# Calculations with Standard Form
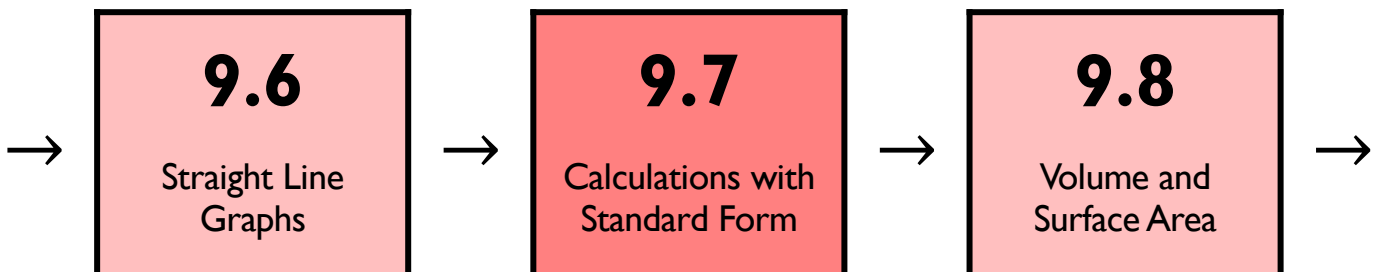
## <u>Solutions</u>

| Solving Equations | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |

| Laws of Indices | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |

| Times Tables | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |

| Calculate Cleverly | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | |

→ | **9.6** Straight Line Graphs | → | **9.7** Calculations with Standard Form | → | **9.8** Volume and Surface Area | →

**Card 1**

1. Solve:

$$5x + 2 = 2x + 14$$

$$x = 4$$

2. Simplify:

$$10^4 \times 10^{-8}$$

$$x^{-4}$$

3.

| × | 9 | 8 | 7 | 0 |
|---|---|---|---|---|
| 6 | 54 | 48 | 42 | 0 |
| 3 | 27 | 24 | 21 | 0 |
| 2 | 18 | 16 | 14 | 0 |
| 8 | 72 | 64 | 56 | 0 |

4. Calculate cleverly:

$$2.8 \times 13 + 7.2 \times 13$$

$$10 \times 13 = 130$$

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**Card 2**

1. Solve:

$$5x + 2 = 22 + x$$

$$x = 5$$

2. Simplify:

$$1000 \times 10^8$$

$$10^{11}$$

3.

| × | 7 | 9 | 1 | 20 |
|---|---|---|---|---|
| 7 | 49 | 63 | 7 | 140 |
| 9 | 63 | 81 | 9 | 180 |
| 1 | 7 | 9 | 1 | 20 |
| 20 | 140 | 180 | 20 | 400 |

4. Calculate cleverly:

$$3.6 \times 57 + 5.7 \times 64$$

$$10 \times 57 = 570$$

**Card 3**

**1. Solve:**

$$2 - 3x = 2x - 18$$

$$x = 4$$

**2. Simplify:**

$$0.01 \times 10^{11}$$

$$10^9$$

**3.**

| × | 0.5 | 0.25 | 1.5 | 2.5 |
|---|-----|------|-----|-----|
| 1 | 0.5 | 0.25 | 1.5 | 2.5 |
| 2 | 1 | 0.5 | 3 | 5 |
| 6 | 3 | 1.5 | 9 | 15 |
| 4 | 2 | 1 | 6 | 10 |

**4. Cleverly, find the mean**

4300, 4300, 4298, 4306

$$4301 - 1, 4301 - 1, 4301 - 3, 4301 + 5$$

Mean = 4301

**Card 4**

**1. Solve:**

$$2 - 3x = 20 - 9x$$

$$x = 3$$

**2. Simplify:**

$$10^{-4} \times 10^7 \times 0.001$$

$$1$$

**3.**

| × | 12 | 0.5 | −1 | 0.2 |
|----|-----|-----|-----|-----|
| 11 | 132 | 5.5 | -11 | 2.2 |
| 12 | 144 | 6 | -12 | 2.4 |
| 15 | 180 | 7.5 | -15 | 3 |
| 20 | 240 | 10 | -20 | 4 |

