CHAPTER 1

1.1 WHOLE NUMBERS

The decimal system consists of:

- Numerals
    - Symbols (0, 1, 2, 3…)
    - Represent *natural numbers* or *whole numbers*
    - Used to count whole objects or fractions of them
- Integers
    - *Positive*: greater than zero
    - *Negative:* less than zero
- Digits
    - Numerals consist of one or more digits

POSITION OF DIGIT	VALUE	NAME
First	1	Ones (or units)
Second	10	Tens
Third	100	Hundreds
Fourth	1000	Thousands
Fifth	10 000	Tens of thousands
Sixth	100 000	Hundreds of thousands
Seventh	1 000 000	Millions

BASIC MATHEMATICAL OPERATIONS

- Multiplication
    - Several ways of indicating that two numbers are to be multiplied
    - Symmetry is important
    - Same signs = positive result
    - Different signs = negative result
- Division
    - Several ways of indicating that two numbers are to be divided
    - Same signs = positive result
    - Different signs = negative result
- Addition
    - Has symmetry
    - Like signs = use the sign and add
    - Unlike signs – use sign of greater and subtract
- Subtraction
    - The order in which the numbers does affect the result
    - Minus and a minus is a plus
    - Minus and a plus is a minus

ORDER OF OPERATIONS

- Multiplication and division *BEFORE* addition and subtraction
- However, to avoid any ambiguity, we can use *parentheses* (or brackets), which take precedence over *all* four basic operations
- For example: 5 + 4 x 9 can be written as 5 + (4 x 9) to remove this ambiguity

1.2 FRACTIONS
- A fraction can be either proper or improper
    - Proper fraction – numerator less than denominator
    - Improper fraction – numerator is greater than the denominator
- The number on top of the fraction is called the *numerator* and the bottom number is called the *denominator*
- The denominator cannot be zero, because if it is, the result is undefined

ADDITION AND SUBTRACTION OF FRACTIONS
- *Same denominators*
    - Step 1: add or subtract the numerators to obtain the new numerator
    - Step 2: the denominator remains the same
- *Different denominators*
    - Step 1: change denominators to the lowest common multiple
    - Step 2: add or subtract the numerators to obtain the new numerator

MULTIPLICATION AND DIVISION OF FRACTION
- *Multiplication*
    - Step 1: multiply the numerators to get new numerator
    - Step 2: multiply denominators to get new denominator
    - Step 3: use any common factors to divide the numerator and denominator, to simplify the answer
- *Division*
    - Step 1: invert the second fraction
    - Step 2: multiply it by the first fraction

1.3 DECIMALS
- Any fractions can be expressed as a decimal by dividing the numerator by the denominator
- A decimal consists of three components:
- Any zeros on the right-hand end after the decimal point and after the last digit do not change the number's value

RULES FOR DECIMALS
- *Addition and subtraction*
    - Align the numbers so that the decimal points are directly underneath each other
- *Multiplication*
    - Step 1: count the number of digits to the right of each decimal point for each number
    - Step 2: add the number of digits in step 1 to obtain a number, say x
    - Step 3: multiply the two original decimals, ignoring the decimal points
    - Step 4: mark the decimal point in the answer to step 3 so that there are x digits to the right of the decimal point
- *Division*
    - Step 1: count the number of digits that are in the divisor to the right of decimal point, call this number x
    - Step 2: move the decimal point in the dividend x places to the right (adding zeros as necessary), do the same to the divisor

- o The quotient of this division is the answer

1.4 EXPONENTS
- An *exponent* or power of a number is written as a *superscript* to a number called the *base*
- The base number is said to be in exponential form
- For example: a^n
  - o Where a is the base
  - o Where n is the exponent or power

POSITIVE EXPONENTS
- If numbers with the same base, a^n and a^m, then product will have the same base. The exponent will bet the sum of the two original exponents
  - o $a^n \times a^m = a^{n+m}$
- For the quotient, if the two numbers have the same base, the exponent will be the difference between the original exponents
  - o $a^n \div a^m = a^{n+m}$
- A number in exponential form is raised to another exponent; the result is the original base raised to the product of the exponents
  - o $(a^n)^m = a^{nm}$

NEGATIVE EXPONENTS
- A number expressed with negative exponent is equal to the reciprocal of the same number with a negative sign
  - o $a^{-n} = \frac{1}{a^n}$

FRACTIOANL EXPONENTS
- Exponents can be expressed as a fraction
  - o N is of the form $\frac{1}{k}$ (where k is an integer)
  - o $a^{\frac{1}{k}}$ is said to be the 'kth root of a'. The kth root of a number is one such that when it is multiplied by itself k times, you get that number
  - o $a^{\frac{1}{k}} = \sqrt[k]{a}$

ZERO EXPONENT
- Any base raised to the power of 0 equals 1
- Expect for 0^0 which is undefined