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MATHEMATICS REVISION NOTES

Sequential Operations.

Example: $\frac{15 \times 2}{5} + \frac{20 \times 3}{10} - \frac{8 \times 2}{4}$

Rules: Multiplications and divisions are done before additions or subtractions.
Multiplications and divisions can be done in any order.

Solution: $\frac{15 \times 2}{5} + \frac{20 \times 3}{10} - \frac{8 \times 2}{4} = \frac{30}{5} + \frac{60}{10} - \frac{16}{4} = 6 + 6 - 4 = 8$

or $\frac{15 \times 2}{5} + \frac{20 \times 3}{10} - \frac{8 \times 2}{4} = 3 \times 2 + 2 \times 3 - 2 \times 2$

$$= 6 + 6 - 4$$

$$= 8$$

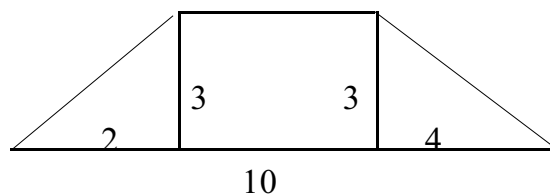
Note that the same answer results regardless of whether the multiplications or divisions are carried out first. However, the additions and subtractions must be done last.

Brackets should be used where a part of the total calculation is to be isolated or to avoid any possible ambiguity. Although it is usually not shown, a multiplication sign is understood to exist between a number immediately outside a set of brackets and the contents of the brackets. For example, $12(3 + 8)$ means $12 \times (3 + 8)$.

Operations within the brackets should be done first, so in this example, the steps are to add the $3 + 8$ and then multiply the result by 12, not multiply 12 by 3 and then add 8. Where there are brackets within brackets, complete the operations contained by the innermost brackets first. Thus, $12(3 + (2 \times 4)) = 12(3 + 8) = 132$

Illustrative Problem:

Calculate the area of carpet needed for a room which has the floor plan shown below. Dimensions are in metres.



Solution:

Area of each of the triangular sections = $\frac{1}{2} \times \text{height} \times \text{base}$

Area of the rectangular section = height \times length

$$\begin{aligned} \text{Area} &= \frac{1}{2} \times 3 \times 4 + 3 \times 10 + \frac{1}{2} \times 3 \times 2 \\ &= 6 + 30 + 3 \\ &= 39 \text{ m}^2 \end{aligned}$$

Practice Questions.

1. $13 + 3 \times 10 - 16 \times 2 =$
2. $27 \div 9 + 4 \times 2 - 6 \div 3 + \frac{6-4}{2} =$
3. $\frac{1}{2}(7 \times 4 - 4 \times 2 + 6 \times 5) =$
4. $\frac{1}{5}(12 + 2 \times 6 - \frac{1}{2}(6 \times 3) + 10) =$

Answers: 1. 11 2. 10 3. 25 4. 5

Signs in multiplication and division.

Rules:

Multiplication

positive \times positive = positive	$+ \times + = +$
positive \times negative = negative	$+ \times - = -$
negative \times negative = positive	$- \times - = +$

Division

positive \div positive = positive	$+ \div + = +$
positive \div negative = negative	$+ \div - = -$
negative \div positive = negative	$- \div + = -$
negative \div negative = positive	$- \div - = +$

Examples:

$$\begin{aligned} 2 \times 2 &= 4 \\ 2 \times -2 &= -4 \\ -2 \times -2 &= 4 \\ 4 \div 2 &= 2 \\ 4 \div -2 &= -2 \\ -4 \div 2 &= -2 \\ -4 \div -2 &= 2 \end{aligned}$$

Illustrative problem:

The enthalpy change for the reaction

$\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ is obtained from enthalpy of formation data in the following calculation.

$$\begin{aligned}\Delta H^\circ &= [(-393.5) + 2 \times (-241.8)] - [(-74.87) + 0] \\ &= [(-877.1)] - [(-74.87)] \\ &= -877.1 + 74.87 \\ &= -802 \text{ kJ mol}^{-1} \text{ to 3 significant figures.}\end{aligned}$$

Note that a – outside brackets amounts to multiplying the number(s) inside the brackets by –1 and thus reverses their signs. This was illustrated in the above problem. Thus $5 - (3 - 6) = 5 - (-3) = 5 + 3 = 8$.

Practice Questions.

