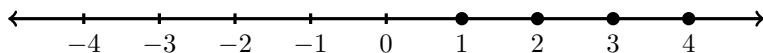# Handout 1

Number Theory, Set Theory & More

1.1 Natural Numbers ($\mathbb{N}$)

The natural numbers are basically all *positive whole numbers*, i.e. any number that you can count with your fingers, as in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, etc., going on indefinitely.[i] Decimals are not included in this set (e.g. $0.25 \notin \mathbb{N}$).

As far as the Project-Maths syllabus is concerned, '0' is *not* a member of the set of natural numbers. That's why it is excluded from the number line above.[ii] If you want to include 0 in your set of natural numbers, you would use the notation $\mathbb{N}_0$. That *'subscript zero'* lets everybody know that zero is included in your set, e.g. $\mathbb{N}_0 = \{0, 1, 2, 3, \dots\}$

1.2 Integers ($\mathbb{Z}$)
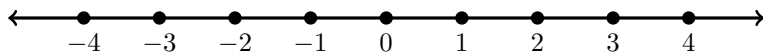
The integers is the set of *all whole numbers*. Don't incorrectly say that the integers are "the set of positive and negative whole numbers" because guess what, zero is neither positive nor negative, and zero is an element of the set of integers. (Zero is *'unsigned'*, i.e. no sign.)

The set of positive integers, $\mathbb{Z}^+$, is $\{1, 2, 3, 4, \dots\}$. The negative integers, $\mathbb{Z}^-$, is $\{-1, -2, -3, -4, \dots\}$
The set of positive integers including zero, $\mathbb{Z}_0^+$, is $\{0, 1, 2, 3, \dots\}$
The set of negative integers including zero, $\mathbb{Z}_0^-$, is $\{0, -1, -2, -3, \dots\}$
(The same notation applies for rational numbers $\mathbb{Q}$, and real numbers $\mathbb{R}$.)

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[i]'I.e.' is short for the Latin *id est* and it basically means 'that is'. 'Etc.' is a written abbreviation for the Latin *et cetera* and means 'and the rest'. 'E.g.' in Latin stands for *exempli gratia* and roughly means 'for example'.

[ii]There's a lack of agreement in maths and science communities with whether zero is included as an element of the set of natural numbers, or not. Some people say it is, some people say it isn't. For those of us who want to be clear, we may notate the set of natural numbers excluding 0 as $\mathbb{N}^+$, (with the *'superscript plus'* symbol,) and the set of natural numbers including 0 as $\mathbb{N}_0$. In the Project-Maths syllabus, $\mathbb{N} = \mathbb{N}^+$.

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