Mathematics

in school inspection

January 2013

Information Pack for Training

This pack contains the information you will need to refer to during the activities.

New Early Learning Goals for Mathematics (September 2012)

Numbers	Shape, space and measures
Children count reliably with numbers from 1 to 20, place them in order and say which number is one more or one less than a given number. Using quantities and objects, they add and subtract two single-digit numbers and count on or back to find the answer. They solve problems, including doubling, halving and sharing.	Children use everyday language to talk about size, weight, capacity, position, distance, time and money to compare quantities and objects and to solve problems. They recognise, create and describe patterns. They explore characteristics of everyday objects and shapes and use mathematical language to describe them.

These new expectations are higher than previously:

- working with numbers 1-20 rather than 1-10 (note difficulty of language for 11-19, particularly for the 'teens')
- doubling, halving and sharing
- addition and subtraction more developed than previously, though linked to practical activities
- mathematical language to describe 'characteristics' of objects and shapes
- problem solving in both ELGs rather than as a statement which children attaining 6+ points may not have been taught or have attained

Former Early Learning Goals for problem solving, reasoning and numeracy

(Points 4 to 8 represent working within the ELGs but are not hierarchical. Children who achieve any six points or more in each scale are said to be 'working securely within the ELGs', but may not have met point 8. Point 9 represents working beyond the ELGs.)

Scale point	Numbers as labels and for counting	Calculating	Shape, space and measures
4	Says number names in order	Relates addition by combining two groups	Talks about, recognises and recreates simple patterns
5	Recognises numerals 1 to 9	Relates subtraction to taking away	Uses everyday words to describe position
6	Counts reliably up to 10 everyday objects	In practical activities and discussion, begins to use the vocabulary involved in adding and subtracting	Uses language such as 'circle' or 'bigger' to describe the shape and size of solids and flat shapes
7	Orders numbers up to 10	Finds one more or one less than a number from 1 to 10	Uses language such as 'greater', 'smaller', 'heavier' or 'lighter' to compare quantities
8	Uses developing mathematical ideas and methods to solve practical problems	Uses developing mathematical ideas and methods to solve practical problems	Uses developing mathematical ideas and methods to solve practical problems
9	Recognises, counts, orders, writes and uses numbers up to 20	Uses a range of strategies for addition and subtraction, including some mental recall of number bonds	Uses mathematical language to describe solid (3D) objects and flat (2D) shapes

National data on the Foundation Stage Profile

Percentages at 6+ and at 9 points in each scale and all three scales combined since 2010

	2010 % 6+	2011 % 6+	2012 % 6+	2012 % 9 points
NLC	89	90	91	17
C	76	78	80	7
SSM	84	85	86	7
all three scales	72	74	77	n/a

The three prime areas and four specific areas

	Prime Areas	***Personal, Social and Emotional Development***	***Physical Development***	***Communication and Language***
Specific areas		▪ *Making relationships* ▪ *Self-confidence and self-awareness* ▪ *Managing feelings and behaviour*	▪ *Moving and handling* ▪ *Health and self-care*	▪ *Listening and attention* ▪ *Understanding* ▪ *Speaking*
Literacy	▪ Reading ▪ Writing			
Mathematics	▪ Numbers ▪ Shape, space and measures	*Children are confident to try new activities … will talk about their ideas, and will choose the resources they need for their chosen activities. They say when they do or don't need help. (PSED ELG)*		*Children … answer 'how' and 'why' questions about their experiences. Children express themselves effectively … develop their own … explanations by connecting ideas and events. (CL ELG)*
Understanding the World	▪ People and communities ▪ The world ▪ Technology			
Expressive Arts and Design	▪ Exploring and using media and materials ▪ Being imaginative			

Characteristics of Effective learning	
Playing and exploring – engagement	**Finding out and exploring**
	Playing with what they know
	Being willing to 'have a go'
Active learning – motivation	**Being involved and concentrating**
	Keeping trying
	Enjoying achieving what they set out to do
Creating and thinking critically – thinking	**Having their own ideas** • Thinking of ideas • Finding ways to solve problems • Finding new ways to do things
	Making links • Making links and noticing patterns in their experience • Making predictions • Testing their ideas • Developing ideas of grouping, sequences, cause and effect
	Choosing ways to do things • Planning, making decisions about how to approach a task, solve a problem and reach a goal • Checking how well their activities are going • Changing strategy as needed • Reviewing how well the approach worked

Video of numbers to 20 on a washing line

While watching the video, record your notes below. Give specific mathematical detail.

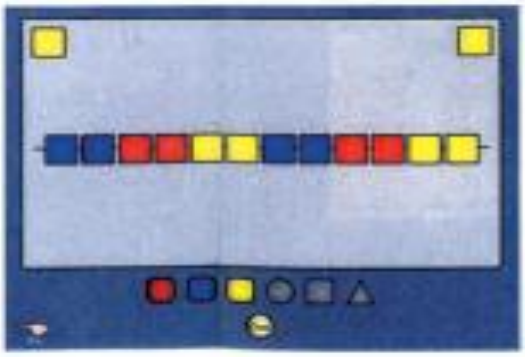
What mathematics do the children use in doing this activity?

