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Sample topic from the Y8 Fission Guide to the National Curriculum

You have permission to print off this topic
and try it with your students.

This document contains the complete topic (p01-31) and answers (p32-33)

Teachers' notes, worksheets, Star Challenge answers, revision and assessment
for this topic can be downloaded and printed off in the
Y8 Fission Resource Sample document.



Fission

ENJOYMENT

The 'Maths is ...' Jugglers

Knowledge

Skills

Understanding

The Fission Guide to the National Curriculum

Topic 11

Skills in Algebra

CONTENTS

- Section 1: Simple algebraic expressions
- Section 2: More complex algebraic expressions
- Section 3: Equations
- Section 4: A systematic approach to solving equations
- Section 5: Getting more difficult
- Section 6: Solving inequations
- Section 7: Problems, expressions and equations
- Section 8: Equations with brackets
- Section 9: Equations with fractions

Worksheets are required for :

- p4: Six-to-six dominoes
- p10: One star solution patterns & Two star solution patterns
- p18: Crossnumber equations
- p28: Diamond lattice challenge & Equation square puzzles
- p33: The mega-challenge crossword

The Big Edd Guide (Y7) and The Fission Guide (Y8) are **the original texts** that motivated both Teachers and Students - and markedly raised the attainment, in so many schools.

These texts form a two year course. They deliver Levels 4–6 and dip into Level 7.

Big Edd and Fission provide **a sound broad based course** with **the accent on extension**, rather than acceleration. Basic techniques are taught/reinforced and plenty of practice given, but the accent is on problem-solving skills and enjoyment of mathematics. Students are encouraged and enabled to tackle difficult problems.



THE FISSION GUIDE

Topic Title	Main Sections	High Level Challenges
Number Handling <i>Part 1</i>	pp05 – 22	pp23 – 28
Number Handling <i>Part 2</i>	pp29 – 41	pp42 – 46
Symmetry	pp47 – 68	pp69 – 74
Work. w. Letters and Dir. Nos <i>Pt 1</i>	pp75 – 97	pp98 – 100
Work. w. Letters and Dir. Nos <i>Pt 2</i>	pp101 – 123	pp124 – 128
Working with Data	pp129 – 154	pp155 – 158
Fractions, Decimals and % <i>Part 1</i>	pp159 – 178	pp179 – 181
Fractions, Decimals and % <i>Part 2</i>	pp182 – 203	pp204 – 210
Probability	pp211 – 236	pp237 – 238
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Skills in Algebra SAMPLE TOPIC	pp277 – 302	pp303 – 310
Miscellaneous High Level Challenges	—————	pp311 – 330
ANSWERS	pp331 – 352	

THE FISSION GUIDE

At the end of each topic is a section of
HIGH LEVEL CHALLENGES.

Able students are expected to tackle these Challenges
when they have finished a section
(rather than moving onto the next section).

They can also do them in their own time.

Some of these challenges have section labels.
These indicate which section should have been completed
before that challenge should be attempted.

At the end of the book is a section of
MISCELLANEOUS HIGH LEVEL CHALLENGES.

These are not linked to any topics in the book
and can be done at any times and in any order.

They range from short problems to fairly lengthy problems,
to linked sets of problems.

The **High Level Challenges** were first used in the highly successful predecessor to *Headbanger*, the *Big Edd Guide*.

At Tarporley High School, students in our two top sets loved them. Almost all top set students did every High Level Challenge. Many completed all 152 of them before the end of the year, and came back and asked for more. (So there are now 200 in *Headbanger*.)

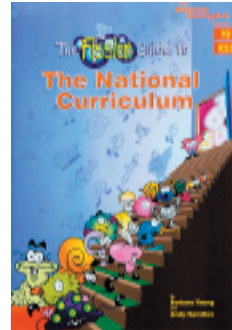
But, unexpectedly, many of the students in our two second sets tackled a lot of these problems with great enthusiasm. These students had successes with puzzles and problems that we had thought well beyond them. Confidence and motivation soared and, later, so did exam results.

Other schools using this material report similar reactions.

There are two versions of our Y8 National Curriculum Mathematics Course.

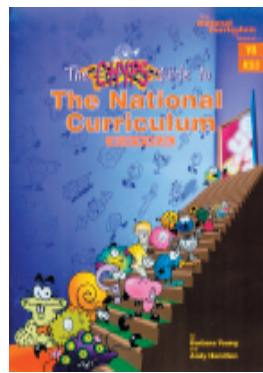
The mainstream course (*The Fission Guide*) is suitable for the upper 60% of students.

For able students, the *Fission Guide* contains **High Level Challenges** which are linked to the topics being studied and the **Miscellaneous High Level Challenges** which are independent of the topics being studied.



A5 text

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A4 text

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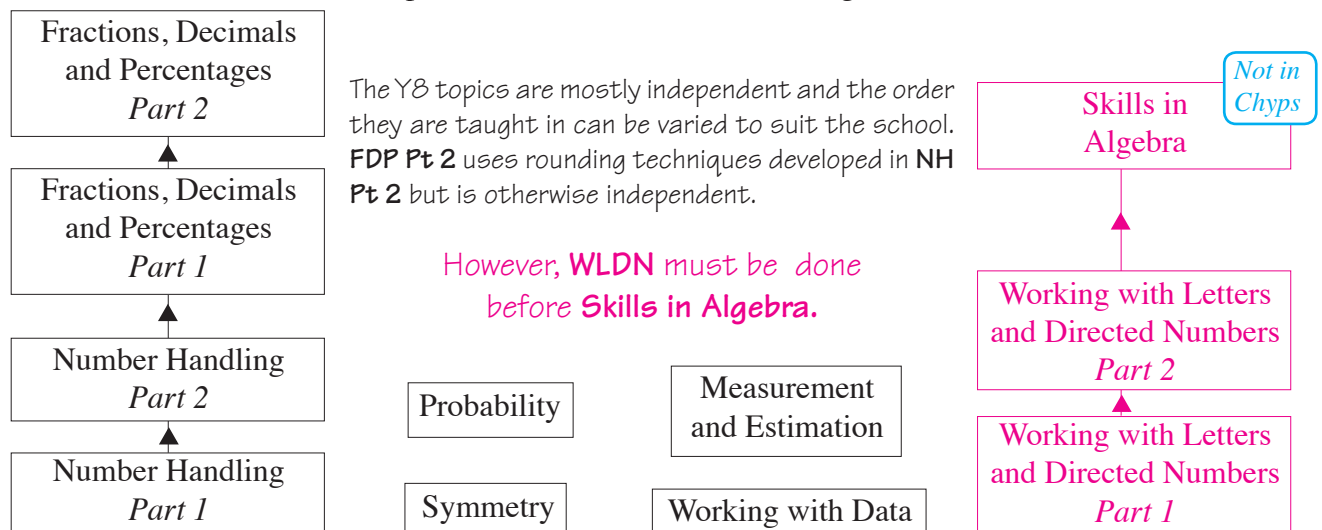
The **EXTRA** course (*The Chyps Guide*) is suitable for the lower 50% of students.

For low attainers, the *Chyps Guide* develops one idea at a time, before combining several ideas that have just been learnt. It also contains **EXTRA** rote practice exercises.

In both *Fission* and *Chyps*, three of the topics have been split into two parts because we found that this suited low attainers better. However, they can be done together as one topic, if required. An optional mid-topic test is provided for each of the split topics.

Star Challenges motivate students in both courses.

One Teachers' Resource Assessment Pack is provided for both these courses together.



The CHYPS Guide **EXTRA**

An unusual approach to Mathematics for Low Attainers – that works !!

Students in our lower sets said

“We don’t want a course that only does the easy stuff (a ‘dumbo’ course).

We want to do the same work as everyone else.

- So, will you please:
- make the instructions and explanations clearer
 - introduce ideas more slowly and put in extra steps
 - put in extra practice
 - make the work interesting”

SO WE DID !



Our EXTRA texts for LOW ATTAINERS do not follow the route of so many other texts for these students.

Instead of giving them lots of easy material, we took the syllabus and delivered it in such a way that LOW ATTAINERS could understand and cope with the ideas and techniques.

We gave them what they had asked for !!

But we couldn’t have produced these texts had it not been for the active help of the students themselves. We started with the mainstream texts and students really enjoyed finding out what didn’t work for them - but, more importantly, WHY!! They quickly became expert at pinpointing where the material didn’t work for them and helping to find what would work for them.

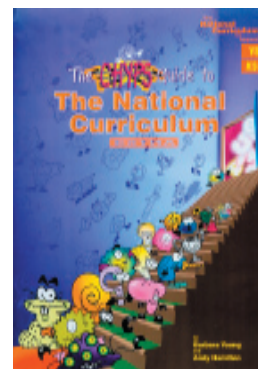
Devising ways that would work took a lot of working/trialling with LOW ATTAINERS, but we ended up with the EXTRA texts – which work exceptionally well, particularly with bottom sets, disaffected students and students at Pupil Referral Units.

This **EXTRA** course :

- has been specially developed for low attainers
- is a version of the Y8 Framework course
- has lots of EXTRA practice on all techniques
- can be run alongside the mainstream course
- can stand on its own
- is suitable for the lower 50% of the ability range

Each student:

- takes responsibility for his/her own learning
- can decide how much practice (s)he needs to do for each technique
- can try Star Challenges when (s)he feels ready for them
- will be capable of taking the mainstream tests



The authors firmly believe that all students can tackle the material in the mainstream course. However, some students need :

- more time to get to grips with the ideas and techniques involved
- lots of EXTRA practice
- one idea at a time introduced step-by-step
- to meet ideas and techniques over and over again

Most students in lower sets are underachieving.
This course aims to raise the level of achievement of these students.
Students can transfer to or from the mainstream course.

How does the Star Challenge system work ?

The number of stars is a measure of the difficulty of the Challenge.

So, one star denotes a basic fairly easy challenge.

However, students should not be discouraged from attempting any Challenges.

For example, students may earn fewer stars from many two or three star challenges, with partially correct answers.

Students of lower ability can amaze you with what they can achieve, if they really want to tackle problems that you might think beyond them.

A true cautionary tale

Three very low ability students were working together. They had to. Mark was severely dyslexic - he could not read at all. Jason could read very well, but could make no sense of what he was reading. Matthew was very slow at everything. Between them, they could tackle problems.

Jason would read the question. Mark would explain what it was all about. Together the three of them would work out how to solve the problem.

One day they had done all the one star problems. They asked me if they could try the three star problem - The Chest of Drawers. It contained a mixture of fractions and decimals and both cm and mm. My first reaction was to tell them that it was too difficult for them - but I said they could try it, provided they accepted that they might not be able to do it.

About ten minutes later, they brought me the correct answer. I couldn't believe that they had solved such a complex problem. I changed the data (marked below in blue). They were back a few minutes later with the correct answer. Then I made a big mistake. I asked them to tell me how they had worked it out. I couldn't follow their explanation at all !!

From then on I never restricted the choice of Star Challenges of even the least able students.

Star Challenge

The chest of drawers

A chest of drawers 84 cm high has a 42.5 mm top and a 90 mm base. Four identical drawers fit in between, with 22.5 mm between each drawer.

Work out the height of each drawer in cm.

If the 22.5 mm gaps were reduced to 12.5 mm each, what would be the height of each drawer then?

The diagram shows a chest of drawers with a total height of 84 cm. It has a top panel of $4\frac{1}{4}$ cm and a base of 9 cm. There are four drawers in between. The gap between the top panel and the first drawer is $2\frac{1}{4}$ cm. The gap between the last drawer and the base is $2\frac{1}{4}$ cm. A double-headed arrow with a question mark indicates the height of one of the drawers.

What do schools do with the stars students earn for Star Challenges ?

One school:

- gives a house point for each star.
- has a commendation system and awards a commendation for so many stars. They also award stars for effort when the books are taken in each fortnight.
- gives a smiley face for 5 stars
- gives a Mars Bar for 10 stars
- gives a copy of one of a group of Chaos posters for 20 stars (very popular with low attainers)
-

It doesn't matter what you do. It is the sense of achievement that is most important.

However, a system that awards something for so many stars, then starts them collecting the next set of stars, means that students keep track of how many stars they have and how many more they need towards the next 'prize' – instead of (possibly invidious) comparisons of the total number of stars each student has.



