International Association for the Evaluation of Educational Achievement

Teacher Education Study in Mathematics (TEDS-M) 2008

Released Items

Future Teacher Mathematics Content Knowledge (MCK) and Mathematics Pedagogical Content Knowledge (MPCK) - Primary

Prepared by:

- **Australian Council for Educational Research for the TEDS-M International Study Center (Michigan State University, East Lansing, USA)**

TEDS-M Primary Level Released Items

The goal for selecting the released set of test items was to have approximately 25% of each of the full item sets for Mathematics Content Knowledge (MCK) and Mathematics Pedagogical Content Knowledge (MPCK) that would represent the full range of difficulty, content, and item format.

The initial step in the selection was to take a stratified random sample of the items, stratifying on both proportion correct and sub-domains of MCK and MPCK. The next step was to consider if the selected items were part of item sets. If they were, an attempt was made to use the full set so that the full context of the items would be made public. Representation of the Anchor Points was another important consideration as was balance of item formats (MC, CR, CMC). Ownership of the items was also considered. The test items were then reviewed to determine if they efficiently and accurately represented the full item set.

The set of released items consists of:

- 24 MCK items (9 from the Algebra sub-domain, 6 from Geometry, 7 from Number and 2 from Data) including samples of the Cognitive sub-domains of Knowing (15), Applying (8) and Reasoning (1); and

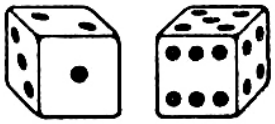
- 10 MPCK items (2 from the Algebra domain, 2 from Geometry, 3 from Number, and 2 from Data) illustrating the two sub-domains of Curriculum/Planning (6) and Enacting (4).

The following table gives the TEDS-M ID Number of the released Items and other relevant information.

Main Study ID	Knowledge Dimension	Content Domain	Sub-domain	Label	Item format	Key	Max Points
MFC106	MCK	Data	Applying	Fairness of two-dice game	MC	2	1
MFC108	MPCK	Algebra	Enacting	Equation best representing [Amy's] pattern	MC	3	1
MFC202A	MCK	Algebra	Knowing	Truth of algebraic statements	CMC	2	1
MFC202B	MCK	Algebra	Knowing	Truth of algebraic statements	CMC	2	1
MFC202C	MCK	Algebra	Knowing	Truth of algebraic statements	CMC	1	1
MFC202D	MCK	Algebra	Knowing	Truth of algebraic statements	CMC	2	1
MFC203	MCK	Geometry	Applying	Area of walkway around rectangular pool	MC	3	1
MFC204	MCK	Geometry	Knowing	Interpreting student Venn diagrams about quadrilaterals	MC	3	1
MFC206A	MCK	Number	Applying	Solving a rate problem about fuel use	MC	2	1
MFC206B	MPCK	Number	Planning	Create a different problem about fuel used	CR	SG	1
MFC208A	MPCK	Number	Enacting	[Jeremy's] misconception in using a calculator	CR	SG	2
MFC208B	MPCK	Number	Enacting	Visual representation to model 0.2 x 6	CR	SG	2
MFC303	MCK	Algebra	Applying	Unknown mass on a balance	MC	3	1
MFC304	MCK	Number	Knowing	How many decimal numbers between two numbers?	MC	4	1
MFC307A	MCK	Geometry	Knowing	Solving a volume problem about blocks	MC	1	1
MFC307B	MPCK	Geometry	Curric/Plan	Reword a question about volume and blocks	CR	SG	2
MFC308	MCK	Algebra	Applying	Rule for the number of people around n tables	CR	SG	2
MFC312	MPCK	Algebra	Curric/Plan	Equation not representable by a pan balance	MC	2	1
MFC408	MCK	Geometry	Applying	Area of scalene triangle on grid	MC	1	1
MFC410	MPCK	Data	Enacting	Similarities and differences in data presentation	CR	SG	2
MFC412A	MCK	Algebra	Knowing	Three consecutive even numbers - meaning of k	MC	1	1
MFC412B	MCK	Algebra	Knowing	Three consecutive odd numbers - correct expression	MC	2	1
MFC501	MCK	Geometry	Knowing	Net of triangular prism	MC	4	1
MFC502A	MCK	Data	Reasoning	Unlabeled bar graph - interpreting information	MC	3	1
MFC502B	MPCK	Data	Curric/Plan	Difficulty with a data representation problem	CR	SG	2
MFC505	MPCK	Number	Curric/Plan	The two most difficult number-story problems	CR	SG	2
MFC503A	MCK	Number	Knowing	Numbers - rational or irrational	CMC	2	1
MFC503B	MCK	Number	Knowing	Numbers - rational or irrational	CMC	1	1
MFC503C	MCK	Number	Knowing	Numbers - rational or irrational	CMC	1	1
MFC503D	MCK	Number	Knowing	Numbers - rational or irrational	CMC	1	1
MFC508	MCK	Algebra	Applying	Matchstick pattern - predict Figure 10	MC	2	1
MFC509	MCK	Algebra	Knowing	The larger of 2n and n + 2	CR	SG	2
MFC511	MCK	Geometry	Applying	Length of ribbon of two gift boxes	CR	2	2
MFC513	MPCK	Geometry	Curric/Plan	Two reasons for measuring with paper clips	CR	SG	2

ID: MFC106	MS Booklet: PM1, PM5	MS Block: B1PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Data		Sub-domain: Applying	

MFC106 Two fair six-sided number cubes are thrown in a probability game and the two numbers at the top are recorded.



[Josie] wins if the difference between the two numbers is 0, 1 or 2.
[Farid] wins if the difference between the two numbers is 3, 4 or 5.

The students discuss whether the game is fair.

Which of the following statements is correct?

Check <u>one</u> box.

A. Both have an equal chance of winning. ☐ 1

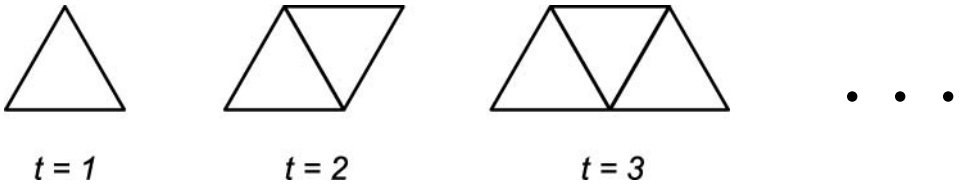
B. [Josie] has the greater chance of winning. ☐ 2

C. [Farid] has the greater chance of winning. ☐ 3

D. As the game involves number cubes, it's not possible to say who has the greater chance of winning. ☐ 4

ID: MFC108	MS Booklet: PM1, PM5	MS Block: B1PM	Item Format: MC	Max Points: 1
Outcome: MPCK	Domain: Algebra		Sub-domain: Enacting	

MFC108 [Amy] is building a sequence of geometric figures with toothpicks by following the pattern shown below. Each new figure has one extra triangle.
Variable *t* denotes the position of a figure in the sequence.