How well was the activity set up to encourage understanding and problem solving?

Judge both children against the ELG for numbers.

What inspection activities would you do next to follow up this observation?

EYFS exemplification

	Create and describe patterns *She enjoyed using the computer to create her own symmetrical pattern after seeing some Rangoli patterns. She used the pointer to select colours and draw on the smartboard. She said 'look at my pattern' when she had finished.* Possible questions ▪ Tell me how your pattern works. ▪ What would come next in your pattern?
Possible questions ▪ Do you go to see your aunty in the afternoon? What time do you go? What do you do afterwards? ▪ What's the day after Saturday?	Sequencing time *Yahya said to Mahdi 'Today is Friday 25th of November. So yesterday was Thursday and tomorrow is Saturday. I'm going to see my aunty then.'*
	Subtraction using objects *I showed him the eggs inside a full box of 6 which he counted. Then behind a screen I removed 2 eggs and closed the box. Then I showed him the 2 eggs that I had removed and asked 'How many eggs are left in the box'. He said '4'.* Possible questions ▪ How did you work that out? ▪ I have taken another egg out (show him this egg, that you have removed without him seeing). How many are left?
 	Doubling *She said 'double 1' when she threw the dice, then she moved her counter two places.* *She said 'double six' when she picked up the domino. When I asked her how many spots altogether, she said '12'.* Possible questions ▪ How much did you move the counter? ▪ Is this domino a double (showing a non-double)?
	Halving *Hannah and Honey were playing in the shop. They used the language of capacity – full, empty, half full – to talk about how full the bottles were. They were able to place the bottles in order starting with the fullest.* Possible questions ▪ (Show a larger/smaller container half full) Is this half full? ▪ How many of this one will fill that one?

Numbers of vehicles

A girl has lined up vehicles like this:

It indicates she has done some sorting and possibly some counting.
Individually:

- Jot down some questions you might ask this girl to check her knowledge and understanding of number.

Comparative language video

You are going to see a short video of a teaching assistant asking a child to compare heights of family members she has drawn.

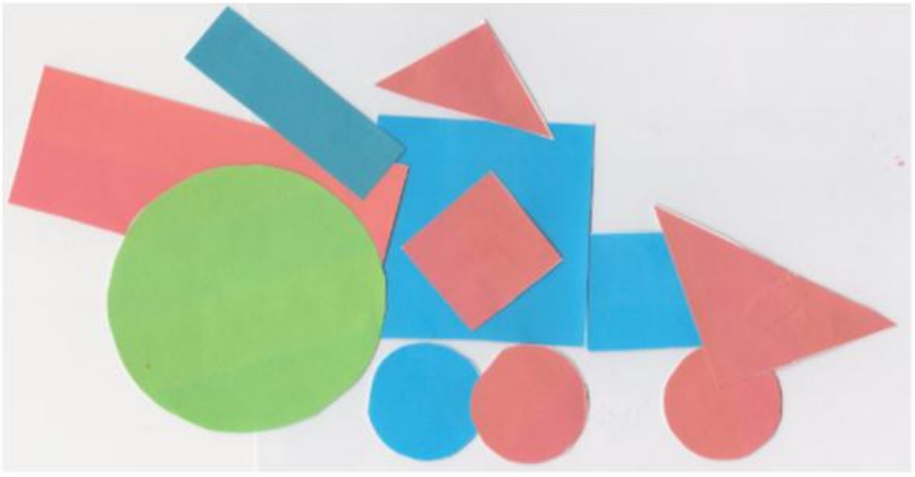
While watching the video:

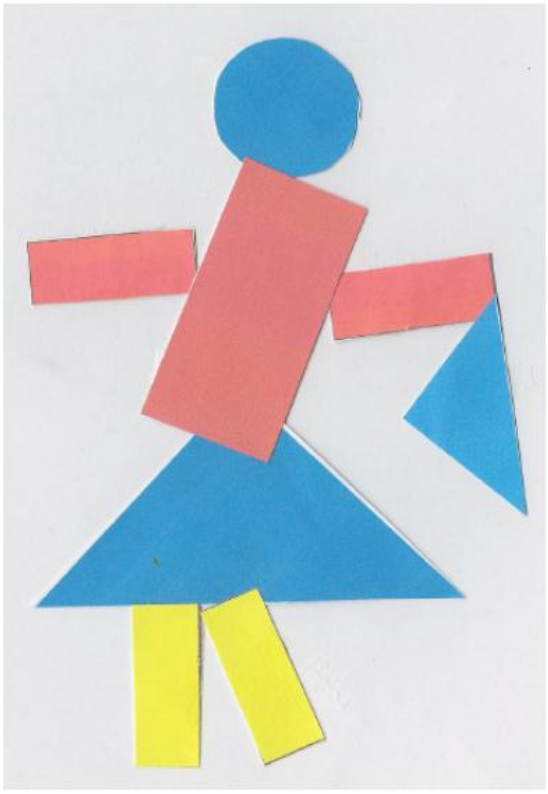
- Note down the specific mathematical language used

- Think about the questions the TA asks, particularly how she checks the child's responses.

