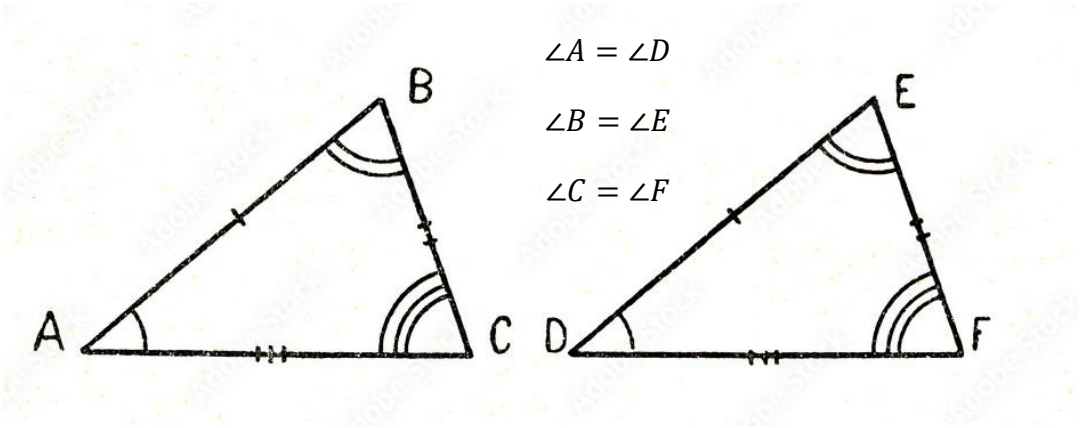
Section 5.1 – Scale

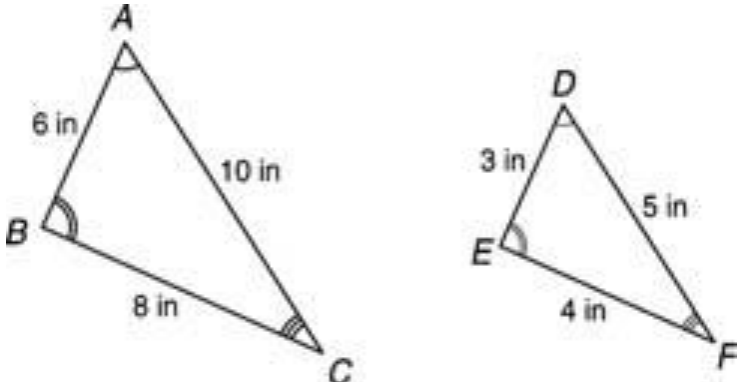
This booklet belongs to:_____**Block:** _____

Similar Shape Requirements

- When two or more objects are *to **scale*** it is **implied** that they are **similar figures**
- When shapes or figures are **SIMILAR** it is a **MUST** that the:
  - **Corresponding Angles** are **EQUAL**



  - **Corresponding sides** have **PROPORTIONATE RATIOS**



- If you measure $\frac{Big}{Small}$ we get a Ratio of: $\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF} = 2$
- If you measure $\frac{Small}{Big}$ we get a Ratio of: $\frac{DE}{AB} = \frac{DF}{AC} = \frac{EF}{BC} = \frac{1}{2}$

As long as you are **consistent** the **ratios** should always be **proportionate**

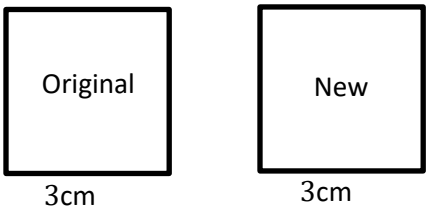
Scale

- Once we know the shapes are similar, we can calculate the scale factor
- For basic shapes, it matters which is the Image and which is the Object
- The Object is the original, Replication is the Image

There are three scenarios for Scale Factor

- If two shaped are the **SAME SIZE** what is the Scale Factor?

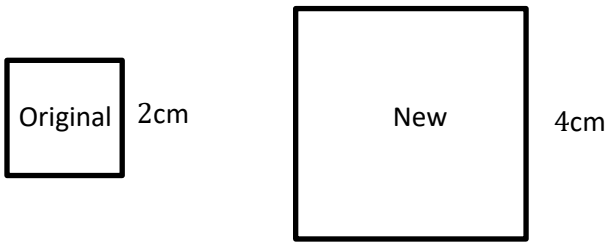
i)



What is the Scale? Obviously, since they are the same it is 1

- So, if the **IMAGE** is **larger**, would it make sense for the Scale Factor to be bigger or less than 1?

