KS2 Reasoning & Problem Solving Questions
Reasoning and Problem Solving Questions

Information

This booklet contains over 40 reasoning and problem solving questions suitable for KS2 and KS3 classes. These are the questions that we have been putting out each day in March 2016 on Twitter in the run up to SATS.

The answers are provided with some simple notes at the back of the booklet and for some questions supplementary questions and variation has been provided.

We hope to release more questions like this over the course of next year including some open ended problems. Please keep a look out for our work. If you have not seen our schemes and assessments for primary then please take a look at our website www.whiterosemathshub.co.uk

As always we welcome any feedback on the work we are doing and the materials that we are releasing.

Thank you for taking an interest in our work.

The White Rose Maths Hub Team
Reasoning and Problem Solving Questions

Children’s Responses

Children’s responses will tell you a lot about their depth of understanding of a given topic. For example

Some children may approach this using trial and error.
Some may say that 1.5 is equivalent to \( \frac{3}{2} \) and then try and work out equivalent fractions e.g. \( \frac{6}{4}, \frac{9}{6} \) and realise difference increases by 1 each time.
Some may try and form an equation.

Bar Modelling – Pictorial Methods

Many of the problem solving questions in this booklet can be solved using a bar modelling method. Encourage children to use diagrams to help them solve the problem.

Here is a problem where bar modelling would help.

If you want to find out more about bar modelling please contact the Hub.

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1. Here are 3 identical rectangles. Part of each shape has been shaded. What fraction of the middle shape is shaded?

2. Here are 3 identical rectangles. Part of each shape has been shaded. What fraction of the middle shape is shaded?
1 Mrs Jones has £20 to spend on presents. 
She buys 4 mugs and 3 teddy bears. 
What is the greatest number of key-rings she can buy?

2 Lollies are sold in two sizes, small and large. 
Sanjay buys two small lollies for 92p 
Jenny buys 5 small lollies and 3 large lollies and pays with a £10 note. 
Jenny receives £4.16 change. 
How much does one large lolly cost?
1. Here is a square.
   Inside the square is an equilateral triangle.
   The perimeter of the triangle is 54 cm.
   Find the perimeter of the square.

2. The perimeter of the rectangle is 33 metres.
   Find the length of the rectangle.
Fractions Friday

1. Choose one of these symbols

   \(<, >\) or \(=\)

   to make the number sentences correct.

   \[
   \frac{1}{5} \quad \quad \quad \frac{1}{7} \quad \quad \quad \frac{3}{5} \quad \quad \quad \frac{4}{7}
   \]

   You may use the fraction strips below to help you.

2. A square is divided into smaller squares.

   What fraction is shaded?
1. Des has two bags of sweets.
   Each bag contains only lime and strawberry sweets.
   There are 20 sweets in each bag.
   
   - In the first bag there is 1 lime sweet for every 3 strawberry.
   - In the second bag there are 2 lime sweets for every 3 strawberry.

   How many more lime sweets are there in the second bag?

2. A tower is made of red and green cubes.
   For every 1 red cube there are 2 green cubes.
   Each cube has a height of 2.5cm
   The tower is 30cm tall.

   How many green cubes are in the tower?
1. Three numbers are marked on a number line.

   A  O  C  B

   - The difference between A and B is 28
   - The difference between A and C is 19
   - D is 10 less than C

What is the value of D?
Can you mark D on the number line?

2. Louise is thinking of a number.

   - It is less than 50
   - It is a 2-digit number.
   - 3 is a factor of this number.
   - The sum of its digits is one third of the number.

What number is Louise thinking of?
1. The diagram shows two identical triangles. The co-ordinates of three points are shown. Find the co-ordinates of point A.

2. A is the point (0, -10)
   B is point (8, 0)
   The distance from A to B is two-thirds of the distance from A to C
   Find the co-ordinates of C.
1 Work out the missing values

\( \frac{2}{5} \) of 30 = 3 \times \_

\( \frac{7}{10} \) of 30 = \( \frac{3}{4} \) of \_

2 Here is a number card

A quarter of the card is 14

Find \( \frac{2}{7} \) of the card.

3 Sarah has some cookies in a jar.

In January she eats \( \frac{5}{8} \) of the cookies.

There are 12 cookies left in the jar.

How many were in the jar at the start?
Number Reasoning

Here is part of a multiplication grid.

<table>
<thead>
<tr>
<th>×</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
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<td>9</td>
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</tr>
</tbody>
</table>

Shade in any other squares that have the same answer as the shaded square.

Sally multiplies a number by 100
Her answer has three digits.
The hundreds and ones digit are the same.
The sum of the digits is 10
What number could Sally have started with?
Are there any others?
Shape Problems

1. This shape is made of a regular pentagon and a square.

   The area of the square is 81cm².

   Find the perimeter of the shape.

2. This diagram is made up of two different sized rectangles.

   For each large rectangle the length is double the width.

   The length of the diagram is 60m.