In finding a mathematical description of the pattern, [Amy] explains her thinking by saying:

I use three sticks for each triangle.

Then I see that I am counting one stick twice for each triangle, except the last one, so I have to remove those.

Variable *n* represents the total number of toothpicks used in a figure.

Which of the equations below best represent [Amy's] statement in algebraic notation?

Check <u>one</u> box.

A. $n = 2t + 1$ ☐1

B. $n = 2(t + 1) - 1$ ☐2

C. $n = 3t - (t - 1)$ ☐3

D. $n = 3t + 1 - t$ ☐4

Code	Response	Item: MFC201B	
	Correct Response		
20	Correct rewording of the question in (a) with **numbers** (3, 1, 12 and 8) *Examples:* *• 3 of the sectors are blue, 1 is purple, 12 are orange and 8 are red.*		
21	Correct rewording of the question in (a) with **percentages** (12.5%, 4.2%, 50%, 33.3%). Percentages must be in decimal form and **not** contain fractions. *Example:* *• 12.5% of the sectors are blue, 4.2% is purple, 50% are orange and 33.3% are red.* *• 12% are blue, 4% are purple, 50% are orange, 33% are red.* Note: Accept roundings (12%, 13%, 4%, 33%, 33.5%) and sums of 99% - 101%		
	Partially Correct Response		
10	A Code 20 or 21 response but with **one calculation error.** *Examples:* *• **One** number in error. (Parts do not sum to 24.)* *Example: 3 are blue, 1 is purple, 12 are orange, 6 are red* (*Red in error. Sum = 22*). *• **One** percentage is in significant error (That is, sum is not in the range 99% - 101%)* *Example: 12.5% are blue, 2.4% are purple, 50% are orange, 33% are red.* (*Purple in error. Sum is 97.9%.)*		
11	Correct rewording of the question in (a) with **fractions that have a common denominator of 24** $\left(\frac{3}{24},\frac{1}{24},\frac{12}{24},\frac{8}{24}\right)$ *Example:* $\frac{3}{24}$ *of the sectors are blue,* $\frac{1}{24}$ *is purple,* $\frac{12}{24}$ *are orange and* $\frac{8}{24}$ *are red.*		
12	Makes up a correct question but **different** to (a) and **without** fractions. Total number of sectors must be given. *Example:* *• 20 sectors, 5 are blue, 2 are purple, 9 are orange and 4 are red.* *• 30 sectors, 10% are blue, 20% are purple, 30% are orange, 40% are red.*		
	Incorrect Response		
70	A Code 20 or 21 response but with **more than one calculation error.** *Examples:* *• 4 are blue, 1 is purple, 12 are orange and 6 are red. (Blue and red in error.)* *• 8% are blue, 2.4 % are purple, 50% are orange and 33% are red. (Blue and purple in error.)*		
71	The **fractions** in the question are written **in words, even if correct**. *Example:* *• "One part of eight sectors are blue, one twenty-fourth are purple, …")* *• 1 of each 8 sectors are blue, 1 of each 24 sectors are purple, …..*		
72	A response that describes in general terms that the problem could be reworded **without actually showing how.** *Example:* *• "You could reword the problem in numbers/percentages."*		
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task) *Example: Questions that are not meaningful/have no answer*		
	Non-response	99	Blank

ID: MFC202ABCD	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: CMC	Max Points: 4
Outcome: MCK	Domain: Algebra		Sub-domain: Knowing	

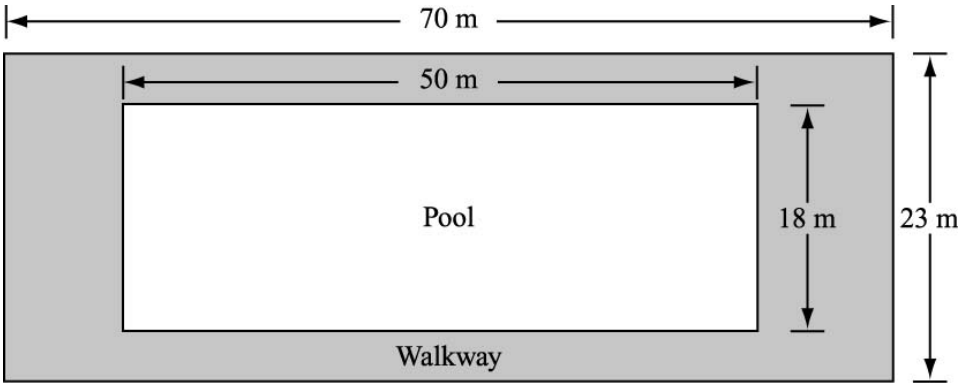
Indicate whether each of the following statements is true for the set of all whole numbers a, b and c greater than zero.

Check <u>one</u> box in <u>each</u> row.

			True	Not True
MFC202A	A.	$a - b = b - a$	☐ 1	☐ 2
MFC202B	B.	$a \div b = b \div a$	☐ 1	☐ 2
MFC202C	C.	$(a + b) + c = a + (b + c)$	☐ 1	☐ 2
MFC202D	D.	$(a - b) - c = a - (b - c)$	☐ 1	☐ 2

ID: MFC203	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Geometry		Sub-domain: Applying	

A rectangular-shaped swimming pool has a paved walkway (shaded) around it as shown.



not to scale

What is the area of the walkway?

Check <u>one</u> box.

A. 100 m^2 ☐1

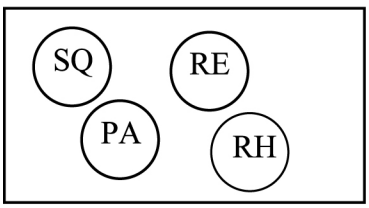
B. 161 m^2 ☐2

C. 710 m^2 ☐3

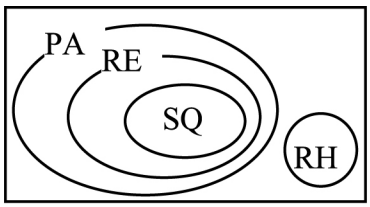
D. 1610 m^2 ☐4

ID: MFC204	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Geometry		Sub-domain: Knowing	

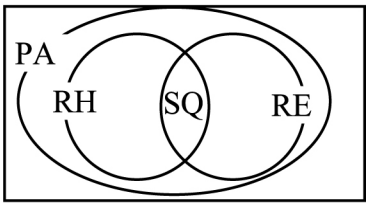
MFC204 Three students have drawn the following Venn diagrams showing the relationships between four quadrilaterals:
Rectangles (RE), Parallelograms (PA), Rhombuses (RH), and Squares (SQ).



[Tian]



[Rini]



[Mia]

Which student's diagram is correct?

Check <u>one</u> box.