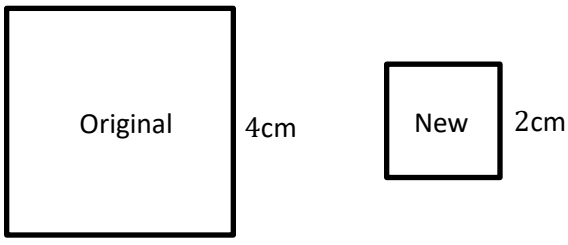
ii)



It's **TWICE** as big, the Scale Factor is 2

- If the **IMAGE** is **smaller**, would it make sense for the Scale Factor to be bigger or less than 1?

iii)



It's **HALF** the size, the Scale Factor is $\frac{1}{2}$

It means that the **Scale Factor**, the **proportional of Image to Object** is always written.

$$\boldsymbol{Scale\ Factor = \frac{New}{Orignal}}$$

From above… here is the calculation, and the specific type of size change.

i)

$$\frac{New}{Original} = \frac{3}{3} = 1, \qquad \boldsymbol{Equal\ to\ 1}\ means\ they\ are\ the\ \boldsymbol{SAME\ SIZE}$$

ii)

$$\frac{New}{Original} = \frac{4}{2} = 2, \qquad \boldsymbol{Greater\ than\ 1}\ is\ called\ an\ \boldsymbol{ENLARGEMENT}$$

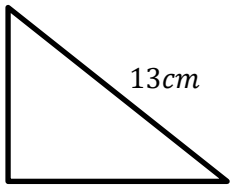
iii)

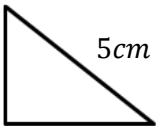
$$\frac{New}{Original} = \frac{2}{4} = \frac{1}{2}, \qquad \boldsymbol{Less\ than\ 1}\ is\ called\ a\ \boldsymbol{REDUCTION}$$

Example 1: Assuming the following are **SIMILAR**, what is the Scale Factor of the following shape?

Solution 2:

New ***Original***





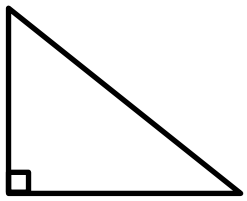
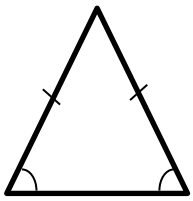
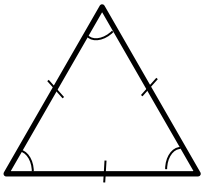
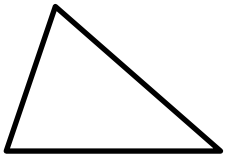
$$Scale = \frac{Image}{Object} \rightarrow \frac{13}{5} \rightarrow Greater\ than\ 1, so\ it's\ an\ ENLARGEMENT$$

The **Reproduction (New)** is $\frac{13}{5}$ the size of the **ORIGINAL OBJECT**.

- In this section we will be comparing a variety of shapes, we call them **POLYGONS**
- Polygons are a **union of three or more segments**, where each segment intersects with exactly two other segments at its endpoint (vertices)
- Here is an example of the most used and discussed POLYGONS

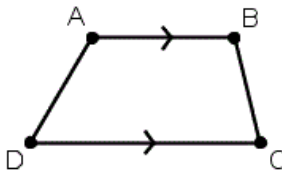
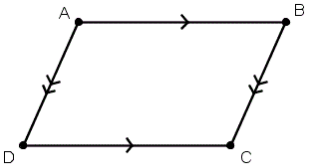
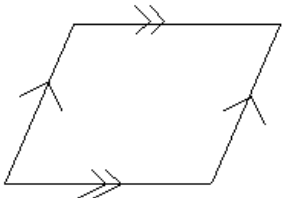
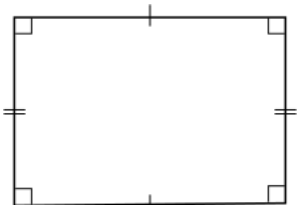
Triangle – A 3-sided Polygon

