PART 3

UNIT 1

AUTUMN first half

NUMBER: PROPERTIES
MENTAL METHODS

UNIT 1

NUMBER: PROPERTIES MENTAL METHODS

SUGGESTED TIME **4 hours**

TEACHING OBJECTIVES

- Know squares to at least 10 × 10.
- Find a difference by counting up through next multiple of 10, 100, 1000.
- Add and subtract two-digit whole numbers.
- Recognise and extend number sequences formed by counting from any number in steps of constant size, extend beyond zero when counting back.
- Generate terms of a number sequence given a rule.

SECTION 1 Square numbers

SECTION 2 Simple sequences

SECTION 3 Mental addition

SECTION 4 Mental subtraction

HOMEWORK

- Identify mental recall and mental calculation skills that pupils need to learn and consolidate.
- Learn square numbers to at least 10 × 10.
- Use the Star Challenges.

Unit 1 Checklist for pupils

Square numbers

You will:

- learn what we mean by square numbers ☐
- recall number facts for square numbers, eg $8 \times 8 = 64$
  $\square \times \square = 49$ ☐

Simple sequences

You will:

- recognise and extend number sequences by adding or subtracting ☐
- extend beyond zero when counting back ☐
- recognise and explain patterns in sequences ☐

Mental addition and subtraction

You will:

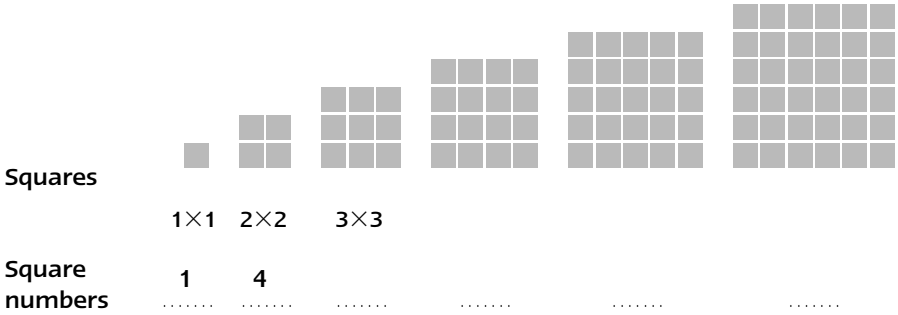
- add and subtract 10, 20, 30... to two-digit numbers ☐
- add and subtract 1 to 9 to any whole number ☐
- add pairs of two-digit numbers by adding tens and units separately ☐
- subtract numbers by counting up through the next multiple of 10, 100 or 1000 ☐
- subtract pairs of two-digit numbers ☐

UNIT 1

SECTION 1: SQUARE NUMBERS

DIRECT TEACHING POINTS

- Quickly revise odd and even numbers. You need to demonstrate the link between square numbers and their spatial arrangements. Pupils need to have this visual picture.



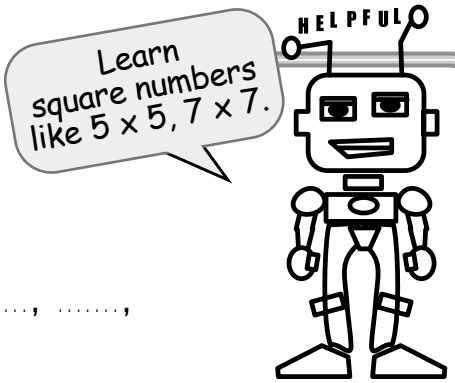
- Star Challenge 2 is an activity that pupils could attempt individually and then discuss their results in pairs.
- Learning square numbers up to 10 × 10 can be reinforced as homework.
- Square numbers provide pupils with key facts to learn multiplication tables, for example 8 × 7 can be deduced from 7 × 7. You need to teach this and build on it during the year.
- Discuss with pupils which square numbers they should know and when it is appropriate to use a calculator to work out others.
- You can revisit square numbers regularly in mental sessions.

