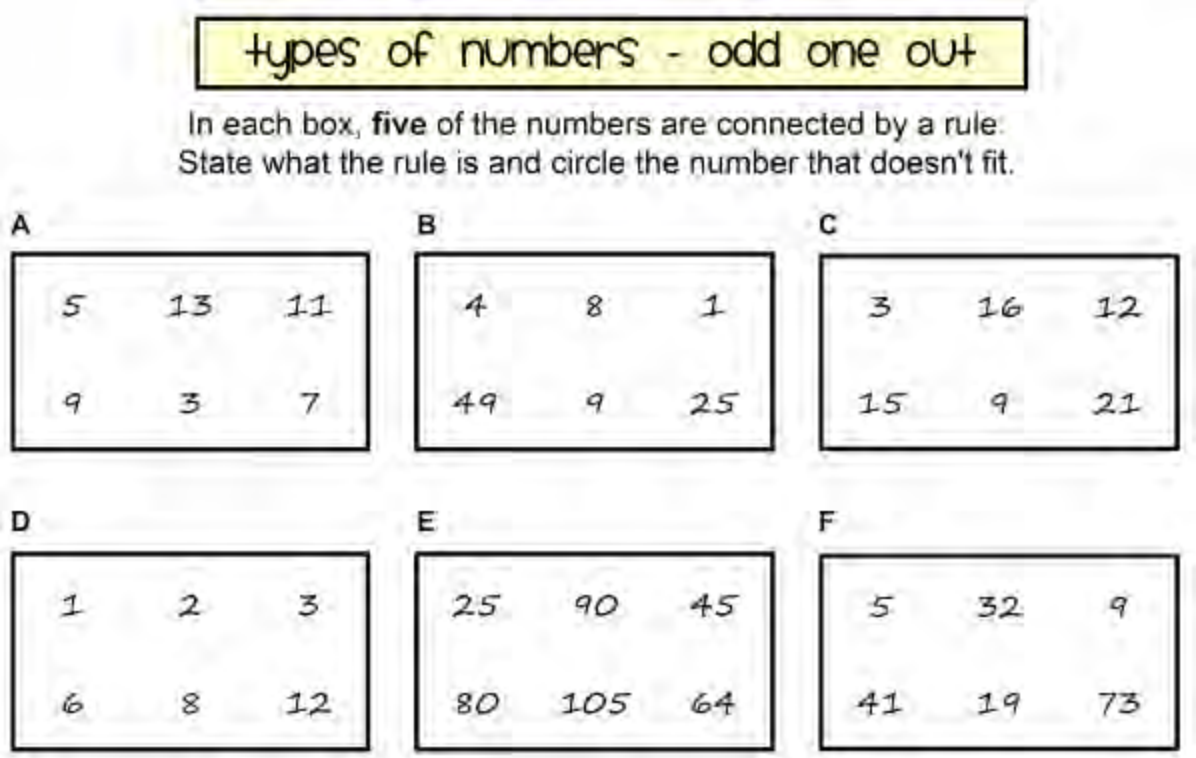
# Example




Gareth Metcalfe

Mr Metacognition

# Example




MathsPad

Mr Metacognition

# Stay In Touch!

Twitter: @MrMetacognition

BlueSky: @mrmetacognition.bsky.social

Email: mrmetacognition@gmail.com

LinkedIn: Nathan Burns

Mr Metacognition