There are four types of Triangles

	Right Triangle • Has a $90°$ angle		Isosceles Triangle • Two sides the same • Two angles the same
	Equilateral Triangle • All sides the same • All angles the same		Scalene Triangle • No sides the same • No angles the same

Quadrilateral – A 4-sided Polygon

We will look at 5 different types

	Trapezoid • One pair of Parallel Sides		Parallelogram • Both opposite Sides Parallel and Equal
	Rhombus • Same as a parallelogram, but all sides equal		Rectangle • Four equal angles • Opposite sides Parallel and Equal

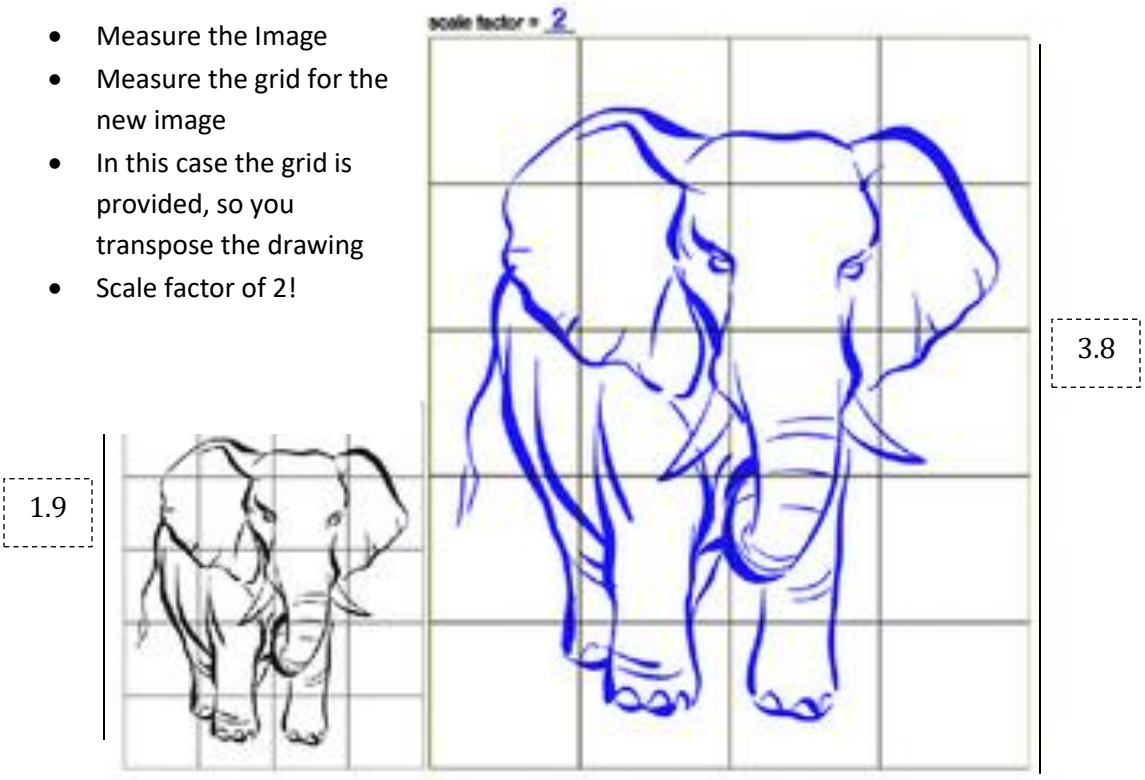
Square is a special type of rectangle

Drawing images at different Scales

- Scale drawing are used all the time
- It wouldn't always be **practical** to draw items their original size, we need to be able to **scale them up or down**
    - Think about representing an ant, it wouldn't be efficient to try to identify anatomy unless we increase the size
    - Or think about a building, if we wanted to fit a drawing on a piece of paper we would need to scale it down

- We need to **use scale factor** to keep the drawings accurate, every aspect needs to be scaled up or down accordingly.

- Measure the Image
- Measure the grid for the new image
- In this case the grid is provided, so you transpose the drawing
- Scale factor of 2!



Scale of Existing Pieces

- New/Original doesn't really work when we are talking about actual objects. What matters is which you are comparing to which

Example: Consider the Golden Gate Bridge.

