The National Strategies
Secondary

Assessing pupils' progress in mathematics at Key Stage 3

Year 7 assessment package
Number/algebra

Teacher pack

department for
children, schools and families

QCA Qualifications and Curriculum Authority

Year 7 Number/Algebra task: *Rules R Us* and *What's my picture?*

Levels 3/4/5

The lesson plans in this pack are set out in two columns. The left-hand column has indicative times for activities, highlights the resource sheets required and also has some examples of questions which teachers may wish to use with pupils during the activities. The right-hand column describes each activity in detail.

APP ASSESSMENT CRITERIA
These lessons may generate evidence to help inform judgements against a number of assessment criteria, including the following:

Algebra
- level 5: construct, express in symbolic form, and use simple formulae involving one or two operations

Number and the number system
- level 5: use understanding of place value to multiply and divide whole numbers and decimals by 10, 100 and 1000 and explain the effect

Using and applying mathematics
- level 5: show understanding of situations by describing them mathematically using symbols, words and diagrams.

LESSON 1: *RULES R US*
Resources
- Two sets of digit cards, each numbered with the digits 1 to 9 **(T1L1resource1 and 2)**. One set should show digits in black and the other set in red, though the words 'Black' and 'Red' have been included in case printing in colour is not possible
- *Rules R Us cards* **(T1L1resource3 to 6)**
  Preparation: Before the lesson, print or stick one copy of each resource sheet onto card. Again, if it is not possible to print using colour, the words 'Black' and 'Red' are given under the digits. (Alternatively, copy the sheets onto blank plastic cards to create a more durable resource: labelling which set a given card belongs to helps ensure that cards are returned to their correct envelopes at the end of the lesson.) Cut out the cards from set A, shuffle to lose the ordering, then place them inside an envelope labelled 'A'. Repeat until you have 11 envelopes labelled 'A' to 'K'. Note that you may need to adapt this part of the activity to the needs and ability level of your class. You may, for example, wish to use multiple copies of sets that generate easier rules, removing ones that are more demanding. You may also wish to use the blank resource sheet **(T1L1resource7)** to create sets of cards from rules of your choice
- Assessment sheets for pupils:
  Each pupil needs one or more of the following worksheets, depending on ability:
  Level 3/4 pupils: *Rules R Us sheet 1* **(T1L1assess1)**
  Level 4/5 pupils: *Rules R Us sheet 2* **(T1L1assess2)**
  Level 5 pupils: *Rules R Us sheet 3* **(T1L1assess3)**
  Pupils who complete the assessment with confidence may wish to attempt the next in the series of worksheets. For level 4/5 pupils, the following worksheet is available:
  Extension activity: *Rules R Us sheet 4* **(T1L1assess4)**
- Paper for group activity and any rough working

Starter
about 10 minutes

T1L1resource1
T1L1resource2

Tell the pupils you are thinking of a rule. You are going to ask a pupil to choose one black digit and one red digit from the digit cards **(T1L1resource1 and 2)**. Then you will tell them if their cards are a winning combination… or not.

Ask a pupil and, provided the sum of their digits is greater than 4, use the rule that the digits must add to that total. For example: if the pupil chooses black 4 and red 6, the rule is that **the digits must add to 10**. Say that black 4, red 6 is a winning combination.

If the sum of the digits is not greater than 4, say it is not a winning combination, then ask another pupil to choose.

Now ask for other pairs of digits. List all of the suggested combinations on the board, separating the winning combinations from the losing ones and always recording the black digit on the left, e.g.

Black	Red
4	6

Black	Red
5	6

Encourage pupils to state what they think the rule might be. At this stage do not confirm whether a rule is correct, but ask the pupils to test the suggested rule by giving further winning combinations. Continue until all winning combinations have been found.

If no one had said e.g. black 7 and red 3, how could you tell from our ordered list that this is a winning combination?

Discuss how you know there are no more winning combinations. Would rearranging the combinations in the table help pupils to be certain that there are no more winning ones?

As the digits in the black column are ascending/increasing, the red digits are…? [descending/ decreasing]

What is a short, mathematical way of describing the rule?

Discuss the rule. Start by writing it in words, e.g. 'the black digit and the red digit must add to 10', but discuss what shorthand could be used to save time. Note that some pupils will wish to use multiple letters, e.g. '*b d*' for the black digit. Discourage this by emphasising the need to be as concise as possible, e.g. suggesting $\boldsymbol{b + r = 10}$

Look at the winning combinations for the rule b + r = *14. Why doesn't it matter if we write the rule as* r + b = *14 instead?*

Repeat the activity using a different but similar rule, e.g. $\boldsymbol{b + r = 14}$

Talk about this new rule, e.g. $b + r = 14$
Is it the same rule as $r + b = 14$? Why?

Are the winning combinations the same for the rules b = *6* – r *and* r + b = *6?*

Finally, show the pupils this table:

b	*r*
6	3
9	6
4	1

Are the winning combinations the same for the rules b – r = *6 and* r – b = *6?*

Using only the digit cards 1 to 9, how many different winning combinations are there for the rules r + b = *2,* r + b = *3,* r + b = *4 and so on?*

Explain that only three winning combinations are shown. What other winning combinations might there be, and why?

Ask pupils for the rule, i.e. $b - 3 = r$

	Discuss different ways to write the same rule, e.g. $b - r = 3$, $b = r + 3$, $b = 3 + r$, $r = b - 3$ … How can we be certain that these rules are the same? Is $b - r = 3$ the same rule as $r - b = 3$? Why not? (Note that choosing values for b and r and checking the results is a worthwhile and valid strategy.)
Group activity about 20 minutes **T1L1resource3** **T1L1resource4** **T1L1resource5** **T1L1resource6** **or** **T1L1resource7** *How else can we write* b × *2* = r*?* *Is there a shorter way of writing it?* *What about* b = r ÷ *2?*	Give each group one envelope which they must not open until told **(T1L1resource3 to 6 or T1L1resource7)**. Keep any spare envelopes on an easily accessible table. Tell the pupils that each envelope contains all the winning combinations for a rule: they should use these cards to work out the correct rule which they should write down on a sheet of paper, alongside the label letter from the envelope. Then they should place all the cards back in the envelope and return it to the table. They should then take a different envelope… and so on. The winning group will be the first one to find all the rules, at which point the answers can be given (see below). Note that limiting the number of envelopes, perhaps to one more than the number of groups, can increase motivation as groups become more eager for a specific envelope. Also note that teachers may wish to adapt this activity to the needs of their particular class. A worksheet template **(T1L1resource7)** is provided for this purpose. Answers: Set A $b + r = 7$, or $b = 7 - r$, etc Set B $b - 2 = r$, or $b - r = 2$, etc Set C $b = r$, or $b - r = 0$, etc Set D $b + 5 = r$, or $b = r - 5$, etc Set E $b + r = 15$, or $b = 15 - r$, etc Set F $b \times 2 = r$, or $b = r \div 2$, etc Set G $b - 4 = r$, or $b - r = 4$, etc Set H $b^2 = r$, or $b \times b = r$, etc Set I $b \div 2 = r$, or $b = 2 \times r$, etc Set J $b \times 3 = r$, or $b = r \div 3$, etc Set K $b \div 3 = r$, or $b = 3 \times r$, etc Briefly discuss answers. Remind the pupils that so far only the digits 1 to 9 have been used when making winning combinations. Ask what other types of numbers could be used – e.g. bigger numbers, smaller numbers, negatives, decimals, fractions, etc. Tell the pupils that the rules used so far have been ‘one-step’ rules with just one number operation, but that some rules could be ‘two-step’ rules, e.g. $b \times 2 - 3 = r$.

Assessment activity about 15 minutes **T1L1assess1** **T1L1assess2** **T1L1assess3** **T1L1assess4** *'Addition makes numbers bigger.' When is this statement true and when is it false?* *'Subtraction makes numbers smaller.' When is this statement true and when is it false?*	Give out the assessment sheets as listed below. Please stress to pupils that they should try to use a range of operations and different types of numbers, e.g. negatives or non-integers, wherever they feel confident in order to show what they can do. Level 3/4 pupils: *Rules R Us sheet 1* **(T1L1assess1)** Level 4/5 pupils: *Rules R Us sheet 2* **(T1L1assess2)** Level 5 pupils: *Rules R Us sheet 3* **(T1L1assess3)** If time permits, pupils who complete the assessment with confidence may wish to attempt a further worksheet. The following worksheet is available for level 4/5 pupils: Extension activity: *Rules R Us sheet 4* **(T1L1assess4)**
Plenary about 5 minutes *How can we check whether all three rules have the same winning combinations?* *Explain the difference between these three equations.* *How could you use inverse operations to check that a calculation is correct?*	Show the pupils these three rules: $m = d + 8$ $d = m - 8$ $8 = d + m$ Does it matter that the letters used are not *b* and *r*? Are the three rules the same? How do you know? (As noted earlier, choosing values for *m* and *d* and checking the results is a worthwhile and valid strategy.) What should the pupils change to make the rules the same?