**4. Cleverly, find the mean**

2.5, 2.6, 2.8, 4.1

$$3 - 0.5, 3 - 0.4, 3 - 0.2, 3 + 1.1$$

Mean = 3

# Task 1: Converting To and From Standard Form

| Jo has answered these questions **correctly**. | Read the examples then answer the following. |
|---|---|
| a. Convert 31 000 000 to standard form.<br><br>31 000 000 = 3.1×10 000 000<br><br>= 3.1×10$^7$ | 1. Jo's friend says the answer is $31×10^6$. Explain why Jo's friend is incorrect.<br><br>$31×10^6$ is not in standard form.<br><br>2. What if Jo were asked to convert 310 000 000?<br><br>$3.1×100\ 000\ 000 = 3.1×10^8$ |
| b. Write $2.6×10^{-5}$ as an ordinary number.<br><br>2.6×10$^{-5}$ = 2.6×0.00001<br><br>= 0.000026 | 3. What number would be $3.1×10^{-4}$ when written in standard form?<br><br>0.00031 |

# Task 2: Fill in the gaps

| Ordinary Number | Standard Form |
|---|---|
| 64000 | $6.4×10^4$ |
| 64 | $6.4×10^1$ |
| 0.64 | $6.4×10^{-1}$ |
| 0.000064 | $6.4×10^{-5}$ |
| 0.000046 | $4.6×10^{-5}$ |

| Ordinary Number | Standard Form |
|---|---|
| $4.61×10^{-5}$ | 0.0000461 |
| $4.61×10^6$ | 4610000 |
| 75200 | $7.52×10^4$ |
| 0.000752 | $7.52×10^{-4}$ |
| 0.0007502 | $7.502×10^{-4}$ |

# Task 3: Explain why each number is not in standard form

| | |
|---|---|
| $65×10^3$ | The significand is greater than 10. |
| $6.5×3^{10}$ | The base of the power is not 10. |
| $6.5×10^{3.8}$ | The index of the power is not an integer. |
| $0.65×10^3$ | The significand is less than 1. |
| $6.5 + 10^3$ | There is an addition instead of a multiplication. |

# Task 4: Converting and Adding in Standard Form

| Question | Calculation | Answer | ...in S. Form |
|---|---|---|---|
| $3\times10^4 + 2\times10^3$ | $30000 + 2000$ | $32000$ | $3.2\times10^4$ |
| $5.4\times10^3 - 6\times10^2$ | $5400 - 600$ | $4800$ | $4.8\times10^3$ |
| $5\times10^2 + 6\times10^3$ | $500 + 6000$ | $6500$ | $6.5\times10^3$ |
| $9\times10^{-4} + 4\times10^{-3}$ | $0.0009 + 0.004$ | $0.0049$ | $4.9\times10^{-3}$ |
| $3\times10^{-2} - 2.4\times10^{-2}$ | $0.03 - 0.024$ | $0.006$ | $6\times10^{-3}$ |
| e.g. $8\times10^{-4} + 7\times10^{-5}$ | e.g. $0.0008 + 0.00007$ | $0.00087$ | $8.7\times10^{-4}$ |
| e.g. $3\times10^3 - 2\times10^2$ | e.g $3000 - 200$ | $2800$ | $2.8\times10^3$ |
| $3\times10^3 + 2\times10^5$ | $3000+200000$ | $203000$ | $2.03\times10^5$ |
| $3\times10^{43} + 2\times10^{45}$ | | | $2.03\times10^{45}$ |

# Task 5: Adding in Standard Form Without Converting

*Toby has answered this question **correctly**.*

Calculate $3\times10^{43} + 2\times10^{45}$, leaving your answer in standard form.

**Toby**

$$3\times10^{43} + 2\times10^{45}$$
$$= 3\times10^{43} + 200\times10^{43}$$
$$= 203\times10^{43}$$
$$= 2.03\times100\times10^{43}$$
$$= 2.03\times10^{45}$$

**Toby's Friend**

$$3\times10^{43} + 2\times10^{45}$$
$$= 0.03\times10^{45} + 2\times10^{45}$$
$$= 2.03\times10^{45}$$

*Read the examples then answer the following.*

1. Why did Toby not leave his final answer as $203\times10^{43}$?

   That would not be in standard form.