1. $-3(2 \times -6) - 2[4(-6 \div 2) - 8(7 + 6 \times 3)]$
2. $2(-412 - 234) - 3((345) + 2(-173))$
3. $-16/4 + 27[(36/(-2)) - 18(10 - 4)]$
4. $48/(-12) + 16[(-15/5) \times 2/3]$
5. $5((-35) + (-256)) - 3((-127) + (412))$
6. $27/((-3) + (-2) \times (-3))$

Answers: 1. 460 2. -1286 3. -3406 4. -36 5. -2310 6. -3

Division by fractions.

Example: $4 \div 2/3$

Rule: Multiply the number by the reciprocal of the fraction – i.e. invert the fraction and multiply it by the number. Note that all calculators have a $1/x$ button that gives the reciprocal of x.

$$\text{Solution: } 4 \div \frac{2}{3} = 4 \times \frac{3}{2} = \frac{12}{2} = 6$$

Illustrative Problem:

It is anticipated that guests at a party will each drink $\frac{3}{4}$ of a bottle of wine. How many guests will a box of 1 dozen bottles supply?

Solution: $12 \div \frac{3}{4} = 12 \times \frac{4}{3} = 16$ guests.

Practice Questions.

1. $9 \div \frac{3}{5} =$

2. $8 \div \frac{2}{3} =$

3. $14 \div \frac{2}{7} =$

4. $72 \div \frac{4}{9} =$

Answers: 1. 15 2. 12 3. 49 4. 162

Division of one fraction by another fraction.

Example: $\frac{3}{4} \div \frac{2}{5}$

Rule: Multiply the first fraction by the reciprocal of the second fraction.

Solution: $\frac{3}{4} \div \frac{2}{5} = \frac{3}{4} \times \frac{5}{2} = \frac{15}{8} = 1\frac{7}{8}$

Practice Questions.

1. $\frac{5}{6} \div \frac{2}{3} =$

2. $\frac{3}{4} \div \frac{1}{8} =$

3. $\frac{5}{12} \div \frac{5}{6} =$

4. $\frac{3}{64} \div \frac{3}{32} =$

Answers: 1. $1\frac{1}{4}$ 2. 6 3. $\frac{1}{2}$ 4. $\frac{1}{2}$

Interconversion of percentages, fractions and decimals.

Examples: (i) Express 7.5% as a decimal.
 (ii) Convert $\frac{2}{1000}$ to a percentage.

Rules: Conversion from percentage – divide by 100 (i.e. move the decimal point two places to the left.)

Conversion of a fraction to a percentage – evaluate the fraction and then multiply by 100 (i.e. move the decimal point two places to the right.)

Solutions: (i) $7.5\% = 0.075$
 (ii) $\frac{2}{1000} = 0.002 = 0.2\%$

Illustrative Problems:

(i) Teachers receive a pay rise of 5% pa. How much extra does this amount to if a teacher's salary before the rise is \$30000?

Solution: $5\% = 0.05$
 $5\% \text{ of } 30000 = 0.05 \times 30000 = \1500

(ii) To compensate for the GST, pensions rose from \$150 to \$160 pw. What percentage is this increase?

Solution: Increase = \$10 pw
 Converting to a fractional increase,
 $\text{Increase} = \frac{10}{150} = 0.067$
 $\% \text{ increase} = 0.067 \times 100 = 6.7\%$

Practice Questions.

- Express each of the following as a decimal: 56%; 25%, 13.2%, 88.75%.
- Convert each of the following to a percentage: $\frac{7}{8}$, $\frac{3}{4}$, $\frac{9}{16}$, $\frac{7}{32}$.

Answers: 1. 0.56 0.25 0.132 0.8875
 2. 87.5 75% 56.23% 21.875%

Proportion calculations.

Example:

If 4 items cost 5 dollars, how much do 20 items cost?

First calculate the cost of 1 item:

$$\text{Cost per item} = 5 \div 4 \text{ or } \frac{5}{4} \text{ dollars}$$

Then multiply by the number of items to be bought:

$$\begin{aligned} \text{Total cost} &= \text{cost per item} \times \text{number of items} \\ &= \frac{5}{4} \times 20 \\ &= 25 \text{ dollars} \end{aligned}$$

This is an example of proportionality. In general terms, if a is to b as c is to d, i.e.

$\frac{a}{b} = \frac{c}{d}$, then given any three of a, b, c or d, the fourth number can be calculated.

Illustrative Problem 1:

If apples cost \$2.40 per dozen, what is the cost of 20 apples?

Solution: Let the cost of 20 apples = x.

$$\frac{2.40}{12} = \frac{x}{20}$$

Therefore $x = \frac{2.40 \times 20}{12} = \4.00

Illustrative Problem 2:

From a titration reaction it is found that 25.00 mL of a solution contain 0.00873 moles of acid. How many moles of the acid would be in 1000 mL of solution?

Solution: 25.00 mL contains 0.00873 mole

$$\therefore \text{by proportion, 1.00 mL contains } \frac{0.00873}{25.00} \text{ mole}$$

and 1000 mL contains $\frac{0.00873 \times 1000}{25.00} \text{ mole} = 0.269 \text{ mole}$

Practice questions.

1. If 1.00 mole of sodium chloride has a mass of 58.5 g, what is the mass of 0.75 mole of this compound?
2. It requires 6000 joules of heat energy to melt 18.9 g of ice. How much heat would be needed to melt 54.0 g of ice?
3. A solution of sodium chloride contains 1.55 moles of this compound dissolved in 1800 mL of solution. How many moles would there be in 700 mL?

Answers: 1. 44 g 2. 17.1 kJ 3. 0.603 mole

Exponential notation.

This is a convenient way of representing numbers which are very large or very small. For example, while it is convenient to write ten as 10 or one hundred as 100, larger numbers such as one million are often better written as 10^6 .

When a number is written in this form, it is called an exponential and it consists of a base (10) and an exponent (the power to which 10 is raised). Thus one million is represented as the base 10 raised to the power 6 when written as 10^6 . This is really 1×10^6 , the 1 being called the pre-exponential term, but the 1 is often deleted.

exponent

Thus, in exponential notation, 1×10^6

↙ ↘

pre-exponential base

term

To deduce the exponent, count the number of places that the decimal point must be moved to the left until the number becomes 1. *Note that increasing the exponent by 1 actually increases the number by a factor of 10.*

Examples: Starting with 1,000 = 10^3 ,
 $10 \times 1000 = 10,000 = 10^4$ and
 $10 \times 10,000 = 100,000 = 10^5$.
 $1,000,000,000,000 = 10^{12}$

Note that any number raised to power 0 = 1, so $10^0 = 1$.
 [See the next section for the proof of this.]

For numbers where the pre-exponential term is not 1, the pre-exponential term must be shown. Thus 120,000,000 can be written as 120×10^6 or 12×10^7 or as 1.2×10^8 . In scientific notation, the pre-exponential term is usually written as less than 10 so that in this example it would be 1.2×10^8 or 1.20×10^8 or 1.200×10^8 etc, depending on how many significant figures one wishes to include .

Examples: $5600 = 5.6 \times 10^3$ (2 significant figures)

$246000000 = 2.46 \times 10^8$ (3 significant figures)

If more significant figures are required, they are included as zeros appended to the pre-exponential term. The exponent when it is an integer such as in the above examples is only a scale factor and gives no indication of the number of significant figures. Using the example above, 5.60×10^3 is 3 significant figures and 5.600×10^3 is 4 significant figures.

Similarly, small numbers such as one tenth are conveniently written as 0.1 for example. However a number such as one millionth (0.000,001) may be written as 10^{-6} or, more correctly, as 1×10^{-6} , with advantage. A number such as 0.000,000,12 can be written conveniently as 12×10^{-8} or as 1.2×10^{-7} . The exponent required can be deduced by counting the number of places the decimal point must be moved to the right to obtain the pre-exponential component used and a minus sign must prefix the exponent.

Examples: $0.0034 = 34 \times 10^{-4}$ (or 3.4×10^{-3})

$0.000,000,77 = 77 \times 10^{-8}$ (or 7.7×10^{-7})

Illustrative Problem 1:

There are 602,000,000,000,000,000,000,000 atoms of carbon in 12 grams of carbon. Write this number using exponential notation.

Solution: No decimal point is shown and in this situation it is understood to be at the extreme right of the number. Moving the decimal point to the left 23 places gives 6.022 as the pre-exponential term (to 4 significant figures) and 10^{23} as the exponential term. i.e. 6.022×10^{23} atoms.