LESSON 2: *WHAT'S MY PICTURE?*

Resources

- Teacher OHT/whiteboard slide: *What's my picture? – the beginning* **(T1L2teacher1)**
  A red OHT pen or board pen will also be needed
- Each pupil, or each group of pupils, needs one copy of the following pupil resource sheet:
  What's my picture? sheet 1 **(T1L2pupil1)**
- Each pupil needs a red pen, pencil or crayon
- Teacher OHT/whiteboard slide:
  What's my picture? sheet 1 (answers) **(T1L2teacher2)**
- Assessment sheets for pupils:
  Each pupil needs one or more of the following pairs of worksheets, depending on ability:
  Level 3/4 pupils: *What's my picture? sheet 2* **(T1L2assess1a)**
  What's my picture? sheet 2 (continued) **(T1L2assess1b)**
  Level 5 pupils: *What's my picture? sheet 3* **(T1L2assess2a)**
  What's my picture? sheet 3 (continued) **(T1L2assess2b)**
- Each pupil, or each group of pupils, needs either graph paper or squared paper, or one copy of the following pupil resource sheet:
  What's my picture? sheet 4 **(T1L2pupil2)**
  Note that teachers may wish to use this pupil resource sheet as an OHT/whiteboard slide, to help illustrate pupils' findings
- Squared paper for group activity and any rough working

Starter about 5 minutes *What is the smallest possible difference between* b *and* r*?* *If* b = *0.2* [or alternative decimal]*, what is the value of* r*? What if* r *were 0.2* [or same alternative decimal]*?* *What is* b *if* r *is equal to 0.02?* *If I add 0.1 to* b*, what must I do to* r*?* *If I subtract 0.2 from* b*, what must I do to* r*?*	Give the rule $b + r = 3$ and ask for winning combinations. Record correct answers on the board in a table, spacing entries so that others can be inserted, to keep the winning combinations in numerical order. If necessary, prompt pupils for combinations using zero or decimals (for now you may wish to avoid negatives). Ask whether we could make a table big enough to show all winning combinations? Why not? Now ask what the *r* value is if the *b* value is 0.2 (choose a different value if 0.2 is already in the table). Repeat a few times to establish the idea of finding the *r* value if the *b* value is known.
Individual/whole-class activity about 10 minutes **T1L2teacher1** **T1L2pupil1** **T1L2teacher2**	Show the top half of the OHT/whiteboard slide: *What's my picture? – the beginning* **(T1L2teacher1)** Only the first number line should be shown. Say that the rule is $b + r = 3$ The black dot is at zero. Where should the red dot be if $b + r = 3$? Ask a pupil to put a red dot at the correct place on the number line. Then show the second number line with the black dot at 1. Where should its red dot be?

Is there a quick way to know where the dots go? *Does/will your picture have any symmetry? Can you explain your answer?* *What would the picture look like if the number lines were extended, so that the* b *values could be negative?* *What might the picture look like if the horizontal scale ran from –1 to 2 instead of from 0 to 3? Would it be symmetrical?* *If you joined the dots with two straight lines, where would they meet? Why?* *What scale could you use to ensure one number line has the black and red dots in the same position* [e.g. any range including the value 1.5]*?* *Why are the lines straight and not curved? Could they curve? How could you make this happen?* *If we change the scale on our sets of number lines to allow any range of numbers, however large or small, would we still get the same shape?*	Finally show the third number line with the black dot at 2.5. Where should its red dot be? Give out the pupil resource sheet: *What's my picture? sheet 1* **(T1L2pupil1)** Explain that the resource sheet shows a set of these number lines, one under the other, and the dots show some of the *b* values. Explain that they should put a dot on each of the number lines to represent the *r* value for each given *b* value, remembering that the rule is $b + r = 3$. Give the pupils time to complete this task. Discuss the picture using, if needed, OHT/whiteboard slide: *What's my picture? sheet 1 (answers)* **(T1L2teacher2)** What would the values of *b* and *r* be for the red and black dots to be in the same position (i.e. so that the lines of dots 'meet' or 'intersect')? What would it look like if the number lines were extended to show numbers that were bigger than 3 and smaller than 0? Suppose the *b* value was a really large number, what would we know about its *r* value? What if the *r* value was a really large number? What if more values were shown between 0 and 3?
Assessment activity about 20 minutes **T1L2assess1a** **T1L2assess1b** **T1L2assess2a** **T1L2assess2b**	Before this activity starts, discuss the set of number lines and remind the pupils that not all the *b* values and *r* values can be shown. Ask pupils to describe the *b* values that are not shown, e.g. negative numbers, numbers greater than 3, numbers that are not multiples of 0.2. Give out the assessment sheets as listed below: Level 3/4 pupils: *What's my picture? sheet 2* **(T1L2assess1a)** *What's my picture? sheet 2 (continued)* **(T1L2assess1b)** Level 5 pupils: *What's my picture? sheet 3* **(T1L2assess2a)** *What's my picture? sheet 3 (continued)* **(T1L2assess2b)** During the activity, the pupils need to refer to their resource sheet *What's my picture? sheet 1* **(T1L2pupil1)** as they begin to generalise. Teachers may need to reassure pupils during the assessment that for some of the *b* values given, the *r* values cannot be plotted on the number lines.

Group activity about 10 minutes **T1L2pupil2** *Probing questions used in the individual/whole-class activity can also be used here.*	Remind pupils what the picture for $b + r = 3$ looked like. What do they think the picture for $b + 2 \times r = 3$ will look like? Ensure that pupils understand the rule by discussing at least one pair of values, e.g. $b = 0, r = 1.5$ Some pupils can then create the picture for $b + 2 \times r = 3$, while others could create other pictures, e.g. for $b + 3 \times r = 3$ or $b + 0.5 \times r = 3$ The pupil resource sheet *What's my picture? sheet 4* **(T1L2pupil2)** may be useful for this activity, or pupils may prefer to create their own number lines starting with their own values of b.
Plenary about 5 minutes **T1L2pupil2**	Draw together findings from the group activity. What is the same and what is different about their pictures? What can they predict? Teachers may wish to use the pupil resource sheet *What's my picture? sheet 4* **(T1L2pupil2)** as an OHT/whiteboard slide, to help illustrate pupils' findings.

Teacher resource sheets

T1L1resource1

Black digit cards

1 **Black**	2 **Black**	3 **Black**
4 **Black**	5 **Black**	6 **Black**
7 **Black**	8 **Black**	9 **Black**