A. [Tian] ☐1

B. [Rini] ☐2

C. [Mia] ☐3

ID: MFC206A	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Number		Sub-domain: Applying	

MFC206A (a) A machine uses 2.4 litres of fuel for every 30 hours of operation.
How many litres of fuel will the machine use in 100 hours if it continues to use fuel at the same rate?

Check <u>one</u> box.

A. 7.2 ☐ 1

B. 8.0 ☐ 2

C. 8.4 ☐ 3

D. 9.6 ☐ 4

ID: MFC206B	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: MC	Max Points: 1
Outcome: MPCK	Domain: Number		Sub-domain: Planning	

MFC206B

(b) Create a different problem of the same type as the problem in (a) (same processes/operations) that is **EASIER** for <primary> children to solve.

Code	Response	Item: MFC206B
	Correct Response	
10	A different problem of the **same type** (same processes/operations) but is **easier** to solve. *Example:* • *A machine uses 3 litres of fuel for every 30 hours of operation. How many litres of fuel will the machine use in 100 hours?* • *A car uses 2.4 litres of fuel for every 50 km. How many litres of fuel will the car use in 100 km?*	
	Incorrect Response	
70	A different problem of the **same type** (same processes/operations) but is **NOT easier** to solve. (Note: Items judged to be of the **same** level of difficulty are NOT easier.) *Examples:* • *A machine uses 2 litres of fuel for every 30 hours of operation. How many litres of fuel will the machine use in 100 hours? (2 is not divisible by 3)* • *A tap drips 2 litres of water every day. How many ml is this per second? (the metric knowledge required and computational load is significantly higher)*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task) *Example:* • *Questions that are not meaningful/have no answer*	
	Non-response	
99	Blank	

ID: MFC208A	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Number		Sub-domain: Enacting	

[Jeremy] notices that when he enters 0.2×6 into a calculator his answer is smaller than 6, and when he enters $6 \div 0.2$ he gets a number greater than 6. He is puzzled by this, and asks his teacher for a new calculator!

(a) What is [Jeremy's] most likely misconception?

MFC208A

Code	Response	Item: MFC208A
	Correct Response	
20	Responses that suggest the misconception is that multiplication always gives a larger answer **and** that division always gives a smaller answer. *Example:* • *He thinks that when you multiply the answer should be larger and when you divide the answer should be smaller.*	
	Partially correct Response	
10	Responses that suggest the misconception is that multiplication always gives a larger answer **or** that division always gives a smaller answer **but not both**. *Examples:* • *He thinks that when you multiply the answer should be larger than either/both numbers.* • *He thinks that division should give an answer that is smaller than the numbers you started with.*	
11	Responses that suggest that Jeremy considers 0.2 as a whole number. *Example:* • *He thinks he is multiplying and dividing by 2 rather than by 0.2.*	
	Incorrect Response	
70	Responses relating to understanding of decimal numbers, decimal multiplication/division or use of a calculator. *Example:* • *He doesn't understand decimal multiplication (or division).* • *He doesn't know how to use his calculator.* • *Mathematical operations.* • *The decimal point.*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Non-response	
99	Blank	

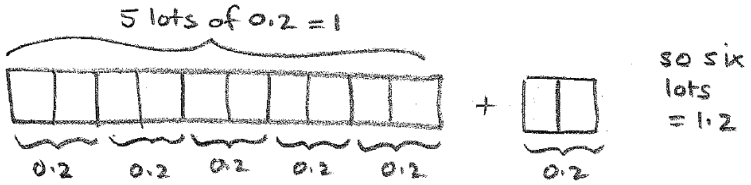
ID: MFC208B	MS Booklet: PM1, PM2	MS Block: B2PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Number		Sub-domain: Enacting	

MFC208B (b) Draw a visual representation that the teacher could use to model 0.2 × 6 to help [Jeremy] understand **WHY** the answer is what it is?

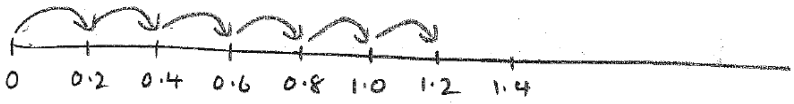
Code	Response	Item: MFC208B
	Correct Response	
20	A suitable visual representation that clearly shows why 0.2 × 6 is 1.2. *Example:* • *6 lots of 0.2 making it clear that 5 lots of 0.2 = 1, probably with some annotation. See Pictures 1, 2, 3 and 4 below.*	
	Partially Correct Response	
10	A visual representation that shows 6 lots of 0.2 but does NOT make it clear how this equals 1.2. Accept 0.2 shown as one-fifth or as two-tenths. *Example: See Picture 5 below.*	
11	A visual representation that shows how 5 lots of 0.2 make a whole but does NOT make it clear how 6 lots of 0.2 equals 1.2 *Example: See Picture 6 below.*	
12	A visual representation of an equation 0.2 × 6 = 1.2 without showing why it is true. *Example: See Picture 7 below.* • 0.2 + 0.2 + 0.2 + 0.2 + 0.2 + 0.2 = 1.2	
	Incorrect Response	
70	A visual representation showing 6 lots of 0.2 without showing what 0.2 is or how 5 lots of 0.2 equals 1. *Example: See Picture 8 below.*	
71	An example in words suggesting counting in lots of 0.2. *Example:* • *"Count 6 lot's of 0.2 as follows: 0.2, 0.4, 0.6, 0.8, 1.0, 1.2"* Note: This is a good teaching strategy but is not a visual representation.	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task) *Example: An equation or written calculation of the form* 0.2 × 6 = 1.2	
	Non-response	
99	Blank	

Correct Responses (Code 20)