Note that apart from the inconvenience of the length of writing the number 602200000000000000000000, the precision of this experimentally determined quantity is certainly not to 25 significant figures! Consequently, another advantage of using exponential notation is that it allows one to trim the pre-exponential term to an appropriate number of digits corresponding to the accuracy of the number. In this case, the best experimental data gives the number as $6.022136736 \times 10^{23}$.

Illustrative Problem 2:

Diamonds consist of pure carbon. If 12.0 grams of carbon contains 6.022×10^{23} carbon atoms, how many carbon atoms are in a diamond which weighs 1.20 grams?

Solution: Let the number of carbon atoms be n .

$$\text{Number of carbon atoms in 1.0 g of carbon} = \frac{6.022 \times 10^{23}}{12.0}$$

$$\therefore \text{the number in 1.20 g} = \frac{6.022 \times 10^{23}}{12.0} \times 1.20 = 0.602 \times 10^{23} \text{ atoms}$$

or 6.02×10^{22} atoms.

Practice Questions.

Convert each of the following to the exponential form to base 10. Give 3 significant figures in the pre-exponential term in each case.

- | | |
|------------------------------|---------------------------|
| 1. 441000000000 | 2. 3750000000000000000000 |
| 3. 0.000000000000000127 | 4. 0.000580 |
| 5. 1000000000000000000000000 | 6. 0.00264 |

- Answers. 1. 4.41×10^{11} 2. 3.75×10^{21} 3. 1.27×10^{-15}
4. 5.80×10^{-4} 5. 1.00×10^{23} 6. 2.64×10^{-3}

Multiplication and Division Using Exponentials.**(a) Multiplication**

Example: $10^6 \times 10^3$

Rule: Provided the exponentials have the same base, **add** the exponents of the numbers to be multiplied.

$$\text{Solution: } 10^6 \times 10^3 = 10^{(6+3)} = 10^9$$

(b) Division

Example: $10^6 \div 10^2$

Rule: Provided the exponentials have the same base, **subtract** the exponent of the denominator from the exponent of the numerator of the numbers being divided.

Solution: $10^6 \div 10^2 = 10^{(6-2)} = 10^4$

Be careful when the exponent on the bottom is negative:

e.g. $10^8 \div 10^{-2} = 10^{(8-(-2))} = 10^{(8+2)} = 10^{10}$

Proof that $n^0 = 1$:

As an example, consider 2^0 .

This can be rewritten as $2^0 = 2^{(1-1)} = \frac{2^1}{2^1}$ which cancels to $= 1$

The same is valid for any number, n.

Illustrative Problem 1:

The world's population was 6 billion (6×10^9) people as of 2000. If each person on average consumes 1000 Calories per day, how many Calories are required to feed the entire population for 100 days?

Solution:

$$\begin{aligned} \text{Total Calories} &= \text{number of people} \times \text{Calories per day} \times \text{number of days} \\ &= 6 \times 10^9 \times 1,000 \times 10^3 \times 1.00 \times 10^2 \\ &= 6 \times 10^{(9+3+2)} \\ &= 6 \times 10^{14} \text{ Calories} \end{aligned}$$

Illustrative Problem 2:

If the total area of rainforest remaining on the planet $= 1 \times 10^6$ square kilometres and the population is 6×10^9 people, how many people are there on average per square kilometre of remaining rainforest?

Solution:

$$\begin{aligned} \text{Persons per square kilometre} &= \text{number of people} \div \text{number of square kilometres} \\ &= 6 \times 10^9 \div 1 \times 10^6 \\ &= 6 \times 10^{(9-6)} \\ &= 6 \times 10^3 \text{ people/square kilometre} \end{aligned}$$

If the pre-exponential component of more than one of the numbers is not 1, then the pre-exponential terms are multiplied or divided as a separate calculation. This is illustrated in the next example.

Illustrative Problem 3:

If each person creates on average 5×10^3 kg of garbage during a lifetime, what is the total garbage created by the current population of 6×10^9 people?

Solution:

$$\begin{aligned} \text{Total garbage} &= \text{average per person} \times \text{number of people} \\ &= 5 \times 10^3 \times 6 \times 10^9 \\ &= 6 \times 5 \times 10^{(3+9)} \\ &= 30 \times 10^{12} \text{ or } 3 \times 10^{13} \text{ kg/person.} \end{aligned}$$

Illustrative Problem 4:

If the total GDP of the world is $\$12 \times 10^{12}$, what is the average GDP per person?