T1L1resource2

Red digit cards

1 Red	2 Red	3 Red
4 Red	5 Red	6 Red
7 Red	8 Red	9 Red

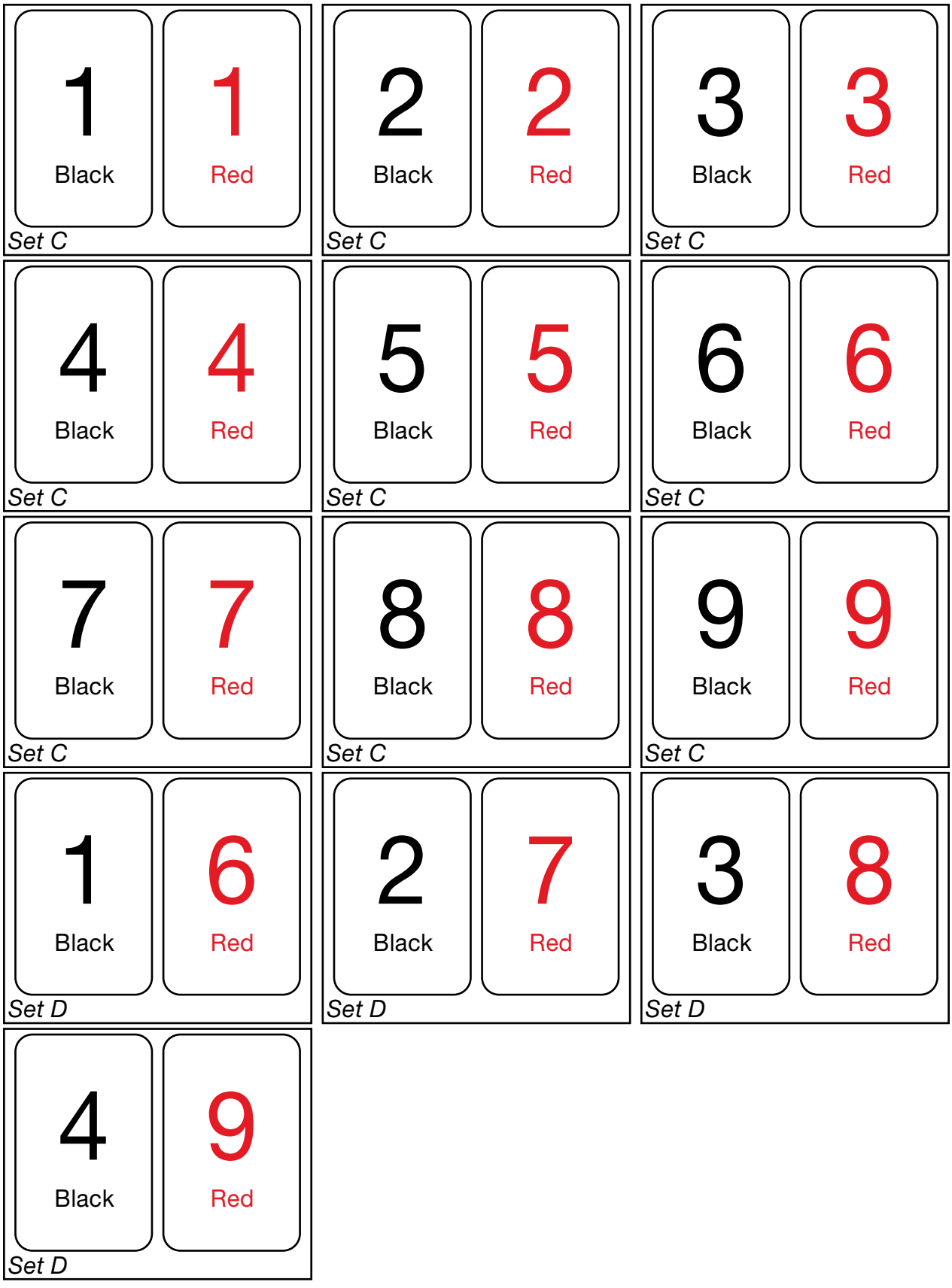
T1L1resource3

***Rules R Us cards*, Set A and Set B**

1 Black / 6 Red — *Set A*	2 Black / 5 Red — *Set A*	3 Black / 4 Red — *Set A*
4 Black / 3 Red — *Set A*	5 Black / 2 Red — *Set A*	6 Black / 1 Red — *Set A*
3 Black / 1 Red — *Set B*	4 Black / 2 Red — *Set B*	5 Black / 3 Red — *Set B*
6 Black / 4 Red — *Set B*	7 Black / 5 Red — *Set B*	8 Black / 6 Red — *Set B*
9 Black / 7 Red — *Set B*		

T1L1resource4

***Rules R Us cards*, Set C and Set D**



T1L1resource5

***Rules R Us cards*, Set E, Set F and Set G**

6 Black, 9 Red — *Set E*	7 Black, 8 Red — *Set E*	8 Black, 7 Red — *Set E*
9 Black, 6 Red — *Set E*		1 Black, 2 Red — *Set F*
2 Black, 4 Red — *Set F*	3 Black, 6 Red — *Set F*	4 Black, 8 Red — *Set F*
9 Black, 5 Red — *Set G*	8 Black, 4 Red — *Set G*	7 Black, 3 Red — *Set G*
6 Black, 2 Red — *Set G*	5 Black, 1 Red — *Set G*	

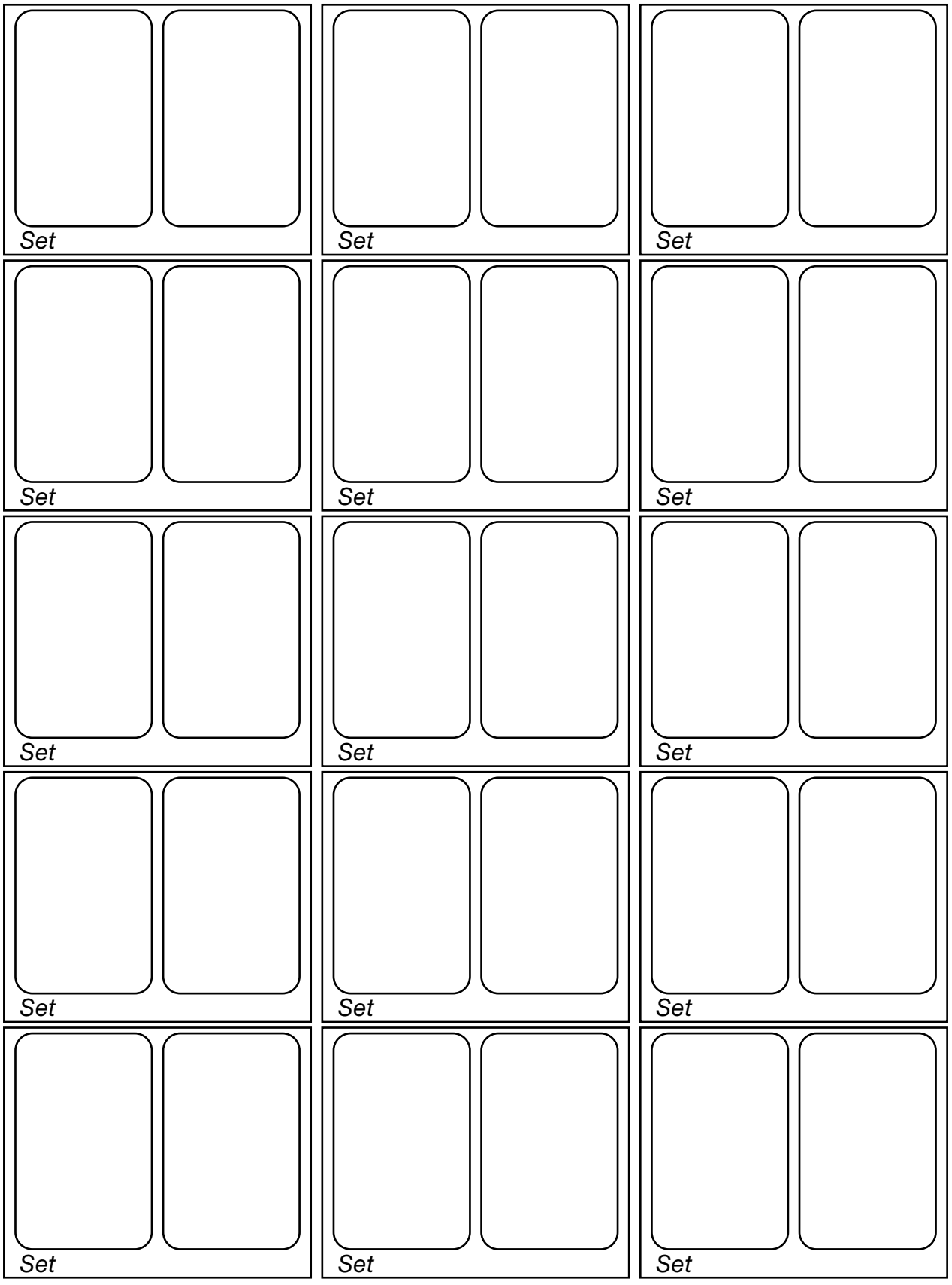
T1L1resource6

***Rules R Us cards*, Set H, Set I, Set J and Set K**

1 Black, 1 Red — *Set H*	2 Black, 4 Red — *Set H*	3 Black, 9 Red — *Set H*
8 Black, 4 Red — *Set I*	6 Black, 3 Red — *Set I*	4 Black, 2 Red — *Set I*
2 Black, 1 Red — *Set I*		
1 Black, 3 Red — *Set J*	2 Black, 6 Red — *Set J*	3 Black, 9 Red — *Set J*
9 Black, 3 Red — *Set K*	6 Black, 2 Red — *Set K*	3 Black, 1 Red — *Set K*