Shapes activity

In a creative activity led by a teaching assistant, children had a pack of gummed shapes (squares, circles, triangles and rectangles) in two sizes and four colours (red, blue, yellow and green). They made pictures by sticking them on large sheets of paper.
These are two children's pictures.





The TA asked, 'What is your picture?', 'What colours did you use?'
Look back at the shape Early Learning Goal on page 2.

With your partner decide on **good**

- questions on shape to stimulate mathematical discussion
- support for additional adults to generate such discussion.

You might want to annotate the pictures with your questions.

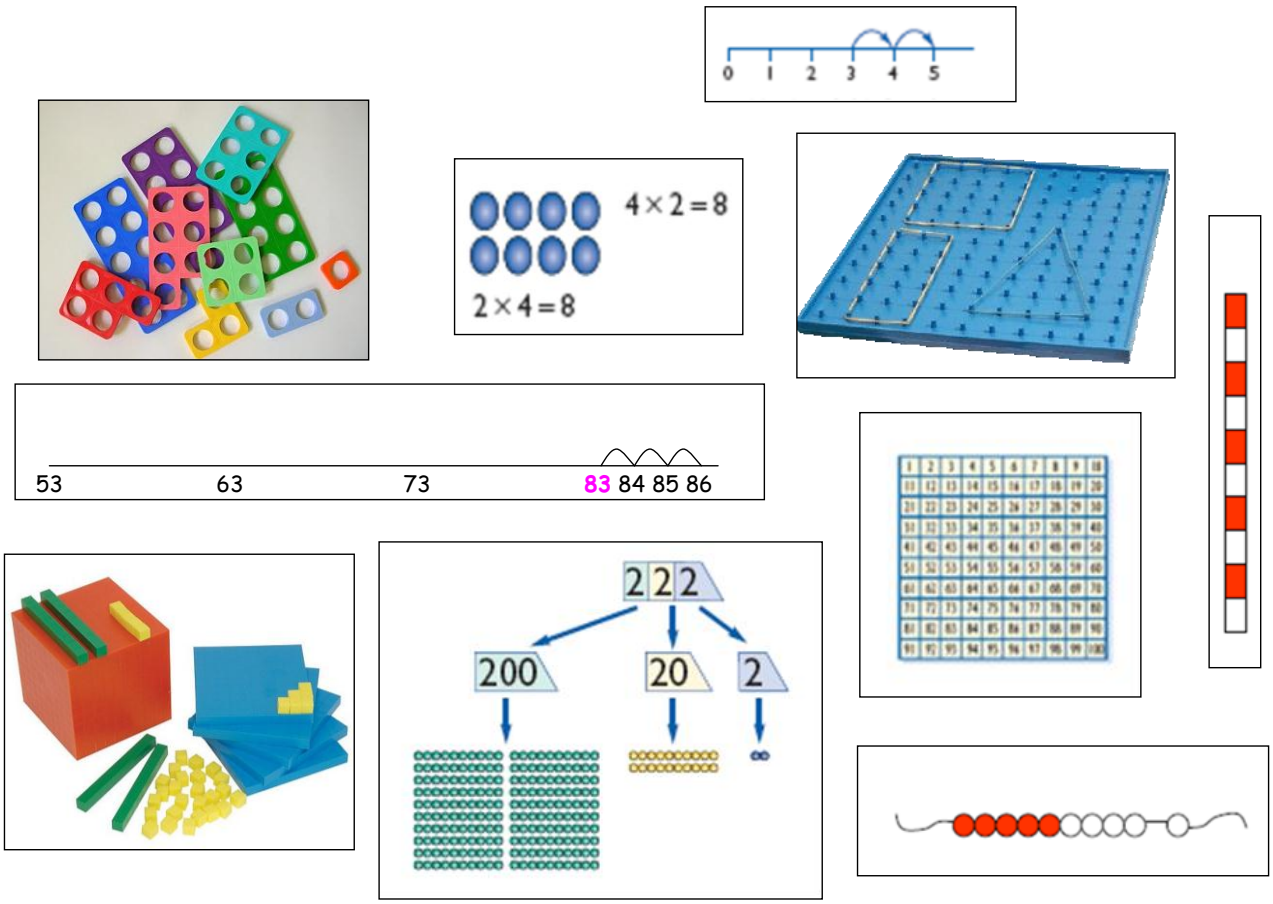
Case study of two pupils

Joe and Jade had similar Level 5 Key Stage 2 results in English and mathematics.
Make a note of the positive and negative factors which affected their progression in mathematics.

