## Reasoning and Problem Solving Algebra - Year 6

## About This Resource

This resource is aimed at Year 6 Secure and has been designed to give children the opportunity to consolidate the skills they have learned in Spring Block 3 Algebra.

The questions are based on a selection of the same 'small steps' that are addressed in the block, but are presented in a different way so children can work through the pack independently and demonstrate their understanding and skills.

## Small Steps

Find a rule - one step
Find a rule - two step
Use an algebraic rule
Substitution
Formulae
Word Problems
Solve simple one step equations
Solve two step equations
Find pairs of values
Enumerate possibilities

## National Curriculum Objectives

Mathematics Year 6: (6A1) Express missing number problems algebraically Mathematics Year 6: (6A2) Use simple formulae
Mathematics Year 6: (6A3) Generate and describe linear number sequences Mathematics Year 6: (6A4) Find pairs of numbers that satisfy an equation with two unknowns
Mathematics Year 6: (6A5) Enumerate possibilities of combinations of two variables

Did you like this resource? Don't forget to review it on our website.


PSSST! PSSSST! Listen very carefully - I have only a matter of moments. I'm currently undercover as security for the President. Information suggests there is a secret plot to import illegal plutonium to our country! Will send messages for you to decipher; no longer safe to speak.

Each letter below has an $N^{\text {th }}$ value which you will need to input into the formulas!

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | w | X | Y | Z |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathbf{1 2}$ | $\mathbf{1 1}$ | $\mathbf{1 0}$ | $\mathbf{9}$ | $\mathbf{8}$ | $\mathbf{7}$ | $\mathbf{6}$ | $\mathbf{5}$ | $\mathbf{4}$ | $\mathbf{3}$ | $\mathbf{2}$ | $\mathbf{1}$ | $\mathbf{0}$ | $\mathbf{2 5}$ | 24 | $\mathbf{2 3}$ | $\mathbf{2 2}$ | $\mathbf{2 1}$ | $\mathbf{2 0}$ | $\mathbf{1 9}$ | $\mathbf{1 8}$ | $\mathbf{1 7}$ | $\mathbf{1 6}$ | $\mathbf{1 5}$ | $\mathbf{1 4}$ | $\mathbf{1 3}$ |

1. You have been contacted by a government agent; he will send you information in code. You will need to break the codes and feedback to the Governor of the Spy Agency - a person known to you only as THE BOSS.

2. THE BOSS has been on the phone and needs you to convert a message. You must create a code using the values in the table above and altering the numbers consistently. Write your formula and create a code for the message:

Send map coordinates and vehicle type.

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3. As chief code writer, you are in charge of agreeing the formulae written by less experienced team members. Check the two step codes below and simplify those which could become single step codes.

| $2 \mathrm{~N}+3$ | $12 \mathrm{~N} \div 3+1$ |
| :---: | :---: |
| $N+8-9$ | N+23-5 |
| $3 \mathrm{~N} \div 1$ | 8N-8 |

THE BOSS is unhappy with the amount of codes that needed re-writing. Write some advice to support the other members of the team to help avoid this in the future.

When writing two step codes...
4. Use the formula to work out the message.

5. THE BOSS has asked you to run the training for the new coders. Check their work and highlight those which are accurate to be selected for the Spy Agency.

| INPUT |
| :---: |
| 5 |
| 6 |
| 9 |
| 3 |

\(\left.\begin{array}{|c|}\hline INPUT <br>
4 <br>
4 <br>
5 <br>

7\end{array}\right] \quad \square \mathrm{x}-2, \square\)| OUTPUT |
| :---: |
| 30 |
| 54 |
| 33 |
| 49 |

6. Calculate the code and translate the message.


## FORMULA:



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7. Some of the new coders have come to your office asking for help. They are confused, everyone has written a different code but some are getting the same output for their messages. Can you explain what has gone wrong and how they could change their codes to ensure each is different.

| FORMULAE | What went wrong? | New formulae |
| :---: | :---: | :---: |
| $2 y-2$ |  |  |
| $2(y-1)$ |  |  |
| $a+2-5$ |  |  |
| $a-3$ |  |  |
| $4 n-n$ |  |  |
| $3 n$ |  |  |
| $2 \times(3 b-4)$ |  |  |
| $6 b-8$ |  |  |
|  |  |  |



All undercover agents have 2 number IDs our man is known as 3,5 . The other agents' numbers can be substituted into this formula:

$$
a \times b=24
$$

8. How many agents are there and what are their numbers?
१. For the final assignment, the agents will need items to maintain their cover until the last moment. You have a box which can hold 75 kg of weight. The agents have requested overalls which weigh 5 kg and spanners which weigh 10kg. How many different combinations of overalls and spanners can you put in the box?
9. The agents are posing as mechanics at the single strip air field. We can only survey the airport for 22 hours. Helicopters need 3 hours turn around time, planes need 4 hours turn around time. The agency knows our package will arrive by helicopter. How many potential helicopters could there be in all different combinations of planes and helicopters?

The agents have taken their places. You are ready to receive any last minute changes with your support coders on standby to reply to messages which may alter the whole course of the assignment. This is the final chance to make or break it! The helicopter is spotted over head... this is it! Confirmation that the criminals are on board and have the plutonium in their possession. The agents swoop and secure the gang and the plutonium! Just one problem - the case has an encrypted message. You and your team need to crack it before the timer gets to zero and the whole landing strip goes up with all your agents too!


$$
\begin{aligned}
& 7(x-1) \\
& 8963
\end{aligned}
$$


11. What 8-digit code should the agent type in?

Well done! Your algebraic knowledge saved the day! The world is safe once again and you had a serious hand in that brilliant maths!


1. 'Found where the package will land'
2. Children's answers will vary depending on 'code' written. Teachers should check codes to ensure message translates accurately.

| $\begin{gathered} 2 N+3 \\ N+8-9 \end{gathered}$ | $2 \mathrm{~N}+3$ | $\begin{aligned} & 12 \mathrm{~N} \div 3+1 \\ & \mathrm{~N}+23-5 \end{aligned}$ | $4 \mathrm{~N}+1$ |
| :---: | :---: | :---: | :---: |
|  | N-1 |  | $N+18$ |
| $3 \mathrm{~N} \div 1$ | 3 N | 8N-8 | $8(\mathrm{~N}-1)$ |

When writing two step codes do not use inverse operations (+ and - or x and $\div$ ) as these work together and end up being one-step codes. Obey the rules of order of operations to write the code in its simplest form.
4. 'Hi plane drop at six nine zero four'
5. $23,35,17$

54, 33
6. $2(\mathrm{~N}-1)$, 'Item lands at four bye'

| FORMULAE | What went wrong? | New formulae <br> Answers will vary but should give different outputs |
| :---: | :---: | :---: |
| $2 y-2$ | The second formula will multiply out to equal $2 y-2$ so they create the same output. | $2 y-2$ |
| $2(y-1)$ |  | $y-1$ |
| $a+2-5$ | Add 5, subtract 2 is equal to subtract 3 so the two formulae equate. The second is a simplification of the first. | $a+2$ |
| $a-3$ |  | $a-3$ |
| $4 \mathrm{n}-\mathrm{n}$ | If you multiply a number by 4 then minus the original number, you will have 3 times the number. | $4 \mathrm{n}-3$ |
| $3 n$ |  | $3 n$ |
| $2 \times(3 b-4)$ | When the 2 x in the first equation is applied to the brackets it becomes the second equation. The second formula is a simplification of the first. | $3 \times(3 b-4)$ |
| $6 b-8$ |  | $6 b-8$ |

8. There are 8 other agents: $\begin{array}{lllllll}3,8 & 8,3 & 4,6 & 6,4 & 12,2 & 2,12 & 1,24\end{array} \quad 24,1$
9. $o=$ overalls $s=$ spanners
$1 o+7 s, \quad 3 o+6 s, \quad 5 o+5 s, \quad 7 o+4 s, \quad 9 o+3 s, \quad 11 o+2 s, \quad 13 o+1 s$
10. $p=$ planes $h=$ helicopters
$1 p+6 h, 2 p+4 h, 3 p+3 h$ or $4 p+2 h$ would fit into the 22 hour slot.
11. $49,56,35,14$

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