T1L1resource7

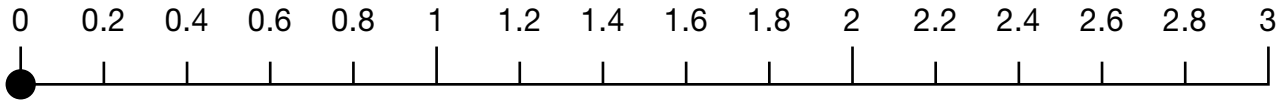
***Rules R Us cards*, blank**

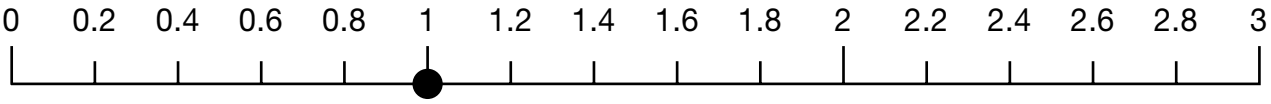


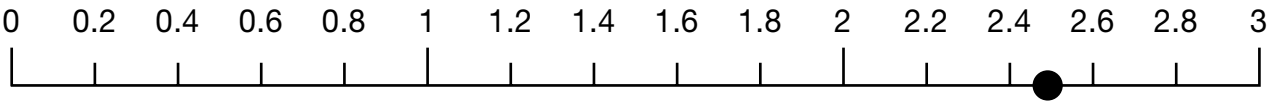
T1L2teacher1

What's my picture? – the beginning

$b + r = 3$



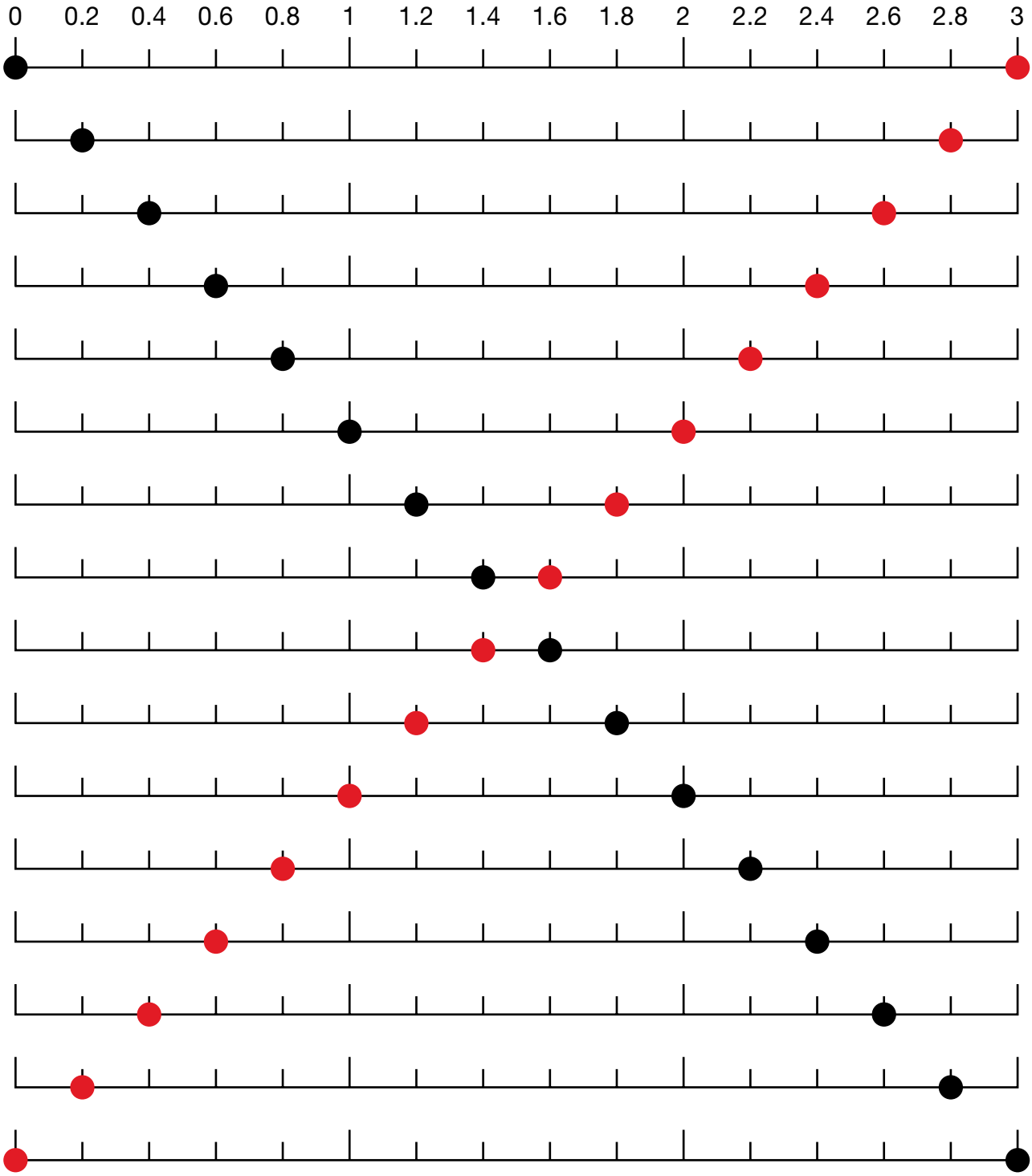




T1L2teacher2

***What's my picture? sheet 1* (answers)**

$b + r = 3$



Pupil sheets

T1L1assess1

Rules R Us sheet 1 Name: _____

Each table shows three winning combinations.
What could the rules be? Write each rule in the correct box.

b	*r*
1	5
3	3
4	2

Rule:

b	*r*
5	50
6	60
7	70

Rule:

b	*r*
12	11
18	17
30	29

Rule:

Look at the pair of tables below.
They show the same winning combination… **but their rules are different**.
What could the rules be?
Write them in the boxes, then write **another two winning combinations** for each rule.

b	*r*
5	10
.....	.....
.....	.....

Rule:

b	*r*
5	10
.....	.....
.....	.....

Rule:

T1L1assess2

Rules R Us sheet 2 Name: _____

Each of these tables shows three winning combinations.
What could the rules be? Write them in the boxes.

b	*r*
2	10
6	6
9	3

Rule:

b	*r*
4.5	3.5
9.5	8.5
16.5	15.5

Rule:

Now look at the first pair of tables below.
They show the same winning combination… **but their rules are different**.
What could the rules be?
Write them in the boxes, then write **another two winning combinations** for each rule.

b	*r*
2	6
.....	.....
.....	.....

Rule:

b	*r*
2	6
.....	.....
.....	.....

Rule:

Do the same for this pair.

b	*r*
8	4
.....	.....
.....	.....

Rule:

b	*r*
8	4
.....	.....
.....	.....

Rule:

T1L1assess3

Rules R Us sheet 3 Name: _____

Each pair of tables shows the same winning combination… **but their rules are different**.
What could the rules be?
Write them in the boxes, then write **another two winning combinations** for each rule.

b	*r*
5	2.5
.....	.....
.....	.....

Rule:

b	*r*
5	2.5
.....	.....
.....	.....

Rule:

b	*r*
0.1	1
.....	.....
.....	.....

Rule:

b	*r*
0.1	1
.....	.....
.....	.....

Rule:

b	*r*
4	−4
.....	.....
.....	.....

Rule:

b	*r*
4	−4
.....	.....
.....	.....

Rule:

T1L1assess4

Rules R Us sheet 4

Name: _____

In how many **different** ways can you write the rule $b + r = 3$?

In *Rules R Us sheet 3*, the table for each rule showed three winning combinations. How many winning combinations are there for each rule? Why?

Here is one of the winning combinations for another rule:

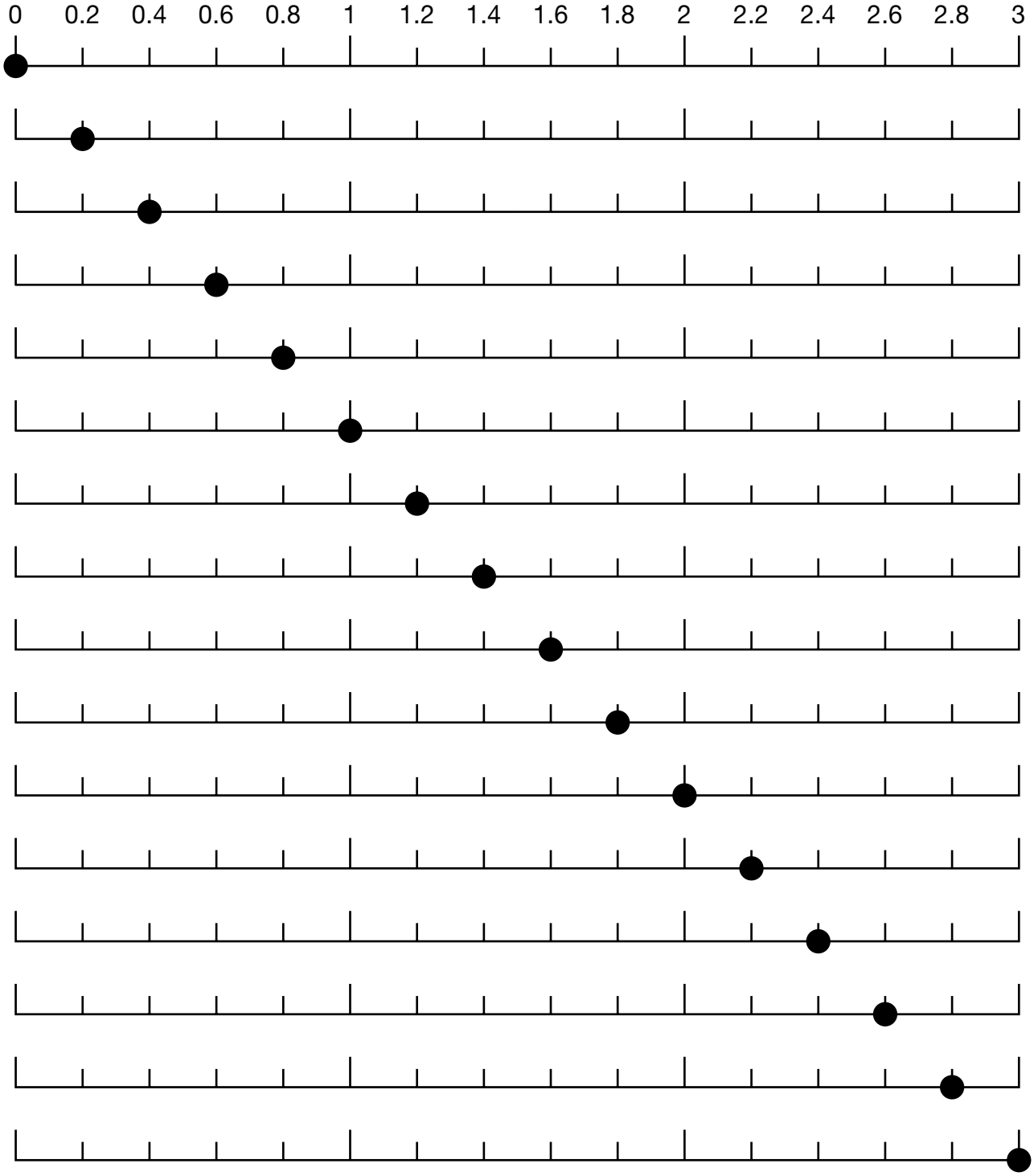
b	r
4	6

What could the rule be? Write as many different rules as you can.