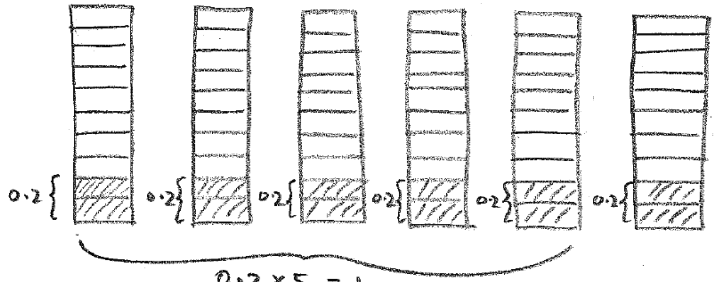
Picture 1



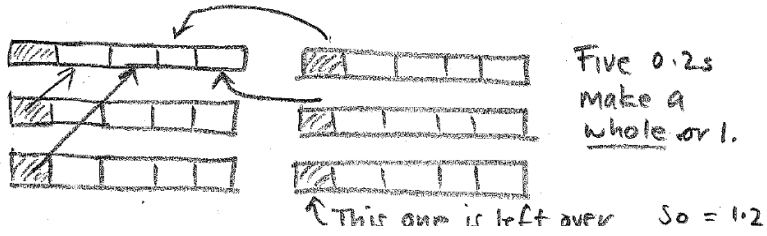
Picture 2



Picture 3

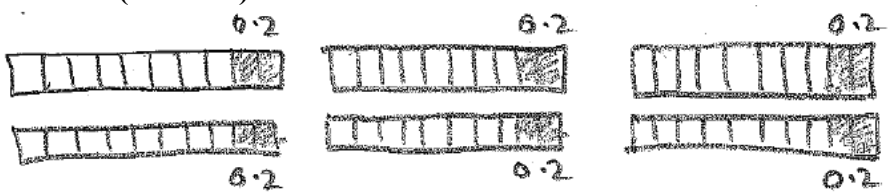


Picture 4

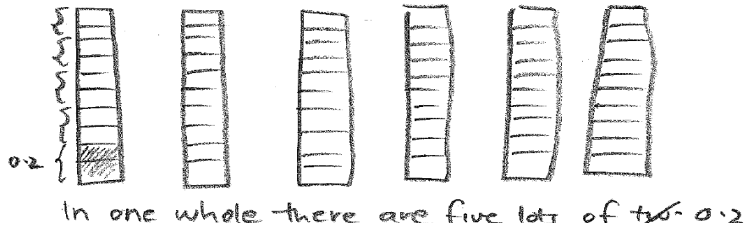


Partially Correct Responses

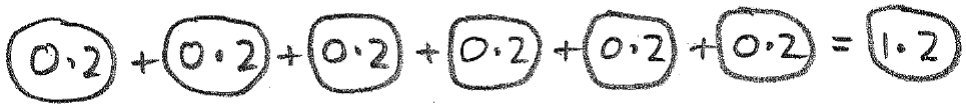
Picture 5 (Code 10)



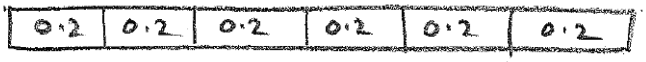
Picture 6 (Code 11)



Picture 7 (Code 12)

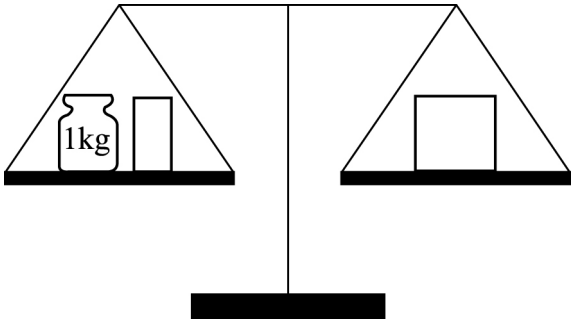


Incorrect response (Code 70)
Picture 8



ID: MFC303	MS Booklet: PM2, PM3	MS Block: B3PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Algebra		Sub-domain: Applying	

MFC303 The objects on the scale make it balance exactly. On the left pan there is a 1 kg mass and half a brick. On the right pan there is one whole brick.



What is the mass of one whole brick?

Check <u>one</u> box.

A. 0.5 kg ☐1
B. 1 kg ☐2
C. 2 kg ☐3
D. 3 kg ☐4

ID: MFC304	MS Booklet: PM2, PM3	MS Block: B3PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Number		Sub-domain: Knowing	

MFC304 How many decimal numbers are there between 0.20 and 0.30?

Check <u>one</u> box.

A. 9 ☐ 1

B. 10 ☐ 2

C. 99 ☐ 3

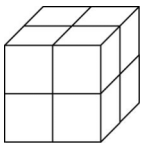
D. An infinite number ☐ 4

ID: MFC307A	MS Booklet: PM2, PM3	MS Block: B3PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Geometry		Sub-domain: Knowing	

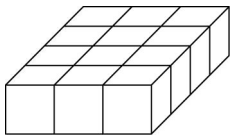
The following problem was given to <primary school> children.

All the small blocks are the same size. Which stack of blocks has a different volume from the others?

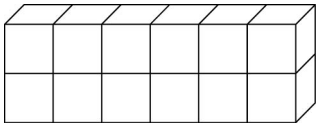
A.



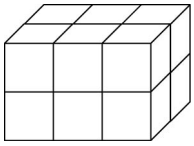
B.



C.



D.



MFC307A (a) What is the correct answer to this question?

Check <u>one</u> box.

A. Stack A ☐1

B. Stack B ☐2

C. Stack C ☐3

D. Stack D ☐4

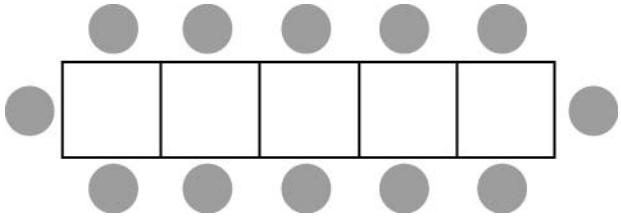
ID: MFC307B	MS Booklet: PM2, PM3	MS Block: B3PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Geometry		Sub-domain: Curriculum/Planning	

MFC307B (b) How could the question above be rewritten so that it assesses the same skills but **WITHOUT** using the word **VOLUME**?

Code	Response	Item: MFC307B
	Correct Response	
20	A reworded version of the question in (a) that assesses the **same** skills but **without** using the word 'volume'. *Examples:* • *Which stack of blocks is made from a different number of small blocks compared to the others?* • *All the small blocks are the same mass/weight. Which stack of blocks has a different mass/weight from the others?*	
	Partially Correct Response	
10	A question without the word 'volume' that assesses the **same** skills but is a **different question** to (a). Examples: • *Which stack of blocks has **less** blocks than any other?* • *Which stack of blocks takes up the **least** space?*	
	Incorrect Response	
70	A meaningful/answerable rewording of the question that assesses a skill **other than volume**. *Example:* • *Which stack of blocks has the largest **surface area**?*	
71	An unclear/ill-defined/unanswerable question *Examples:* • *Which stack of blocks is not equal in **size** to the others? ('Size' is too vague.)* • *Which stack of blocks takes up the **most** space? (There are 3 with the same volume.)* • *One of the stacks is different from the others. Solve the mystery! (Different in what way?)*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task, unsolvable)	
	Non-response	
99	Blank	

ID: MFC308	MS Booklet: PM2, PM3	MS Block: B3PM	Item Format: CR	Max Points: 1
Outcome: MCK	Domain: Algebra		Sub-domain: Applying	

A square table can seat four people, one on each side. When 5 square tables are placed side by side, as shown below, 12 people can sit around them, 5 on each side and 2 on the ends.



How many people can sit around *n* square tables when they are placed side by side?

MFC308 Write your answer to the problem in terms of *n*.