KEY VOCABULARY TO LEARN AND USE

square number

Square numbers

1 The first ten square numbers



Complete:

The first ten square numbers are

1, 4, ..., ..., ..., ..., ..., ..., ..., ...,

2 More square numbers

Complete:

The second square number = 4

The fourth square number = 16

The sixth square number = ...

The tenth square number = ...

Work out:

The thirteenth square number = ...

The 45th square number = ...

3 Squaring numbers

This is a table of numbers and their squares.

Fill in the gaps:

Numbers	2	3	7	9		12	0			4	6			11
Squares	4	9	49		25			1	64			4	100	

Square numbers

STAR CHALLENGE 1 Calculator squares search

★

9–10 correct 1 star

Complete the square numbers:

1 ..... × ..... = 16

2 ..... × ..... = 64

3 ..... × ..... = 144

4 ..... × ..... = 169

5 ..... × ..... = 225

6 ..... × ..... = 484

7 ..... squared = 25

8 ..... squared = 841

9 ..... squared = 900

10 ***n*** **squared = 7921 – what is the value of *n*?** .....

STAR CHALLENGE 2 Sums of two squares

★★

19–20 correct 2 stars
15–18 correct 1 star

Squares are:

	1	4	9	16
25	36	49	64	81
100	121	144	.....	

Write each number below as the sum of two squares.

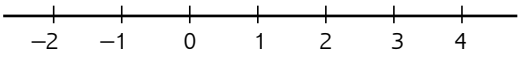
2 = 1 + 1	17 = ... + ...	20 = ... + ...
5 = 1 + 4	50 = ... + ...	25 = ... + ...
13 = 4 + 9	80 = ... + ...	125 = ... + ...
18 = 9 + 9	65 = ... + ...	85 = ... + ...
8 = ... + ...	74 = ... + ...	61 = ... + ...
10 = ... + ...	104 = ... + ...	169 = ... + ...
106 = ... + ...	145 = ... + ...	26 = ... + ...
52 = ... + ...	202 = ... + ...	313 = ... + ...

UNIT 1

SECTION 2: SIMPLE SEQUENCES

DIRECT TEACHING POINTS

- There are many opportunities within this section to teach and consolidate mental addition and subtraction strategies, for example, adding and subtracting 9.
- Counting on and back in equal steps from zero helps reinforce multiples and multiplication facts.
- Practise this work orally with written exercises used as consolidation as appropriate.
- Demonstrate to pupils the patterns in our number system.
  $6 + 5$ $16 + 5$ $96 + 5$ are basically the same calculation.
- Use a number line, extended below zero, as a visual prompt.



- Pupils find counting back more difficult than counting on. It needs more practice.

KEY VOCABULARY TO LEARN AND USE

sequence *add* *subtract*
minus *multiple*

UNIT 1

Simple sequences

1 Counting on and back in 6s

Extend each sequence by counting on or back in 6s:

1	6	12	18	.....	.....	.....	.....
2	21	27	33	.....	.....	.....	.....
3	50	56	.....	.....	.....	.....	.....
4	60	54	48	.....	.....	.....	.....
5	100	94	.....	.....	.....	.....	.....
6	52	46	.....	.....	.....	.....	.....
7	27	21	15	.....	.....	−3	.....
8	20	14	.....	.....	.....	.....	.....

2 Counting on and back in 9s

Extend each sequence by counting on or back in 9s:

1	9	18	27	.....	.....	.....	.....
2	29	38	.....	.....	.....	.....	.....
3	63	54	.....	.....	.....	.....	.....
4	65	56	.....	.....	.....	.....	.....
5	27	18	.....	.....	−9	.....	.....
6	30	21	.....	.....	−6	.....	.....
7	50	41	.....	.....	.....	.....	.....
8	6	−3	.....	.....	.....	.....	.....

Simple sequences

3 Rules for counting on and back

What is the rule?
Extend each sequence:

1	Rule: add 8	4	12	.....	.....	.....	.....	.....
2	Rule: add	5	12	.....	.....	.....	.....	.....
3	Rule: add	21	27	.....	.....	.....	.....	.....
4	Rule: subtract 9	83	74	65	.....	.....	.....	.....
5	Rule:	78	70	62	.....	.....	.....	.....
6	Rule:	−2	2	.....	.....	.....	.....	.....
7	Rule:	18	29	.....	.....	.....	.....	.....
8	Rule:	50	75	100	.....	.....	.....	.....