T1L2pupil1

What's my picture? sheet 1 Name: _____

$b + r = 3$

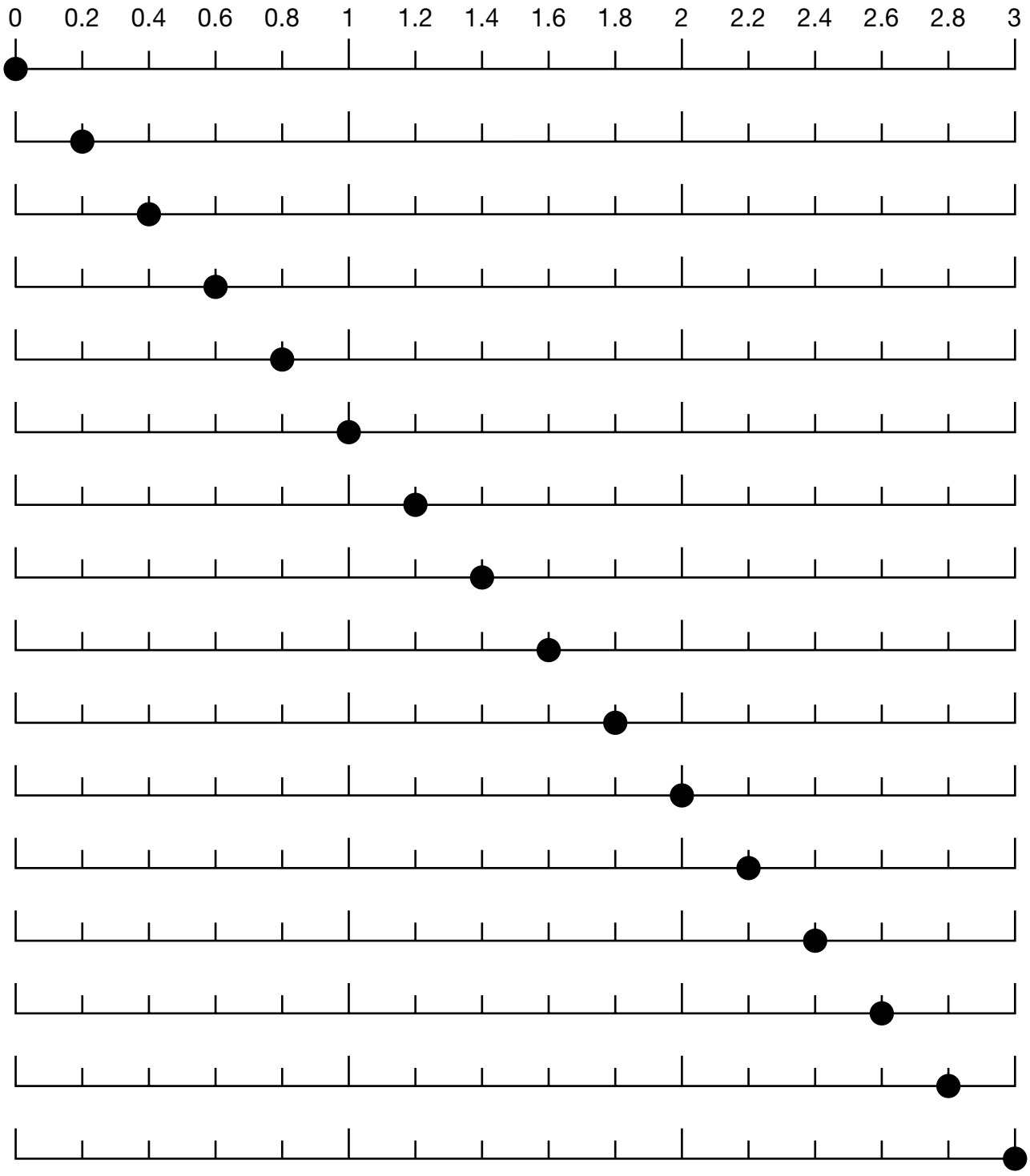


T1L2assess1a

What's my picture? sheet 2 Name: _____

Complete the picture by showing the red dots.

$b + r = 2$



T1L2assess1b

What's my picture? sheet 2 (continued) Name: _____

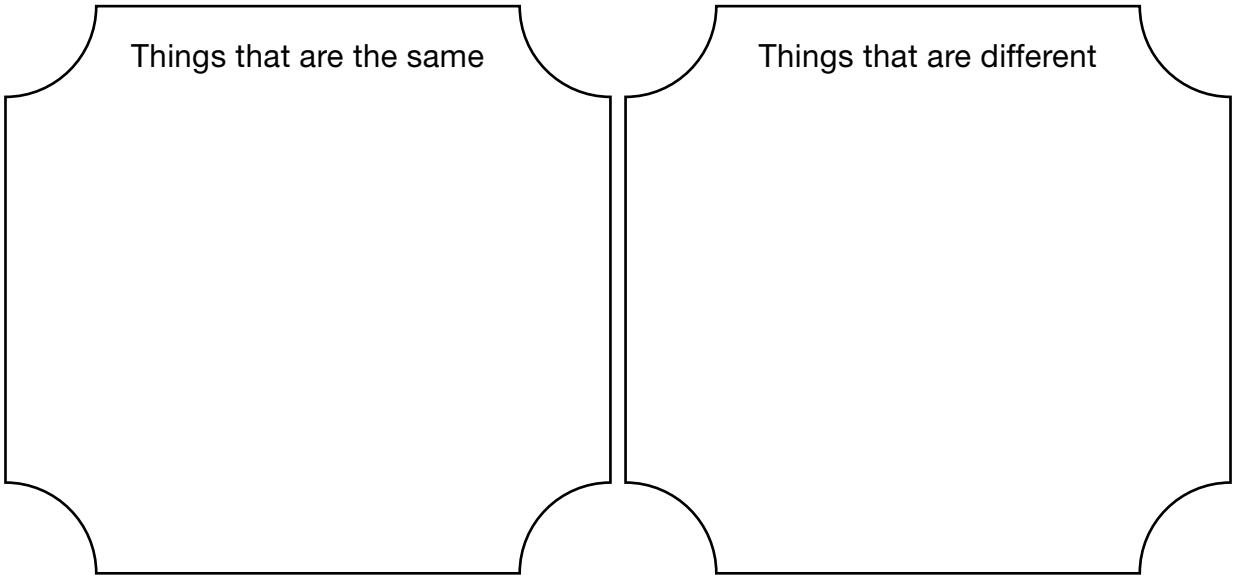
Many pairs of values of *b* and *r* are not shown on your number line picture.

Choose a *b* value that is not on your number line picture .....

What would its *r* value be? .....

Look at your pictures for $b + r = 2$ and $b + r = 3$

What is the same and what is different about your pictures?



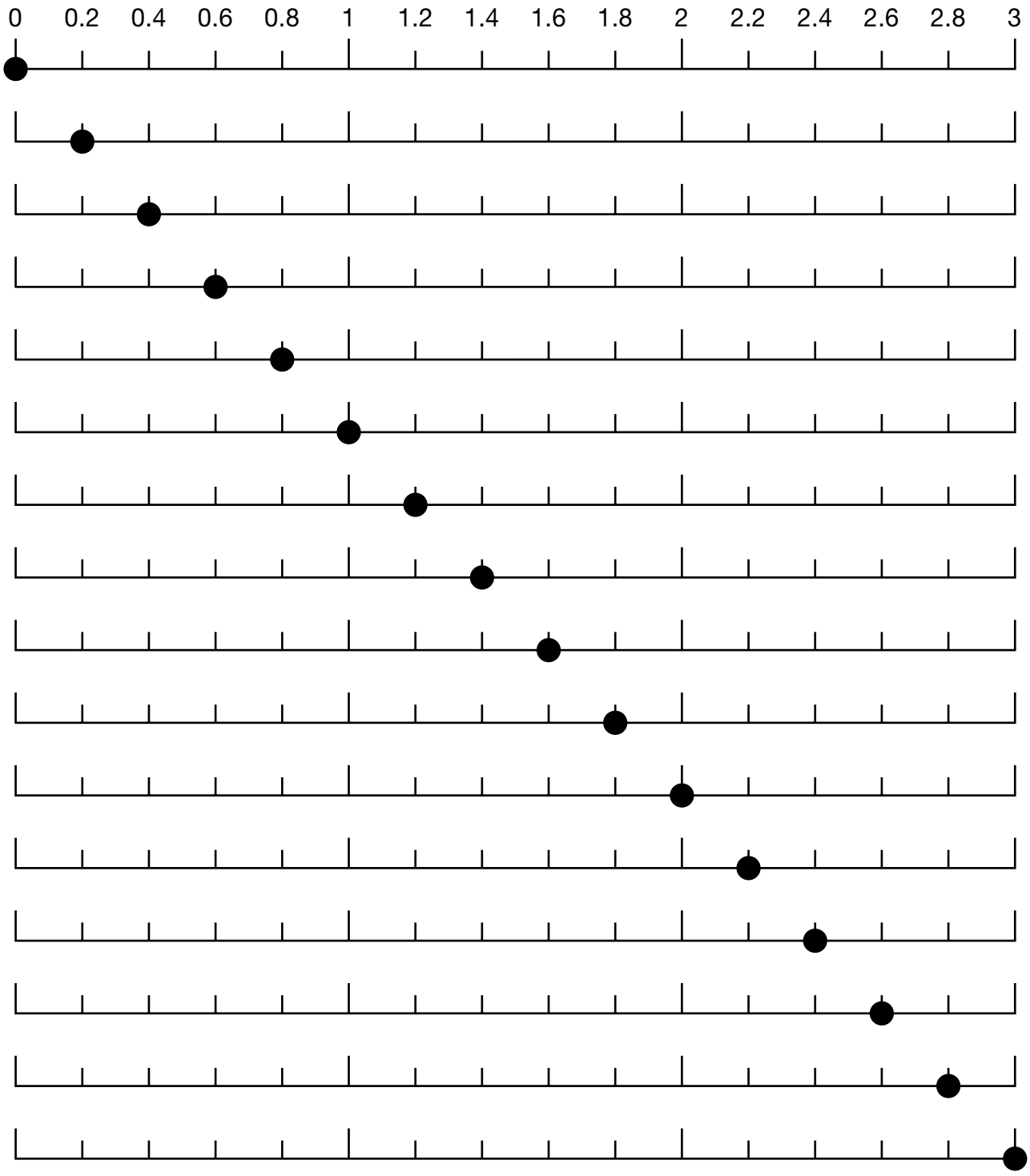
What would the picture for $\boldsymbol{b + r = 1}$ look like?
You can write your answer in words, or you can do a small sketch below, or you can draw it on your sheet called '*What's my picture? sheet 2*'.