   Find the area of one of the small rectangles.
### Fractions & Percentages

1. \( \frac{1}{2} \) of \( A \) = \( B \)

2. 25\% of \( B \) = \( C \)

   If \( A \) is 36 find the value of \( C \)

2. 25\% of \( P \) = \( Q \)

   \( \frac{1}{5} \) of \( Q \) = \( R \)

   10\% of \( R \) = 7

   Calculate \( P + R \)

### Question 3

Geoff is reading a book.

On Monday he reads \( \frac{1}{3} \) of the book.

On Tuesday he reads \( \frac{3}{10} \) of the remaining pages.

He has 35 pages left to read.

How many pages are in the book?

For Q3 you may find it helpful to draw a bar model or other diagram to help you.
1. In the pyramid the two numbers below add to the make the number above.
Complete the number pyramid.

Can you write all of your answers as fractions in their simplest form?

2. A plank of wood is 4.6 metres long.

Three lengths of wood are cut from the plank.

How much wood is left?
1. Class 6 are doing a survey. They ask 20 people this question.  
   “How many pets do you own?”  
   The results are shown in this bar chart.

   How many pets in total do these people own?

2. Here are the heights of three horses.  
   160cm  \( \frac{1}{2} \) m  1.73m  
   What is the mean height?  
   Tino is another horse.  
   The mean height of all four horses is 1.62m  
   Find the height of Tino.
1. Filip buys 4 strawberry cupcakes and 1 chocolate cupcake.

Filip paid £3.70.

A chocolate cupcake costs 25 pence more than a strawberry one.

How much does a chocolate cupcake cost?

2. A shape is made up of a square and rectangle.

The perimeter of the shape is 70 cm.
The area of the square is 121 cm².

What is the area of the rectangle?
1 Two friends buy some chocolate bars. Each bar cost £1.18.

There is a special offer on.

Buy one bar, get a second half price

They buy 5 bars and split the cost equally.

How much do they each pay?

2 A shop owner buys oranges in boxes of 5. She buys 8 boxes of oranges. The cost of each box is £2.40.

The owner sells the oranges separately. She sells them for 70 pence each.

By the end of the week she sells \( \frac{9}{10} \) of the oranges.

How much profit has she made?
1  Laura buys:

- 3kg of potatoes
- and 2.5kg of carrots.

She pays with a £20 note.

How much change does she get?

2  Here are two number cards.

Here is some information about the cards.

- When you divide A by B you get 1.5
- The difference between A and B is 7

Find the value of A and B.
1. A 5p coin has a thickness of 1.6mm.

Jake makes a tower of 5p coins worth 90p. What is the height of the coins in cm?

2. Jamie has a number.

If I divide my number by 5 I get 12.

What answer does Jamie get if she divides the same number by 15? Explain your answer.

3. Here is a rule for generating a sequence.

Multiply the previous term by 3 and subtract 4.

The second term of the sequence is 5.

Find the difference between the first and fourth terms of the sequence.
Weighty Problems

1. A football and toy train together weigh 360g.

Three footballs and two toy trains weigh 810g.

Find the weight of a toy train.

2. The mass of a box of chocolates is 290g. The box contains 7 identical chocolates.

Manish eats 3 chocolates. The mass of the box is now 194g.

Find the weight of the empty box.
1 The symbol ★ means

Double the first number and then subtract the second number

e.g. $5 \star 2 = 8$

Find the missing values

$$\frac{2}{5} \star \frac{3}{10} = \square$$

$$2 \star \square = 2\frac{1}{4}$$

$$\left(\frac{3}{4} \star \frac{1}{2}\right) \star 3\frac{2}{5} = \square$$

2 Maz and Fred each make a tower using red and yellow cubes.

Their towers are the same height.

- $\frac{3}{8}$ of Maz’s tower are red cubes
- $\frac{5}{6}$ of Fred’s tower are red cubes

Maz uses 9 red cubes.

How many red cubes does Fred use?
One egg and one slice of toast costs £1.94

Three eggs and two slices of toast costs £5

How much does one slice of toast cost?

These three chicks lay some eggs.

Beth lays twice as many as Kelsey.
Caroline lays 4 more than Beth.
They lay 44 eggs in total.
How many eggs does Caroline lay?

You might find it useful to draw a bar model or other diagram to answer Q2.
1. Beans can be bought in single tins or as a multipack of 4 tins.

Ben buys 10 single tins.
John buys 2 multipacks and 2 single tins.

I paid £1.24 less than Ben.

How much does a multipack of beans cost?

2. Cola is sold in bottles and cans.

Yasmin buys 5 cans and 3 bottles.
She sells the cola in glasses.