2. Explain why $2\times10^{45}$ is equal to $200\times10^{43}$.

   $200\times10^{43} = 2\times10^2\times10^{43} = 2\times10^{45}$

3. What if the question was to calculate $3\times10^{43} + 2\times10^{46}$

   $= 2.003\times10^{46}$

4. Toby's friend uses a slightly different method for the same question. Complete her answer. Which method do you prefer? Why?

   Toby's friend does one less step.

# Task 6: Adding and Subtracting in Standard Form

| | | | | |
|---|---|---|---|---|
| $3\times10^{43} + 2\times10^{45}$ | $2.03\times10^{45}$ | | $6\times10^{19} + 4\times10^{21}$ | $4.06\times10^{21}$ |
| $3\times10^{45} + 2\times10^{43}$ | $3.02\times10^{45}$ | | $6\times10^{21} + 2\times10^{19}$ | $6.02\times10^{21}$ |
| $3\times10^{46} + 2\times10^{43}$ | $3.002\times10^{46}$ | | $6\times10^{21} + 2\times10^{18}$ | $6.002\times10^{21}$ |
| $3\times10^{46} - 2\times10^{43}$ | $2.998\times10^{46}$ | | $6\times10^{21} - 2\times10^{18}$ | $5.998\times10^{21}$ |
| $3.9\times10^{46} + 2\times10^{43}$ | $3.902\times10^{46}$ | | $6\times10^{21} + 2.1\times10^{18}$ | $6.0021\times10^{21}$ |
| $3.9\times10^{44} + 2\times10^{43}$ | $4.1\times10^{43}$ | | $6\times10^{17} + 2.1\times10^{18}$ | $2.7\times10^{18}$ |
| $3.9\times10^{-44} + 2\times10^{-43}$ | $2.39\times10^{-43}$ | | $6\times10^{-17} + 2.1\times10^{-18}$ | $6.21\times10^{-17}$ |
| $3.9\times10^{-44} + 9.2\times10^{-43}$ | $9.59\times10^{-43}$ | | $6.3\times10^{-17} + 2.1\times10^{-18}$ | $6.51\times10^{-17}$ |
| $3.9\times10^{-44} + 9.7\times10^{-43}$ | $1.009\times10^{-42}$ | | $6.3\times10^{-17} + 8.1\times10^{-18}$ | $7.11\times10^{-17}$ |
| $3.9\times10^{-45} + 9.7\times10^{-43}$ | $9.739\times10^{-43}$ | | $6.3\times10^{-16} + 8.1\times10^{-18}$ | $6.381\times10^{-16}$ |
| $3.9\times10^{-45} + 9.97\times10^{-43}$ | $1.0009\times10^{-42}$ | | $6.03\times10^{-16} - 8.1\times10^{-18}$ | $5.949\times10^{-16}$ |

| $+$ | $7\times10^{8}$ | $4\times10^{9}$ | $6.2\times10^{8}$ |
|---|---|---|---|
| $2\times10^{8}$ | $9\times10^{8}$ | $4.2\times10^{9}$ | $6.4\times10^{8}$ |
| $8\times10^{7}$ | $1.5\times10^{9}$ | $4.08\times10^{9}$ | $7\times10^{8}$ |
| $3.9\times10^{8}$ | $1.09\times10^{9}$ | $4.39\times10^{9}$ | $1.01\times10^{9}$ |

| $-$ | $7\times10^{8}$ | $4\times10^{9}$ | $6.2\times10^{8}$ |
|---|---|---|---|
| $2\times10^{8}$ | $5\times10^{8}$ | $3.8\times10^{8}$ | $6\times10^{8}$ |
| $8\times10^{7}$ | $6.2\times10^{8}$ | $3.92\times10^{9}$ | $5.4\times10^{8}$ |
| $3.9\times10^{8}$ | $3.1\times10^{8}$ | $3.61\times10^{9}$ | $2.3\times10^{8}$ |