T1L2assess2a

What's my picture? sheet 3 Name: _____

Complete the picture by showing the red dots.

$b - r = 1$



T1L2assess2b

What's my picture? sheet 3 (continued) Name: _____

Many pairs of values of b and r are not shown on the number line picture.

Choose a b value that is smaller than 0 .....

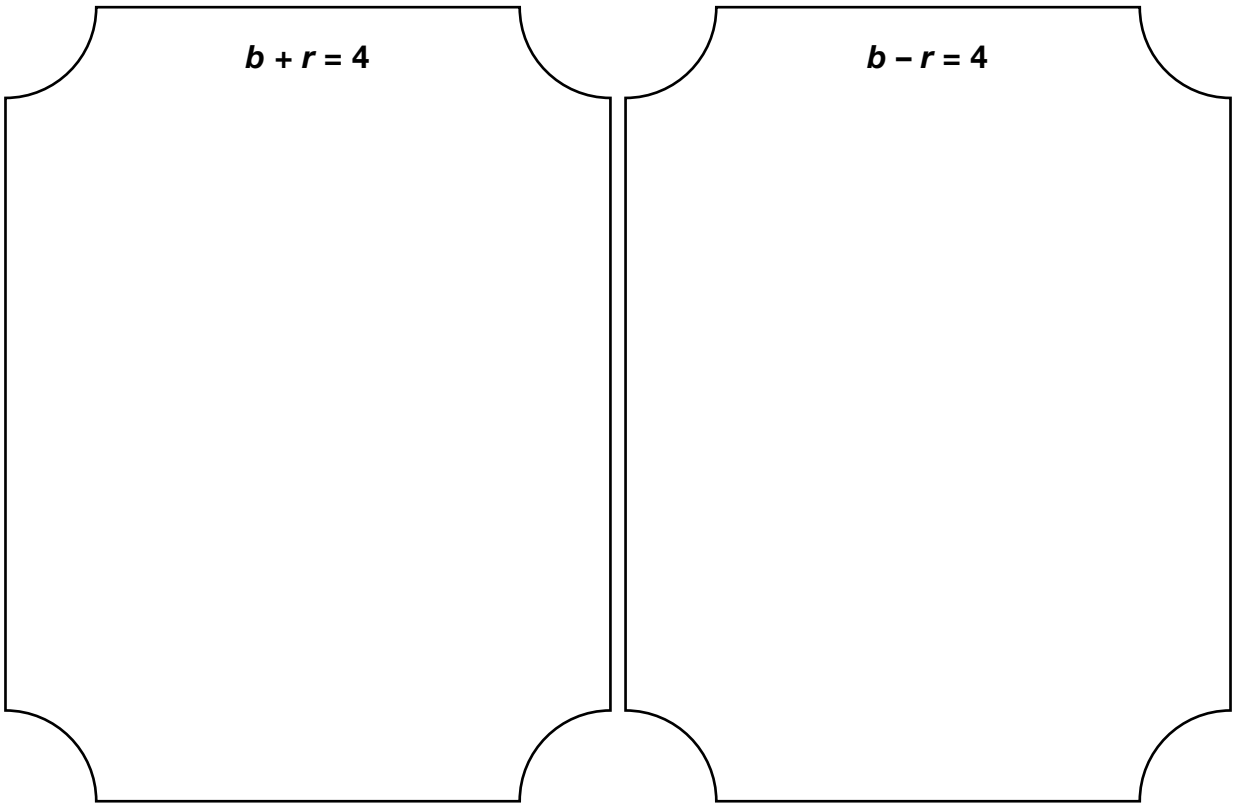
What would its r value be? .....

The picture for $b + r = 3$ was two lines that would cross where b and r are both 1.5

Describe your picture for $b - r = 1$

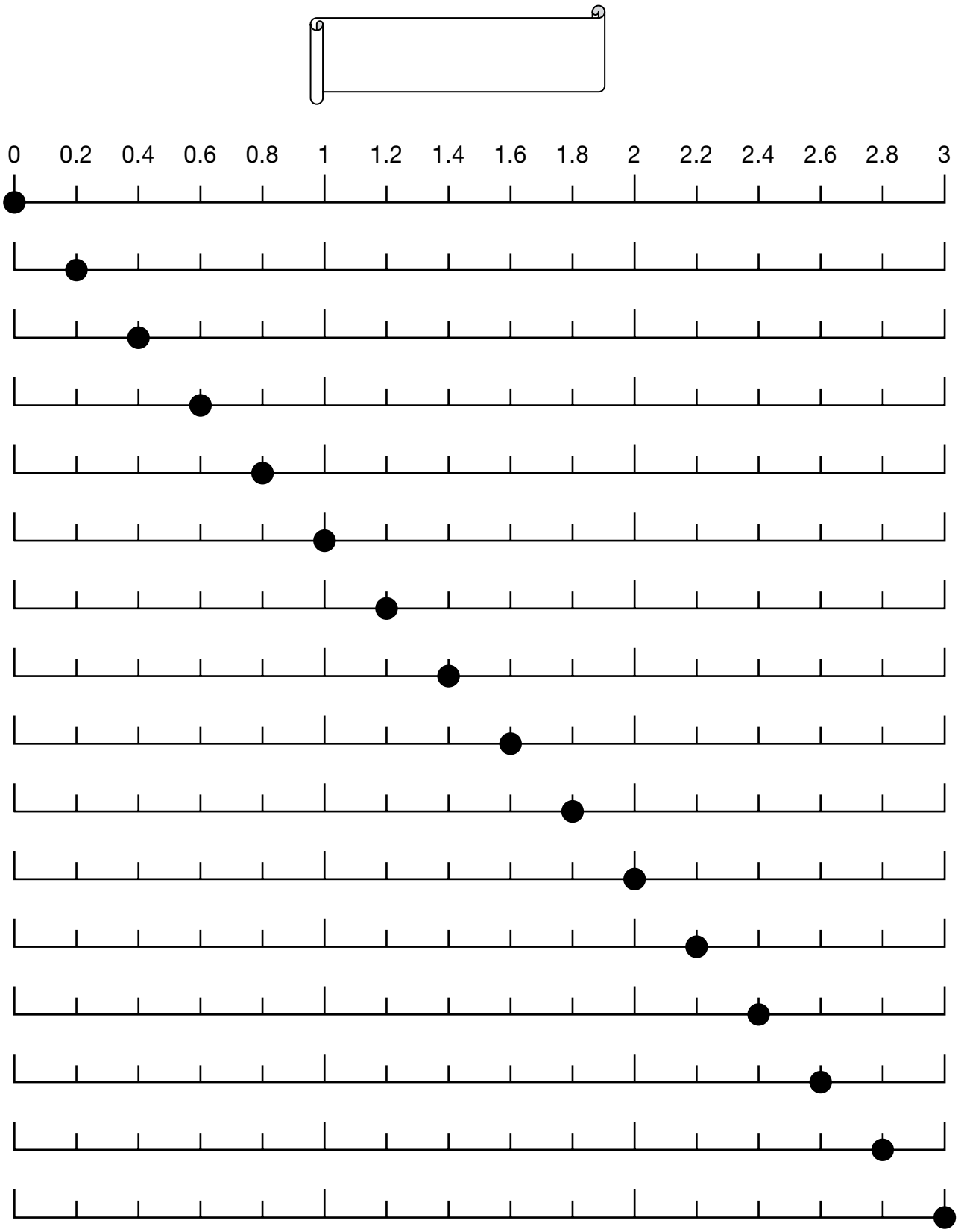
What would the pictures for $b + r = 4$ and $b - r = 4$ look like?

You can write your answer in words, or you can do a small sketch below.



