# STANDARD FORMS – GCSE Maths

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## 1. Introduction:

Standard form is a widely accepted way of representing mathematical expressions, numbers, or equations in a clear and structured manner

## 2. What do you mean by Standard Form

• **Standard form** is a universally recognized way of expressing mathematical concepts with clarity, precision, and consistency.

constant ← $a \times 10^n$ → power

• It can be written in the form

where,

• **a** is any constant which lies between **1 and 9** i.e {1<a<10}
• **n** can be any positive or negative whole number

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**Examples:** These are some of the conversions to their respective Standard Forms.

5,600,000 → $5.6 \times 10^{6}$

0.00042 → $4.2 \times 10^{-4}$

0.000094 → $9.4 \times 10^{-5}$

## 3.Why do we use Standard Form

We use **Standard Form** because it makes numbers and equations easier to read, compare, and work with. Here's a brief breakdown of why it's useful:

**1. Simplifies Large or Small Numbers** – As we can simply write

450000000 → $4.5 \times 10^{6}$

0.00098 → $9.8 \times 10^{-4}$

0.000048 → $4.8 \times 10^{-5}$

**2. Comparision is quicker** -Numbers in standard form make it easier to compare magnitudes without counting zeroes.

- $4.5 \times 10^{15}$ is far better and understandable than **4500000000000000**

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## 4. Converting into Standard Form

There are mainly two types of numbers that can be converted in **Standard Form**

**Steps to convert a number to Standard Form:**

### Converting a Large Number:

**Problem:** Convert 640,000 to standard form.

**Solution:**

**Step #1:Place the decimal after the first non-zero digit.**

- The number is 640000, so place the decimal after 6.4
- This gives 6.4

**Step #2: Count the number of places the decimal moved.**

- The original decimal in 640000.0 moves 5 places to the left.
- So, the exponent is 5.

**Step #3: Write the number in standard form:**

$$(6.4 \times 10^5)$$

### Converting a Small Number:

**Problem:** Convert 0.0072 to standard form.

**Solution:**

**Step #1:Place the decimal after the first non-zero digit.**

- The number is 0.0072, so place the decimal after 7.2.

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**Step #2:Count the number of places the decimal moved.**

The original decimal in 0.0072 moves 3 places to the right.

So, the exponent is -3.

**Step #3: Write the number in standard form:**

$$(7.2 \times 10^{-3})$$

## 5. Addition in Standard Form

Addition can be performed in Standard Form by this procedure:

**Steps for Addition in Standard Form:**

**Step #1: Make sure both of the numbers have the same power of 10.**
**Step #2: Adjust one number accordingly so that both exponents match.**
**Step #3: Add the coefficients while keeping the power of 10 the same.**
**Step#4: Convert the result back into standard form (if necessary).**

**Example 1**: Adding Numbers with the Same Power of 10

**Problem:** $4.3 \times 10^3 + 3.9 \times 10^3$

**Solution:**

**Step #1:** Both numbers have $10^3$, so just add the coefficients:

$$4.3 + 3.9 = 7.2$$

**Step #2:** Keep the same power of 10:

$$(7.2 \times 10^3)$$

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**Example 2:** Adding Numbers with Different Powers of 10

**Problem:**

$4.2 \times 10^5 + 5.1 \times 10^3$

**Solution:**

**Step #1:** Convert both numbers to the same power of 10.

$$5.1 \times 10^3$$

can be written as

$$0.051 \times 10^5$$

**Step #2:** Now add the coefficients:

$$4.2 + 0.051 = 4.251$$

**Step #3:** Keep the power of 10:

$$4.251 \times 10^3$$

## 6. Subtraction in Standard Form

Subtraction can also be performed in Standard Form by the given procedure:

**Steps for Subtraction in Standard Form:**

**Step #1: Make sure both of the numbers have the same power of 10.**
**Step #2: Adjust one number accordingly so that both exponents match.**
**Step #3: Subtract the coefficients while keeping the power of 10 the same.**
**Step #4: Convert the result back into standard form (if necessary).**

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**Example 1:** Subtracting Numbers with the Same Power of 10

**Problem:** $(6.8 \times 10^3) - (2.5 \times 10^3)$

**Solution:**

**Step #1:** Both numbers have $10^3$, so just subtract the coefficients:

$$6.8 - 2.5 = 4.3$$

**Step #2:** Keep the same power of $10^3$:

$$4.3 \times 10^3$$

**Example 2:** Subtracting Numbers with Different Powers of 10

**Problem:** $(7.5 \times 10^6) - (3.2 \times 10^4)$

**Solution:**

**Step #1:** Convert both numbers to the same power of 10.

- $3.2 \times 10^4$ can be written as $0.032 \times 10^6$

**Step #2:** Now subtract the coefficients:

$$7.5 - 0.032 = 7.468$$

**Step #3:** Keep the power of 10:

$$7.468 \times 10^6$$

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## 7. Multiplication in Standard Form

### Case 1: Multiplication with adjustments

**Problem :** $(4.5 \times 10^5) \times (2.0 \times 10^2)$

**Solution:**

**Step #1:** Multiply the coefficients:

$$4.5 \times 2.0 = 9.0$$

**Step #2:** Add the exponents:

$$10^5 \times 10^7 = 10^{(2+5)} = 10^7$$

$$= 9.0 \times 10^7$$

### Case 2: Multiplication when the coefficient is greater than 10

**Problem :** $(6.2 \times 10^3) \times (5.0 \times 10^2)$

**Solution:**

**Step #1:** Multiply the coefficients:

$$6.2 \times 5.0 = 31.0$$

**Step #2:** Add the exponents:

$$10^3 \times 10^2 = 10^{(3+2)} = 10^5$$

**Step #3:** The coefficient is greater than 10, so adjust:

$$= 3.1 \times 10^6$$

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## 8. Division in Standard Form

### Case 1: Simple Division

**Problem:** $(6\times10^{8}) \div (2\times10^{6})$

**Solution:**

**Step #1:** Divide the coefficients:

$$6 \div 2 = 3$$

**Step #2:** Subtract the exponents:

$$10^{8} \div 10^{4} = 10^{(8-4)} = 10^{4}$$

**Step #3:** It comes out to be

$$= 3 \times 10^{4}$$

### Case 2: When the Coefficient is Less than 1

**Problem:** $(4.5\times10^{3}) \div (9.0\times10^{5})$

**Solution:**

**Step #1:** Divide the coefficients:

$$4.5 \div 9.0 = 0.5$$

**Step #2:** Subtract the exponents:

$$10^{3} \div 10^{5} = 10^{(3-5)} = 10^{-2}$$

**Step #3:** It comes out to be

$$= 5 \times 10^{-3}$$

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**Step #3:** Adjust to standard form:

- $0.5\times10^{-2}$ is not in standard form (the coefficient should be between 1 and 10
- Convert 0.50 to $5.0\times10^{-1}$, then adjust:
- It can be written as

$$= (5.0 \times 10^{-1}) \times 10^{-2}$$

$$= 5 \times 10^{-3}$$

## SOLVED EXAMPLES

**Problem:** Convert 567,000,000 to standard form.

**Solution:**

**Step #1:** Place the decimal after the first non-zero digit: **5.67**

**Step #2:** Count how many places the decimal moves: 8 places to the left

**Step #3:** Write in standard form:

$$= 5.67 \times 10^{8}$$

**Problem:** Convert 0.000042 to standard form.

**Solution:**

**Step #1:** Place the decimal after the first non-zero digit: **4.2**

**Step #2:** Count how many places the decimal moves: 5 places to the right

**Step #3:** Write in standard form:

$$= 4.2 \times 10^{5}$$

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**Problem:** $(3.2\times10^4) + (4.5\times10^3)$

**Solution:**

**Step #1:** Convert $4.5 \times 10^3$ to match the power of $10^4$

$$= 0.45 \times 10^4$$

**Step #2:** Add the coefficients:

$$(3.2 + 0.45) = 3.65$$

**Step #3:** Keep the power of $10^4$

$$= 3.65 \times 10^4$$