Solution:

$$\begin{aligned} \text{Average GDP} &= \text{total GDP} \div \text{number of people} \\ &= \frac{12 \times 10^{12}}{6 \times 10^9} \\ &= \frac{12}{6} \times 10^{(12-9)} \\ &= \$2 \times 10^3 \text{ per person} \end{aligned}$$

Illustrative Problem 5:

Convert 2×10^{-4} metre into micrometres (μm) given 1 micrometre = 10^{-6} metre.

Solution:

$$\text{Number of micrometres} = \frac{2 \times 10^{-4}}{10^{-6}} = 2 \times 10^{(-4 - (-6))} = 2 \times 10^{+2} \text{ micrometres}$$

Practice Questions.

1. $10^4 \times 10^5 =$

2. $10^{15} \div 10^4 =$

3. $10^7 \times 10^{-3} =$

4. $6.0 \times 10^5 \div 2 \times 10^2 =$

5. $8 \times 10^8 \div 4 \times 10^{-3} =$

6. $4 \times 10^5 \div 2 \times 10^{-6} =$

7. $3 \times 10^{-10} \div 1.5 \times 10^{-4} =$

8. $6 \times 10^3 \times 2 \times 10^{-7} \div 4 \times 10^{-2} =$

Answers.

1. 10^9

2. 10^{11}

3. 10^{10}

4. 3×10^3

5. 2×10^{11}

6. 2×10^{11}

7. 2×10^{-6}

8. 3×10^{-2}

Logarithms.

Any number can be expressed in the exponential form without a pre-exponential term (or more precisely, with 1 for the pre-exponential term). The exponent is the logarithm (log for short) to the base ten such that 10 raised to that power equals the number.

Thus $\log_{10}n$ is the power to which 10 must be raised to equal n or $10^{\log n} = n$.

e.g. $\log_{10}10 = 1$

i.e. $10^1 = 10$

$\log_{10}100 = 2$

$10^2 = 100$

$\log_{10}2 = 0.30$

$10^{0.30} = 2$

Usually the base is not shown and then it is understood to be 10.

The log of any number can most easily be obtained from basic calculators by entering the number and pressing the LOG key. Some calculators such as the Casio fx100s require the LOG key to be pressed first, enter the number and then press the = key.

Practice Questions.

Obtain the logs of the following numbers. Give each to 3 decimal places.

Thence express each number in the form 10^x . What do you notice about the answers to questions 3, 4 and 5?

1. 2.483 2. 10.870 3. 194 4. 1940 5. 19400

Answers. 1. 0.395; $10^{0.395}$ 2. 1.036; $10^{1.036}$ 3. 2.288; $10^{2.288}$

4. 3.288; $10^{3.288}$ 5. 4.288; $10^{4.288}$

The answers to Q3 - Q5 increase by 1 sequentially because the numbers they represent have increased by a factor of 10 in sequence.

Entering exponential numbers into calculators.

For most calculators, the following procedure applies:

1. Enter the pre-exponential term
2. Press the E or EXP key
3. Enter the exponent
4. If the exponent has a minus sign, press the +/- key
5. Press ENTER key

If the number has no pre-exponential term (i.e. this term is 1), then most calculators have a 10^x key which is quicker. To use this key:

1. Enter the exponent.
2. If the exponent has a minus sign, press the +/- key.
3. Press the 10^x key. Note that on most calculators, the 10^x key is on the upper register, so it is necessary to press the SHIFT key before pressing the 10^x key.

Illustrative Problem 1:

Evaluate $10^{-2.53}$

Solution: Enter 2.53, press the +/- key, then the SHIFT and 10^x keys.

Answer is 0.0032

Illustrative Problem 2:

pH is defined as $-\log_{10}$ of the hydrogen ion concentration. Calculate the pH of a solution having a hydrogen ion concentration = 4.5×10^{-4} M.

Solution:

$$\text{pH} = -\log(4.5 \times 10^{-4}) = -(-3.35) = 3.35$$

Calculator steps: Enter 4.5, press EXP key, enter 4, press (+/-) key, press LOG key. Finally, as we need the negative log, press the +/- key to get the pH.

Practice Questions.

Enter the following into your calculator:

1. $10^{15.0}$ 2. $10^{-4.3}$ 3. 3×10^{12} 4. 16×10^{-9} 5. 23×10^{22}

Converting from the log form.