T1L2pupil2

What's my picture? sheet 4 Name: _____



Solutions and performance indicators

LESSON 1: *RULES R US* **Solutions**

Rules R Us sheet 1 (target level 3/4)	**T1L1assess1**
Solutions	Notes
$b + r = 6$, or equivalent	**Good** responses give correct rules using letters. **Better** responses also use conventional algebraic notation where appropriate.
$b \times 10 = r$, or equivalent	
$b - 1 = r$, or equivalent	
Any rule that works for $b = 5$ and $r = 10$, e.g. $b + r = 15$, $b + 5 = r$ or $b \times 2 = r$ Two pairs of values that work for their rule	**Good** responses for the pair of tables give two correct rules that look different from one another. **Better** responses give two correct rules that are not equivalent to one another and also give pairs of values that work for their rules.
A different rule from any given previously that works for $b = 5$ and $r = 10$ Two pairs of values that work for their rule	
Rules R Us sheet 2 (target level 4/5)	**T1L1assess2**
Solutions	Notes
$b + r = 12$, or equivalent	**Good** responses give correct rules using letters.
$b - 1 = r$, or equivalent	
Any rule that works for $b = 2$ and $r = 6$, e.g. $b + r = 8$, $b + 4 = r$ or $b \times 3 = r$ Two pairs of values that work for their rule	**Good** responses for each pair of tables give two correct rules that look different from one another. **Better** responses give two correct rules that are not equivalent to one another and also give pairs of values that work for their rules.
A different rule from any given previously that works for $b = 2$ and $r = 6$ Two pairs of values that work for their rule	
Any rule that works for $b = 8$ and $r = 4$, e.g. $b + r = 12$, $b - 4 = r$ or $b \div 2 = r$ Two pairs of values that work for their rule	
A different rule from any given previously that works for $b = 8$ and $r = 4$ Two pairs of values that work for their rule	

Rules R Us sheet 3 (target level 5)	**T1L1assess3**
Solutions	Notes
Any rule that works for $b = 5$ and $r = 2.5$, e.g. $b + r = 7.5$, $b - 2.5 = r$ or $b \div 2 = r$ Two pairs of values that work for their rule	**Good** responses for each pair of tables give two correct rules that look different from one another. **Better** responses give two correct rules that are not equivalent to one another and also give pairs of values that work for their rules.
A different rule from any given previously that works for $b = 5$ and $r = 2.5$ Two pairs of values that work for their rule	
Any rule that works for $b = 0.1$ and $r = 1$, e.g. $b + r = 1.1$, $b + 0.9 = r$ or $b \times 10 = r$ Two pairs of values that work for their rule	
A different rule from any given previously that works for $b = 0.1$ and $r = 1$ Two pairs of values that work for their rule	
Any rule that works for $b = 4$ and $r = -4$, e.g. $b + r = 0$ or $b - 8 = r$ Two pairs of values that work for their rule	
A different rule from any given previously that works for $b = 4$ and $r = -4$ Two pairs of values that work for their rule	

Rules R Us sheet 4 (extension activity)	**T1L1assess4**
Solutions	Notes
Equations that are equivalent to $b + r = 3$, e.g. $r + b = 3$ $\quad b = 3 - r$ $\quad r = 3 - b$ $-b = r - 3$ $\quad -r = b - 3$ $\quad b + r - 3 = 0$ $2b - b + r = 3$ $\quad b + r = 10 - 7$ $\quad b + r + 1 = 4$	**Good** responses may also contain incorrect equations that look similar. **Better** responses give a range of equations and are more consistent.
Response indicating that there is an infinite number of combinations, e.g. • 'You can have an infinite number' • 'You can have as many as you want' • 'It goes on forever' An explanation for why this is the case, e.g. • 'There are an infinite number of numbers to use' • 'You can use decimal numbers with as many decimal places as you like' • 'Use negative numbers, e.g. 4 and –4, 5 and –5…'	**Good** responses show understanding that there is an infinite number of combinations. **Better** responses also give an explanation showing some generality.
Different rules that work for $b = 4$ and $r = 6$, e.g. $b + r = 10$ $\quad b + 2 = r$ $\quad b \times 1.5 = r$ $b \times 2 - 2 = r$ $\quad b \div 2 + 4 = r$ $\quad b \times r = 24$ $b \div r = \frac{2}{3}$ $\quad b \times 3 + r \times 5 = 42$ [Note that apparently different equations may be equivalent, e.g. $b + r = 10$ and $b = 10 - r$]	**Good** responses may also contain some incorrect equations or equations that are actually equivalent. **Better** responses give a range of equations and are more consistent.

LESSON 1: *RULES R US* Performance indicators

Note that performance indicators involving an element of 'Using and applying mathematics' are given in **bold**.

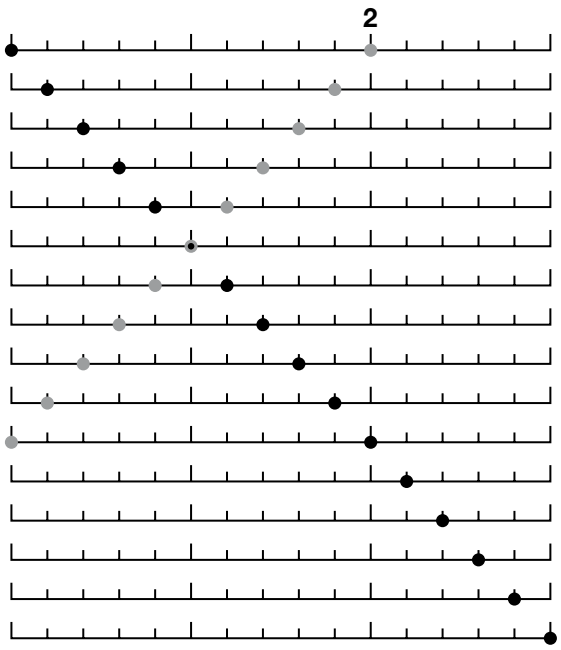
<table>
<tr><th>Worksheet</th><th>Performance indicators</th></tr>
<tr><td>Rules R Us sheet 1
(target level 3/4)
T1L1assess1</td><td rowspan="3">Level 3:
At this level, pupils are generally able to:
• write simple rules linking two variables using symbols;
• write pairs of values that work for their rule, using small positive integers;
• think of simple alternative rules that work for common pairs of values.
However, they are less likely to be able to:
• use letters to stand for variables consistently for all rules with varying operations;
• retain the idea that the rule must link the pairs of numbers in the rows rather than reflecting patterns in the numbers in the columns.

Level 4:
At this level, pupils are generally able to:
• write rules linking two variables using symbols consistently;
• think of alternative rules that work for common pairs of values, using some different operations;
• write pairs of values that work for their rule, using a range of fairly simple numbers;
• give some equivalent rules by rearranging a simple rule, e.g. $r + b = 3$ as equivalent to $b + r = 3$.
However, they are less likely to be able to:
• show familiarity with conventional algebraic notation, e.g. $\frac{b}{2}$ for $b \div 2$;
• use rules with a range of operations or more than one step;
• recognise that, when trying to give different rules, some rules that look different are actually equivalent, e.g. $b \times 3 = r$ and $r \div 3 = b$;
• experiment with non-integers or negatives that work for their rule;
• avoid incorrect, but similar, equations when trying to give equivalent equations, e.g. $b + 3 = r$ as equivalent to $b + r = 3$;
• show some understanding that there is an infinite number of pairs of values that satisfy a given rule.

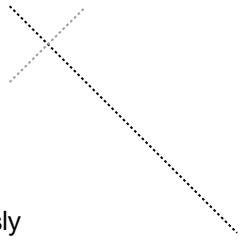
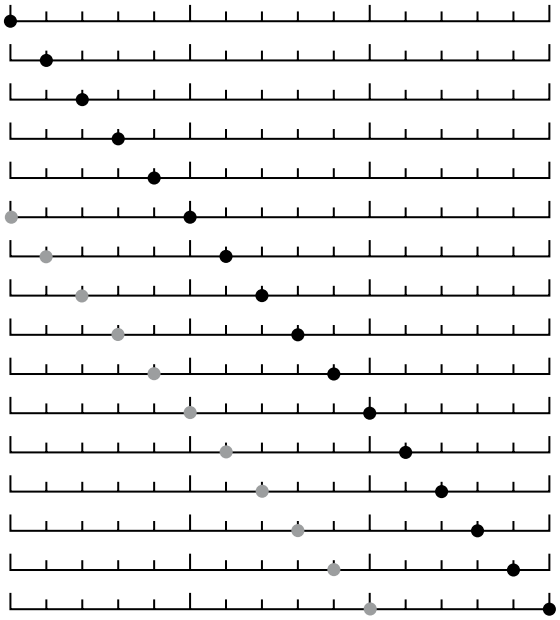
(See next page for level 5 indicators)</td></tr>
<tr><td>Rules R Us sheet 2
(target level 4/5)
T1L1assess2</td></tr>
<tr><td>Rules R Us sheet 4
(extension activity)
T1L1assess4</td></tr>
</table>