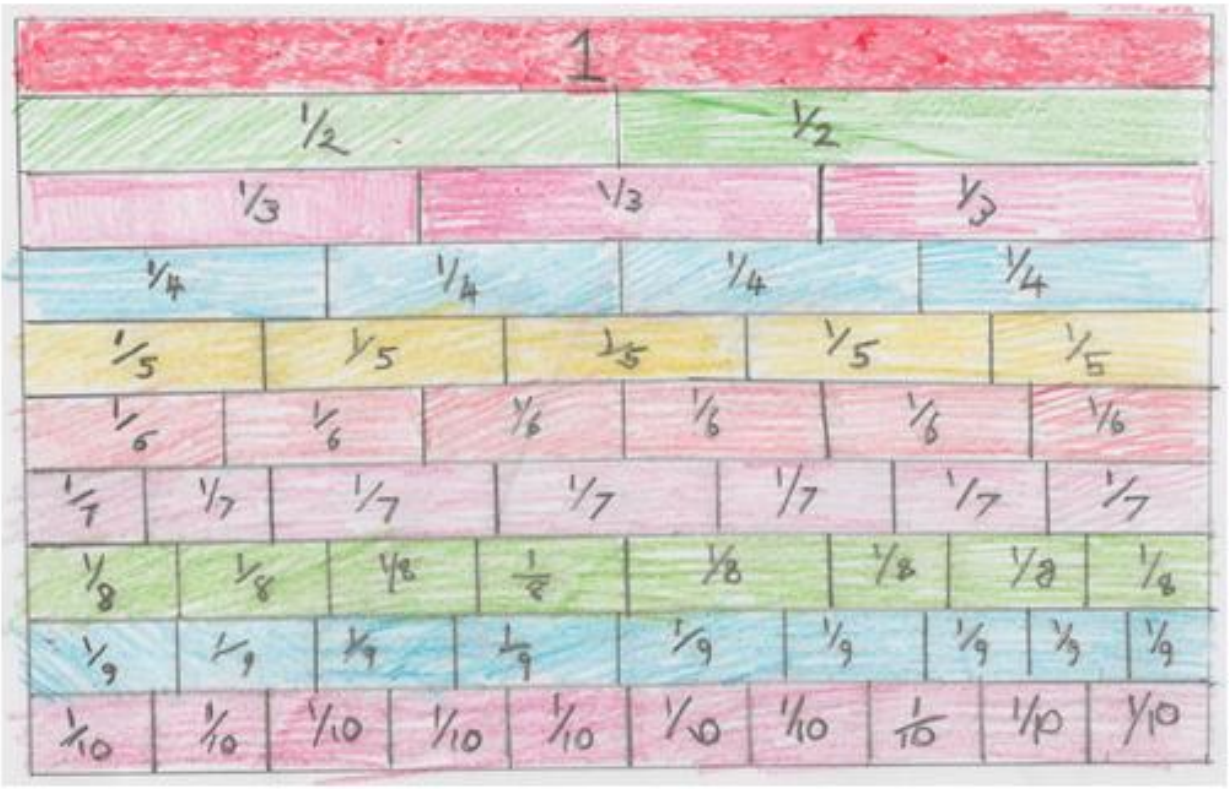
Joe	Jade
▪ Set 1 out of 6 throughout Y7-Y11 ▪ Attained GCSE grade A	▪ Y7 set 1/6 for one term then set 2/6 until the end of Y8 ▪ Y9, Y10 and Y11 set 3/6, the top Foundation Tier set ▪ Attained GCSE grade C

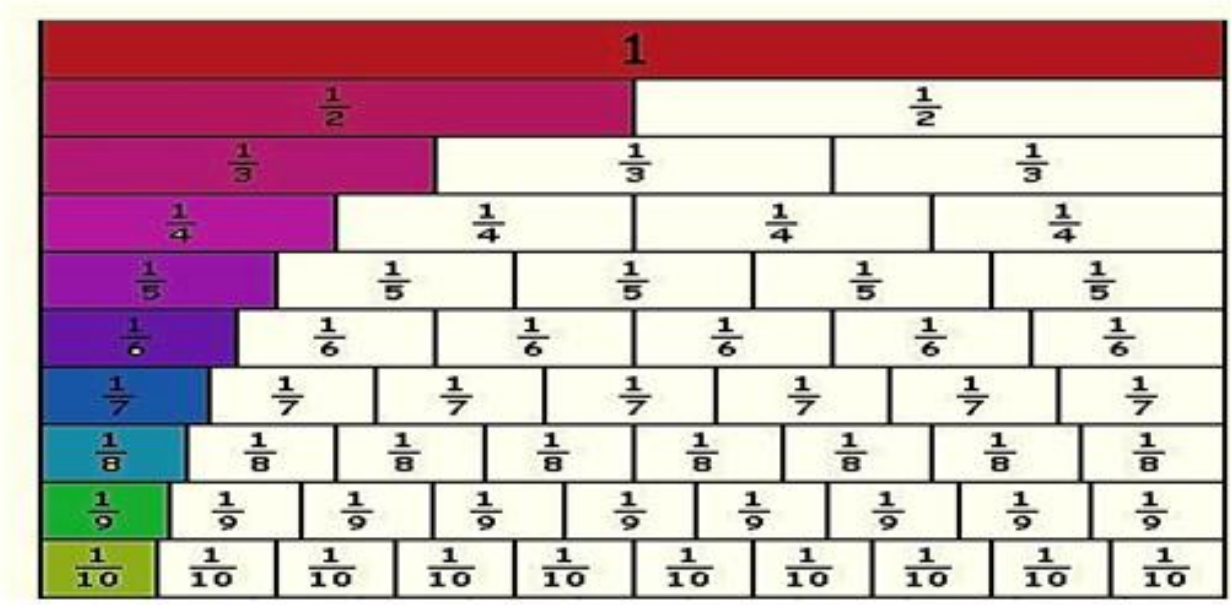
Resources to help build concepts

What is the name of each of these diagrams and pieces of equipment?