Before the bridge physically existed, they would have created a model to demonstrate what the bridge would look like. The scale depends on how you compare the two pieces:

The **ACTUAL bridge** is 5000 times as big as the model that was made to demonstrate it. In that case, the Scale Factor is: $5000:1$ This means: $\frac{5000}{1}$ or 5000 times as big	The MODEL bridge is a 5000^{th} the size of the completed bridge. In this case, the Scale Factor is: $1:5000$ This means: $\frac{1}{5000}$ or 5000 times smaller

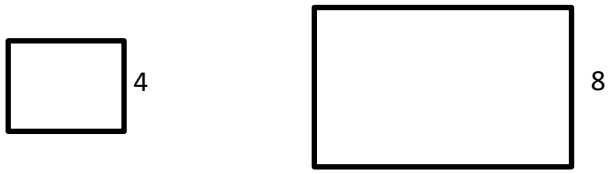
The Ratios are interchangeable, depending on the given scenario. This will come in handy during unit conversions.

Section 5.1 – Practice Problems

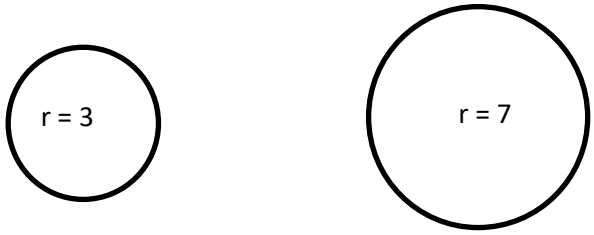
What is the **Scale Factor** of the following images? In order to be to scale the two objects are assumed to be **Similar Figures**.

1. Original New

2. Original New



3. Original New



4. Explain what Scale Factor represents in your own words. Give me an example that you've seen before. (Not shapes on paper in math)

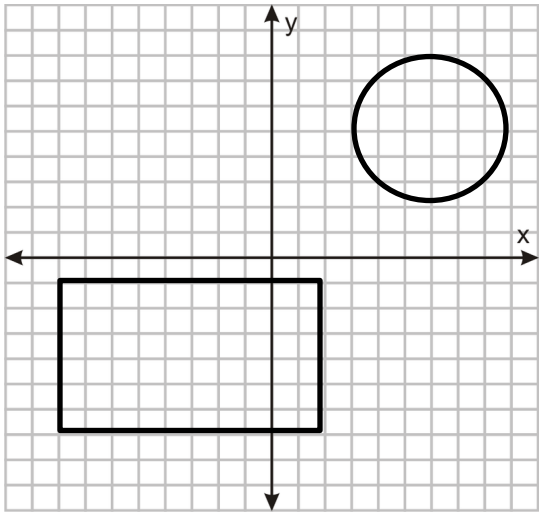
5. A vertical pole 3m high has a shadow 5m long. If a vertical building is 66m high, how long is the building's shadow at the same time of day?

6. A 193kg lunar vehicle weighs 31kg on the moon. How much does 90kg person weigh on the moon?

7. A hockey rink is 96m by 48m draw a scale model of a hockey rink if the scale factor is 1cm to 12m. You'll need a ruler.

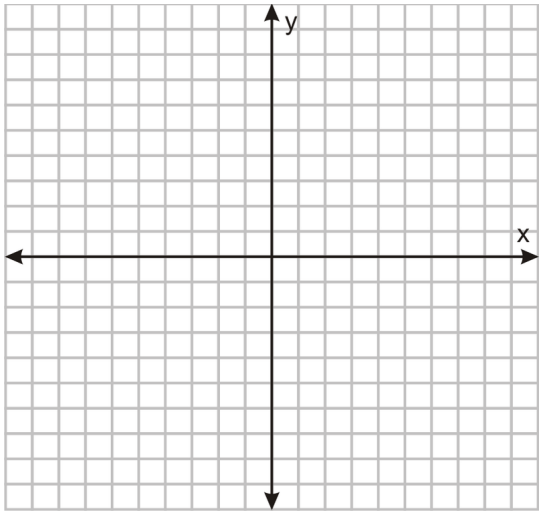
8. If the height of the model display of the New Vic High building is 30cm, and the height of the actual building in 30m. How can we describe the ratio of the two? Demonstrate how the ratio changes depending on how we compare. Careful with unit. $(1\text{m} = 100\text{cm})$

9. Draw the following image to the given scale factors
(grid is for accurate measurement, location of image does not matter)



Scale Factor of $\frac{1}{2}$

→



10. Complete the following, identify the scale factor

Original Size is:

New Size is:

Scale Factor: