

## Integer Division and Modular Arithmetic

### Integer Division

When we divide one integer by another (non-zero) integer then, provided that the first integer is a multiple of the second then the result is a whole number (equal to that multiple).

Example

$$\frac{48}{6} = 8$$

If the second number is not a multiple of the first then we could interpret the result as a fraction or decimal.

Example

$$\frac{48}{5} = 9\frac{3}{5} = 9.6$$

Another, perhaps more simple, way of interpreting integer division is to express the result as a whole number with a remainder term (also a whole number).

Example

$$\frac{48}{5} = 9 \text{ remainder } 3$$

### Modular Arithmetic

Modular arithmetic involves integers only. There is a modulo; a whole number and only integers including zero and up to but not including the modulo exist in modular arithmetic. For example if the modulo was 5, then only the numbers 0, 1, 2, 3 and 4 exist in the arithmetic. Any integer outside this range is re-interpreted back in the range such that for example 5 is equivalent to 0,  $6 \equiv 1$ ,  $7 \equiv 2$  etc.

A number in modulo arithmetic is equal to the remainder term when the original number is divided by the modulo.

Returning to the previous example

$$48 \equiv 3 \pmod{5}$$