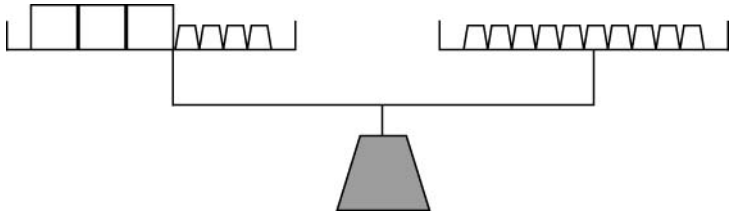
•

Code	Response	Item: MFC308
	Correct Response	
20	$2n + 2$ or equivalent expression. *Examples:* • $(n \times 2) + 2$ • $2(n + 1)$ • $4n – 2(n – 1)$	
21	Correct rule in words in terms of n. *Example:* • n multiplied by 2, then add 2.	
	Partially Correct Response *[See Note below]*	
10	Correct rule but with variable confusion. **Variable(s) defined**. *Examples:* • $n = 2x + 2$ *where* x *= no. of tables*. • $p = 2t + 2$ *where* t *= no. of tables and* p *= no. of people.*	
11	Correct rule but with variable confusion. **Variable(s) NOT defined**. *Examples:* • $2x + 2$ • $4x – 2(x – 1)$	
12	Correct rule in words but **NOT** in terms of n. *Example:* • Multiply by two and add two.	
13	An iterative rule. *Examples:* • $P_n = P_{n-1} + 2$ • *Add 2 each time you add a table/square.*	
	Incorrect Response	
70	An incorrect rule, in words or symbols. *Examples:* $2n – 2$	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Non-response	
99	Blank	

Note: After psychometric analysis, this was recoded to a dichotomous item

ID: MFC312	MS Booklet: PM2, PM3	MS Block: B3PM	Item Format: MC	Max Points: 1
Outcome: MPCK	Domain: Algebra		Sub-domain: Curriculum/Planning	

MFC312 If B represents the weight (in grams) of each box, ☐, pictured below, and ⏢ represents a one-gram weight, the equation $3B + 4 = 10$ can be pictured by the pan balance shown below.



An inequality such as $3B + 4 < 10$ or $3B + 4 > 10$ would show one side of the pan balance lower than the other.

Ms. [Clarke] is preparing to teach a unit on solving linear equations and inequalities.

If X represents the weight of a given box, which of the following sentences can **NOT BE REPRESENTED** by a pan balance?

Check <u>one</u> box.

A. $13 = 4X + 5$ ☐1

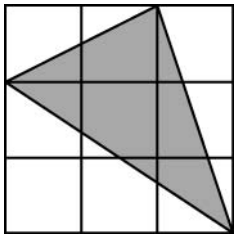
B. $3X + 10 = 4$ ☐2

C. $3X + 3 = 2X + 15$ ☐3

D. $9 + 6X < 21$ ☐4

ID: MFC408	MS Booklet: PM3, PM4	MS Block: B4PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Geometry		Sub-domain: Applying	

The area of each small square is 1 cm^2.



What is the area of the shaded triangle in cm^2?

Check <u>one</u> box.

A. 3.5 cm^2 ☐1

B. 4 cm^2 ☐2

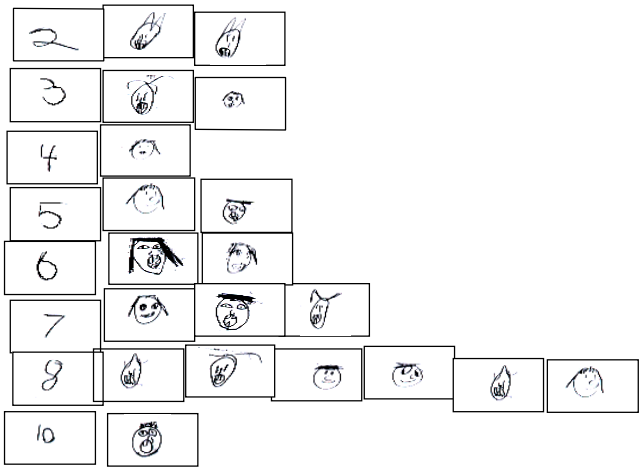
C. 4.5 cm^2 ☐3

D. 5 cm^2 ☐4

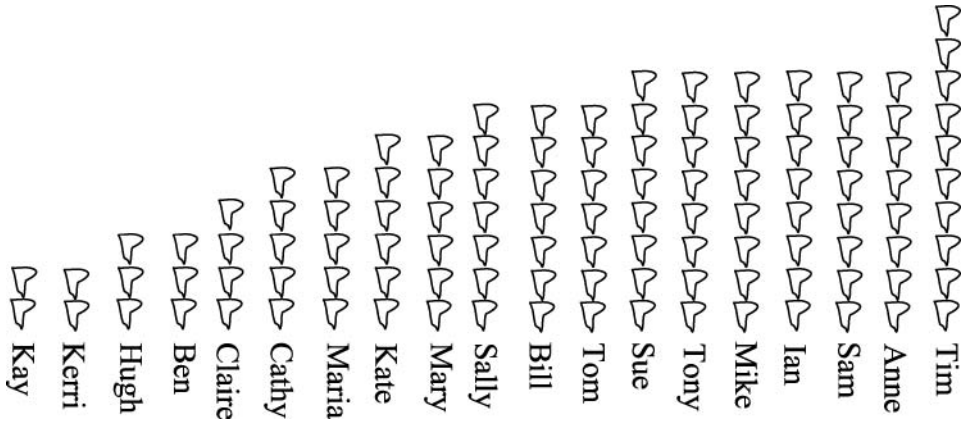
ID: MFC410	MS Booklet: PM3, PM4	MS Block: B4PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Data		Sub-domain: Enacting	

Imagine that two <primary> students in the same class have created the following representations to show the number of teeth lost by their classmates.

[Mary] drew pictures of her classmates on cards to make this graph.



[Sally] cut out pictures of teeth to make this graph.



MFC410 From a data presentation point of view, how are the representations alike and how are they different?

Alike:

Different:

Code	Response	Item: MFC410
	Correct Response	
20	Responses that indicate how the representations are **alike** AND how they are **different.** Alike: *Examples:* • *They both show the same data/same number of teeth lost.* • *They are both pictorial representations.* • *They are both forms of bar graphs.* • *They are both skewed in the same direction.* Different: *Examples:* • *Mary has grouped the data/done a frequency tally whereas Sally has not.* • *'In Mary's graph each bar or column represents the number of teeth lost, whereas in Sally's graph each column or stack represents a student.'* • *Mary's graph is categorized by the number of teeth lost whereas Sally's is person by person.*	
	Partially Correct Response	
10	**The 'alike' description is acceptable** but the 'different' description is not acceptable, trivial or is missing. Alike: *Example:* • *They both show the same number of teeth lost.* Different: *Examples:* • *Mary's is easier to comprehend than Sally's.*	
11	**The 'different' description is acceptable** but the 'alike' description is not acceptable, trivial or is missing. Alike: *Example:* • *They both made graphs about teeth.* (Trivial) Different: *Examples:* • *Sally made column for each student whereas Mary made a column for each number of teeth lost.*	
	Incorrect Response	
70	Responses that are insufficient or trivial. Alike: *Examples:* • *They are both graphs.* • *Both graphs are about teeth.* Different: *Examples:* • *Mary used numbers, Sally didn't.* • *Mary's is hard to read, Sally's is easier.*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Non-response	
99	Blank	

ID: MFC412A	MS Booklet: PM3, PM4	MS Block: B4PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Algebra		Sub-domain: Knowing	

[Sam] wanted to find three consecutive **EVEN** numbers that add up to 84.
He wrote the equation $k + (k + 2) + (k + 4) = 84$.

IFC412A (a) What does the letter k represent?

Check <u>one</u> box.

A. The least of the three even numbers. ☐ 1

B. The middle even number. ☐ 2

C. The greatest of the three even numbers. ☐ 3

D. The average of the three even numbers. ☐ 4

ID: MFC412B	MS Booklet: PM3, PM4	MS Block: B4PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Algebra		Sub-domain: Knowing	

IFC412B Which of the following expressions could represent the sum of three consecutive **ODD** numbers?

Check <u>one</u> box.

A. $m + (m + 1) + (m + 3)$ ☐ 1

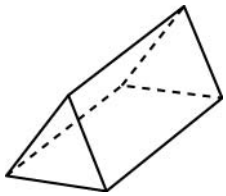
B. $m + (m + 2) + (m + 4)$ ☐ 2

C. $m + (m + 3) + (m + 5)$ ☐ 3

D. $m + (m + 4) + (m + 6)$ ☐ 4

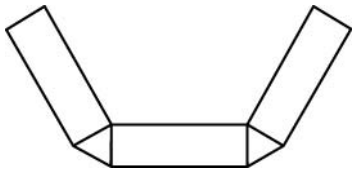
ID: MFC501	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Geometry		Sub-domain: Knowing	

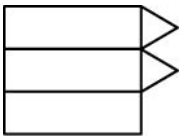
MFC501

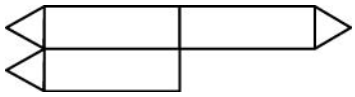


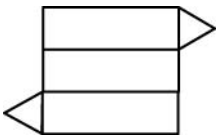
Which of the following could be folded to make a shape like the 3-D figure above?

Check <u>one</u> box.

A.  ☐ 1

B.  ☐ 2

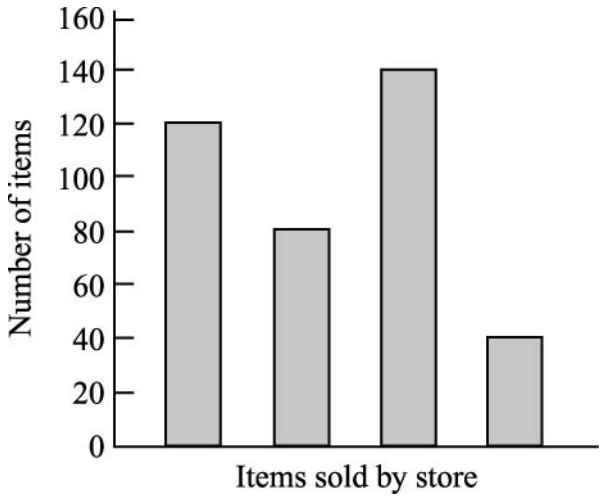
C.  ☐ 3

D.  ☐ 4

ID: MFC502A	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Data		Sub-domain: Reasoning	

The following problem was given to children in <primary> school.

The graph shows the number of pens, pencils, rulers and erasers sold by a store in one week.



The names of the items are missing from the graph. Pens were the item most often sold. Fewer erasers than any other item were sold. More pencils than rulers were sold.

MFC502A (a) How many pencils were sold?

Check <u>one</u> box.

A. 40 ☐ 1

B. 80 ☐ 2

C. 120 ☐ 3

D. 140 ☐ 4

ID: MFC502B	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Data		Sub-domain: Curriculum/Planning	

MFC502B

(b) Some <primary> students would experience difficulty with a problem of this type. What is the main difficulty you would expect? Explain clearly with reference to the problem.

Code	Response	Item: MFC502B
	Correct Response	
20	Responses that refer to reading and comprehension difficulties related to the **complexity of the language** used in the question with **reasons** and/or **references to specific examples.** Examples: • *The language used is quite challenging. Example, "fewer than any other" and "more pencils than rulers".* • *Students would be challenged by the difficulty/complexity of the wording in the question such as 'most often' 'fewer'. There is a considerable load on their 'higher order' skills as they are required to organise, interpret and relate back to the graph.* • *The items described in the text are listed in a different order to the bars on the graph creating logistic or sequencing challenges.*	
	Partially Correct Response	
10	Less detailed responses that recognize that the language is likely to be a difficulty for children but **without reasons or examples.** *Examples:* • *They would have trouble with the language used in the question.* • *Reading and comprehending the text would be difficult for many children.* • *There is a considerable amount of information to read, organize, sequence and relate to the graph.*	
11	A statement describing difficulties attributable to the graph rather than the text. *Examples:* • *They would have trouble reading the graph.* • *The names are missing from the graph and they wouldn't have experienced this before.*	
12	A statement attributing difficulties to the level of **problem-solving** or **analysis** required without explaining how/why. *Examples:* • *They would have trouble analyzing the information in the problem.* • *The problem requires problem-solving strategies and they would have trouble with that.*	
	Incorrect Response	
79	Incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Non-response	
99	Blank	

ID: MFC503ABCD	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: CMC	Max Points: 4
Outcome: MCK	Domain: Number		Sub-domain: Knowing	

Indicate for each number whether it is rational or irrational.

Check <u>one</u> box in each <u>row</u>.

		Rational	**Irrational**
MFC503A	A. π	☐ 1	☐ 2
MFC503B	B. 2	☐ 1	☐ 2
MFC503C	C. $\sqrt{49}$	☐ 1	☐ 2
MFC503D	D. $-\frac{3}{2}$	☐ 1	☐ 2

ID: MFC505	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Number		Sub-domain: Curriculum/Planning	

A <Grade 1> teacher asks her students to solve the following four story problems, in any way they like, including using materials if they wish.

Problem 1: [Jose] has 3 packets of stickers. There are 6 stickers in each pack. How many stickers does [Jose] have altogether?

Problem 2: [Jorgen] had 5 fish in his tank. He was given 7 more for his birthday. How many fish did he have then?

Problem 3: [John] had some toy cars. He lost 7 toy cars. Now he has 4 cars left. How many toy cars did [John] have before he lost any?

Problem 4: [Marcy] had 13 balloons. 5 balloons popped. How many balloons did she have left?

The teacher notices that two of the problems are more difficult for her children than the other two.

MFC505 Identify the **TWO** problems which are likely to be more **DIFFICULT** to solve for <Grade 1> children.

Problem _____ and Problem _____

Code	Response	Item: MFC505
	Correct Response	
20	Problem 1 and Problem 3 (or Problem 3 and Problem 1)	
	Partially Correct Response	
10	Problem 1 only correct (with or without Problems 2 and 4) *Examples:* • *Problem 1 and Problem 2 (or 2 and 1)* • *Problem 1 and Problem 4 (or 4 and 1)* • *Problem 1 and Problem ___ (blank)*	
11	Problem 3 only correct (with or without Problems 2 and 4) *Examples:* • *Problem 3 and Problem 2 (or 2 and 3)* • *Problem 3 and Problem 4 (or 4 and 3)* • *Problem 3 and Problem ___ (blank)*	
	Incorrect Response	
70	At least one problem selected but **neither Problem 1 nor Problem 3.** *Examples:* • *Problem 2 and Problem 4 (or 4 and 2)* • *Problem 2 and Problem ___ (blank)* • *Problem 4 and Problem ___ (blank)*	
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)	
	Non-response	
99	Blank	

ID: MFC508	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: MC	Max Points: 1
Outcome: MCK	Domain: Algebra		Sub-domain: Applying	

MFC508 Matchsticks are arranged as shown in the figures.

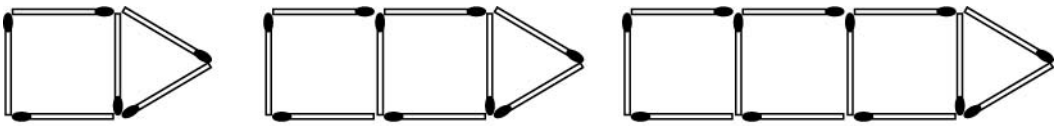


Figure 1 Figure 2 Figure 3

If the pattern is continued, how many matchsticks would be used to make Figure 10?

Check <u>one</u> box.

A. 30 ☐1

B. 33 ☐2

C. 36 ☐3

D. 39 ☐4

E. 42 ☐5

ID: MFC509	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: CR	Max Points: 2
Outcome: MCK	Domain: Algebra		Sub-domain: Knowing	

Students who had been studying algebra were asked the following question:

For any number n, which is larger, $2n$ or $n + 2$?

MFC509

Give the answer and show your reasoning or working.

<table>
<tr><th>Code</th><th>Response</th><th>Item ID: MFC509</th></tr>
<tr><td></td><td colspan="2">Correct Response</td></tr>
<tr><td>20</td><td colspan="2">A correct general solution written in words or using inequalities.
Examples:
• Correct inequality statements
If $n > 2$, then $2n > n + 2$.
If $n = 2$, then $2n = n + 2$.
If $n < 2$, then $2n < n + 2$.
OR without the $n = 2$ case
If $n > 2$, then $2n > n + 2$.
If $n < 2$, then $2n < n + 2$.

• In words, such as, “$n + 2$ is larger when n is less than 2 and $2n$ is larger when n is greater than 2.”</td></tr>
<tr><td>21</td><td colspan="2">A correct general solution using graphs.
• Responses that construct a graph of $y = n + 2$ and $y = 2n$ AND show on the graph where one is greater than the other OR conclude in words that $n + 2 > 2n$ when $n < 2$ and $2n > n + 2$ when $n > 2$.</td></tr>
<tr><td>22</td><td colspan="2">A correct, ordered, specific-value solution.
Examples:
• A table (or sequential list of ordered pairs) with values of n and evaluations of $2n$ and $n+2$ AND from the table/list conclude that $n + 2 > 2n$ when $n < 2$ and $2n > n + 2$ when $n > 2$.

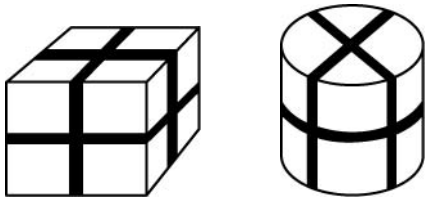
<table>
<tr><th>n</th><th>$2n$</th><th>$n + 2$</th></tr>
<tr><td>1</td><td>2</td><td>3</td></tr>
<tr><td>2</td><td>4</td><td>4</td></tr>
<tr><td>3</td><td>6</td><td>5</td></tr>
<tr><td>4</td><td>8</td><td>6</td></tr>
</table>

“The table shows that $2n$ is less than $n+2$ when n is less than 2 and that $2n$ is greater than $n+2$ when n is greater than 2.”</td></tr>
</table>

	Partially Correct Response
10	**General responses** that are 'on the right track' but incomplete or are limited in some way. *Examples:* • *One correct inequality without the other.* *E.g. If* $n > 2$*, then* $2n > n + 2$*.* *E.g.* $2n$ *is greater than* $n + 2$ *when* n *is greater than* 2*.* • *Two inequalities but only one is correct.* *E.g. (a) If* $n < 2$*, then* $2n > n + 2$ *(incorrect) and if* $n > 2$*, then* $n + 2 < 2n$ *(correct).* *E.g. (b) If* $n < 2$*,* $n + 2$ *is larger (correct) and if* $n > 2$*,* $n + 2$ *is larger (incorrect).*
11	**Graphical solutions** that are 'on the right track' but incomplete or are limited in some way. *Examples:* • *Two correct graphs* ***without*** *showing on the graph where one is greater than the other OR* ***without*** *concluding in words that* $n + 2 > 2n$ *when* $n < 2$ *and* $2n > n + 2$ *when* $n > 2$*.* • *Two graphs but* ***only one is correct****. The conclusion or annotation with the graphs must be correct for the two graphs shown.*
12	**Specific-value solutions** that are 'on the right track' but incomplete or are limited in some way. *Examples:* • *Responses that use trial-and-error and* ***more than one*** *specific value of n but* ***do not generalize*** *them into the same categories as shown under code 20.* • *Responses that say it* ***depends on the value of n*** *with* ***more than one*** *supporting example. For example, "It depends. When* $n = 1$*,* $n + 2$ *is larger, when* $n = 5$*,* $2n$ *is larger."*
	Incorrect Response
70	Responses that indicate that: • it cannot be known which is larger because the value of n is not known*; or* • 'it depends on the value of n*',* **with no (or only one)** supporting example or with no other valid argument.
71	One correct inequality only and an additional error. *Examples:* • $2n > n + 2$ *when* $n > 1$ • $n + 2$ *is greater than* $2n$ *when n is* 1 *or less* (Has assumed n is integral)
72	Conclusion reached on the basis of **only one specific value of n**. *Example: If* $n = 10$*,* $2n = 20$ *and* $n + 2 = 12$ *so* $2n > n + 2$
73	Responses that select $2n$ with no correct qualifying inequality (e.g. without 'when $n > 2$')
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task).
	No Response
99	Blank.

