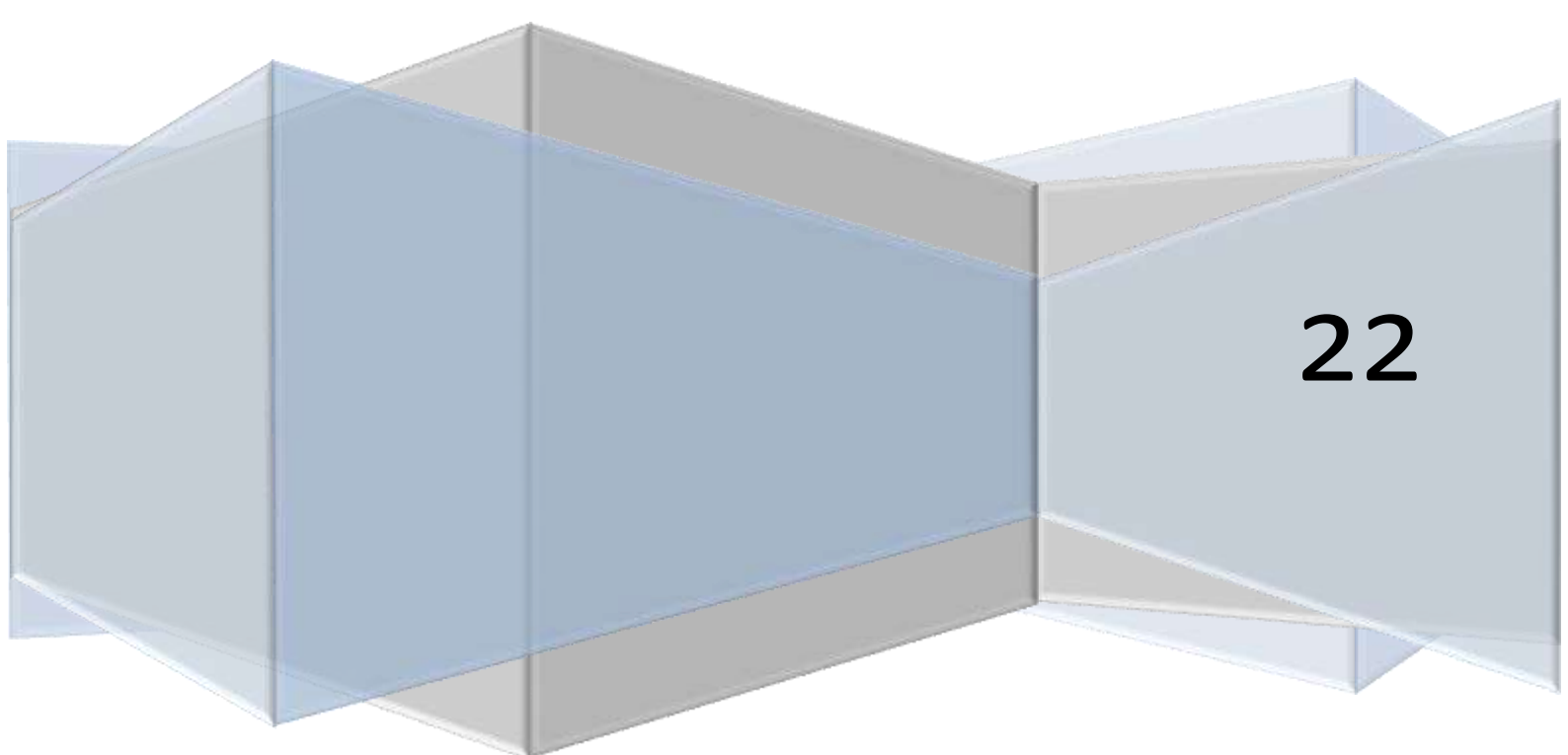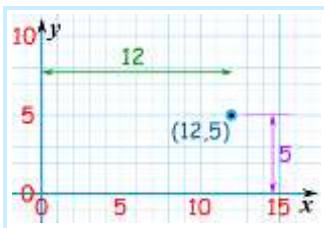# Class 8

Mathematics Prerequisite

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Mathematics

KNOWLEDGE

Point

A point is an exact location. It has no size, only position. Points usually have a name, often a letter like "A", or even "W"

The exact location of a point can be shown using Cartesian Coordinates.

Here we see the point $(12, 5)$
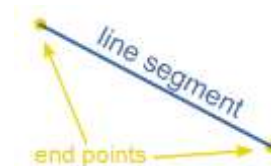
Line

A line is straight (no curves), has no thickness, and extends in both directions without end (infinitely).
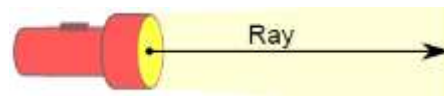
A line has **no ends** !