Fraction walls





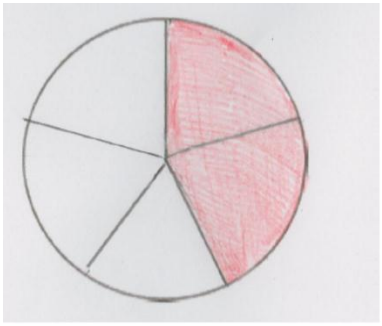
Equivalent fraction diagrams

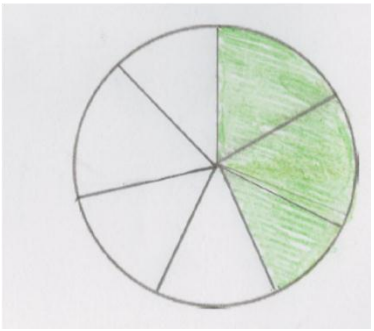
Create a different type of diagram to convince your partner why $^{3}/_{7}$ and $^{6}/_{14}$ are equivalent.

Fraction diagrams

A Year 6 boy was asked 'Are $^{2}/_{5}$ and $^{3}/_{7}$ equivalent?'

He drew these two diagrams and stated that the fractions were equivalent.





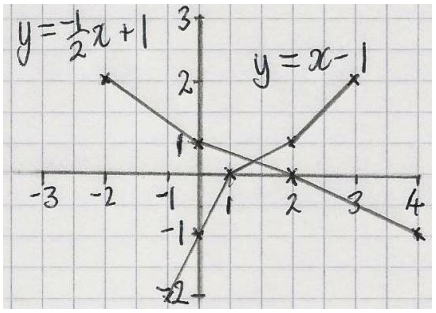
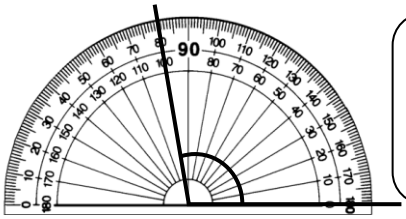
What would you ask this boy, to find out how much he understood?

Errors and misconceptions

Several errors are illustrated below. They are caused by:

- underlying misconceptions
- unhelpful rules
- lack of precision with the order of language and symbols.

With your partner, see if you can identify the underlying misconception or cause of each error.

206 in words is twenty six	*In order, smallest first:* *3.2 3.6 3.15 3.82 3.140*
Take 6 away from 11 *6 − 11 = 5*	*10% of 70 = 70 ÷ 10 = 7* *20% of 60 = 60 ÷ 20 = 3*
2.7 x 10 = 2.70	$^{-}2 \times {}^{-}8 = {}^{+}16$ $^{-}1 + {}^{-}4 = {}^{+}5$
	 The angle measures 80°

A

Work Scrutiny

Collecting like terms worksheet

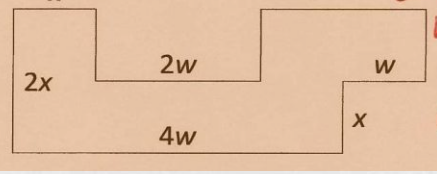
Remember what we learned about this when we moved the cards around:

5x	− 4y	− 3x	+ 3y
(+)5x	− 4y	− 3x	+3y
(+)5x	− 3x	− 4y	+3y
= 5x	− 3x	− 4y	+ 3y

$= (5-3)x + (-4+3)y = \underline{2x-y}$

1. $2x + 3y + 3x + 4y =$ 5x + 7y ✓
2. $-3u + 5u + 2v - 2v =$ 2u + 0v ✓ = 2u
3. $11x + 3 - 7x - 5 =$ 4x − 2 ✓
4. $p + 3q - 2p - q =$ −p + 2q ✓
5. $3m - 2n - m - 3n =$ 2m − 5n ✓

6. Find the perimeter of this shape:



I think you forgot the unmarked sides

8w + 3x ×

Correction please:

= 10w + 6x ✓

7. Prove that if you add any three consecutive numbers together, the answer is always divisible by 3. [Hint: Let the first number be *n*, so the next two are ...]

n ✓ + n+1 ✓ + n+2 ✓ = 3n+3 ✓ How does this prove it can be divided by 3?

(3n+3) ÷ 3 = n+1 ✓ good

I think you've got the idea. SPa 17/10

Try this: 4(x+y) + 2(x−y) =

4x+4y+2x−2y = 6x+2y ✓ Excellent. SPa 24/10

Green highlight shows pupil's response to initial marking, later checked by teacher

B

17 October 2013

LO: simplify linear expressions by collecting like terms

Examples:

remember a means 1a

① 5a + 3a + a = 9a

② 2a + 3b + 4a + 5b

= 2a + 4a + 3b + 5b = 6a + 8b

③ 7x + 4y − 3x − 2y

= 7x − 3x + 4y − 2y = 4x + 2y

Exercise 5b p47

1. 2a + 4a + 12a = 18a ✓
2. 2p + 3q + 5q = 2p + 8q ✓
3. 5s + 3t + 4s + t = 9s + 4t ✓
4. 12e + 4f + 3e + 3f = 15e + 7f ✓
5. 4g + 2h + h + g = 5g + 3h ✓
6. a + 3a + 3b + 4b = 4a + 7b ✓
7. d + 3c + 3d + 2c = 4d + 5c ✓
8. 3j − 4k + 2j + k = j + 5k ×
9. 2u − 3u − 4u =

5b

Very neat work and only 1 wrong

Well done. Next steps: equations

C

Pencil ticks show marking by the pupil

17Oct12

LO: collecting like terms

1. $a+2b+2a+3b = 3a+5b = 8ab$ ✓ ✗
2. $3a+2b+2a+4b = 5a+6b = 11ab$ ✓ ✗
3. $a+2b+a+3b+4a = 6a+5b = 11ab$ ✓ ✗
4. $3a+3b+c+2b+5c = 3a+5b+6c = 14abc$ ✓ ✗
5. $3a+6b+4c+3a+2b+6c = 6a+8b+10c = 24abc$ ✓ ✗
6. $4a+3b-a+2b = 3a+1b = 4ab$ ✗ ✗
7. $6a+5b-3a+3b = 3a+2b = 5ab$ ✗ ✗
8. $4a+2b-3a+4b = 1a-2b$ ✗

I think you've got the idea when you add but need to stop there. Remember - you can't add apples and bananas.

Target: Revise minus questions

This is level 5 work

Work Scrutiny

D

17 October 2012

Collecting like terms Level 5

+3a +2b +2a -3b

= +3a +2a +2b -3b

= 5a -b

+3+2=5

+2-3=-1

-1b is written -b

1. +2x -3y +5x -2y

   = +2x +5x -3y -2y = 7x -y

   = 7x -4 5y ✓

2. 5x+3y-2x-y

   = 5x-2x+3y-y = 3x+2y ✓

3. 4s-3t+2s+2t

   = 4s+2s-3t+2t = 6s-5t ✓

4. p+12q-3p-7q

   = p-3p+12q-7q = -2p+5q ✓

5. -2k-3l+4l-3k

   = -2k-3k-3l+4l = 5k+l ✗

   → -5k+l

6. 3u+4-2u+6 = ?

Not enough work for 20 mins

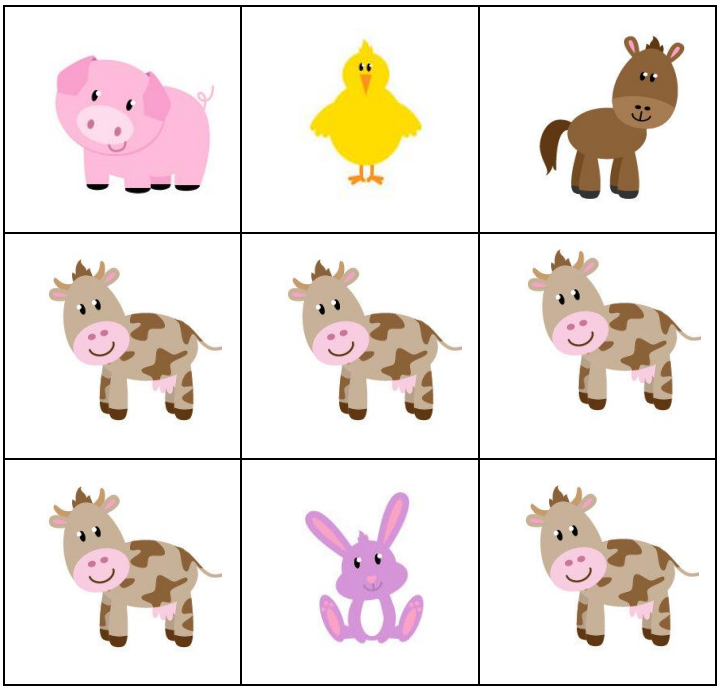
First few OK but check minuses

But you said two minuses makes a plus.

Teacher's big tick relates to Q1-4 (changed by pupil and ticked when T read out answers)

Green highlight shows pupil's response to marking

Puzzles

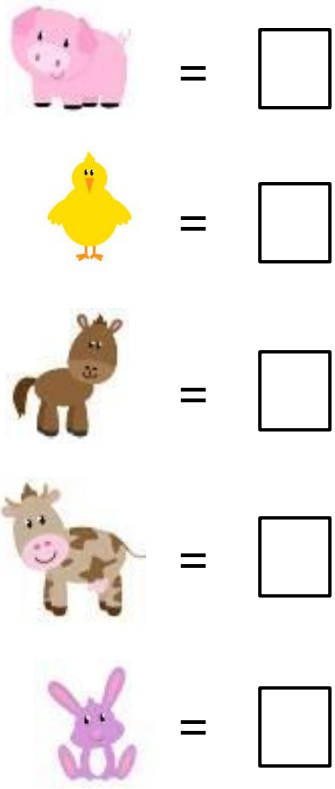


= 12

= 15

= 13

= 14 = 10 = 16

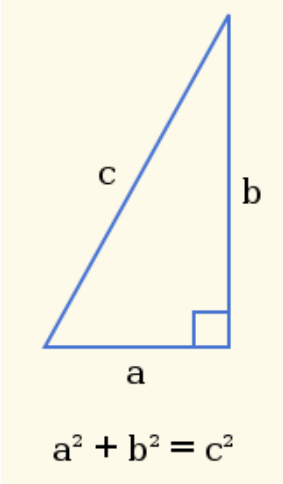


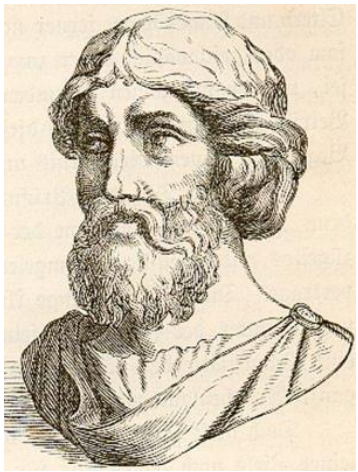
Total cost £21

ELLE
ANNA
ALLY

- Look at the worksheet on Pythagoras' Theorem.
- With your partner, consider its potential for developing pupils' problem solving skills and understanding.
- With what quality of teaching and learning might it be consistent?
- Identify the points for development about the worksheet you would feed back to the teacher.

Pythagoras' Theorem – worksheet



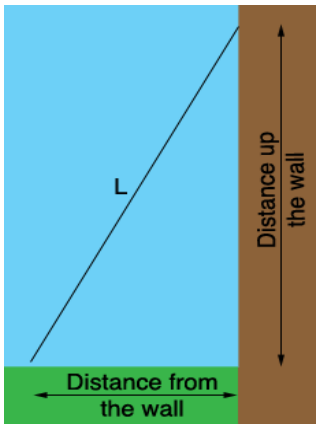


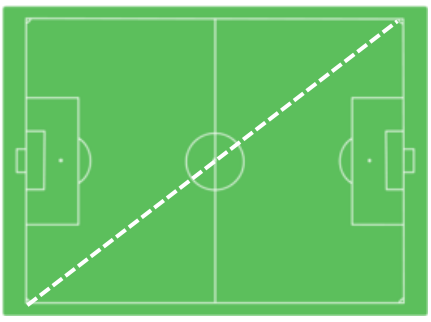
In each question, use the values of a and b given to work out c.

1. a = 6cm, b = 8cm
2. a = 5cm, b = 12cm
3. a = 12m, b = 9m
4. a = 8cm, b = 15cm
5. a = 4mm, b = 7mm
6. a = 10cm, b = 3cm
7. a = 1.8cm, b = 8cm
8. a = 3.8cm, b = 7.2cm
9. a = 11.5m, b = 9.8m
10. a = 4.55km, b = 9.12km

11. The diagram opposite shows a ladder leaning against a wall. The foot of the ladder is placed a distance of 1m from the wall and the ladder reaches a distance of 5.5m up the wall.

    How long is the ladder?





12. The picture opposite shows the dimensions of a football pitch.

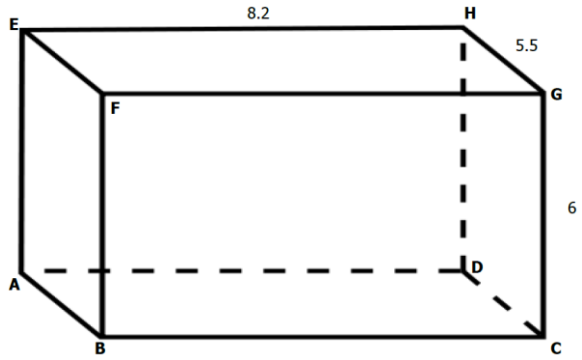
    How long is the diagonal line from corner to corner?

Cuboids video

- You are going to see four extracts of strong teaching on 3D geometry starting with diagonals of cuboids. (An expert on ICT in mathematics education is observing the lesson.)
- You will be gathering evidence on how the teacher develops pupils':
  - problem-solving skills
  - conceptual understanding.
- Also record actions or words that demonstrate pupils' understanding or lack of it.
- Record descriptive detail that would be helpful later to inform evaluations and judgements, areas for development, and feedback to the teacher. No evaluation is needed at this stage.

This cuboid is used in the first two extracts.

Record mathematical details for each extract. You may wish to use the diagram.



Extract 1: What is the longest stick that would fit into this box?