ID: MFC511	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: CR	Max Points: 2
Outcome: MCK	Domain: Geometry		Sub-domain: Applying	

Two gift boxes wrapped with ribbon are shown below. Box A is a cube of side-length 10 cm. Box B is a cylinder with height and diameter 10 cm each.

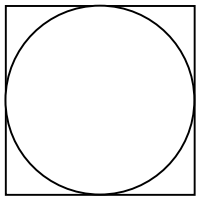


A B

MFC511

Which box needs the longer ribbon? _____

Explain how you arrived at your answer

Code	Response	Item: MFC511 and MFC703
	Correct Response	
20	Box A with a correct and complete explanation involving calculations of ribbon lengths *Examples:* • *Box A needs ribbon. Box B needs* $4 \times 20 = 80$ *cm plus the circumference which is* 10π . $10\pi < 40$ *so Box A needs more ribbon.* • *Box A. Box A needs* 120 *cm but box B needs about* 110 *cm (using* $\pi = 3$*).*	
21	Box A based upon a complete argument (with or without calculation) comparing the square and circumference (both of equal 'width') together **with a statement that the other lengths of ribbon are equal.** *Examples:* • *Box A because the circumference of a circle diameter 10 is less than the perimeter of a square of side 10 and the other lengths of ribbon are the same.* • *Box A. As shown in the diagram, the ribbon around the cylinder is less than the ribbon around the square. The other lengths of ribbon are equal on each box. Therefore Box B needs less ribbon altogether than Box A.*  • *Box A. The circumference is about 31.4 but the perimeter of the square is 40. So Box A needs more ribbon because the other ribbon is the same (80) on both boxes.*	

*Note: Accept reasonable approximations of π such as 3.14, 3.1, 3, 22/7 etc.

Continued next page

	Partially Correct Response
10	Box A with a correct and complete explanation as in Code 20 but with **one identifiable calculation error** (or use of a wrong formula) logically leading to Box A. *Example:* • *Box A because Box A needs 120 cm and Box B needs* **60** + 10π < 120.
11	Box B with a correct and complete explanation as in Code 20 but with **one identifiable calculation error** (or use of a wrong formula) logically leading to Box B. *Examples:* • 80 + 10π = 120.4 (rather than 111.4) > 120. • *Box B because Box A needs 120 cm of ribbon and box B needs 80 +* 25π *> 120. (Used area formula instead of circumference formula but intending to compare perimeter.)*
12	Box A with an explanation that correctly calculates and compares the lengths of ribbon on each box that are **different** but **fails to mention that the other lengths of ribbon are the same.** *Example:* • *Box A needs more ribbon because the circumference of the cylinder is* 10π *which is less than the perimeter of the square,* 40.
13	Box A with an explanation that correctly supports the choice of Box A but that is **limited** and/or **lacking the detail** of a Code 20 or 21 response. *Examples:* • *Box A because Box B can fit inside Box A.* • *Box A because the circumference is less than the perimeter.* • *Box A. You can see it's bigger. Its ribbon is 120 cm but Box B would be less.*
	Incorrect Response
70	Box A **without** any explanation or calculation. *Example: Box A*
71	Box A or B with an explanation based on a **conceptual error**. *Examples:* • *Box A but with an explanation based upon surface* ***area or volume****.* • *Box A because it has more sides.*
72	Box A or B with an explanation based on **incorrect and/or incomplete** ribbon lengths for **both** boxes. *Example:* • *Box B because Box A needs* 60 *cm but box B needs more than* 80.
73	Neither. The length of ribbon needed is the **same.** *Example:* • *Length width and height are the same therefore they need the same amount of ribbon.*
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task) *Example:* • *Box B* **without** any explanation or calculation.
	Non-response
99	Blank

ID: MFC513	MS Booklet: PM4, PM5	MS Block: B5PM	Item Format: CR	Max Points: 2
Outcome: MPCK	Domain: Geometry		Sub-domain: Curriculum/Planning	

MFC513

When teaching children about length measurement for the first time, Mrs. [Ho] prefers to begin by having the children measure the width of their book using paper clips, then again using pencils.

Give **TWO** reasons she could have for preferring to do this rather than simply teaching the children how to use a ruler?

Reason 1:

Reason 2:

Code	Response	Item: MFC513
Note: Significant and acceptable reasons Reason 1: (Understanding of what measurement is) Using familiar/different units enables understanding of what measurement is, that any object/unit can be used to measure, that the scale on a ruler is just the repetition of a basic unit. Reason 2: (Need for standard units) Use of non-standard units can, by creating uncertainty about length, show the **need** for standard/formal units and possibly create opportunities to discuss the (historical) development of measurement. Reason 3: (Choosing most appropriate unit) Using objects of different lengths helps children learn how to decide which unit/object is the most appropriate to measure a given length.		
	Correct Response	
20	Responses that give **any TWO** of the three significant and acceptable reasons noted above.	
	Partially Correct Response	
10	Responses that give **Reason 1 only**: (Understanding of what measurement is) *Examples:* • *Using familiar objects to measure enables young students to focus just on the idea of measurement before they have to deal with formal units and the skill of using a ruler.* • *Using everyday objects to measure shows that anything can be used to measure and makes measurement easier to understand because there is no abstract scale to read.*	
11	Responses that give **Reason 2 only**: (Need for standard units) *Examples:* • *Using non-standard units of different length to measure gives differing numbers of units for the same length and shows that we need standard units.* • *Using different units like paper clips and pencils to measure means that students will get different answers for the same length and through discussion about what measurement is can come to realize the need for a common unit and more formal system of measurement.*	
12	Responses that give **Reason 3 only**: (Choosing most appropriate unit) *Examples:* • *The teacher wants the students to see that they should think about which unit is most appropriate for different lengths. Pencils would be more efficient for larger lengths than paperclips, for example. Paperclips would better for shorter lengths. Paces would be better for very long lengths.* • *This would show that long lengths are best measured with large units (pencils) and short lengths are best measured by small units (paper clips).*	

	Incorrect Response
70	Responses that focus on motivation, enjoyment, etc. *Examples:* • *Using concrete materials is more fun, motivating, interesting and engaging.* • *It is not as boring for the students if the teacher uses a variety of methods and aids* • *The teacher knows that the students will enjoy their work more if they can use hands-on materials*
71	Responses that focus on other unrelated or insignificant aspects. *Examples*: • *Using familiar objects such as pencils encourages estimation skills.* • *The teacher wants to encourage creativity by getting students to measure with paper clips and pencils.* • *So that her children will know how to measure with paperclips and pencils.*
79	Other incorrect (including crossed out, erased, stray marks, illegible, or off task)
	Non-response
99	Blank