| $+$ | $6\times10^{14}$ | $1.6\times10^{15}$ | $5.7\times10^{14}$ |
|---|---|---|---|
| $3\times10^{14}$ | $9\times10^{14}$ | $1.9\times10^{15}$ | $8.7\times10^{14}$ |
| $4.9\times10^{14}$ | $1.09\times10^{15}$ | $2.09\times10^{15}$ | $1.06\times10^{15}$ |
| $1.5\times10^{14}$ | $7.5\times10^{14}$ | $2.15\times10^{15}$ | $7.2\times10^{14}$ |

| $-$ | $2\times10^{-3}$ | $7\times10^{-4}$ | $8.2\times10^{-4}$ |
|---|---|---|---|
| $4\times10^{-4}$ | $1.6\times10^{-3}$ | $3\times10^{-4}$ | $4.2\times10^{-4}$ |
| $5\times10^{-5}$ | $1.95\times10^{-3}$ | $6.5\times10^{-4}$ | $7.7\times10^{-4}$ |
| $1.8\times10^{-4}$ | $1.82\times10^{-3}$ | $5.2\times10^{-4}$ | $6.4\times10^{-4}$ |

# Task 7: Adding and Subtracting in Standard Form – Completion Tables

| A | B | A + B | A − B |
|---|---|---|---|
| $4\times10^{17}$ | $7\times10^{16}$ | $4.7\times10^{17}$ | $3.3\times10^{17}$ |
| $3.3\times10^{17}$ | $7\times10^{16}$ | $4\times10^{17}$ | $2.6\times10^{17}$ |
| $4.7\times10^{17}$ | $7\times10^{16}$ | $5.4\times10^{17}$ | $4\times10^{17}$ |
| $9.4\times10^{17}$ | $7\times10^{16}$ | $1.01\times10^{18}$ | $8.7\times10^{17}$ |
| $8.7\times10^{17}$ | $7\times10^{16}$ | $9.4\times10^{17}$ | $8\times10^{17}$ |
| $1.01\times10^{18}$ | $7\times10^{16}$ | $1.08\times10^{18}$ | $9.4\times10^{17}$ |
| $5.4\times10^{17}$ | $4.6\times10^{16}$ | $5.86\times10^{17}$ | $4.94\times10^{17}$ |
| $4.94\times10^{17}$ | $4.6\times10^{16}$ | $5.4\times10^{17}$ | $4.48\times10^{17}$ |
| $5.86\times10^{17}$ | $4.6\times10^{16}$ | $6.32\times10^{17}$ | $5.4\times10^{17}$ |
| $4.6\times10^{16}$ | $8\times10^{15}$ | $5.4\times10^{16}$ | $3.8\times10^{16}$ |
| $5\times10^{16}$ | $4\times10^{15}$ | $5.4\times10^{16}$ | $4.6\times10^{16}$ |

| a | b | a + b | a − b | a × b | a ÷ b |
|---|---|---|---|---|---|
| $6\times10^{17}$ | $2\times10^{17}$ | $8\times10^{17}$ | $4\times10^{17}$ | $1.2\times10^{35}$ | 3 |
| $4\times10^{17}$ | $2\times10^{17}$ | $6\times10^{17}$ | $2\times10^{17}$ | $8\times10^{34}$ | 2 |
| $8\times10^{17}$ | $2\times10^{17}$ | $1\times10^{18}$ | $6\times10^{17}$ | $1.6\times10^{35}$ | 4 |
| $3\times10^{17}$ | $2\times10^{17}$ | $5\times10^{17}$ | $1\times10^{17}$ | $6\times10^{34}$ | 1.5 |
| $1.2\times10^{18}$ | $2\times10^{17}$ | $1.4\times10^{18}$ | $1\times10^{18}$ | $2.4\times10^{35}$ | 6 |
| $6\times10^{18}$ | $2\times10^{17}$ | $6.2\times10^{18}$ | $5.8\times10^{18}$ | $1.2\times10^{36}$ | 30 |
| $4\times10^{-13}$ | $5\times10^{-14}$ | $4.5\times10^{-13}$ | $3.5\times10^{-13}$ | $2\times10^{-26}$ | 8 |
| $3.5\times10^{-13}$ | $5\times10^{-14}$ | $4\times10^{-13}$ | $3\times10^{-13}$ | $1.75\times10^{-26}$ | 7 |
| $4.5\times10^{-13}$ | $5\times10^{-14}$ | $5\times10^{-13}$ | $4\times10^{-13}$ | $2.25\times10^{-26}$ | 9 |
| $8\times10^{-13}$ | $5\times10^{-14}$ | $8.5\times10^{-13}$ | $7.5\times10^{-13}$ | $4\times10^{-26}$ | 16 |
| $2\times10^{-13}$ | $5\times10^{-14}$ | $2.5\times10^{-13}$ | $1.5\times10^{-13}$ | $1\times10^{-26}$ | 4 |
| $4\times10^{-12}$ | $5\times10^{-14}$ | $4.05\times10^{-12}$ | $3.95\times10^{-12}$ | $2\times10^{-25}$ | 80 |