Extract 2: Overcoming misconceptions and calculating the longest diagonal

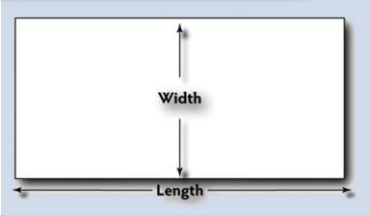
Extract 3: Angle between the space diagonal AG and the base ABCD in a different cuboid

Extract 4: Problems: a) pyramid or b) whether general statements are always, sometimes or never true (e.g. 'the longer the diagonal, the smaller the angle between the diagonal and base')

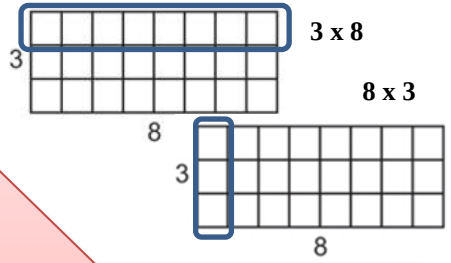
Rectangle area

Teacher A

I start by telling pupils the formula L x W. Then they work through some examples on their whiteboards. I check they can identify the length and the width correctly. Finally, they work through a worksheet. The high-attaining pupils can tackle questions with larger numbers and decimals.

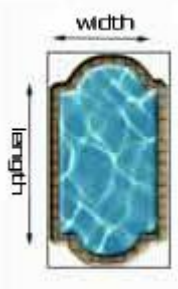


Teacher C



I ask the pupils to count squares inside the rectangles, looking at the rows and the columns. We start by counting, and then adding, for example 8+8+8, and finally 3 lots of 8 or 8 lots of 3. The pupils quickly see why the formula works, and how the same area is built up from rows or columns.

Teaching Assistant B



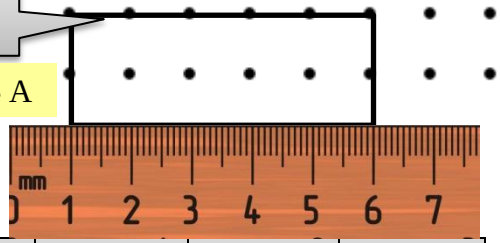
I try to find something that pupils can relate to from their own experience – a swimming pool is a good image because most pupils understand what 'a length of the pool' means. They then recognise the 'length' as the longest side.

Teacher D

I ask the pupils to measure or count along the sides of the rectangles and count the number of squares inside – although sometimes they make mistakes! They put their results in a table and I get them to figure out a connection for themselves.

Length
5 or 6?

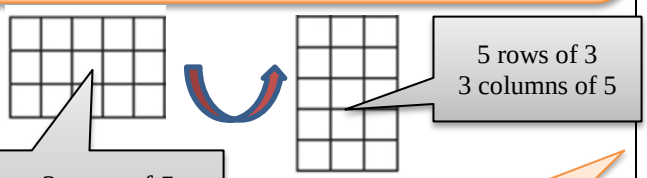
Rectangle A



Rectangle	Length	Width	Area
A	6	2	10
B	3	5	15
C	4	3	11
D	2	4	8
E	5	4	20

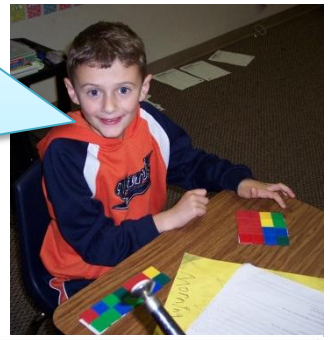
Teacher E

I use tiles to make a rectangle with 15 tiles. We look at it in different orientations. I ask them to describe each one in different ways and explain whether they have the same area.



Then I give each pair 12 tiles and ask them to make a rectangle. I ask if they think they could make another rectangle with 12 tiles, making sure they predict its size before they make it. It's important to ask them to check they've found them all and explain why. Then I give them other numbers of tiles to investigate.

I've learned about factors and square numbers too. You can only make one rectangle with 11 tiles – and I know why!



Area	Length	Width
24 cm²	24 cm	1 cm
	12 cm	2 cm
	8 cm	3 cm
	6 cm	4 cm

Polygons video

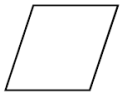
In this lesson, a teacher diagnoses Y11 pupils' understanding of polygons. She asks them to use their own criteria to sort shapes drawn on cards.

This teacher particularly effectively:

- encourages pupils to think, keep trying and gain confidence
- listens precisely to what pupils say
- responds to pupils' answers and questions
- finds out what pupils understand and their misconceptions.

The three extracts are very short with a small gap between them for writing. The table below has a cell for each of the four strengths above. For each extract, write in the cells for which you see evidence.

Record evidence of what the teacher does and its impact. Concentrate on the interaction between teacher and pupils. Use enough detail to support evaluation of the four strengths.

Information about extracts	For each extract, record evidence in the relevant cells below
Extract 1 Circle and ellipse 	encourages pupils to think, keep trying and gain confidence
Extract 2 The teacher points to a rhombus, and asks, 'Is that regular?' 	listens precisely to what pupils say
Extract 3 The teacher asks, 'Is that a polygon?' about these two shapes. 	responds to pupils' answers and questions
	finds out what pupils understand and their misconceptions