Line Segment

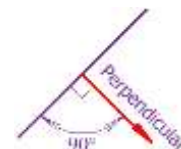When it **does** have ends, it is called a "**Line Segment**".

Ray

When it has just **one end,** it is called a "**Ray**".

Perpendicular Lines

Lines that are at right angles (90°) to each other are perpendicular.

Parallel Lines

Two lines on a plane that **never** meet.

They are always the **same** distance apart.

Here the **red** and **purple** line segments are parallel.

Plane

A plane is a flat surface with no thickness.
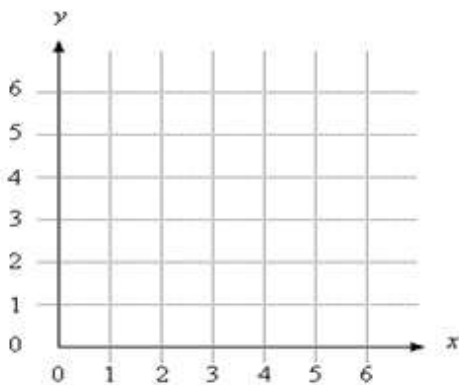It is actually hard to give a real example!
When we draw something on a flat piece of paper we are drawing on a plane ...

... except that the paper itself is not a plane, because it has thickness! And it should extend forever, too.
So the very top of a perfect flat piece of paper
that goes on forever is the right idea!

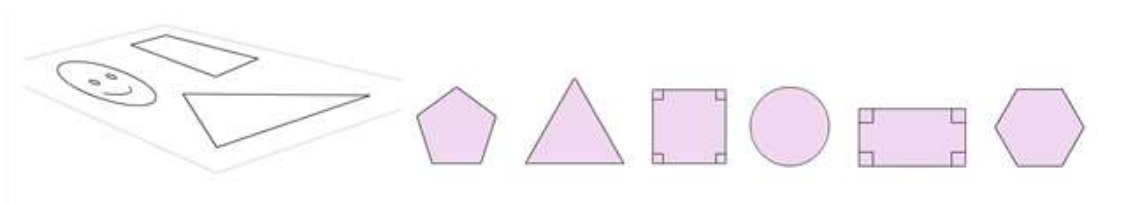## Cartesian plane / Co-ordinate Grid

A **Cartesian plane** / **coordinate grid** has two perpendicular lines, or axes, labeled like number lines.

The x-axis and the y-axis.

The point where the x-axis and the y-axis intersect is called the origin.

2D shapes

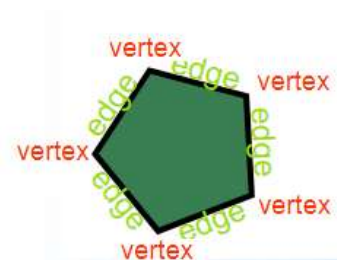Shapes that you can draw on a piece of paper are 2D shapes.

Vertex and Edge

A **vertex** (plural: **vertices**) is a point where two or more lines meet.

An **edge** is a line segment that joins two vertices.

And this pentagon has 5 vertices and 5 edges.

Fractions

A fraction is a part of a whole.

Slice a pizza, and we get fractions:

$^1/_2$ (One-Half) $^1/_4$ (One-Quarter) $^3/_8$ (Three-Eighths)

The top number says how many slices we **have.**
The bottom number says how many **equal slices** it was **cut into**.

Numerator / Denominator

We call the top number the **Numerator**, it is the number of parts we have.
We call the bottom number the **Denominator**, it is the number of parts the whole is divided into.
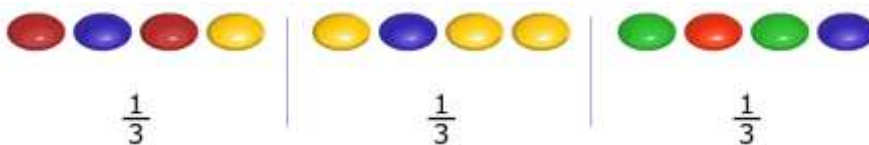
$$\frac{Numerator}{Denominator}$$

You just have to remember these names! (If you forget just think "Down"-ominator)

Fraction of a quantity

If you want to eat $\frac{2}{3}$ of 12 sweets,
split up the sweets into 3 equal groups
as we are dealing with thirds.