STAR CHALLENGE 3 From sequences to rules

50–52 correct 2 stars
42–49 correct 1 star

What is the rule?
Extend each sequence:

1	Rule:	43	51	.....	.....	.....	83	.....
2	Rule:	34	45	.....	.....	.....	89	.....
3	Rule:	150	.....	.....	225	250	.....	.....
4	Rule:	5	30	55	.....	.....	.....	.....
5	Rule:	90	81	72	.....	.....	.....	.....
6	Rule:	−3	3	.....	15	.....	.....	33
7	Rule:	−30	−21	−12	.....	.....	.....	24
8	Rule:	7	13	.....	.....	.....	.....	43

UNIT 1

Simple sequences

STAR CHALLENGE 4

Rules and patterns

All correct 1 star

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81
82	83	84	85	86	87	88	89	90

1 Look at the column with 8 at the top.
What is the rule connecting this sequence of numbers?

.....

.....

2 Start with 8.
Circle each number that is made by adding 7 onto the last number.

.....

.....

3 Describe the pattern made by the numbers you have circled.

.....

.....

UNIT 1

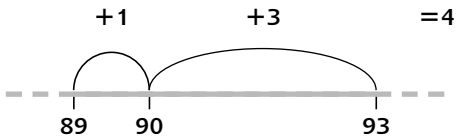
SECTIONS 3 AND 4: MENTAL ADDITION AND SUBTRACTION

DIRECT TEACHING POINTS

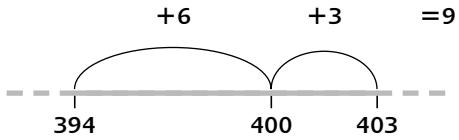
These sections introduce work that needs to be continually practised during the term: addition and subtraction of two 2-digit numbers mentally.

- Pupils need to be secure in recalling addition and subtraction facts to 20.
- Counting orally forward and back over 10, 100 and 1000 boundaries can help consolidate mental work on differences.
  For example:

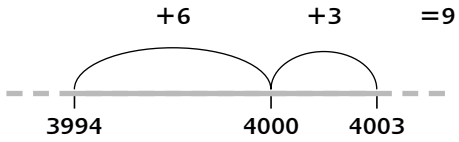
93 – 89



403 – 394



4003 – 3994

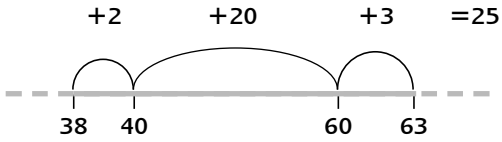


- A prerequisite to the introduction of written calculations is for pupils to be able to add and subtract a pair of two-digit numbers mentally.
- You will need to teach each stage then consolidate. You can teach progression in mental arithmetic strategies by using examples like these:

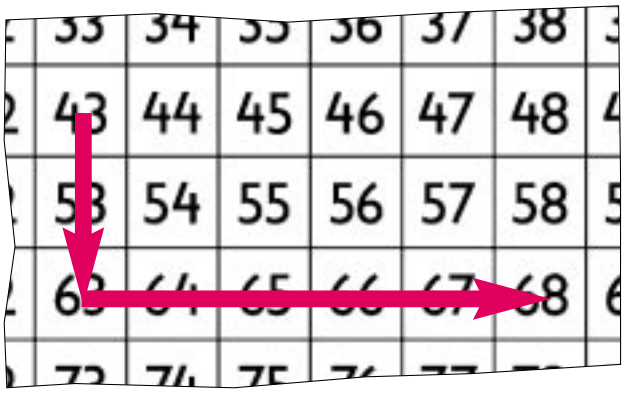
43 + 30	do this by adding 10s		
56 − 20	do this by subtracting 10s		
43 + 8	deduce from 13 + 8 or (43 + 7) + 1		
43 − 8	deduce from 13 − 8 or (43 − 3) − 5		
43 + 32	break this down into (43 + 30) + 2	or (40 + 30) + (3 + 2)	no regroup
54 + 27	break this down into (54 + 20) + 7	or (50 + 20) + (4 + 7)	over 10s boundary
86 + 47	break this down into (86 + 40) + 7	or (80 + 40) + (6 + 7)	over 10s, 100s boundary
93 − 27	break this down into (93 − 20) − 7		across 10s boundary
64 + 39	break this down into (64 + 40) − 1		compensate

- Extend this work to cover multiples of 10 and simple decimals.
  280 + 640 720 − 180 2.7 + 4.6 7.3 − 2.7
- Include examples of money and measures £60 + £3.80 £7.20 − £3.80 5.5 m − 2.8 m
- Demonstrate the use of an empty number line as a support for pupils' mental calculations.

63 – 38



- The visual image on a hundred square is a support for some pupils.



43 + 25 = 68

- Pupils need to progress so that they are not dependent on the number line or hundred square.

KEY VOCABULARY TO LEARN AND USE

add addition sum
subtract minus take away difference

Mental addition

1 Adding and subtracting in your head

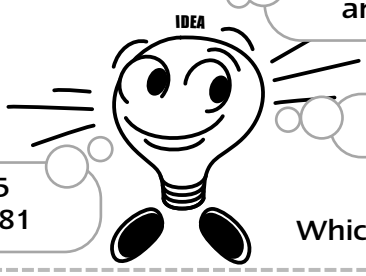
Write down the answers to each of these:

1 27 + 10 = ...
2 68 + 7 = ...
3 72 + 20 = ...
4 37 + 8 = ...
5 23 + 8 = ...
6 61 + 30 = ...
7 93 − 20 = ...
8 48 − 9 = ...
9 48 − 20 = ...
10 74 − 7 = ...
11 86 − 50 = ...
12 97 − 8 = ...

2 Adding pairs of numbers in your head

Example

Work out 45 + 36



Write down the answers to each of these:

1 23 + 35 = ...
2 37 + 42 = ...
3 42 + 34 = ...
4 61 + 27 = ...
5 74 + 28 = ...
6 65 + 33 = ...
7 27 + 43 = ...
8 25 + 35 = ...
9 19 + 21 = ...
10 55 + 37 = ...
11 44 + 48 = ...
12 48 + 67 = ...

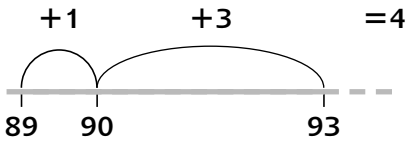
UNIT 1

Mental subtraction

1 Subtracting across the tens boundary

Example

Work out 93 − 89 by counting on. Use an empty number line.



93 − 89 = 4

1 54 − 49 =

2 83 − 76 =

3 75 − 68 =

4 46 − 34 =

Now do it in your head!

5 53 − 44 = ...

6 86 − 79 = ...

7 101 − 97 = ...

8 84 − 78 = ...

9 36 − 25 = ...

10 97 − 85 = ...

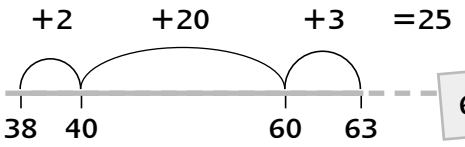
UNIT 1

Mental subtraction

2 Bigger jumps across the tens boundaries

Example

Work out 63 − 38 by counting on. Use an empty number line.



63 − 38 = 25

1 74 − 49 =

2 95 − 36 =

3 63 − 16 =

4 63 − 34 =

5 84 − 39 =

6 105 − 67 =

Work these out in your head.

7 82 − 45 = ...

8 83 − 55 = ...

9 76 − 39 = ...

10 75 − 37 = ...

11 54 − 36 = ...

12 71 − 47 = ...

UNIT 1

Mental subtraction

3 Subtracting across the hundreds boundary

1 204 − 192 =

2 510 − 499 =

3 706 − 690 =

4 612 − 595 =

5 602 − 588 = ...

6 305 − 299 = ...

7 311 − 295 = ...

8 702 − 691 = ...

9 415 − 397 = ...

10 904 − 895 = ...

4 Subtracting across the thousands boundary

1 3004 − 2995 =

2 7010 − 6992 =

3 8006 − 7990 =

4 9009 − 8998 =

5 1011 − 997 = ...

6 2005 − 1997 = ...

7 3004 − 2990 = ...

8 5010 − 4994 = ...

9 6012 − 5980 = ...

10 3015 − 2990 = ...

Mental subtraction

STAR CHALLENGE 5

Counting on mixture

12–15 correct 2 stars
8–11 correct 1 star

Work these out in your head.

1	65 − 42	5	525 − 475	9	540 − 460
2	312 − 280	6	721 − 570	10	86 − 68
3	95 − 59	7	82 − 55	11	650 − 580
4	72 − 23	8	73 − 37	12	842 − 798

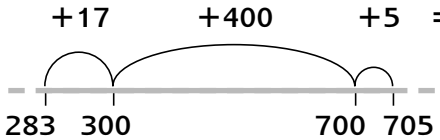
STAR CHALLENGE 6

Bigger jumps across the hundreds boundaries

9 correct 2 stars
7–8 correct 1 star

Example

Work out 705 − 283 by counting on. Use an empty number line.



705 − 283 = 422

1	435 − 190	3	265 − 88	5	535 − 275
2	620 − 370	4	810 − 493	6	825 − 295

Now do these in your head.

7	420 + 199	8	651 + 592	9	922 − 688

UNIT 1

Unit 1 Answers

Section 1 Square numbers

1 The first ten square numbers

1, 4, **9**, **16**, **25**, **36**, **49**, **64**, **81**, **100**

2 More square numbers

4, 16, **36**, **100**, **169**, **2025**

3 Squaring numbers

2	3	7	9	**5**	12	0	**1**	**8**	4	6	**2**	**10**	11
4	9	49	**81**	25	**144**	**0**	1	64	**16**	**36**	4	100	**121**

Section 2 Simple sequences

1 Counting on and back in 6s

1	6	12	18	**24**	**30**	**36**	**42**
2	21	27	33	**39**	**45**	**51**	**57**
3	50	56	**62**	**68**	**74**	**80**	**86**
4	60	54	48	**42**	**36**	**30**	**24**
5	100	94	**88**	**82**	**76**	**70**	**64**
6	52	46	**40**	**34**	**28**	**22**	**16**
7	27	21	15	**9**	**3**	**−3**	**−9**
8	20	14	**8**	**2**	**−4**	**−10**	**−16**

UNIT 1

Unit 1 Answers

Simple sequences *continued*

2 Counting on and back in 9s

1	9	18	27	**36**	**45**	**54**	**63**
2	29	38	**47**	**56**	**65**	**74**	**83**
3	63	54	**45**	**36**	**27**	**18**	**9**
4	65	56	**47**	**38**	**29**	**20**	**11**
5	27	18	**9**	**0**	−9	**−18**	**−27**
6	30	21	**12**	3	−6	**−15**	**−24**
7	50	41	**32**	**23**	**14**	**5**	**−4**
8	6	−3	**−12**	**−21**	**−30**	**−39**	**−48**

3 Rules for counting on and back

1	add 8	4	12	**20**	**28**	**36**	**44**	**52**
2	add **7**	5	12	**19**	**26**	**33**	**40**	**47**
3	add **6**	21	27	**33**	**39**	**45**	**51**	**57**
4	subtract 9	83	74	65	**56**	**47**	**38**	**29**
5	**subtract 8**	78	70	62	**54**	**46**	**38**	**30**
6	**add 4**	−2	2	**6**	**10**	**14**	**18**	**22**
7	**add 11**	18	29	**40**	**51**	**62**	**73**	**84**
8	**add 25**	50	75	100	**125**	**150**	**175**	**200**

Section 3 Mental addition

1 Adding and subtracting in your head

1	**37**	5	**31**	9	**28**
2	**75**	6	**91**	10	**67**
3	**92**	7	**73**	11	**36**
4	**45**	8	**39**	12	**89**

Unit 1 Answers

Section 3 Mental addition *continued*

2 Adding pairs of numbers in your head

1	58	5	102	9	40
2	79	6	98	10	92
3	76	7	70	11	92
4	88	8	60	12	115

Section 4 Mental subtraction

1 Subtracting across tens boundary

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

2 Bigger jumps across the tens boundaries

1	25	5	45	9	37
2	59	6	38	10	38
3	47	7	37	11	18
4	29	8	28	12	24

3 Subtracting across the hundreds boundary

1	12	5	14	9	18
2	11	6	6	10	9
3	16	7	16		
4	17	8	11		

4 Subtracting across the thousands boundary

1	9	5	14	9	32
2	18	6	8	10	25
3	16	7	14		
4	11	8	16		

Unit 1 Answers

Star Challenge answers

Calculator squares search

9–10 correct 1 star

1	**4** × **4** = 16	6	**22** × **22** = 484
2	**8** × **8** = 64	7	**5** squared = 25
3	**12** × **12** = 144	8	**29** squared = 841
4	**13** × **13** = 169	9	**30** squared = 900
5	**15** × **15** = 225	10	*n* = **89**

Sums of two squares

19–20 correct 2 stars
15–18 correct 1 star

2 = 1 + 1	17 = **1** + **16**	20 = **16** + **4**
5 = 1 + 4	50 = **1** + **49**	25 = **16** + **9**
	or **25** + **25**	
13 = 4 + 9	80 = **64** + **16**	125 = **121** + **4**
18 = 9 + 9	65 = **1** + **64**	85 = **81** + **4**
8 = **4** + **4**	74 = **49** + **25**	61 = **36** + **25**
10 = **1** + **9**	104 = **100** + **4**	169 = **144** + **25**
106 = **81** + **25**	145 = **1** + **144**	26 = **25** + **1**
	or **64** + **81**	
52 = **36** + **16**	202 = **81** + **121**	313 = **144** + **169**

UNIT 1

Unit 1 Answers

Star Challenge answers *continued*

STAR CHALLENGE 3 — From sequences to rules

50–52 correct 2 stars
42–49 correct 1 star

1	**add 8**	43	51	**59**	**67**	**75**	83	**91**
2	**add 11**	34	45	**56**	**67**	**78**	89	**100**
3	**add 25**	150	**175**	**200**	225	250	**275**	**300**
4	**add 25**	5	30	55	**80**	**105**	**130**	**155**
5	**subtract 9**	90	81	72	**63**	**54**	**45**	**36**
6	**add 6**	−3	3	**9**	15	**21**	**27**	33
7	**add 9**	−30	−21	−12	**−3**	**6**	**15**	24
8	**add 6**	7	13	**19**	**25**	**31**	**37**	43

STAR CHALLENGE 4 — Rules and patterns

All correct 1 star

1 **add 9**

2

1	2	3	4	5	6	7	(8)	9
10	11	12	13	14	(15)	16	17	18
19	20	21	(22)	23	24	25	26	27
28	(29)	30	31	32	33	34	35	(36)
37	38	39	40	41	42	(43)	44	45
46	47	48	49	(50)	51	52	53	54
55	56	(57)	58	59	60	61	62	63
(64)	65	66	67	68	69	70	(71)	72
73	74	75	76	77	(78)	79	80	81
82	83	84	(85)	86	87	88	89	90

3 **sloping lines going down to the left**

STAR CHALLENGE 5 — Counting on mixture

12–15 correct 2 stars
8–11 correct 1 star

1	**23**	4	**49**	7	**27**	10	**18**
2	**32**	5	**50**	8	**36**	11	**70**
3	**36**	6	**151**	9	**80**	12	**44**

STAR CHALLENGE 6 — Bigger jumps across the hundreds boundaries

9 correct 2 stars
7–8 correct 1 star

1	**245**	4	**317**	7	**619**
2	**250**	5	**260**	8	**1243**
3	**177**	6	**530**	9	**234**