THE NATIONAL CURRICULUM ...
... AND BEYOND ...

Fission

The Fission Guide

to the
National Curriculum

Skills in Algebra

By the end of this topic, you should be able to:

- Level 5
 - use algebraic rules
 - put numbers in algebraic expressions
- Level 6
 - solve simple equations
 - solve more difficult equations
 - solve simple equations systematically
 - solve equations with letters on both sides
- Level 7
 - solve inequalities
 - solve problems using algebra
 - solve equations with fractions
 - solve equations with brackets

Order a **half price** copy of Y8 Fission and/or Chyps
using the Special Offer form
which can be downloaded
from the website
www.mathsisjugglers.co.uk

Skills in Algebra

The ability to work in this very abstract field of mathematics develops at a different rate in every student. This booklet covers a wide range of algebraic skills and you should go as far as you are capable within this booklet. When you reach a stage that is beyond you, then the later techniques should be left until you are mathematically ready for them, which will happen at a different stage for every student.

The ultimate challenge !!

Those who can handle all the techniques in this booklet should also have developed the skills to solve some other equations that they have not yet met. At the end of this topic is **The mega-challenge crossword**. You really are developing into an able mathematician if you can complete this crossword without any help from your parents, teachers or friends – and can show how you work each answer out!

Section 1: Simple algebraic expressions

In this section you will:

- learn what is meant by some common algebraic expressions
- develop expertise in handling these expressions.

All individual work except for the games.

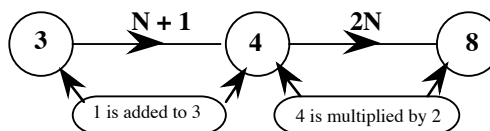
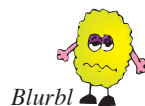
First key to algebraic expressions

Expression	Meaning	Value when $N = 4$
$2N$	2 x the number	8
$\frac{1}{2}N$ or $\frac{N}{2}$	half the number (or the number divided by 2)	2
$3N + 1$	multiply the number by 3, then add 1	13
$3(N + 1)$	add 1 to the number, then multiply by 3	15
$\frac{N}{2} + 1$	divide the number by 2, then add 1	3
$\frac{N+1}{2}$ or $\frac{1}{2}(N+1)$	add 1 to the number, then divide by 2	2.5
$N - 5$	take 5 away from the number	-1
$5 - N$	take the number away from 5	1
$-N$	change the sign of the number	-4
$-2N$	multiply the number by -2	-8

DEVELOPMENT

D1: Chain rule

In all these chains each number is made from the number before it, using the rule given between the numbers.



For each question:

- the numbers in each chain are written in the centre;
- find their correct positions in the chain;
- write down the correct order of the numbers.

<p>A</p> <p>The order of the numbers is 3 → 5 → ... → ... → ... → ... → 3</p>	<p>B</p> <p>The order of the numbers is 4 → ... → ... → ... → ... → ... → 4</p>
<p>C</p> <p>The order of the numbers is 9 → ... → ... → ... → ... → ... → 9</p>	<p>D</p> <p>The order of the numbers is 2 → ... → ... → ... → ... → ... → 2</p>

• Check your answers.

PRACTICE

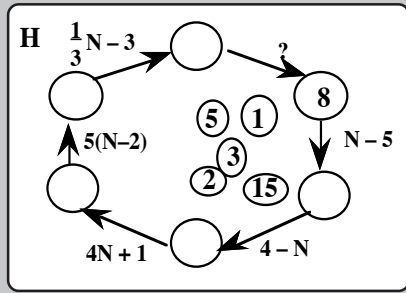
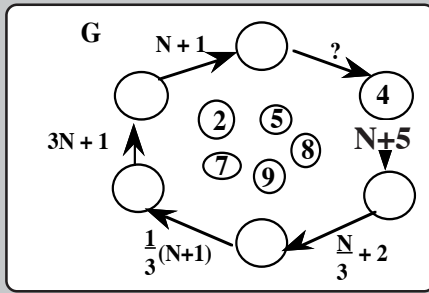
P1: Chain practice

For each question:

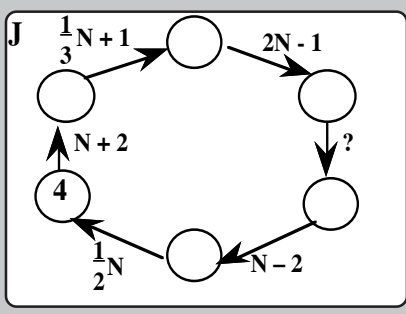
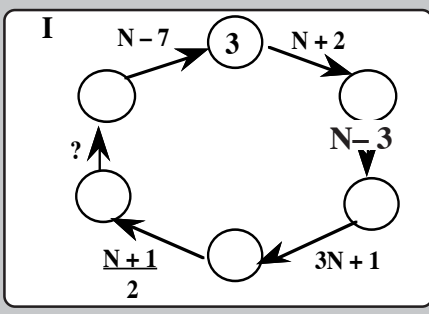
- find the correct positions of the given numbers;
- write down the correct order of the numbers;
- find the missing rule.



<p>E</p>	<p>F</p>
-----------------	-----------------



For the last two chains, YOU have to find the numbers as well as the missing rule.

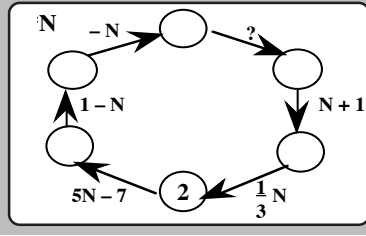
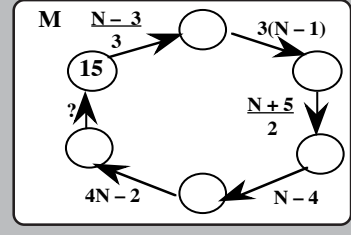
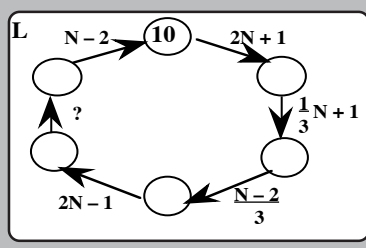
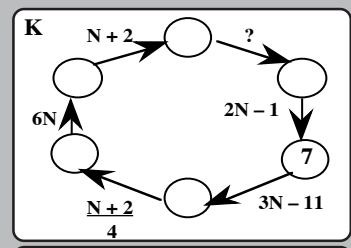


• Check your answers.

Star Challenge 1H

All correct = 1 star

For each question: • find the missing numbers. There are 6 different numbers.
• write down the correct order of the numbers
• find the missing rule



P2: Highest score wins *Two games for 2-3 players* 2 special dice

$b + 5$	$4d$	$3e + 1$	$2(m + 1)$	$2x - 1$	$-x$
$s - 3$	$3g$	$2p + 3$	$2(n - 1)$	$y - 4$	$-2p$
$a - 1$	$5f$	$2g + 1$	$3(s - 2)$	$2z - 3$	$-3m$
$q + 3$	$2x$	$3p - 1$	$3(t + 1)$	$3w + 2$	$8 - 2x$

Make a set of these 24 cards. Each card must be the same size.
 Get a dice with the numbers $-3, -2, -1, 1, 2, 3$ (or stick labels on an ordinary dice).
 You will need two of these dice for the second game.

RULES

- Game 1:**
- Shuffle cards. Place the pack *face down* on the table.
 - Each player takes one card and places it *face up* on the table.
 - The dice is rolled.
 - The number on the dice is the value of the letter on each card. Each player works out the value of the expression on his/her card.
 - The player with the highest score takes the cards. [If two scores are the highest, the cards are placed back at the bottom of the pack.]
 - The winner is the player with the most cards at the end of the game.

Game 2: The same rules as for Game 1 EXCEPT that 2 dice are rolled (each with $-3, -2, -1, 1, 2, 3$). Each player can choose which score to use.

Star Challenge 2H 2H

2 correct Tasks = 2 stars
 1 correct Task = 1 star

Six-to-six dominoes

Put each of these sets of dominoes in order.

The number following each rule is made from the number before it, using the rule. Write down the numbers in the correct order.

Dominoes 1

START 6 → N+5	2 → -N+6	3 → 8-N	4 → 3N+1	5 → 4N+5
7 → 2N-4	8 → N+2	9 → 1N+4	10 → N-1	11 → 2N-1
13 → 2(N-3)	20 → 1(N-2)	21 → 1(N-3)	25 → 1N+3	6 → FINISH

Dominoes 2

START 6 → 2N-1	4 → 3N+1	4 → N+2	5 → 2(N+3)	7 → 2N-10
8 → 1(N+2)	9 → N+1	10 → 1N+3	10 → 2N-6	11 → 2(N-6)
12 → 1N+5	13 → N-6	14 → 3(N-10)	16 → 20-N	6 → FINISH

• Show your solutions to your teacher.

A FISSION GUIDE

page 4

Skills in Algebra

- Your teacher has the solutions to these.

Y8 Fission Sample Topic

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Section 2: More complex algebraic expressions

In this section you will develop expertise in handling more complex expressions.

Second key to algebraic expressions

Expression	Meaning	Value when $N = 4$
N^2	square the number ($N \times N$)	16
$N^2 - 3$	square the number, then take away 3	13
$(N-3)^2$	take away 3 from the number, then square the answer	1
$3N^2$	square the number, then multiply by 3	48
$(3N)^2$	multiply the number by 3, then square the answer	144
N^3	cube the number ($N \times N \times N$)	64
$N(N-1)$	number x (one less than the number)	12
$(N-1)(N+2)$	(one less than the number) x (two more than the number)	18
$\frac{N-1}{N-2}$	(one less than the number) divided by (2 less than the number)	1.5

DEVELOPMENT

D1: Expressions with equal value



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1.
$$\frac{N+1}{2N-3} \quad \frac{N^3-1}{3N-7} \quad \frac{2N-1}{N+3} \quad \frac{N^2-11}{N+3}$$

If $N = 4$, which four of these expressions have equal value ?

2.
$$\frac{3N-2}{N^3-2} \quad \frac{4N-2}{2(N-1)+2} \quad \frac{(N+2)(N-1)}{4(N+1)} \quad \frac{2N}{3} \quad N^2+N$$

If $N = 2$, which five of these expressions have equal value ?

3.
$$\frac{N(N-1)(N-2)}{N^3-2} \quad \frac{2N-3}{4N-3(N-1)N} \quad \frac{N^2-N(N-1)^2+2}{3} \quad \frac{2N^2}{6} \quad \frac{(2N)^2}{6}$$

If $N = 3$, which five of these expressions have equal value ?

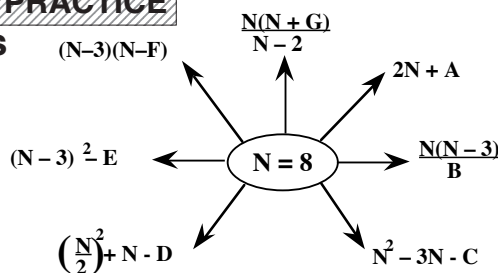
• Check your answers.

PRACTICE

P1: Star expressions

Each of these expressions has the value 20 when $N = 8$

What are the values of A, B, C, D, E, F, G ?



P2: Highest score challenge !

Game for 2-3 players

RULES : These are the same as for Game 2 of "Highest score wins" in section 1.
However, you play the game with these cards.

n^2	$2t^2$	$(2r)^2$	$\frac{x^2-1}{x-1}$	$(p-1)(p+2)$	$(3-p)^2$
$(a+1)^2$	b^2+1	$-s^2$	$\frac{y^2+y}{y}$	$\frac{k^2-1}{k+1}$	v^3
$(c-1)^2$	d^2-1	$m(m+1)$	$(w-1)(w+1)$	$(3m-1)(m+1)$	w^3+w
p^2+2	$(q-2)^2$	$n(n-1)$	$(s-2)(s+2)$	$(2n+1)(n-1)$	$1+z+z^2$

Star Challenge 3H

All correct = 1 star

$$(2N+2)(N+3)$$

$$(N+4)^2-1$$

$$\frac{(N+1)^2(N^2+2N)}{N+2}$$

For one particular value of N, each of these expressions has the same value.
What is the value of N ?

• Your teacher has the answer to this.

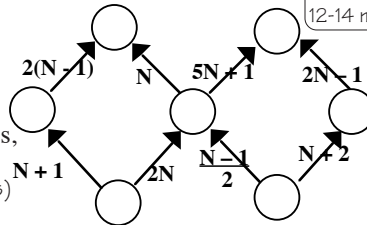
Star Challenge 4H=4H

15-16 marks = 2 stars
12-14 marks = 1 star

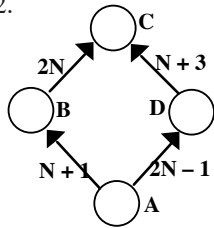
1.

Put 4 in the middle circle.
Work out what numbers
should go in the other circles,
using the given rules.

(6 marks)



2.



(a) Put 3 in the circle A.

Work out the numbers that go in the other circles.

(b) Do you get the same number in C, whether you work it out by the ABC route, or the ADC route ?

(c) Try another number in A.

Does the same thing happen ? (5 marks)

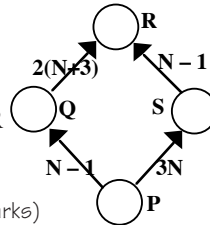
3. (a)

Put 5 in the circle P. Work out the numbers that go in the other circles.

(b) Do you get the same number in R, whether you work it out by the PQR route, or the PSR route ?

(c) Try another number in P.

Does the same thing happen ? (5 marks)



• Your teacher has the answers to this.

Section 3: Equations

In this section you will:

- meet equations
- solve equations by inspection.

Expressions and Equations

$2N + 1$ is an **expression**.

For each value of N , the expression has a different value.

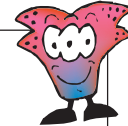
$2N + 1 = 7$ is an **equation**.

When $N = 3$, it is a true statement.

When $N =$ another number, it is not a true statement.

$N = 3$ is **the solution** of $2N + 1 = 7$.

Expressions and equations can use any letters, not just N .



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DEVELOPMENT

D1: Numbers and rules

– Individual work

Copy out each table and its rule. Replace the boxes with the correct numbers.

Read as 'becomes'

$$N \rightarrow N + 3$$

$$1 \rightarrow 4$$

$$3 \rightarrow 6$$

$$4 \rightarrow \square$$

$$6 \rightarrow \square$$

$$-1 \rightarrow \square$$

$$-4 \rightarrow \square$$

$$N \rightarrow N - 5$$

$$1 \rightarrow -4$$

$$5 \rightarrow \square$$

$$6 \rightarrow \square$$

$$8 \rightarrow \square$$

$$-2 \rightarrow \square$$

$$0 \rightarrow \square$$

$$N \rightarrow N + 4$$

$$2 \rightarrow 6$$

$$3 \rightarrow \square$$

$$-5 \rightarrow \square$$

$$\square \rightarrow 9$$

$$\square \rightarrow 13$$

$$\square \rightarrow 1$$

$$N \rightarrow 2N$$

$$3 \rightarrow \square$$

$$-1 \rightarrow \square$$

$$5 \rightarrow \square$$

$$\square \rightarrow 14$$

$$\square \rightarrow -4$$

$$\square \rightarrow 12$$

$$N \rightarrow 3N - 1$$

$$1 \rightarrow \square$$

$$2 \rightarrow \square$$

$$5 \rightarrow \square$$

$$\square \rightarrow 8$$

$$\square \rightarrow 29$$

$$\square \rightarrow 20$$

$$N \rightarrow N + 4$$

$$2 \rightarrow \square$$

$$6 \rightarrow \square$$

$$10 \rightarrow \square$$

$$\square \rightarrow 3$$

$$\square \rightarrow 5$$

$$\square \rightarrow 11$$

• Check your answers.

D2: Rules and equations

– Individual work

Copy and complete each table.

1. $\frac{N \rightarrow 3N}{2 \rightarrow 6}$

$\square \rightarrow 21$

For what value of N does $3N = 21$?

2. $\frac{N \rightarrow N+5}{3 \rightarrow 8}$

$\square \rightarrow 11$

For what value of N does $N + 5 = 11$?

3. $\frac{N \rightarrow 2N-1}{3 \rightarrow 5}$

$\square \rightarrow 17$

For what value of N does $2N - 1 = 17$?

4. $\frac{N \rightarrow 10N+1}{2 \rightarrow 21}$

$\square \rightarrow 51$

For what value of N does $10N + 1 = 51$?

In each question, you have been **solving the equation**
or **finding the solution of the equation.**

5. For what value of N does $2N = 6$?

6. For what value of N does $N + 1 = 5$?

Find the solution of these equations:

7. $3N = 30$

8. $N + 5 = 6$

9. $2N - 1 = 7$

10. $10N + 1 = 31$

Solve these equations:

11. $3N = 12$

12. $N + 5 = 9$

13. $2N - 1 = 19$

14. $10N + 1 = 71$

• Check your answers.

PRACTICE

P1: A line of four solutions

– Game for 2-3 players – (could also be played individually).

THE BOARD IS ON THE NEXT PAGE.

RULES:

Each player:

- rolls the dice;
- finds an equation on the board which has that solution;
- puts a counter on that equation.

The winner is the first player with four counters in a straight line.

counters



Kooldood

A line of four solutions

A game for 2-3 players

Rules are on previous page

$\frac{n}{2} + 3 = 5$	$7 - k = 6$	$2(n - 1) = 8$	$\frac{l}{3} + 3 = 5$	$m(m-1) = 2$	$5(2e - 1) = 25$
$4(y - 2) = 16$	$\frac{15}{x+1} = 5$	$5z + 3 = 23$	$2b + 1 = 7$	$5x + 3 = 8$	$m^2 = 25$
$3z + 1 = 16$	$3(5 + t) = 18$	$N - 1 = 2$	$\frac{k+8}{5} = 2$	$3(d + 1) = 21$	$3p = 12$
$5(t + 3) = 25$	$3y^2 = 75$	$\frac{12}{x} + 1 = 3$	$2(p + 6) = 18$	$\frac{1}{2}n + 3 = 5$	$n(n+1) = 2$
$x^2 + 1 = 17$	$4q - 2 = 10$	$x + 5 = 11$	$n + 7 = 8$	$t^2 - 1 = 3$	$\frac{1}{2}(p - 1) = 2$
$\left[\frac{c}{2}\right]^2 + 1 = 10$	$10 - m = 6$	$7(3 - p) = 14$	$3n - 1 = 14$	$\frac{1}{2}(x + 6) = 4$	$4x - 2 = 10$

A FISSION GUIDE

page 9

Skills in Algebra

Star Challenge 5H All correct = 1 star

One star solution pattern

Solution – colour key

Solution	1	2	3	4	5
Colour	Red	Blue	Green	Orange	Yellow

Solve each equation.

Colour each rectangle with the solution colour.

(For example: each equation with solution 1 is coloured red.)

$p + 3 = 4$	$2c + 3 = 13$	$5k = 15$	$2a + 1 = 7$	$3p - 10 = 5$	$3p + 1 = 7$
$2j - 1 = 9$	$2r + 1 = 3$	$12 - n = 8$	$2m = 8$	$6t = 12$	$4b - 11 = 9$
$6p + 1 = 25$	$3x - 2 = 7$	$5s - 4 = 1$	$5 + 3p = 11$	$10c - 5 = 25$	$3 + 2p = 11$
$2v - 1 = 7$	$5 + q = 8$	$3r - 1 = 2$	$5z - 1 = 9$	$5 + 2f = 11$	$4 + u = 8$
$w + 3 = 8$	$5 + 2b = 7$	$2n - 1 = 7$	$3b + 1 = 13$	$3 + 3d = 9$	$6 - m = 1$
$9 - 4e = 5$	$3k + 1 = 16$	$4y = 3y + 3$	$10 - g = 7$	$2y = 10$	$4n + 3 = 11$

• Show your answers to your teacher.

Star Challenge 6H/6H 34-36 correct = 2 stars 30-33 correct = 1 star

Two star solution pattern

Solution – colour key

Solution	2	3	4	-1	-2	-3
Colour	Yellow	Red	Blue	Green	Orange	Pink

Solve each equation.

Colour each rectangle with the solution colour.

$10 + 2v = 16$	$7 + m = 6$	$3z + 1 = 7$	$2x + 5 = -1$	$4 - f = 7$	$10p - 1 = 19$
$2 + 3r = -1$	$8 - 3p = -4$	$5 - q = 6$	$4 + 2r = 0$	$13 + s = 11$	$1 - q = -2$
$7n - 1 = 20$	$2 - w = 3$	$4d - 1 = 15$	$4t + 7 = 3$	$2t + 4 = 0$	$s + 4 = 3$
$2f + 4 = -2$	$p + p + p = -6$	$h + 3 = 0$	$7 + 2k = 15$	$4m + 3 = 11$	$9 - 2k = 3$
$5u - 2 = 13$	$2y - 3 = -7$	$5 - k = 7$	$8 - 3r = 2$	$c + 2c = 12$	$7 - k = 5$
$3k + 7 = 1$	$4 - x = 7$	$j + j = -6$	$p + 1 = -1$	$4 + t = 3t$	$5b + 2 = 17$

Remember: $-(-2) = +2$

• Show your answers to your teacher.

Beyond this point the material is totally individualised work. The concepts and the skills required will gradually increase in difficulty. It is intended that you should proceed as far as you can, depending on your state of mathematical development. Any skills not developed at this stage will be met again later in the course.

You will develop a series of techniques for solving different types of equations. It is important that you master the skills at each stage, before moving onto the next stage. All algebraic skills need practice. The more practice you do, the more skillful you become. Racing through the material, without doing sufficient practice at each stage, means that the limit of what you will be able to do will be reached earlier in the material.

Section 4: A systematic approach to solving equations *All individual work*

In this section you will learn and practise some basic techniques for solving equations.

DEVELOPMENT

D1: The story so far ...

So far, you have developed your own ways of solving equations.

Find the solutions to as many of these equations as possible.

There is only one solution for each equation.

$$A : 2N + 5 = 17$$

$$B : 2 + 4y = 14$$

$$C : \frac{1}{2}x - 3 = 2$$

$$D : 3x - 5 = 16$$

$$E : 3x - 5 = 17$$

$$F : 2(3y - 1) = 22$$

$$G : 3p + 2 = 13$$

$$H : 7t + 3 - 2t = 23$$

$$I : 4a + 3 - 2a = 3a + 1$$

$$J : \frac{3m - 2}{m + 1} = 2$$

• *Check your answers.*



Inaspin

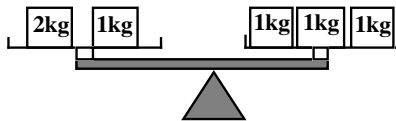
You should have found that there were some of these equations you could not solve.

Why do you think you could not solve them ?

You are now going to learn some techniques for solving complex equations. However, to understand these techniques more easily, you will first learn how to use them to solve simpler equations – the sort you can already solve for yourself. Then you will apply these techniques to solving the difficult equations.

D2: Balancing scales

1.



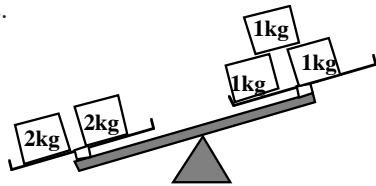
This is a set of scales.

The scales **balance** when there are equal weights on each side.

They balance now.

- (a) Will they balance if 1 kg is taken off each side ?
 (b) Will they balance if 2 kg is added onto each side ?

2.

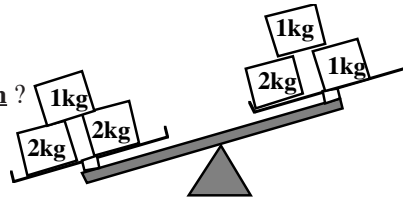


You need to make these scales balance.

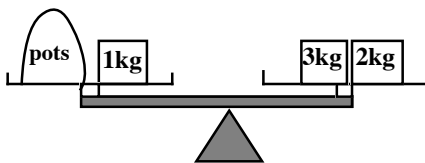
- (a) To which side do you **add** a weight ?
 (b) What weight do you add ?

3. You need to make these scales balance.

- (a) Which side do you **take** a weight **from** ?
 (b) What weight do you take ?



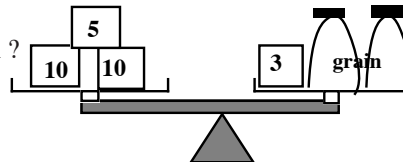
4.



What does the bag of potatoes weigh?

5.

What does each bag of grain weigh ?
 All measurements are in kg.



• Check your answers.

D3: Balancing equations

Find the weight of each rabbit.

PICTURE METHOD

EQUATION METHOD

$$\begin{array}{l|l} \text{take 3} & 2r + 3 = 7 \\ & 2r = 4 \\ \div 2 & r = 2 \end{array}$$

Frizzbang

Copy and complete the equation method for each of these sets of pictures:

1.

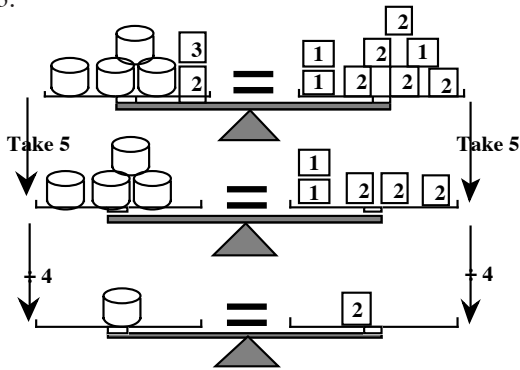
EQUATION METHOD

$$\begin{array}{l|l} -2 & 3p + 2 = 11 \\ & \dots = \dots \\ \div 3 & \dots = \dots \end{array}$$

2.

$$\begin{array}{l|l} -40 & 2c + 40 = 140 \\ & \dots = \dots \\ \div 2 & \dots = \dots \end{array}$$

3.



$$\begin{array}{c}
 \boxed{} \\
 \boxed{}
 \end{array}
 \left| \begin{array}{l}
 4c + 5 = \dots \\
 \dots = \dots \\
 \dots = \dots
 \end{array} \right.
 \begin{array}{c}
 \boxed{} \\
 \boxed{}
 \end{array}$$

Don't forget to put the instructions in the boxes!

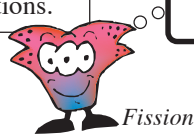
• Check your answers.

D4: Equations without pictures

A short cut	$2m + 6 = 10$
-6	$2m = 6$
$\div 2$	$m = 3$

Just write the instructions on *one* side of the equations.

Even though the instructions are only written on one side of the equation, the rule is always: "whatever you do to one side of the equation, you must do the same to the other side."



Copy and complete:

1. $5p + 3 = 18$	2. $3k - 1 = 11$	3. $4e - 2 = 18$
-3 $=$	$+1$ $=$	$+2$ $=$
$\div 5$ $=$	$\div 3$ $=$	$\div 4$ $=$

Solve these equations. Set out your working as in questions 1 – 3.

- | | | |
|------------------|------------------|-------------------|
| 4. $3y + 5 = 14$ | 7. $7x + 7 = 42$ | 10. $8b - 3 = 13$ |
| 5. $6p - 3 = 15$ | 8. $9a - 2 = 43$ | 11. $2p + 1 = 15$ |
| 6. $2d + 4 = 20$ | 9. $4m + 2 = 14$ | 12. $7k - 3 = 18$ |

• Check your answers.

PRACTICE

P1: Practice Exercises

Solve these equations.

Set out all working as in D4.

Do one batch of questions at a time then CHECK YOUR ANSWERS.

You may not need to do every batch.

When you feel you are good at this technique, do the Star Challenge.

Batch A:

- | | | |
|------------------|------------------|-------------------|
| 1. $3p + 9 = 24$ | 6. $6t + 4 = 40$ | 11. $9h - 7 = 11$ |
| 2. $8v - 3 = 21$ | 7. $8x - 8 = 16$ | 12. $7c - 5 = 37$ |
| 3. $2k + 1 = 11$ | 8. $7y - 5 = 16$ | 13. $5s + 3 = 28$ |
| 4. $5x - 9 = 16$ | 9. $5x + 3 = 33$ | 14. $8j + 6 = 46$ |
| 5. $7r + 2 = 79$ | 10. $2w - 2 = 8$ | 15. $3q - 3 = 24$ |

STOP! Have you checked all your answers – and found out where you went wrong?

Batch B:

- | | | |
|------------------|------------------|--------------------|
| 1. $2d + 7 = 15$ | 6. $4e + 6 = 50$ | 11. $5y - 4 = 36$ |
| 2. $9n - 2 = 25$ | 7. $2d - 6 = 10$ | 12. $2b - 3 = 17$ |
| 3. $2b - 5 = 11$ | 8. $2m - 1 = 29$ | 13. $5q + 13 = 38$ |
| 4. $2x + 3 = 19$ | 9. $5f + 4 = 49$ | 14. $9n - 7 = 47$ |
| 5. $5t - 6 = 19$ | 10. $8v - 2 = 6$ | 15. $3g - 2 = 13$ |

Batch C:

- | | | |
|------------------|-------------------|-------------------|
| 1. $2x + 4 = 20$ | 6. $4 + 3s = 16$ | 11. $7q + 2 = 30$ |
| 2. $2p - 1 = 9$ | 7. $3x - 2 = 10$ | 12. $3c - 4 = 5$ |
| 3. $3y - 1 = 11$ | 8. $10a - 19 = 1$ | 13. $2p + 5 = 11$ |
| 4. $3x + 1 = 7$ | 9. $8x + 8 = 24$ | 14. $4z + 3 = 15$ |
| 5. $4a - 3 = 13$ | 10. $6r - 7 = 23$ | 15. $3r - 1 = 20$ |

It is a total waste of your time if you go onto the next batch of questions without checking your answers first! You need to know whether what you are doing is correct!



Do-med

Star Challenge H

13-15 correct = 1 star

Solve these equations. Set out all working as in D4.

- | | | |
|-------------------|-------------------|---------------------|
| 1. $5z - 1 = 9$ | 6. $7n - 5 = 30$ | 11. $3p + 5 = 65$ |
| 2. $14 + 3m = 20$ | 7. $4p - 3 = 13$ | 12. $4m - 3 = 61$ |
| 3. $7 + 3n = 13$ | 8. $-1 + 5t = 9$ | 13. $7c + 11 = 81$ |
| 4. $4 + 2r = 6$ | 9. $3 + 4z = 43$ | 14. $3e - 3 = 60$ |
| 5. $15 + 7p = 29$ | 10. $5d - 1 = 49$ | 15. $4f + 16 = 100$ |

• Your teacher has the answers for these.

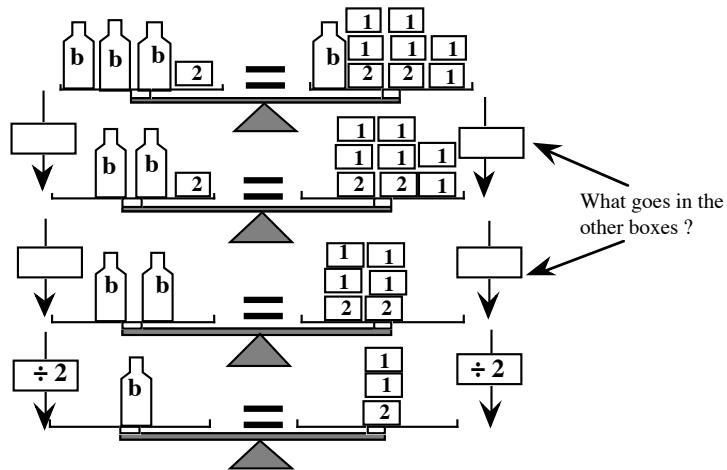
Section 5: Getting more difficult

In this section you will solve more difficult equations.

DEVELOPMENT

D1: Unknowns on both sides

1.



2.

$$\begin{array}{l} \boxed{} \quad 4p - 3 = 2p + 5 \\ \boxed{} \quad 2p - 3 = 5 \\ \boxed{} \quad 2p = 8 \\ \boxed{} \quad p = 4 \end{array}$$

Copy this question.
Put the correct instructions
into the boxes.

Even though the instructions are only written on one side of the equation, the rule is always:
"whatever you do to one side of the equation, you must do the same to the other side."



Solve these equations.

Set your working out as in question 2. Icee

- | | | |
|------------------------|----------------------|-------------------------|
| 3. $7a + 3 = a + 21$ | 6. $8y - 4 = y + 31$ | 9. $6q - 6 = 4q + 2$ |
| 4. $10b + 8 = b + 62$ | 7. $3p - 9 = 2p - 3$ | 10. $9x + 11 = x + 51$ |
| 5. $10e + 6 = 4e + 36$ | 8. $5m + 8 = m + 36$ | 11. $4e + 10 = 2e + 26$ |

• Check your answers.
Skills in Algebra

PRACTICE

P1: Practice Exercises

Solve these equations.

Set out all working as in D4.

Do one batch of questions at a time then CHECK YOUR ANSWERS.

You may not need to do every batch.

When you feel you are good at this technique, do the Star Challenge.

Batch A:

- | | | |
|------------------------|------------------------|-------------------------|
| 1. $10k + 3 = 5k + 18$ | 6. $3w - 6 = 14 - 2w$ | 11. $9h - 5 = 3h + 49$ |
| 2. $5p - 6 = 4p - 2$ | 7. $9k + 6 = k + 22$ | 12. $5r + 3 = 17 - 2r$ |
| 3. $3e + 7 = 2e + 11$ | 8. $4m + 11 = 3m + 16$ | 13. $10p - 6 = 3p + 43$ |
| 4. $10d + 1 = 8d + 9$ | 9. $3b - 9 = b + 5$ | 14. $5f + 6 = f + 34$ |
| 5. $8r - 2 = r + 40$ | 10. $5t + 6 = 4t + 8$ | 15. $8u - 8 = 55 - u$ |

STOP! Have you checked all your answers – and found out where you went wrong?

Batch B:

- | | | |
|------------------------|-------------------------|-------------------------|
| 1. $10v + 8 = 9v + 13$ | 6. $4y + 1 = 11 + 3y$ | 11. $6g - 7 = 5g - 5$ |
| 2. $4r - 5 = 3r + 2$ | 7. $10c - 1 = c + 71$ | 12. $9a - 1 = 97 - 5a$ |
| 3. $8p - 9 = 3p + 36$ | 8. $10m - 10 = 7m + 23$ | 13. $9x - 5 = 85 - x$ |
| 4. $10h - 3 = 6h + 13$ | 9. $8d + 7 = 52 + 3d$ | 14. $7e + 12 = 21 + 4e$ |
| 5. $5n - 9 = 47 - 3n$ | 10. $9u + 10 = 76 + 3u$ | 15. $6c + 5 = 35 - 4c$ |

Batch C:

- | | | |
|----------------------|------------------------|------------------------|
| 1. $3x + 1 = x + 9$ | 6. $5 + e = 17 - 2e$ | 11. $2w - 4 = 16 - 3w$ |
| 2. $4p + 7 = 3p + 9$ | 7. $7r = 8 + 5r$ | 12. $2m - 21 = 6 - m$ |
| 3. $5c = 8 + 3c$ | 8. $9p - 4 = 5p + 12$ | 13. $8a - 19 = 6 + 3a$ |
| 4. $7g - 2 = 5g + 8$ | 9. $6n + 5 = 13 + 4n$ | 14. $7g = 3g + 20$ |
| 5. $7p - 8 = 3p - 4$ | 10. $8t - 20 = 5t - 2$ | 15. $6b + 7 - 3b = 16$ |

Star Challenge

13-15 correct = 1 star

Solve these equations. Show all working.

- | | | |
|------------------------|--------------------------|---------------------------|
| 1. $5x + 3 = 2x + 15$ | 6. $6m - 5 = 4m + 7$ | 11. $8p - 12 = 5p - 3$ |
| 2. $6e + 5 = 3e + 14$ | 7. $3h - 7 = h + 1$ | 12. $5t - 4 = 2t + 5$ |
| 3. $10d + 3 = 4d + 21$ | 8. $9j + 1 = 5j + 9$ | 13. $23r - 27 = 16r - 13$ |
| 4. $5t - 3 = 2t + 9$ | 9. $11x + 26 = 10x + 28$ | 14. $16y - 35 = 7y - 8$ |
| 5. $9x + 1 = 5x + 9$ | 10. $12w - 6 = 7w - 1$ | 15. $11x - 51 = 6x - 1$ |

Star Challenge 9H-9H

40-43 correct = 2 stars
34-39 correct = 1 star

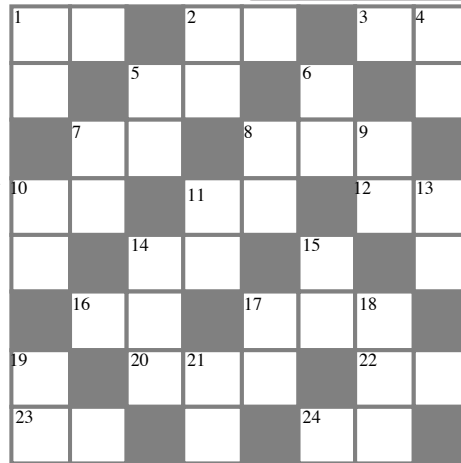
Crossnumber equations

The answers to this crossword are the solutions to each of the equations below.

Take one double spread of your book.

Stick this worksheet on one of the pages.

Solve each of the equations on the other page.



Show all working out.

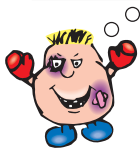
Across

1. $3p - 15 = 21$
2. $2n - 16 = n + 17$
3. $x - 3 = 25 - x$
5. $5 + 2b = 128 - b$
7. $2h - 14 = h + 12$
8. $120 - z = 8$
10. $b + 7 = 2b - 6$
11. $2k - 6 = 100$
12. $15 - x = x - 13$
14. $\frac{1}{3}p + 1 = 8$
16. $2s + 3 + s = 34 + 2s$
17. $2t - 26 = 1000$
20. $x - 23 = 100$
22. $5 + 2p = 21 + p$
23. $2g - 100 = 26 - g$
24. $10m = 400$

Down

1. $5y = 60 + y$
2. $2p + 3 = 65$
4. $3q = 2q + 42$
5. $5c + 4 = 4c + 50$
6. $10e + 2 = 8e + 44$
7. $3f - 9 = 60$
8. $20 - a = 7$
9. $3r - 13 = 50$
10. $5x + 12 = 4x + 29$
11. $100 - m = 49$
13. $100 - 2j = j - 44$
14. $v - 200 = 11$
15. $3x - 33 = 2x + 38$
17. $2y - 6 = 100$
18. $5n - 150 = 4n + 160$
19. $t + 6 = 74 - t$
21. $50 - q = 21$

Stars will not be awarded unless all working is shown for each of these equations.



• Show your answers to your teacher.

Section 6: Solving inequations

In this section you will:

- review inequality symbols
- solve inequations.

DEVELOPMENT

D1: True or false ?

Symbols of inequality

<

less than

>

greater than

≤

less than or equal to

≥

greater than or equal to

State whether each statement is true or false:

1. $100 > 99$
2. $43 < 3$
3. $7 \geq 7$
4. $-1 < 1$
5. $-1 > -2$
6. $-3 > 2$
7. $-30 < -15$
8. $-5 > -1$

• Check your answers.

D2: Hypothesis testing

$2 < 6$ is a true statement

If you add 3 to each side of this statement,

you get $5 < 9$ which is also a true statement

Test each hypothesis on the statement $2 < 6$

Decide if it is true or false.

Write down the true hypothesis.



Idea

Hypotheses:

1. If you **add the same number** to each side of the inequation, it is still true.
2. If you **take the same number from** each side of the inequation, it is still true.
3. If you **multiply** both sides of the inequation **by a positive number**, it is still true.
4. If you **divide** both sides of the inequation **by a positive number**, it is still true.
5. If you **multiply** both sides of the inequation **by a negative number**, it is still true.
6. If you **divide** both sides of the inequation **by a negative number**, it is still true.

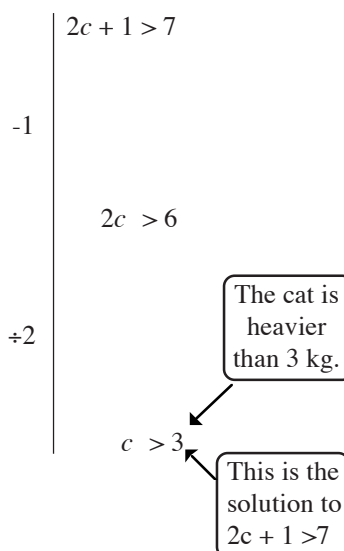
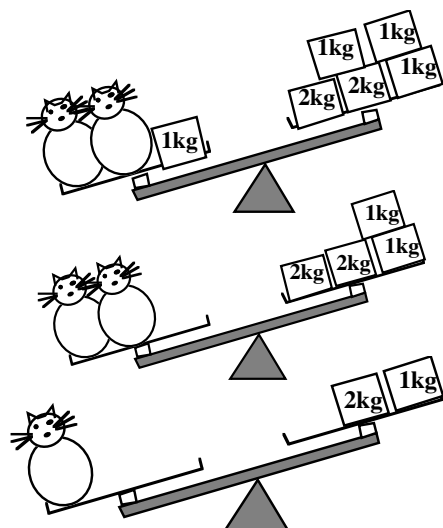
• Check your answers.

$2n + 1$ is an **expression**.

$2n + 1 = 7$ is an **equation** – it contains an equals sign.

$2n + 1 > 7$ is an **inequation** – it contains an inequality sign.

D3: Solving inequations



Solve each inequation. Show all your working.

- | | | |
|--------------------|---------------------|----------------------|
| 1. $c + 5 > 8$ | 5. $5c - 3 > 7$ | 9. $5 + 2p < 17$ |
| 2. $9 + t \leq 14$ | 6. $2d - 1 > 15$ | 10. $5z + 1 \geq 21$ |
| 3. $m - 2 < 5$ | 7. $3n + 4 \leq 16$ | 11. $4t < 3t + 2$ |
| 4. $f - 5 \geq 7$ | 8. $3m - 2 < 4$ | 12. $3 + 4u \geq 11$ |

• Check your answers.

PRACTICE

P1: Solving inequations using positive & negative numbers

Solve each inequation. Show all your working.

- | | | |
|------------------|-----------------|-------------------|
| 1. $4r \leq -8$ | 4. $3c > 12$ | 7. $-5m > 10$ |
| 2. $2q > 6$ | 5. $-2v < 6$ | 8. $-5m \geq -20$ |
| 3. $-3n \leq -9$ | 6. $-p \geq -5$ | 9. $5m \geq -30$ |

• Check your answers.

Star Challenge 10H

Solve each inequation. Show all your working.

- | | | |
|------------------|-----------------|------------------|
| 1. $-c > -7$ | 4. $-7p > 28$ | 7. $-3x - 4 > 2$ |
| 2. $-6t \geq 18$ | 5. $-3m < -15$ | 8. $5 - 2m < -7$ |
| 3. $7c < 21$ | 6. $4x \geq 12$ | 9. $3 - 4n > 11$ |

• Your teacher has the answers to these.

Section 7: Problems, expressions & equations

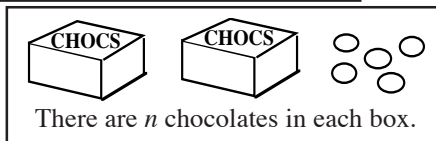
In this section you will work with problems using algebraic expressions and equations.

DEVELOPMENT

D1: Sweet problems

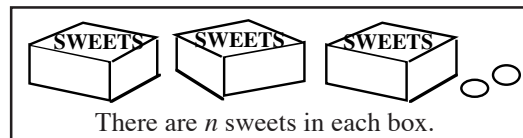
$2t + 7$ is an expression $2t + 7 = 11$ is an equation

1. (a) How many chocolates are there in 2 boxes ?



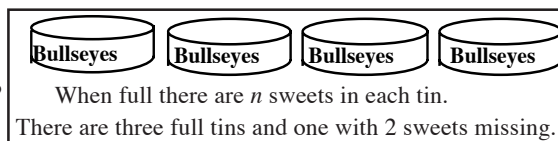
- (b) *There are 2 boxes and five extra chocolates.*
How many chocolates are there altogether ? The answer is an expression in n .
- (c) If $n = 10$, how many chocolates are there altogether ?
- (d) If $n = 12$, how many chocolates are there altogether ?
- (e) If $n = 20$, how many chocolates are there altogether ?
- (f) *There are 35 chocolates altogether.* What is the value of n ?
- (g) *There are 23 chocolates altogether.* What is the value of n ?
- (h) Solve $2n + 5 = 21$

2. (a) How many sweets are there altogether ?



- (b) If $n = 20$, how many sweets are there altogether ?
- (c) If $n = 15$, how many sweets are there altogether ?
- (d) *There are 32 sweets altogether.* What is the value of n ?
- (e) *There are 38 sweets altogether.* How many sweets are there in each box ?
- (f) Solve $3n + 2 = 23$

3. (a) How many sweets are there altogether ?



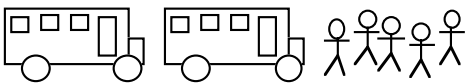
- (a) How many sweets are there altogether ?
- (b) If $n = 15$, how many sweets are there altogether ?
- (c) If $n = 11$, how many sweets are there altogether ?
- (d) *There are 38 sweets altogether.* What equation do you need to solve to find the number in each tin. What is its solution ?
- (e) Solve $4n - 2 = 46$



• Check your answers.

D2: Transport problems

1.



At the end of the football match,
 m men went home in each minibus.
 There were 2 minibuses. 5 men walked home.

- How many men were there altogether? (The answer is an expression involving m)
- If $m = 15$, how many men were there?
- If $m = 21$, how many men were there?
- There were 45 men altogether. How many went in each minibus?
- Solve $2m + 5 = 17$.

2.

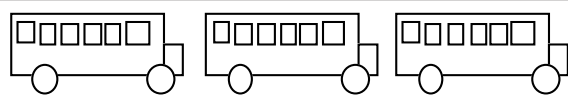
Some girls were travelling to a school to play netball matches.
 N girls went in a minibus. 3 cycled.

- How many girls were there altogether? (The answer is an expression involving N)
- There were 22 girls altogether. Write this as an equation involving N .
- Solve the equation.

• Check your answers.

Star Challenge

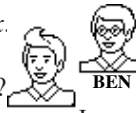
1.



Each coach holds p passengers.
 There are two full coaches and one with 5 empty seats.

- Write the total number of passengers as an expression in p . (1 mark)
- If $p = 25$, what is the total number of passengers? (1 mark)
- If $p = 40$, what is the total number of passengers? (1 mark)
- The total number of passengers is 100.
 Write this as an equation involving p and solve it. (3 marks)

- Write Ben's age as an expression involving x .
 - Their ages are added together.
 What is their total age as an expression in x ?
 Simplify the expression. (2 marks)
 - Their total age is 23. Write an equation that tells you this. (1 mark)
 - Solve the equation. (2 marks)
 - How old is Tom? How old is Ben? (2 marks)



• Your teacher has the answers to these.

Section 8: Equations with brackets

In this section you will :

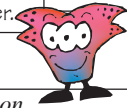
- review multiplying out brackets
- solve equations that have brackets in them

DEVELOPMENT

D1: Multiplying out brackets

EXAMPLE *Multiply out $3(4m - n)$*
 $3(4m - n) = 12m - 3n$

Always write
down both the
original
expression and
the answer.



Fission

Multiply out the brackets:

1. $3(4a + 2c)$ 3. $2(3r + 2s)$ 5. $6(a - b)$ 7. $2(3 - 4c)$ 9. $2(s + t - 2v)$
 2. $5(2n - 3m)$ 4. $2(4a + 3)$ 6. $4(2 + 3e)$ 8. $7(p + 2)$ 10. $3(4 - v + 3u)$

• Check your answers.

D2: Simple equations with brackets

For each equation:

- multiply out the brackets
- solve the equation
- show all working out.

1. $5(a + 3) = 50$ 4. $2(c - 1) = 8$ 7. $2(x + 8) = 22$
 2. $5(h - 3) = 20$ 5. $2(3e - 6) = 54$ 8. $2(5q - 1) = 18$
 3. $6(2d + 5) = 114$ 6. $3(2r + 5) = 87$ 9. $4(n - 2) = 4$

• Check your answers.

PRACTICE

P1: Practice exercises

Solve these equations. Show all your working.

Do one batch of questions at a time then CHECK YOUR ANSWERS.

Do as many batches as you need.

Batch A:

1. $2(2m + 1) = 14$ 5. $5(x - 5) = 35$ 9. $6(1 + 3d) = 42$
 2. $8(n - 1) = 24$ 6. $7(2 + y) = 14$ 10. $2(5p + 1) = 32$
 3. $5(g + 4) = 30$ 7. $4(b + 4) = 40$ 11. $4(3y - 1) = 44$
 4. $2(3e - 4) = 16$ 8. $5(2b - 1) = 15$ 12. $2(3 + 10e) = 106$

Batch B:

1. $7(p + 3) = 35$ 5. $2(7f - 12) = 4$ 9. $10(4n - 10) = 60$
 2. $4(2q - 1) = 28$ 6. $9(x - 5) = 18$ 10. $8(5v - 8) = 16$
 3. $2(3x + 5) = 22$ 7. $11(a + 4) = 55$ 11. $11(x + 2) = 33$
 4. $4(2y + 1) = 12$ 8. $3(3m - 1) = 24$ 12. $4(4p - 5) = 28$

P2: A little more difficult

Solve each equation. Show all your working.

Do one batch of questions at a time then CHECK YOUR ANSWERS.

Stop when you are good enough to do the Star Challenge(s).

Batch A:

- | | | |
|------------------------|-----------------------|----------------------------|
| 1. $2(a + 1) = a + 8$ | 5. $3(e + 1) = e + 5$ | 9. $3x = 2(5 - x)$ |
| 2. $3(f - 2) = f + 2$ | 6. $2(r - 2) = r + 4$ | 10. $2(q + 1) = 3q$ |
| 3. $4(d + 1) = d + 13$ | 7. $3(p - 2) = p + 4$ | 11. $2x = 4(6 - x)$ |
| 4. $4(y - 2) = y + 1$ | 8. $4(c - 1) = c - 1$ | 12. $3(2j + 1) = 5(1 + j)$ |

Batch B:

- | | |
|----------------------------|--------------------------------------|
| 1. $2(b + 2) = b + 6$ | 7. $2(m + 3) - 1 = 8 + 3m$ |
| 2. $3(2r - 5) = r + 5$ | 8. $4(2r - 3) = 2(3r - 2)$ |
| 3. $3(e - 1) = e + 3$ | 9. $5(e - 4) = 3(8 - e)$ |
| 4. $7(y - 3) = 3(7 + y)$ | 10. $5t + 17(2 + 3t) = 16(1 + 4t)$ |
| 5. $3(3n + 2) = 2(4n + 2)$ | 11. $3(d - 3) = 5(2d + 1)$ |
| 6. $3x + 4 = 2(x + 11)$ | 12. $3(5 - y) = 4(3y + 2) + 27 + 5y$ |

Star Challenge 12H, 12H

11-12 correct = 2 stars

8-10 correct = 1 star

Solve each equation. Show all your working.

- | | |
|-------------------------|---------------------------|
| 1. $f + 2(f + 1) = 8$ | 7. $3(h + 1) = h + 11$ |
| 2. $7(k + 2) = 2k + 19$ | 8. $7(v - 1) = 9 + 3v$ |
| 3. $4(3w - 4) = 7w - 1$ | 9. $5(r + 1) + r = 29$ |
| 4. $4(2p - 3) = 5p - 3$ | 10. $7(g - 1) - 3g = 13$ |
| 5. $2(3x - 1) = 5x + 5$ | 11. $5(2m + 3) - 2m = 31$ |
| 6. $5(3c - 4) = 7c + 4$ | 12. $8e - 26 = 3(3 + e)$ |

Star Challenge 13H, 13H, 13H

Your teacher has the answers to these.

12 correct = 3 stars

10-11 correct = 2 stars

6-9 correct = 1 star

Solve each equation. Show all your working.

- | | |
|---------------------------|---------------------------------|
| 1. $10(n + 1) = 7(n + 4)$ | 7. $8(d + 1) = 2(d + 16)$ |
| 2. $8(n - 9) = 3(n - 4)$ | 8. $9(c - 2) = 8(c - 1)$ |
| 3. $4(d - 6) = 3(d - 1)$ | 9. $5(c + 4) = 3(c + 12)$ |
| 4. $9(v - 2) = 4(v + 3)$ | 10. $8(3 - x) - 5 = 3(2x - 3)$ |
| 5. $6(m - 5) = 5(m - 4)$ | 11. $2(y - 1) + 3(2y + 1) = 33$ |
| 6. $9(n - 2) = 5(n + 2)$ | 12. $3b + 4(b + 6) = -4$ |

• Your teacher has the answers to these.


Section 9: Equations with fractions

In this section you will work with equations that involve fractions.

DEVELOPMENT

D1: Fractions make equations difficult

Fractions can cause problems.
So one approach is to GET RID OF THEM as soon as possible.



6 is the lowest multiple of 2 and 3 → x 6

$\frac{x}{2} - 2 = 5 + \frac{x}{3}$	$3x - 12 = 30 + 2x$
$x - 12 = 30$	$x = 42$

Solve each equation. Show all working.

- | | | | |
|---------------------------|---------------------------|------------------------------|----------------------------|
| 1. $\frac{1}{2}c + 3 = 5$ | 3. $\frac{2}{3}h - 5 = 3$ | 5. $2(k + 1) = \frac{9}{4}$ | 7. $3 + \frac{4k}{5} = 11$ |
| 2. $\frac{3}{2}g + 2 = 8$ | 4. $\frac{5}{3}p - 4 = p$ | 6. $3(3m - 1) = \frac{3}{2}$ | 8. $6 + \frac{3n}{4} = 21$ |

• Check your answers.

PRACTICE

P1: Fraction practice

Solve each equation. Show all working.

- | | | | |
|------------------------------------|-------------------------------------|--|-------------------------------------|
| 1. $\frac{n}{3} - 2 = \frac{n}{4}$ | 3. $\frac{2e}{3} - 7 = \frac{e}{5}$ | 5. $\frac{3k}{4} - 2 = \frac{k}{2}$ | 7. $5 + \frac{x}{4} = \frac{2x}{3}$ |
| 2. $\frac{a}{2} - 6 = \frac{a}{5}$ | 4. $\frac{2t}{3} - \frac{t}{2} = 1$ | 6. $\frac{x}{4} + \frac{x}{6} = \frac{x}{2} - 2$ | 8. $\frac{c}{2} = \frac{c}{7} + 10$ |

• Check your answers.

P2: Getting more difficult

Solve each equation. Show all working.

- | | | | |
|-------------------------------------|--------------------------------------|---|-------------------------------------|
| 1. $\frac{2x}{3} - 5 = \frac{x}{4}$ | 3. $\frac{4t}{9} + 3 = \frac{t}{2}$ | 5. $\frac{3k}{7} - 2 = \frac{k}{3}$ | 7. $8 + \frac{c}{3} = \frac{2c}{5}$ |
| 2. $\frac{a}{2} - 2 = \frac{a}{6}$ | 4. $\frac{3d}{8} - \frac{d}{4} = 11$ | 6. $\frac{2x}{5} + \frac{x}{6} = \frac{x}{2} + 4$ | 8. $\frac{e}{9} = \frac{e}{3} - 4$ |

• Check your answers.

Star Challenge 14H-14H

Solve each equation. Show all working.

- | | | | |
|--------------------------------------|--------------------------------------|--|--|
| 1. $\frac{y}{4} + 5 = \frac{y}{2}$ | 3. $\frac{2e}{5} - 3 = \frac{e}{10}$ | 5. $\frac{5h}{21} - 3 = \frac{h}{6}$ | 7. $\frac{5n}{6} - \frac{3}{4} = \frac{2n}{3}$ |
| 2. $\frac{7b}{8} - 3 = \frac{5b}{6}$ | 4. $\frac{5t}{3} - \frac{t}{9} = 14$ | 6. $\frac{2t}{45} + \frac{t}{2} = \frac{4t}{9} + 18$ | 8. $\frac{c}{12} = \frac{c}{7} - 2$ |

• Your teacher has the answers to these.

7-8 correct = 2 stars
5-6 correct = 1 star

High Level Challenge Section

EXTENSIONS

YOUR TEACHER HAS THE ANSWERS TO THESE.

Ch 1: The structure of a Magic Square

In a Magic Square, the sum of each row, each column and each diagonal is the same.

25 marks = 2 stars
23-24 marks = 2 stars
20-22 marks = 1 star

Section 1

1. Complete these Magic Squares and their Magic Sums: (3 marks)

A

3		
	5	
2		7

B

3		
	11	
9		19

C

	8	
12		3

Magic Sum = Magic Sum = Magic Sum = 24

2. What is the connection between the number in the middle square and the Magic Sum? (2 marks)
3. Look at the numbers in either diagonal of these squares. Look at the differences between the numbers in any one diagonal. What do you notice? (2 marks)
4. If the numbers in a diagonal are 15, 21, x , what is the value of x ? (1 mark)

5. Complete this Magic Square using only the letters m , p and q .

$m - p$		
$m + p + q$	m	
$m - q$		$m + p$

(4 marks)

6. To check that your letters are correct in question 5, put $m = 5$, $p = 2$ and $q = 3$ into your square. You should get Magic Square A (in question 1). (0 marks)
7. What values of m , p and q give Magic Square B? (3 marks)
8. What is special about the Magic Square that you get with $m = 9$, $p = 2$, $q = 3$? (1 mark)
9. What is special about the Magic Square that you get with $m = 37$, $p = 6$, $q = 30$? (1 mark)

10.

1		
		7

 (a) Make four different magic squares by putting any number greater than 7 in the central square. (0 marks)
- (b) One number always appears in the same place. What is it? (1 mark)
- (c) What do you get if you put this number into the central square? (1 mark)

- (d) Complete this algebraic magic square. You should then see why you always get the result in (b). Explain why you always get this result. (6 marks)

$2m-7$	1	
	m	
		7

22 marks = 3 stars 20-21 marks = 2 stars
18-19 marks = 1 star

Section 1

Ch 2: Diabolical magic squares

P

3			13
	14	7	8
	9		
10	5		19

Q

5			14
2	10	19	13
17	4		15

R

3		4	22
12	13		
8	27	9	
		18	

1. Complete the three Magic Squares. (3 marks)

2. The extra properties that a **Diabolical** Magic Square has are:

- the 4 corners also add up to the Magic Sum;
- all sets of four squares with a common corner also add up to the Magic Sum.



Which of the squares in question 1 are diabolical? (3 marks)

3. The elements of a diabolical square have this algebraic structure.

a	$2a+3b$	$3a+b$	$4a+2b$
$3a+3b$	$4a$	$a+2b$	$2a+b$
$2a+2b$	$a+b$	$4a+3b$	$3a$
$4a+b$	$3a+2b$	$2a$	$a+3b$

For any of the squares that you said were diabolical, write down the value of a and b ? (2 marks)

4. For the square in question 3, what is the Magic Sum, in terms of a and b ? (2 marks)

5. Make a diabolical square for $a = 2, b = 5$. (4 marks)

6. Complete the Diabolical Magic Square

whose top left corner is

3	12
15	

(4 marks)

7. Complete the Diabolical Magic Square

whose bottom right corner is

	-6
-4	19

(4 marks)

Section 1

All correct = 3 stars

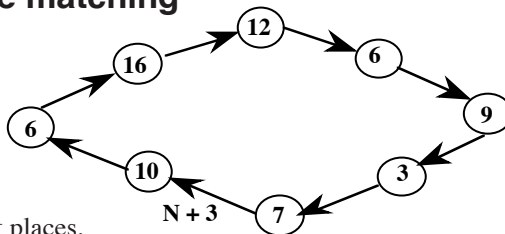
Ch 3: Diabolical challenge

Find the values of a and b that give the numbers 1, 2, 3, ... 16 one in each square of a diabolical square.

Section 1

All correct = 1 star

Ch 4: Rule matching



Put the rules in the correct places.

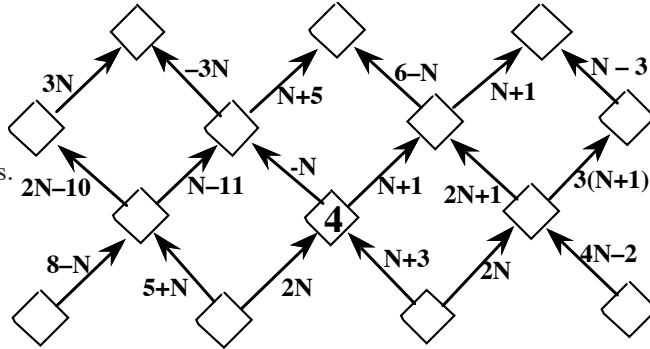
- RULES**
- $N - 4$
 - $N - 6$
 - $2N - 3$
 - $2N + 1$
 - $2(2N - 4)$
 - $\frac{1}{2}N$
 - 3
 - $\frac{1}{2}N + 1$
 - 2

Ch 5: Diamond lattice challenge

Section 2

13 correct = 2 stars
10-12 correct = 1 star

Fill in the numbers in the rest of the diamonds.



Ch 6: Equation square puzzles

Section 2

1 star for each correct puzzle

For each of these puzzles:

- cut out nine pieces of the puzzle;
- put the pieces into a 3 x 3 square so that every equation is next to its solution.

for example: $\frac{x + 1 = 10}{9}$



Puzzle 1

5 1	0 5n - 1 = 24	3 n + 5 = 9	6 2 = 9n u 3n + 1 = 22	2 8 7 + n = 7 2n + 1 = 13
7 2n = 20	4 6 5n - 1 = 4	12 1 = 2 u 3n = 6	2n = 18 5n + 2 = 62	

Puzzle 2

9 3n - 4 = n	2 5 - 3n = 2	4 = n + u 3n - 1 = 5	5n + 1 = 9 5 + 2n = 3	2 2n + 5 = 11 5 - n = -1
3 20 - 6n = 2 10 - 2n = 0	2 3 7 + n = 8	1 5 3n + 1 = 13	4 1	

Ch 7: Think for yourself !

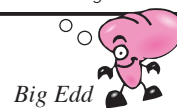
Section 5

18-20 marks = 2 stars
14-17 marks = 1 star

Solve these equations. Show each stage of your working out.

- $6p + 10 + 2p + 8 = 1 + 2p + 24 + 5p$
- $8c + 9 + 9c + 3 = 10 + 6c + 42 + 6c$
- $6x - 4 + 4x + 3 = 17 + 4x + 45 - 3x$
- $5y - 1 + 4y + 8 = 16 + 6y + 13 + y$
- $9n - 7 - 5n + 4 = 7 + 4n - 32 + 2n$
- $7h + 11 + 10h + 3 = 17 + 3h + 21 + 6h$
- $10u - 3 + 3u + 1 = 19 + 4u + 15 - 3u$
- $3k - 5 - k + 7 = 4 + 7k - 44 + 2k$
- $7v - 7 - 2v + 8 = 7 + 3v + 21 - v$
- $9 + 7b - 24 + b = 10b - 3 - 4b + 8$

For each question in Ch 7 – 10, there is 1 mark for the correct answer and 1 mark for clearly shown working out.



Big Edd

Ch 8: Challenge equations

Section 6

24-30 marks = 2 stars
18-23 marks = 1 star

$$6v + 2 = 16$$

$$6v = 14$$

$$v = \frac{14}{6} = \frac{7}{3} = 2\frac{1}{3}$$

The solutions to these equations are either negative numbers, fractions, or both.

Give all fractions as mixed numbers in simplest form.

mixed number in simplest form

Solve each equation. Show each stage of your working out.

- $6t + 3 = 4t + 10$
- $8m - 3 = m + 7$
- $10p - 9 = 8p - 6$
- $5y - 9 = 3y + 6$
- $9k + 8 = k + 14$
- $6x + 7 = 2 - 2x$
- $10n + 4 = n - 2$
- $5q - 3 = q - 11$
- $3r + 5 = 8 - 8r$
- $8h - 7 = 2h + 32$
- $9e - 6 = 3e - 13$
- $8c + 8 = -4 - 4c$
- $10p + 6 = 3p - 43$
- $4y + 4 = 2y - 1$
- $8d + 2 = 9 - d$

Section 6

21-24 marks = 2 stars
17-20 marks = 1 star

Ch 9: More difficult inequations

Solve each inequation. Show all your working out.

- $4x - 28 > 0$
- $3y - 15 < 0$
- $3m + 1 < m - 1$
- $x - 2 \geq 6 - 3x$
- $3c + 1 > c + 5$
- $3z < z + 6$
- $d \leq 40 - d$
- $3e + 5 \leq 15 - 7e$
- $2m + 3 < 27 - 4m$
- $7c + 8 < 5c - 4$
- $9x - 5 \geq 85 - x$
- $7e + 12 < 21 + 4e$

Ch 10: Inequation challenge

Section 6

24-30 marks = 2 stars
18-23 marks = 1 star

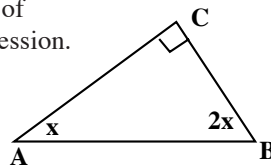
Solve each inequation. Show all your working out.

- $-5z < 15$
- $-5w < 7$
- $\frac{1}{2}d \geq 5$
- $\frac{3}{4}u \leq 6$
- $-3p + 1 < 7$
- $5 - 2y < 4$
- $4p - 7 \leq 2p$
- $\frac{2}{3}m > 1$
- $3x - 6 < -2$
- $6v - 3 \geq 4v + 6$
- $4x - 12 < x + 1$
- $3n - 4 > 5n + 3$
- $-\frac{4}{5}n \geq -8$
- $\frac{1}{3}s + 2 > \frac{1}{2}s$
- $7p - 11 \leq 16 - 2p$

Ch 11: Geometry problems

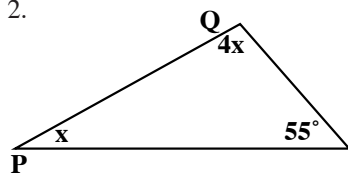
15 correct = 2 stars
11-14 correct = 1 star

- Write an expression in x for the sum of the angles A and B. Simplify the expression.
 - A and B add up to 90° . Write this as an equation involving x .
 - Solve the equation.
 - What size are the angles at A and B ?



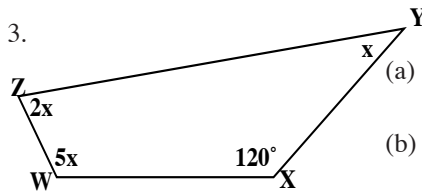
$2x + 5x$ when **simplified** is $7x$

2.



- The sum of these three angles is 180° . Write this as an equation involving x .
- Solve the equation.
- What size are the angles at P and Q ?

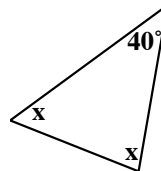
3.



- The sum of these angles is 360° . Write this as an equation involving x .
- Solve the equation and find the size of each of the unknown angles.

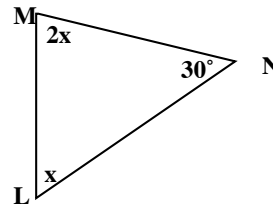
4. The sum of the angles of this triangle is 180° .

- Write this as an equation involving x .
- Solve the equation.

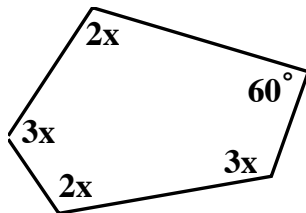


5.

- Write an equation that will help you find the sizes of these angles.
- Solve the equation.
- What is the size of angles L and M.



6.

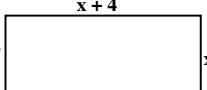


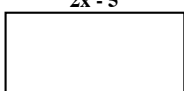
The sum of these angles is 540° .
Find the size of each angle.

Section 7

18-20 marks = 2 stars
14-17 marks = 1 star

Ch 12: Perimeter problems

1. (a) Write an expression for the perimeter of this rectangle in terms of x . Simplify the expression.
- 
- (b) If $x = 5$, what is the perimeter ?
- (c) If $x = 10$, what is the perimeter ?
- (d) The perimeter is 16cm. Write this as an equation involving x .
- (e) Solve the equation.
- (f) What is the length and breadth of the rectangle ? (6 marks)

2. (a) Write an equation in terms of x for the perimeter of this rectangle.
- 
- (b) Solve the equation.
- (c) What is the length and breadth of the rectangle ? (3 marks)

3. The length of a rectangle is twice its breadth.
The perimeter of the rectangle is 48cm.
Let the breadth of the rectangle be x cm.
- (a) Write an equation involving x . (4 marks)
- (b) Solve the equation and find the length and breadth of the rectangle.

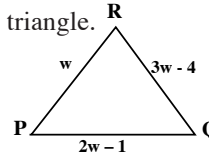
4. The sides of a triangle are y cm, $(3y - 1)$ cm and $(y + 4)$ cm.
Its perimeter is 18cm. (3 marks)

Show how you find the length of each side of the triangle.

5. The perimeter of this triangle is 25 cm.

Which is the longest side and how long is it ?

Show how you work it out. (4 marks)



Section 8

18-20 marks = 2 stars
14-17 marks = 1 star

Ch 13: Multiplying by negative numbers

$$\begin{aligned} & 5x + 2(3x - 1) \\ &= 5x + 6x - 2 \quad (+2 \times -1 = -2) \\ &= 11x - 2 \end{aligned}$$

$$\begin{aligned} & 5x - 2(3x - 1) \\ &= 5x - 6x + 2 \quad (-2 \times -1 = +2) \\ &= -x + 2 \end{aligned}$$

For each question:
2 marks for method
2 marks for accuracy

Solve each equation. Show all working.

- | | |
|-------------------------|---|
| 1. $5p - 3(p - 1) = 11$ | 6. $4(s + 2) - 2(s - 1) = s + 16$ |
| 2. $4x + 2(x - 1) = 16$ | 7. $7n - 2(3n + 1) = 3(n - 4)$ |
| 3. $4x - 2(x - 1) = 16$ | 8. $3(2q - 1) - 2(q + 1) = 25 - q$ |
| 4. $5m + 2(m + 3) = 27$ | 9. $7t - 3(2t + 4) = 5t - 2(t - 7)$ |
| 5. $5m - 2(m + 3) = 27$ | 10. $3(2c - 1) - 2(3 - c) = 6 - 3(5 - c)$ |

Ch 14: Get the message

Section 8

All correct = 1 star

Solve each equation. The value of the solution gives the position of a letter in the alphabet. [1 means a, 2 means b ...]. The letters spell out the message.

<input type="text"/>	$3x - 13 = 2x + 8$
<input type="text"/>	$3(x - 4) = 2(29 - x)$
<input type="text"/>	$2(x - 5) + 3 = 11$
<input type="text"/>	$5(25 - x) = x - 7$
<input type="text"/>	$2(3x - 4) - 2x = 2(x + 1)$
<input type="text"/>	$3(x + 2) - (5 - x) = 3x + 19$
<input type="text"/>	$2(25 - x) + 8 = x + 1$
<input type="text"/>	$5 + 3x = 2(2x + 2)$
<input type="text"/>	$4(2x - 3) = 7x$
<input type="text"/>	$12(21 - x) = 3x + 12$
<input type="text"/>	$2(4x + 3) - (2x - 5) = 41$
<input type="text"/>	$15x + 8 = 3(5 - 2x) + 2(21 - 14x)$
<input type="text"/>	$57 - 17x = x + 3$
<input type="text"/>	$\frac{1}{2}(3x + 1) = 2(x - 1)$

Ch 15: Fraction challenge

Section 9

25-32 marks = 2 stars

18-24 marks = 1 star

	$\frac{2x-3}{3} - \frac{x-3}{2} = 1\frac{2}{5}$	
Rewrite	$\frac{1}{3}(2x-3) - \frac{1}{2}(x-3) = \frac{7}{5}$	
x 30	$10(2x-3) - 15(x-3) = 42$	-15 x -3 = +45
Multiply out brackets	$20x - 30 - 15x + 45 = 42$	
	Now this can be solved in the usual way.	For each question: 2 marks for method 2 marks for accuracy

Solve these equations.

The answers may be fractions/decimals or negative numbers.

- $\frac{2m-1}{3} + \frac{m+2}{2} = 3$
- $\frac{t-2}{4} - \frac{t-4}{6} = \frac{2}{3}$
- $\frac{c}{2} - \frac{(c-1)}{3} = \frac{(1-c)}{6}$
- $\frac{u+5}{2} - \frac{u+1}{4} = 3$
- $\frac{x+4}{4} - \frac{3x-9}{7} = \frac{3}{2}$
- $\frac{n+2}{5} + \frac{n-1}{2} = 2$
- $\frac{3e-1}{4} + \frac{2e+5}{2} = \frac{1}{2}$
- $\frac{2(v-1)}{3} + \frac{3(2v+5)}{4} - \frac{7(3-v)}{12} = 4$

Ch 16: The mega-challenge crossword !!

The answers to this crossword are the solutions to each of the equations. The clues include all the types of equations you have met PLUS SOME YOU WILL HAVE TO WORK OUT HOW TO SOLVE FOR YOURSELVES! If you can complete this crossword without help from anyone else, then you are becoming a very competent mathematician indeed.

Stick this crossword into your book.

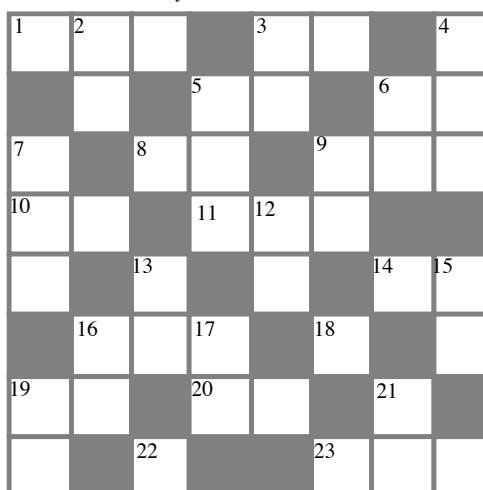
Across

1. $x + 25 = 2(x - 50)$
3. $\frac{x}{x+4} = \frac{9}{10}$
5. $\frac{x}{66} = \frac{1}{3}$
6. $2(x - 3) - 25 = x + 22$
8. $\frac{2x-6}{5} = \frac{x+3}{3}$
9. $\frac{633}{x} + 15 = 18$
10. $3(x - 5) = 2(x + 5)$
11. $\frac{x}{11} + 5 = 15$

14. $\frac{100}{x-1} = 4$
16. $3(x - 22) = 2(x + 28) + 100$
18. $4(5y - 25) = 6y - 2$
19. $\frac{a-4}{6} = 5$
20. $3(50 - x) + x = 54$
22. $\frac{4}{5}(x + 1) = 8$
23. $\frac{40}{x} = \frac{1}{21}$

Down

2. $2(x - 3) - (x + 2) = 15$
3. $\frac{x-7}{x-2} = \frac{5}{6}$
4. $\frac{x+119}{x-6} = 2$
5. $\frac{x+19}{10} = 25$



$$6. \frac{1}{6} \left(\frac{x}{3} + 1 \right) = 3$$

$$7. 4(x - 65) - (2x - 35) = 15$$

$$9. 4(x - 2) + 3 = 3x + 15$$

$$12. \frac{2x+1}{12} = \frac{35}{20}$$

$$13. \frac{40-d}{6} = \frac{4}{3}$$

$$15. \frac{3y}{4} + 2 = 50$$

$$16. \frac{40}{x} = \frac{5}{3}$$

$$17. \frac{x-4}{25} = \frac{4}{5}$$

$$19. \frac{3(p+3)}{4} = 30$$

$$21. 15(100 - x) = x - 4$$

42 squares = 4 stars
40-41 squares = 3 stars
35-39 squares = 2 stars
30-34 squares = 1 star

Skills in Algebra

ANSWERS

Section 1: Simple algebraic expressions p278

D1: Chain rule

- A: 3 → 5 → 4 → 12 → 6 → 7 → 3 B: 4 → 1 → 3 → 6 → 2 → 7 → 4
 C: 9 → 6 → 12 → 15 → 5 → 8 → 9 D: 2 → 6 → 2 → 5 → 3 → 4 → 2

P1: Chain practice

- E: 2, 10, 4, 3, 8; N-2 F: 7, 3, 10, 4, 1; N+4 or 5N G: 9, 5, 2, 7, 8; N-4 or $\frac{1}{2}N$
 H: 3, 1, 5, 15, 2; 4N or N+6 I: 3, 5, 2, 7, 4, 10; N + 6 or 2N+2
 J: 4, 6, 3, 5, 10, 8; 2N or N+5

Section 2: More complex algebraic expressions p282

D1: Expressions with equal value

1. $N+1, N^2-11, 2N-3, 3N-7$ 2. $3N-2, (N+2)(N-1), 2N, 2(N-1) + 2, \frac{4(N+1)}{3}$
 3. $N(N-1)(N-2), N^2-N, (N-1)^2 + 2, N^3-2, (N-1)N, \frac{2N^2}{6}$

P1: Star expressions A=4, B=2, C=20, D=4, E=5, F=4, G=7

Section 3: Equations p284

D1: Numbers and rules

N	N → N+3	N	N → N-5	N	N → N+4	N	N → 2N	N	N → 3N-1	N	N → N+4
1	→ 4	1	→ -4	2	→ 6	3	→ 6	1	→ 2	2	→ 6
3	→ 6	5	→ 0	3	→ 7	-1	→ -2	2	→ 5	6	→ 10
4	→ 7	6	→ 1	-5	→ -1	5	→ 10	5	→ 14	10	→ 14
6	→ 9	8	→ 3	5	→ 9	7	→ 14	3	→ 28	-1	→ 3
-1	→ 2	-2	→ -7	9	→ 13	-2	→ -4	10	→ 29	1	→ 5
-4	→ -1	0	→ -5	-3	→ 1	6	→ 12	7	→ 20	7	→ 11

D2: Rules and equations

1. 7 2. 6 3. 9 4. 5 5. 3 6. 4 7. 10
 8. 1 9. 4 10. 3 11. 4 12. 4 13. 10 14. 7

Section 4: A systematic approach to solving equations p288

D1: The story so far ...

- A: 6 B: 3 C: 10 D: 7 E: $7\frac{1}{3}$ F: 4 G: $3\frac{1}{3}$ H: 4 I: 2 J: 4
 The equations you could not solve either were too complex /involved fractions or both.

D2: Balancing scales

1. (a) Yes (b) Yes 2. (a) Right (b) 1kg 3. (a) left (b) 1 kg 4. 4 kg 5. 11 kg

D3: Balancing equations

1. $3p + 2 = 11$ 2. $2c + 40 = 140$ 3. $4c + 5 = 13$
 $3p = 9$ $2c = 100$ $4c = 8$
 $p = 3$ $c = 50$ $c = 2$

D4: Equations without pictures

1. $5p + 3 = 18$ 2. $3k - 1 = 11$ 3. $4e - 2 = 18$
 $5p = 15$ $3k = 12$ $4e = 20$
 $p = 3$ $k = 4$ $e = 5$
 4. 3 5. 3 6. 8 7. 5 8. 5 9. 3 10. 2 11. 7 12. 3

P1: Practice Exercises

Batch A:

1. 5 2. 3 3. 5 4. 5 5. 11 6. 6 7. 3 8. 3
 9. 6 10. 5 11. 2 12. 6 13. 5 14. 5 15. 9

Batch B:

1. 4 2. 3 3. 8 4. 8 5. 5 6. 11 7. 8 8. 15
 9. 9 10. 1 11. 8 12. 10 13. 5 14. 6 15. 5

Batch C:

1. 8 2. 5 3. 4 4. 2 5. 4 6. 4 7. 4 8. 2
 9. 2 10. 5 11. 4 12. 3 13. 3 14. 3 15. 7

Section 5: Getting more difficult p293

D1: Unknowns on both sides

1. -b & -2 2. -2p, +3, +2 3. 3 4. 6 5. 5 6. 5
 7. 6 8. 7 9. 4 10. 5 11. 8

P1: Practice Exercises

Batch A:

1. 3 2. 4 3. 4 4. 4 5. 6 6. 4 7. 2 8. 5
 9. 7 10. 2 11. 9 12. 2 13. 7 14. 7 15. 7

Batch B:

1. 5 2. 7 3. 9 4. 4 5. 7 6. 10 7. 8 8. 11
 9. 9 10. 11 11. 2 12. 7 13. 9 14. 3 15. 3

Batch C:

1. 4 2. 2 3. 4 4. 5 5. 1 6. 4 7. 4 8. 4
 9. 4 10. 6 11. 4 12. 9 13. 5 14. 5 15. 3

Section 6: Solving inequations p296

D1: True or false

1. T 2. F 3. T 4. T 5. T 6. F 7. T 8. F

D2: Hypothesis testing

1-4 are correct. However, 5 & 6 are not. Hypothesis 5 should read "If you multiply both sides of an equation by a negative number, the inequality sign is reversed."
 Hypothesis 6 should read "If you divide both sides of an equation by a negative number, the inequality sign is reversed."

D3: Solving inequations

1. $c > 3$ 2. $t \leq 5$ 3. $m < 7$ 4. $f \geq 12$ 5. $c > 2$ 6. $d > 8$ 7. $n \leq 4$ 8. $m < 2$
 9. $p < 6$ 10. $z > 4$ 11. $t < 2$ 12. $u \leq 2$

A: Solving inequations using negative numbers

1. $r \leq -2$ 2. $q > 3$ 3. $n \geq 3$ 4. $c > 4$ 5. $v > -3$ 6. $p \geq 5$
 7. $m < -2$ 8. $m \leq 4$ 9. $m \geq -6$

Section 7: Problems, expressions and equations p298**D1: Sweet problems**

1. (a) $2n$ (b) $2n+5$ (c) 25 (d) 29 (e) 45 (f) 15 (g) 9 (h) 8
 2. (a) $3n+2$ (b) 62 (c) 47 (d) 10 (e) 12 (f) 7
 3. (a) $4n-2$ (b) 58 (c) 42 (d) $4n-2=38$; 10 (g) 12

D2: Transport problems

1. (a) $2m+5$ (b) 35 (c) 47 (d) 20 (e) 6
 2. (a) $N+3$ (b) $N+3=22$ (c) 19

Section 8: Equations with brackets p300**D1: Multiplying out brackets**

1. $12a+6c$ 2. $10n-15m$ 3. $6r+4s$ 4. $8a+6$ 5. $6a-6b$ 6. $8+12e$
 7. $6-8c$ 8. $7p+14$ 9. $2s+2t-4v$ 10. $12-3v+9u$

D2: Simple equations with brackets

1. 7 2. 7 3. 7 4. 5 5. 11 6. 12 7. 3 8. 2 9. 3

P1: Practice Exercises**Batch A:**

1. 3 2. 4 3. 2 4. 4 5. 12 6. 0 7. 6 8. 2
 9. 2 10. 3 11. 4 12. 5

Batch B:

1. 2 2. 4 3. 2 4. 1 5. 2 6. 7 7. 1 8. 3
 9. 4 10. 2 11. 1 12. 3

P2: A little more difficult**Batch A:**

1. 6 2. 4 3. 3 4. 3 5. 1 6. 8
 7. 5 8. 1 9. 2 10. 2 11. 4 12. 2

Batch B:

1. 2 2. 4 3. 3 4. 10.5 5. 2 6. 18
 7. -3 8. 4 9. 5.5 10. 2.25 11. -2 12. -1

Section 9: Equations with fractions p302**D1: Fractions make equations difficult**

1. 4 2. 4 3. 12 4. 6 5. $\frac{1}{8}$ 6. $\frac{1}{2}$ 7. 10 8. 20

P1: Fraction practice

1. 24 2. 20 3. 15 4. 6 5. 8 6. 24 7. 12 8. 28

P2: Getting more difficult

1. 12 2. 6 3. 54 4. 88 5. 21 6. 60 7. 120 8. 18