# Task 8: Standard Form Calculations

| $A$ | $A^2$ | $5A$ | 25% of $A$ | $\frac{2}{5}$ of A | $A^{-1}$ |
|---|---|---|---|---|---|
| $4\times10^4$ | $1.6\times10^9$ | $2\times10^5$ | $1\times10^4$ | $1.6\times10^4$ | $2.5\times10^{-5}$ |
| $2\times10^2$ | $4\times10^4$ | $1\times10^3$ | $5\times10^1$ | $8\times10^1$ | $5\times10^{-3}$ |
| $8\times10^3$ | $6.4\times10^7$ | $4\times10^4$ | $2\times10^3$ | $3.2\times10^3$ | $1.25\times10^{-4}$ |
| $1.6\times10^5$ | $2.56\times10^{10}$ | $8\times10^5$ | $4\times10^4$ | $6.4\times10^4$ | $6.25\times10^{-6}$ |
| $1\times10^5$ | $1\times10^{10}$ | $5\times10^5$ | $2.5\times10^4$ | $4\times10^4$ | $1\times10^{-5}$ |
| $2.5\times10^{-5}$ | $6.25\times10^{-10}$ | $1.25\times10^{-4}$ | $6.25\times10^{-6}$ | $1\times10^{-5}$ | $4\times10^4$ |

# Task 9: Standard Form Sequences

Find the next three terms of each arithmetic sequence:

a) $2\times10^3, 6\times10^3$                                      f) $2\times10^3, 1.8\times10^3$

| a) $2\times10^3, 6\times10^3$ | i) $1\times10^4, 1.4\times10^4, 1.8\times10^4$ | f) $2\times10^3, 1.8\times10^3$ | i) $1.6\times10^3, 1.4\times10^3, 1.2\times10^3$ |
|---|---|---|---|
| ii) $(4\times10^3)n - 2\times10^3$ | iii) $7.98\times10^5$ | ii) $(-2\times10^2)n + 2.2\times10^3$ | iii) $-3.78\times10^4$ |
| b) $2\times10^3, 2\times10^4$ | i) $3.8\times10^4, 5.6\times10^4, 6.4\times10^4$ | g) $2\times10^3, 2\times10^5$ | i) $3.98\times10^5, 5.96\times10^5, 7.94\times10^5$ |
| ii) $(1.8\times10^4)n - 1.6\times10^4$ | iii) $3.584\times10^6$ | ii) $(1.98\times10^5)n - 1.96\times10^5$ | iii) $3.9404\times10^7$ |
| c) $2\times10^3, 2.4\times10^3$ | i) $2.8\times10^3, 3.2\times10^3, 3.6\times10^3$ | h) $2\times10^3, 2\times10^2$ | i) $-1.6\times10^3, -3.4\times10^3, -5.2\times10^3$ |
| ii) $(4\times10^2)n + 1.6\times10^3$ | iii) $8.16\times 10^4$ | ii) $(-1.8\times10^3)n + 3.8\times10^3$ | iii) $-3.562\times10^5$ |
| d) $2\times10^3, 3\times10^4$ | i) $5.8\times10^4, 8.6\times10^4, 1.14\times10^5$ | i) $2\times10^{-2}, 6\times10^{-2}$ | i) $1\times10^{-1}, 1.4\times10^{-1}, 1.8\times10^{-1}$ |
| ii) $(2.8\times10^4)n - 2.6\times10^4$ | iii) $5.574\times10^6$ | ii) $(4\times10^{-2})n - 2\times10^{-2}$ | iii) $7.98$ |
| e) $2\times10^3, 1.8\times10^4$ | i) $3.4\times10^4, 5\times10^4, 6.6\times10^4$ | j) $2\times10^{-3}, 1.2\times10^{-2}$ | i) $2.2\times10^{-2}, 3.2\times10^{-2}, 4.2\times10^{-2}$ |
| ii) $(1.6\times10^4)n - 1.4\times10^4$ | iii) $3.186\times10^6$ | ii) $(1\times10^{-2})n - 8\times10^{-3}$ | iii) $1.992$ |

e) $2\times10^3, 1.8\times10^4$                                      j) $2\times10^{-3}, 1.2\times10^{-2}$

*Ext: Find the nth term of each sequence*

# Task 10: Solving Equations with Standard Form

1) $x + 3\times10^6 = 5\times10^6$                     $x = 2\times10^6$

2) $0.7x + 3.3\times10^6 = 5.4\times10^6$           $x = 3\times10^6$

3) $1.3x - 3.7\times10^{-3} = 5.4\times10^{-3}$        $x = 7\times10^{-3}$

4) $(2.3\times10^3)x = 9.2\times10^{-5}$            $x = 4\times10^{-8}$

5) $(6.1\times10^{11})x = 1.92\times10^6 - (3.5\times10^{11})x$     $x = 2\times10^{-6}$

6) $3\times10^{-2} + 5x = 3x + 8\times10^{-2}$        $x = 2.5\times10^{-2}$
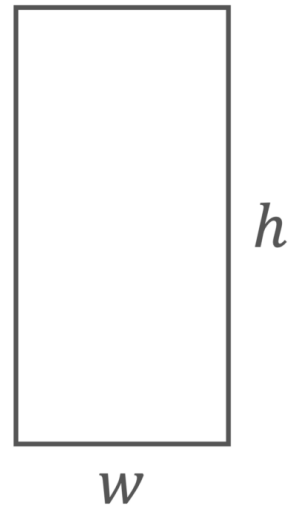
# Task 11: Standard Form with Area and Perimeter

**By @jshmtn**

Fill in the gaps, giving all answers in standard form.

| | $w$ | $h$ | Area | Perimeter |
|---|---|---|---|---|
| 1) | $3\times10^6$ | $4\times10^6$ | $1.2\times10^{13}$ | $1.4\times10^7$ |
| 2) | $9\times10^5$ | $1.2\times10^6$ | $1.08\times10^{12}$ | $4.2\times10^6$ |
| 3) | $8\times10^3$ | $3\times10^4$ | $2.4\times10^8$ | $7.6\times10^4$ |
| 4) | $3\times10^5$ | $3\times10^4$ | $9\times10^9$ | $6.6\times10^6$ |
| 5) | $2\times10^3$ | $3\times10^4$ | $6\times10^7$ | $6.4\times10^4$ |
| 6) | $2\times10^6$ | $3\times10^6$ | $6\times10^{12}$ | $1\times10^7$ |

$h$

$w$

# Task 12: Standard Form Optimisation

1) Using the digits from 1 to 9 at most once each, fill in the gaps to give the largest possible answer:

$$\boxed{8} \times 10^{\boxed{9}} + \boxed{6} \times 10^{\boxed{7}}$$

2) Using the digits from 1 to 9 at most once each, fill in the gaps to give the largest possible answer:

$$\boxed{8} \times 10^{\boxed{9}} - \boxed{2} \times 10^{\boxed{1}}$$

3) Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 40 000:

$$\boxed{3} \times 10^{\boxed{4}} + \boxed{9} \times 10^{\boxed{2}}$$

4) Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 40 000:

$$\boxed{1} \times 10^{\boxed{5}} - \boxed{6} \times 10^{\boxed{4}}$$

5) Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 40 000:

$$\boxed{3}.\boxed{9} \times 10^{\boxed{4}} + \boxed{8} \times 10^{\boxed{2}}$$

6) Using the digits from 1 to 9 at most once each, fill in the gaps to give an answer as close as possible to 40 000:

$$\boxed{1}.\boxed{3} \times 10^{\boxed{5}} - \boxed{9} \times 10^{\boxed{4}}$$