To convert a logarithm back to a normal number, use the 10^x key where x = the log to base 10. Usually the LOG key is the lower register of the 10^x key because they perform opposite actions. Some calculators may have a LOG^{-1} key which performs the same operation as a 10^x key. In either case, simply enter the value of x and press the 10^x or LOG^{-1} key.

Some calculators such as the Casio fx100s require the following procedure: Enter 10, press SHIFT, enter the value of x followed by the +/- key if x is negative, press the = key.

Illustrative Problem:

The equilibrium constant K_a for a weak acid dissociating is given as $10^{-4.76}$. Convert this to the non-exponential form.

Solution:

Enter 4.76 and then press the +/- key followed by the SHIFT key and the 10^x key.
Answer is 0.000017

Using Casio 100 or similar: enter 10, press SHIFT, enter 4.76 and then press +/-, then press the = key.

Practice Questions.

Enter the answers to each of the 5 questions from the earlier section headed "Logarithms" into your calculator and convert them back into their original form.

Exponentials to base e.

The number represented by e (2.71828) is sometimes encountered in chemical calculations as the base for an exponential. Exactly the same rules apply to exponentials to base e as to base 10. There is an e^x key usually on the upper register of most calculators and it is used in the same way as the 10^x key.

If e is the base used for a log, "ln" is used rather than "log_e" and there is an ln key on your calculator.

Example: Give the value for $e^{2.35}$.

Solution: Enter 2.35, press SHIFT and then the e^x key. Answer is 10.49

Example: Obtain $\ln(10.49)$

Solution: Enter 10.49 and press the LN key. Answer is 2.35 (i.e. $10.49 = e^{2.35}$)

Practice Questions.

Use your calculator to evaluate the following:

1. $e^{3.68}$ 2. $\ln 20.55$ 3. $e^{-4.29}$ 4. $\ln 0.0225$ 5. $e^{125.0}$

Answers.

1. 39.65 2. 3.023 3. 1.37×10^{-2} 4. -3.794 5. 1.94×10^{54}

More about logarithms.

An exponent or log is not a normal number but is made up of two components – the digits ahead of (to the left of) the decimal point (called the *characteristic*) and the digits following (to the right of) the decimal point (called the *mantissa*).

The digits to the left of the decimal point in the exponent that constitute the characteristic of the log are scale factors only – thus $10^2 = 100$, $10^3 = 1000$, etc.

The digits to the right of the decimal in the exponent that constitute the mantissa of the log give the number to which the scale factor must be applied.

Thus $10^{2.20}$ means $10^2 \times 10^{0.20} = 100 \times 1.6 = 160$

Note that $10^{3.20} = 10^3 \times 10^{0.20} = 1000 \times 1.6 = 1600$.

Similarly, $10^{4.20} = 16000$,

and $10^{5.20} = 160000$, etc.

That the characteristic does not contribute to the number other than as a scale factor is seen in the following example:

The number 5600 could be written as 5.600×10^3 or as 56.00×10^2 or even as 560.0×10^1 . Using the log function of the calculator, 5600 is $10^{3.748}$. If the number were written as 560.0×10^1 , by applying the log function to 560.0, this becomes $10^{2.748} \times 10^1$ or $10^{3.748}$ when converted to the exponential form – the same as for 5600.

Similarly, 56.00×10^2 is $10^{1.748} \times 10^2 = 10^{3.748}$ and 5.600×10^3 is $10^{0.748} \times 10^3 = 10^{3.748}$ in their exponential forms – all are identical.

So, regardless of which scale factor is used, the mantissa indicates the digits 5600 and the characteristic gives the scale factor to use in conjunction with those digits.

To deduce the number of significant figures when a number is written in the exponential form, count the number of digits including all zeros following the decimal place in the mantissa.

Thus $10^{2.37}$ is two significant figures, $10^{4.1}$ is one significant figure and $10^{6.07}$ is two significant figures.

Practice Questions.

Convert the following numbers from the exponential form. Ensure each answer has the correct number of significant figures.

1. $10^{3.45}$ 2. $10^{3.450}$ 3. $10^{0.165}$ 4. $10^{-8.35}$ 5. $10^{-0.0200}$

Answers.

1. 2.8×10^3 2. 2.82 3. 1.46 4. 4.5×10^{-9} 5. 9.55×10^{-1}