UNIT 1

Knowledge organiser

NUMBER, POWERS, DECIMALS, HCF AND LCM, ROOTS AND ROUNDING

Key words, rules and things to remember for every lesson in this unit.

1.1 Place value

How can we use place value to compare numbers and justify whether they are greater than, less than, equal to or not equal to each other?

KEY WORDS

Digit: One symbol from 0 to 9 used to make numbers. 583 has three digits: 5, 8 and 3.

Place value: The value a digit has because of its column. In 5,096 the 9 is worth 90.

Placeholder: A zero that keeps an empty column in place. 3,058 has no hundreds.

Decimal point: Separates the whole number from the tenths, hundredths and thousandths. 204.7: the 7 is worth 0.7

Million: 1,000,000: 1 followed by six zeros. 5.3 million = 5,300,000

RULES

Th H T U • t h th — Thousands, hundreds, tens, units • tenths, hundredths, thousandths. Each column is worth 10 times the column to its right.

608 > 580 — Compare from the left. The first digit that is different decides. e.g. 6 hundreds > 5 hundreds

3.5 = 3.50 — A trailing zero does not change the value. e.g. 0.42 = 0.420 · 125 < 152 · 204 ≠ 240

MUST REMEMBER

- Line up the digits and the decimal points in place-value columns.
- Compare from the left. The first digit that differs decides which number is larger.
- Trailing zeros do not change the value: 0.42 = 0.420.

1.2 Addition and subtraction

How can we choose efficient addition and subtraction methods, and use estimation and inverse operations to justify that our answers are reasonable?

KEY WORDS

Sum · difference: The answer to an addition · the answer to a subtraction. The difference between 9 and 4 is 5.

Exchange: Trade 10 units for 1 ten, or 1 ten for 10 units. 1 whole = 10 tenths = 100 hundredths

Estimate: A quick calculation using rounded numbers. 1635 + 386 ≈ 1600 + 400 = 2000

Inverse operation: An operation that undoes another. Addition and subtraction are inverses. 2436 + 1527 = 3963, so 3963 − 1527 = 2436

Column method: A written method, one column at a time, starting with the units.

RULES

63 − 21.4 → 63.0 − 21.4 — Line up the decimal points. A placeholder zero does not change the value.

700 + 299 = 999 — Mental method: add 300, then take away 1. e.g. 700 + 300 − 1 = 999

6000 − 3617 = 2383 — Number line: count on from the smaller number. e.g. +3, +80, +300, +2000 = 2383

MUST REMEMBER

- Line up place values. For decimals, line up the decimal points.
- Estimate first so you can spot an unreasonable answer.
- Check with the inverse operation. Show your exchanges.

1.3 Multiplication and division

How can we use place value to choose efficient multiplication and division methods, and justify that our answers are reasonable?

KEY WORDS

Product: The answer when you multiply. The product of 6 and 7 is 42.

Quotient: The answer when you divide. 42 ÷ 7: the quotient is 6.

Dividend · divisor: The number being divided · the number you divide by. In 2.4 ÷ 1.2, 2.4 is the dividend and 1.2 is the divisor.

Partial product: One part of a long multiplication, before adding. 58 × 46 = 58 × 40 + 58 × 6

Estimate: Round to 1 significant figure to check the size of an answer. 254 × 7 ≈ 300 × 7 = 2100

RULES

254 × 7 = 1,778 — Short multiplication: multiply the units first and carry into the next column.

5.2 × 3 = 15.6 — Work out 52 × 3 = 156, then put the 1 decimal place back. e.g. decimal places in the question = decimal places in the answer

2.4 ÷ 1.2 = 24 ÷ 12 — Make the divisor whole: multiply both numbers by the same power of 10. e.g. 71.2 ÷ 0.4 = 712 ÷ 4 = 178

MUST REMEMBER

- Long multiplication: 58 × 46 = 58 × 40 + 58 × 6 = 2,320 + 348 = 2,668.
- Count the decimal places in the question to place the decimal point in the answer.
- Estimate first and check with the inverse operation.

1.4 Negative numbers

How can we use number lines and operation rules to calculate with negative numbers and justify our answers?

KEY WORDS

Negative number: A number less than 0. −5 is 5 less than zero.

Positive number: A number greater than 0. Zero is neither positive nor negative.

Number line: A line showing numbers in order, getting bigger to the right.

Difference: The distance between two numbers. It is always positive. The difference between −8 and 5 is 13.

Inverse operation: An operation that undoes another. −20 ÷ (−4) = 5 because 5 × (−4) = −20

RULES

−3 < −2 < −1 < 0 < 1 < 2 < 3 — Numbers get smaller as you move left and bigger as you move right.

9 − (−4) = 13 — Subtracting a negative is the same as adding. e.g. + (−) moves left · − (−) moves right

−7 × 5 = −35 — Different signs give a negative. Same signs give a positive. e.g. −42 ÷ (−6) = 7 · the same rules work for ÷

MUST REMEMBER

- Subtracting a negative is the same as adding.
- Risen or increased means add. Fallen or lower means subtract.
- A difference is always written as a positive number.

1.5 Rounding

How can we choose an appropriate degree of accuracy, and justify whether a rounded answer is suitable for its purpose?

KEY WORDS

Rounding: Replacing a number with a nearby number that is easier to use. 7,642 ≈ 7,600 (nearest hundred)

Degree of accuracy: How close the rounded number is to the exact value.

Decimal place: Count the digits after the decimal point. 8.36 ≈ 8.4 (1 d.p.)

Significant figure: Count from the first non-zero digit. 0.4726 ≈ 0.47 (2 s.f.)

Approximately equal: The sign ≈ shows a rounded value. 49,782 ≈ 50,000

RULES

18.1693 ≈ 18.17 — Find the rounding digit. The next digit decides: 0 to 4 keep, 5 to 9 round up.

90437 ≈ 90,000 — Significant figures: start counting at the first non-zero digit. e.g. 2 s.f.: 9 and 0, then the next digit is 4, so keep

5.4096 ≈ 5.410 — Keep the zero at the end to show the accuracy. e.g. 3 d.p. needs 3 digits after the point

MUST REMEMBER

- Leading zeros are not significant: 0.00472 to 1 s.f. is 0.005.
- Zeros may need to stay: 67,480 to 1 s.f. is 70,000, not 7.
- Check the answer is sensible and has the accuracy the question asks for.

1.6 Factors, multiples and primes

How can we use factors, multiples and prime numbers to classify numbers, solve number puzzles and justify our answers?

KEY WORDS

Factor: A number that divides exactly into another number. Factors of 12: 1, 2, 3, 4, 6, 12

Multiple: A number in another number's times table. Multiples of 12: 12, 24, 36, 48, …

Prime number: A number with exactly two factors: 1 and itself. 2, 3, 5, 7, 11, 13, 17, 19, 23, 29

Square number: A whole number multiplied by itself. 1, 4, 9, 16, 25, 36, 49

Factor pair: Two whole numbers that multiply to make the number. 24: 1 × 24, 2 × 12, 3 × 8, 4 × 6

RULES

24 = 1 × 24 = 2 × 12 = 3 × 8 = 4 × 6 — Work systematically and stop when the pairs start to repeat. Factors of 24: 1, 2, 3, 4, 6, 8, 12, 24.

$36 = 2^2 \times 3^2$ — Prime factors: 36 = 2 × 2 × 3 × 3. e.g. the prime factors of 36 are 2 and 3

9 = 3 × 3 — Odd does not mean prime: 9 has three factors. e.g. 1, 3 and 9

MUST REMEMBER

- 1 is not a prime number. 2 is the only even prime.
- "Between 25 and 35" means numbers inside the gap.
- "From the list" means your answer must be one of the given numbers.