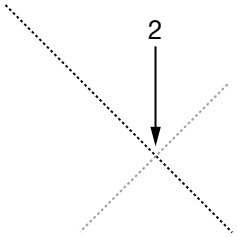
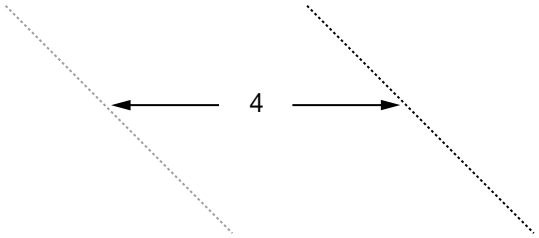
Worksheet	Performance indicators
Rules R Us sheet 3 (target level 5) **T1L1assess3** *Rules R Us sheet 4* (extension activity) **T1L1assess4**	**Level 5:** At this level, pupils are generally able to: • show familiarity with conventional algebraic notation, e.g. $\frac{b}{2}$ for $b \div 2$; • **think of alternative rules that work for common pairs of values**, using a range of different operations or rules with more than one step; • write pairs of values that work for their rule, dealing with non-integers and negatives; • give a range of equivalent rules by rearranging a simple rule, e.g. $3 - b = r$ as equivalent to $b + r = 3$; • avoid incorrect, but similar, equations when trying to give equivalent equations, e.g. $b + 3 = r$ as equivalent to $b + r = 3$; • **show some understanding that there is an infinite number of pairs of values that satisfy a given rule**. However, they are less likely to be able to: • apply conventional algebraic notation consistently; • recognise consistently that, when trying to give *different* rules, some rules that look different are actually equivalent; • give equivalent rules generated by increasing the number of terms or using negative terms, e.g. $b + r + 1 = 4$ or $-b = r - 3$; • **give a general explanation for why there is an infinite number of pairs of values that satisfy a given rule**. **Above level 5:** At these levels, pupils are generally able to: • give evidence for the performance indicators listed previously for pupils working at level 5, plus; • apply conventional algebraic notation consistently; • recognise consistently that, when trying to give *different* rules, some rules that look different are actually equivalent; • give equivalent rules generated by increasing the number of terms or using negative terms, e.g. $b + r + 1 = 4$ or $-b = r - 3$; • **begin to explain why there is an infinite number of pairs of values that satisfy a given rule in general terms** rather than just using specific examples; • use brackets and a range of operations, e.g. squaring, when giving different rules that work for common pairs of values, e.g. $3(b + r) = 30$ or $b^2 - 10 = r$.

LESSON 2: *WHAT'S MY PICTURE?* Solutions

What's my picture? sheet 2 (target level 3/4)	**T1L2assess1a**
Solutions	Notes
	**Good** responses may include extra incorrect points for values of $r > 2$. **Better** responses show only the correct points.

What's my picture? sheet 2 (continued) (target level 3/4)	**T1L2assess1b**
Solutions	Notes
A value of b so that $b < 0$ or $b > 2$, then the correct corresponding value of r so that the pair sums to 2, e.g. -1 and 3 or 10 and -8 OR A value of b that is between 0 and 2 but not shown by a marker on the number lines, then the correct corresponding value of r so that the pair sums to 2, e.g. 0.5 and 1.5 or 0.01 and 1.99	**Good** responses identify a value of b without a corresponding red dot on the number lines. **Better** responses also calculate the corresponding value of r.
Example(s) of things that are the same about the two pictures, e.g. • 'They both make crosses' • 'The black dots go down but the red dots go up' • 'As the red numbers get bigger, the black ones get smaller' • 'The lines are sloping at 45°' Example(s) of things that are different about the two pictures, e.g. • 'The red line is not as long in the 2nd one' • 'The red dots have moved up (or left)' • 'One crosses at 1.5, the other crosses at 1' • 'The red dots start at 3 in one, but 2 in the other'	**Good** responses make general observations about the shape of the pictures. **Better** responses give specific values when describing the pictures in more detail.

What's my picture? sheet 2 (continued) (target level 3/4)	**T1L2assess1b**
Solutions	Notes
Correct statement(s) about or sketch of the picture for $b + r = 1$, e.g. • 'It's a cross' • 'The points meet at 0.5' • 'The red line has moved even further up (or left)' • A sketch (or drawing on their sheet 2 or sheet 4):  The fact that the 'red' line goes through 1 or that the lines cross at 0.5 may not be explicit, provided it is clear enough that the 'red' line within the number line picture is shorter than previously	**Good** responses make general observations about the shape of the picture. **Better** responses give specific values when describing the picture in more detail.
What's my picture? sheet 3 (target level 5)	**T1L2assess2a**
Solutions	Notes
	**Good** responses may include extra incorrect points for values of $r > 2$. **Better** responses show only the correct points.
What's my picture? sheet 3 (continued) (target level 5)	**T1L2assess2b**
Solutions	Notes
A value of b that is less than 0, then the correct corresponding value of r so that $b - r = 1$, e.g. -1 and -2 or -0.1 and -1.1	**Good** responses identify a value of b without a corresponding red dot on the number lines. **Better** responses also calculate the corresponding value of r.
Correct statement(s) about the picture for $b - r = 1$, e.g. • 'The lines are parallel' • 'The lines never cross' • 'The lines are 1 unit apart' • 'The lines are always a distance of 1 apart'	**Good** responses make general observations about the shape of the picture. **Better** responses give specific values and state or imply that lines are parallel when describing the picture in more detail.

What's my picture? sheet 3 (continued) (target level 5)	**T1L2assess2b**
Solutions	Notes
Correct statement(s) about or sketch of the picture for $b + r = 4$, e.g. • 'It's a cross' • 'The points meet at 2' • 'It crosses where b and r are 2' • A sketch:  Note that the external outline of the number line picture is not needed, but there needs to be an indication that the crossing point is where b and r are 2 Correct statement(s) about or sketch of the picture for $b - r = 4$, e.g. • 'The lines are parallel' • 'The lines never cross' • 'They are 4 units apart' • 'The lines are always a distance of 4 apart' • A sketch:  As before, the external outline of the number line picture is not needed, but there needs to be an indication that the lines are four units apart	**Good** responses make general observations about the shape of the pictures. **Better** responses give specific values and state or imply that lines are parallel when describing the pictures in more detail.

LESSON 2: *WHAT'S MY PICTURE?* Performance indicators

Note that performance indicators involving an element of 'Using and applying mathematics' are given in **bold**.

<table>
<tr><th>Worksheet</th><th>Performance indicators</th></tr>
<tr><td>What's my picture? sheet 2
(target level 3/4)
T1L2assess1a</td><td rowspan="2">Level 3:
At this level, pupils are generally able to:
• substitute values into a simple rule, e.g. $b + r = 2$, to find the corresponding values and represent these fairly accurately on a diagram;
• identify a value of b for which no red dot can be shown on the given diagram;
• describe simple features of the pictorial representations of rules, e.g. 'They make crosses' or 'One has a shorter red line';
• plot specific points in order to show the pictorial representation of a similar addition rule.
However, they are less likely to be able to:
• avoid plotting extra incorrect points resulting from an error in calculating with negatives;
• substitute a value of b for which no red dot can be shown in the given rule to find its corresponding value correctly;
• give detailed descriptions of the pictorial representations of rules, e.g. recognising the importance of where the lines cross;
• describe features of the pictorial representation of a similar addition rule, without necessarily needing an accurate diagram.

Level 4:
At this level, pupils are generally able to:
• avoid plotting extra incorrect points resulting from an error in calculating with negatives;
• substitute a value of b for which no red dot can be shown in the given rule to find its corresponding value correctly;
• give detailed descriptions of the pictorial representations of rules, e.g. recognising the importance of where the lines cross;
• describe features of the pictorial representation of a similar addition rule, without necessarily needing an accurate diagram.
However, they are less likely to be able to:
• make advanced observations about the pictorial representations of rules, e.g. 'They slope at 45°' or 'With adding, you always get a cross'.

(See next page for level 5 indicators)</td></tr>
<tr><td>What's my picture? sheet 2 (continued)
(target level 3/4)
T1L2assess1b</td></tr>
</table>

<table>
<tr><th>Worksheet</th><th>Performance indicators</th></tr>
<tr><td>What's my picture? sheet 3
(target level 5)
T1L2assess2a</td><td rowspan="2">Level 5:
At this level, pupils are generally able to:
• give descriptions of pictorial representations of subtraction rules that state or imply that the lines are parallel or note their distance apart;
• predict the appearance of similar addition and subtraction rules without needing an accurate diagram;
• give a description of the pictorial representation of an addition rule that recognises the importance of where the lines cross.
However, they are less likely to be able to:
• substitute a negative value of b in the equation $b - r = 1$ to calculate the correct corresponding value of r;
• give descriptions of pictorial representations of subtraction rules that state or imply that the lines are parallel and recognise the importance of the distance between them.

Above level 5:
At these levels, pupils are generally able to:
• give evidence for the performance indicators listed previously for pupils working at level 5, plus;
• substitute a negative value of b in the equation $b - r = 1$ to calculate the correct corresponding value of r;
• give descriptions of pictorial representations of subtraction rules that state that the lines are parallel and recognise the importance of the distance between them;
• start to generalise about how the pictorial representations for 'addition rules' and 'subtraction rules' behave.</td></tr>
<tr><td>What's my picture? sheet 3 (continued)
(target level 5)
T1L2assess2b</td></tr>
</table>

Audience: Teachers
Date of issue: 06-2009
Ref: **00588-2009PDF-EN-01**

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Published by the Department for
Children, Schools and Families

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