$\frac{1}{3}$ $\frac{1}{3}$ $\frac{1}{3}$
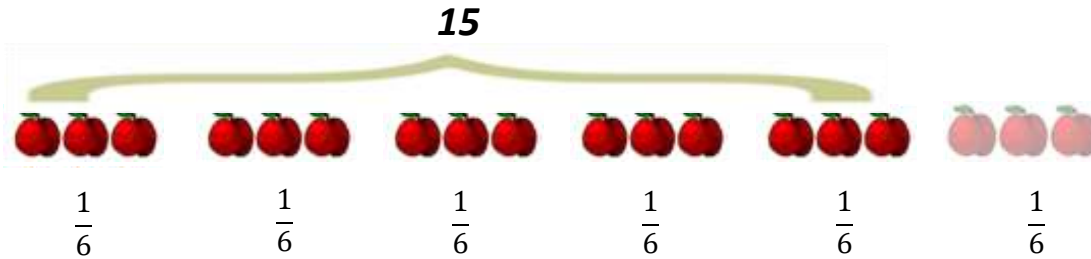
As you need 2 thirds, so you will take 2 sets of 4 sweets.

$\frac{2}{3}$ of 12 = 8

To calculate $\frac{5}{6}$ of 18 apples, split up the apples into 6 equal groups as we are dealing with sixths.

$\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$

There are 6 groups of 3 apples so $\frac{1}{6}$ of 18 is 3.

15

$\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$ $\quad$ $\frac{1}{6}$
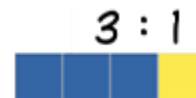
$\frac{5}{6}$ of 18 = 15

Ratios

A ratio compares values**.**

A ratio says how much of one thing there is compared to another thing.

There are 3 blue squares to 1 yellow square

3 : 1

Ratios can be shown in different ways:

Use the ":" to separate the values: 3 : 1

Or we can use the word "to":   3 to 1

A ratio can be scaled up:

Here the ratio is also 3 blue squares to 1 yellow square, even though there are more squares.

3 : 1

6   2

Using Ratios

The trick with ratios is to always multiply or divide the numbers **by the same value**.

Example:

4 : 5 is the same as **4×2 : 5×2 = 8 : 10**

4 : 5
×2   ×2
8 : 10

Recipes

Example: A Recipe for pancakes uses 3 cups of flour and 2 cups of milk.

So the ratio of flour to milk is **3 : 2**

To make pancakes for a LOT of people we might need 4 times the quantity, so we multiply the numbers by 4:

3×4 : 2×4 = 12 : 8

In other words, 12 cups of flour and 8 cups of milk.

The ratio is still the same, so the pancakes should be just as yummy.

Scaling

We can use ratios to scale drawings up or down (by multiplying or dividing).

The height to width ratio of the Pakistan Flag is **2:3**

So for every **2** (inches, meters, whatever) of height there should be **3** of width.

If we make the flag 40 cm high, it should be 60 cm wide
(which is still in the ratio 2:3)

Multiplication can Increase or Decrease a Number

Condition 1

Multiplying any positive number by a **whole number greater than 1** will always increase its value- see the example;

$$2 \times 8 = 16$$

$$3 \times 8 = 24$$

$$4 \times 8 = 32 \; etc.$$

In each it is getting larger, so, yes, multiplication clearly increases a number.
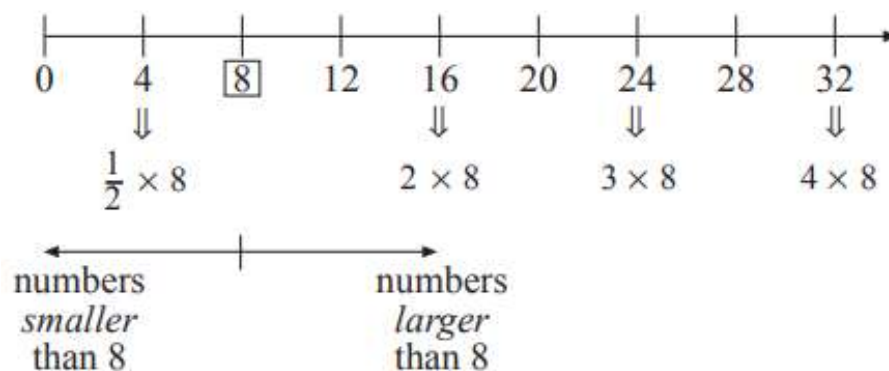
Condition 2

Now multiplying a positive number by a **number less than 1** will always reduce its value – see the example;

$$\frac{1}{2} \times 8 = 4$$
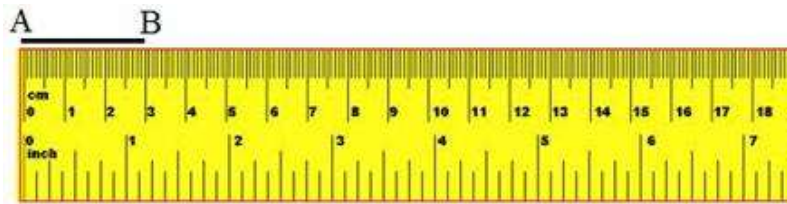
$$0.3 \times 8 = 2.4$$

$$\frac{1}{5} \times 8 = 1.6$$

In each it is getting smaller, so, yes, multiplication clearly decreases a number.

SKILLS

Measure line segment using ruler

Let there be a line-segment AB.
We have to measure its length.

The scale is placed along the line-segment putting its zero (0) mark at A. We see the end B is at the 3 cm mark of the scale. So the length of the line-segment AB = 3 cm.

Measure line segment using Dividers

It is used in measuring the length of a line segment.
It can also be used in map reading, it measures the distance
between two points on a map and that distance
can be used to know the actual distance using a scale.
It can be used to divide a segment into
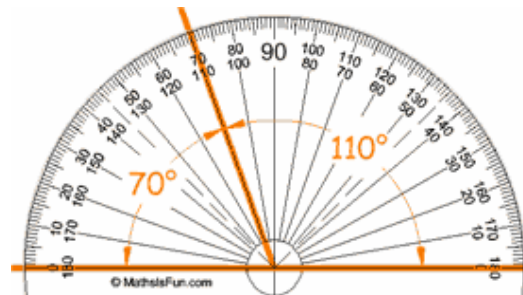several divisions of same length.
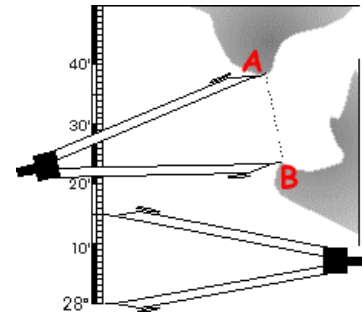
Measure angle using protractor

Protractors usually have two sets of numbers
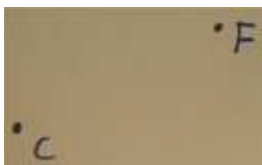going in opposite directions.

Be careful which one you use!

When in doubt think "should this angle be
bigger or smaller than 90° ?"

Draw line segment using ruler or straight edge

A line-segment has two end points.

Mark two points and label them.

Use the ruler or straight edge to join the points.

This is how you draw a line segment.

Draw a circle or an arc using compass

A **compass** is an instrument
used to draw circles or the parts
of circles called arcs.
It consists of two movable arms
hinged together where one arm
has a pointed end and the other arm
holds a pencil.

Hinge

Pencil

Hold for a pencil
(clamp)

Note that a compass is also called
a pair of compasses.

Compass needle
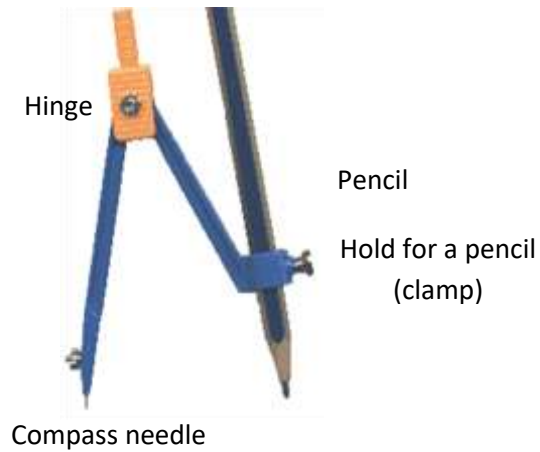
To draw a circle (or arc) with a compass:

Make sure that the hinge at the top of the compass is
tightened so that it does not slip.
Tighten the hold for the pencil so it also does not slip.
Secure a sharp pencil in the clamp of a compass so
the point of the compass and the point of the pencil
are level when the compass is closed.

Adjust the angle of the arms so that
they span the full desired radius.

Put the sharp end of a compass down firmly wherever
you want the middle of your circle to be.
Put the pencil point gently down on the paper.
Keep the compass upright and hold the compass
at the top.
Turn the compass so that the pencil draws a circle.

To draw a circle of radius 4 cm

Step 1: Use a ruler to set the distance from the point of the compass
to the pencil's lead at 4 cm.
Step 2: Place the point of the compass at the centre of the circle.
Step 3: Draw the circle by turning the compass through $360°$.

4 cm