1.7 Order of operations

How can we apply the order of operations accurately, and justify how brackets can change the value of a calculation?

KEY WORDS

Operation: An instruction to calculate, such as +, −, × or ÷.

Brackets: The calculation inside ( ) is done first. (8 − 2) × 3 = 6 × 3 = 18

Indices: A power: how many times a number is multiplied by itself. $2^3 = 2 \times 2 \times 2 = 8$

Equal priority: × and ÷ have equal priority. So do + and −. Work left to right. 18 ÷ 3 × 2 = 6 × 2 = 12

Expression: Numbers, operations and brackets, with no equals sign. $3 + 10 \times 2^3$

RULES

B · I · D M · A S — Brackets, Indices, Division and Multiplication (left to right), Addition and Subtraction (left to right). BIDMAS and BODMAS mean the same thing.

2 + 4 × 5 = 22 — Multiply before you add. e.g. $3 + 10 \times 2^3 = 3 + 80 = 83$

(2 + 4) × 5 = 30 — Brackets change the order, so the answer changes. e.g. same numbers, different answer

MUST REMEMBER

- Multiplication does not always come before division: work left to right.
- Addition does not always come before subtraction: work left to right.
- Check: brackets? indices? × and ÷? + and −?

1.8 Indices

How can we use indices to write numbers efficiently, find square and cube numbers and use roots to find the original number?

KEY WORDS

Index · power: Tells you how many times the base is used as a factor. In 5^4 the index is 4.

Base: The number being multiplied. In 5^4 the base is 5.

Square · cube number: A whole number squared · a whole number cubed. 1, 4, 9, 16, 25 · 1, 8, 27, 64, 125

Square root: The positive number that multiplies by itself to give the value. $\sqrt{49} = 7$

Cube root: The number that multiplies by itself three times to give the value. $\sqrt[3]{27} = 3$

RULES

$5^4 = 5 \times 5 \times 5 \times 5 = 625$ — 5^4 does NOT mean 5 × 4.

$7^2 = 49 \rightleftarrows \sqrt{49} = 7$ — Squaring and square rooting are inverses. e.g. $1^2 = 1$ … $10^2 = 100$

$3^3 = 27 \rightleftarrows \sqrt[3]{27} = 3$ — Cubing and cube rooting are inverses. e.g. $1^3 = 1$, $2^3 = 8$, $3^3 = 27$, $4^3 = 64$, $5^3 = 125$

MUST REMEMBER

- Powers of 2: 2, 4, 8, 16, 32, 64.
- A square root is the **positive** number that squares to give the value.
- Work out the power first: $5 \times 10^3 = 5 \times 1{,}000$.

1.9 Calculator skills

How can we enter complex calculations accurately so that a scientific calculator follows the intended order of operations?

KEY WORDS

Bracket check: Every opening bracket needs a closing bracket. 3 × (8.5 − (2.7 + 1.9)) has two of each.

Power check: Is the square attached to the right number or bracket? $(18 - 7)^2 = 121$

Fraction check: Keep the whole top and the whole bottom together. (3.4 + 5.8) ÷ 8 = 1.15

Root bar: Everything under the bar is square-rooted. √(18 + 7) = 5, but √81 + 5 = 14

Final check: Round only the final answer, as the question asks. 1.597564… ≈ 1.60 (2 d.p.)

RULES

(18 − 7) x² = — Say the keys · enter it · check the display · press =

4.6 × (12.3 − 7.8) — Type × before a bracket. Do not rely on implied multiplication. e.g. = 20.7

(√81 + 5) ÷ 7 = 2 — A short root bar covers only 81. The + 5 is on top, but not inside the root. e.g. (9 + 5) ÷ 7 = 2

MUST REMEMBER

- Calculators follow BIDMAS: they multiply before they add.
- Close a bracket before the square key so the whole bracket is squared.
- Keep the unrounded value on screen and round at the end.