100ml glass of cola only 25p
She sells all of the cola.
How much profit does she make?
## Reasoning and Problem Solving Questions

<table>
<thead>
<tr>
<th>Sheet</th>
<th>Answer</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>What fraction is shaded?</td>
<td>( \frac{3}{20} )</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \frac{13}{30} )</td>
<td></td>
</tr>
<tr>
<td>Presents and lollies</td>
<td>5 keyrings</td>
<td>How much change would she get? £1.18</td>
</tr>
<tr>
<td>Perimeter problems</td>
<td>72 cm</td>
<td>Find the area of the square.</td>
</tr>
<tr>
<td></td>
<td>12.9 m</td>
<td>Find the area of the rectangle.</td>
</tr>
<tr>
<td>Fractions Friday</td>
<td>&gt;, &gt;</td>
<td>Can they write their own problems to challenge each other?</td>
</tr>
<tr>
<td></td>
<td>( \frac{16}{49} )</td>
<td>Shade in more squares so that ( \frac{5}{7} ) is shaded.</td>
</tr>
<tr>
<td>Ratio problems</td>
<td>3 more lime sweets</td>
<td>First bag has 5 lime sweets Second bag has 8 lime sweets How many strawberry sweets are there in total?</td>
</tr>
<tr>
<td></td>
<td>There are 8 green cubes</td>
<td>There are 12 cubes in the tower.</td>
</tr>
<tr>
<td>Number problems</td>
<td>( D = -3 )</td>
<td></td>
</tr>
</tbody>
</table>
Reasoning and Problem Solving Questions

<table>
<thead>
<tr>
<th>Co-ordinate problems</th>
<th>(9,7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(12,5)</td>
</tr>
</tbody>
</table>

| Fraction of an amount | 4  
|-----------------------| 28 |
|                       | 16 |

| 32 cookies |

<table>
<thead>
<tr>
<th>Number reasoning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade in all the square numbers.</td>
</tr>
<tr>
<td>What fraction of the numbers are greater than 50?</td>
</tr>
</tbody>
</table>

| 4.24 is one possibility | Various answers |

Encourage students to make up their own number problems.
## Reasoning and Problem Solving Questions

<table>
<thead>
<tr>
<th><strong>Shape problems</strong></th>
<th>63 cm</th>
<th>Large rectangle: Length = 24 m Width = 12 m Small rectangle: Length = 12 m Width = 8 m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>96 m²</td>
<td></td>
</tr>
<tr>
<td><strong>Fractions &amp; percentages</strong></td>
<td>C = 4.5</td>
<td>B = 18 What happens if the value of A is changed? What is the value of A if B = 36?</td>
</tr>
<tr>
<td></td>
<td>1470</td>
<td>R = 70 Q = 350 P = 1400</td>
</tr>
<tr>
<td></td>
<td>75 pages</td>
<td>A bar model diagram may help students answer this question.</td>
</tr>
</tbody>
</table>

### Wednesday workout

In its simplest form.

Students may find it easier to work in hundredths to begin with.

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## Statistics problems

- 24 pets

Students may struggle to realise that they need to multiply the height of the bar by the number of pets.

<table>
<thead>
<tr>
<th>Height (m)</th>
<th>1.31 m left or equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students may struggle to realise that they need to multiply the height of the bar by the number of pets.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistics problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 pets</td>
</tr>
</tbody>
</table>

### Two different problems

- 94 pence
- $13 \times 11 = 143 \text{ cm}^2$

Some students may have worked out the area of the large rectangle which is $24 \times 11 = 264 \text{ cm}^2$

### Chocolate orange

- £2.36

How much more would they each have to pay if they bought 6 bars? How much would they save by buying the 6 bars together?
## Reasoning and Problem Solving Questions

| **Number problems** | £6 profit | She has 40 oranges in total  
She sells 36 oranges  
She makes £25.20  
They cost her £19.20 |
|---------------------|-----------|---------------------------------------------------|
| **£14.01 change**   | Potatoes cost £2.34  
Carrots cost £3.65 |
| A = 21  
B = 14 | Encourage students to find the fractional equivalent of 1.5 and then use equivalent fractions. |
| **Three quick questions** | 2.88 cm | With explanation.  
Is there a connection between Jamie’s number and the answers? |
| | 4 | |
| | 26 | 1<sup>st</sup> term = 3  
2<sup>nd</sup> term = 5  
3<sup>rd</sup> term = 11  
4<sup>th</sup> term = 29  
Does the difference increase if the 2<sup>nd</sup> term is 8?  
What is the difference if the 2<sup>nd</sup> term is -10 |
| **Weighty problems** | Train = 270 g  
66 g | Football = 90 g  
Each chocolate = 32 g |

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## Reasoning and Problem Solving Questions

<table>
<thead>
<tr>
<th>Fraction problems</th>
<th>$\frac{1}{2}$ or equivalent</th>
<th>Students could make up their own problems and their own special symbols.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1 \frac{3}{4}$ or equivalent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$-1 \frac{2}{5}$ or equivalent</td>
<td></td>
</tr>
<tr>
<td>20 red cubes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Egg problems</th>
<th>82 pence</th>
<th>Egg = £1.12&lt;br&gt;Toast = 82 pence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20 eggs</td>
<td>Students may find it helpful to draw a bar model for this question.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shopping</th>
<th>£1.66 for a multipack</th>
<th>Ben pays £5.70&lt;br&gt;John pays £4.46&lt;br&gt;Students should show all their working out.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>£6.33 profit</td>
<td>Total ml of cola = 5400&lt;br&gt;Total cost = £7.17&lt;br&gt;She can make 54 glasses of cola&lt;br&gt;She gets £13.50 for the 54 glasses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If she wants to make £10 profit, how much would she have to charge per glass of cola?</td>
</tr>
</tbody>
</table>