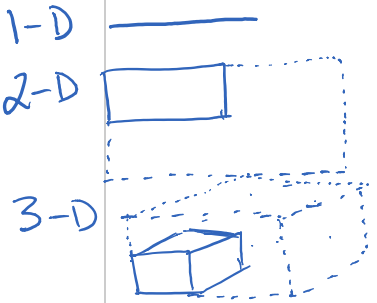
4.1 Enlargements and Reductions

An **enlargement** is an increase in the dimensions of an object by a constant factor. It can be 2-D or 3-D.

An **reduction** is an decrease in the dimensions of an object by a constant factor. It can be 2-D or 3-D.

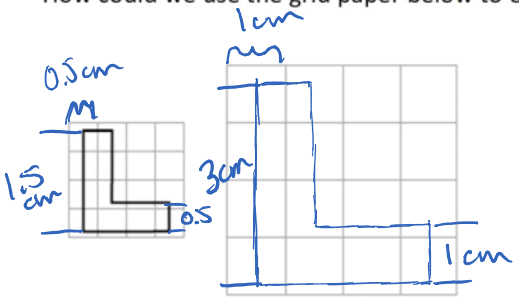
The **scale factor** is the constant factor by which all of the dimensions of an object are enlarged or reduced in a scale drawing.



1-D: Enlarge this 1cm line by a factor of 3 → 3cm

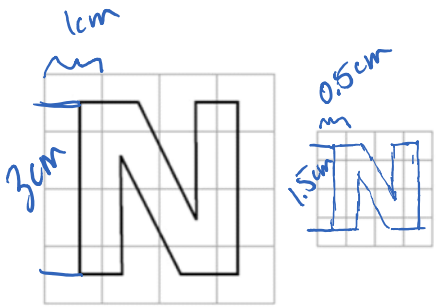
How could we use the grid paper below to enlarge the letter L by a factor of 2?

each line will be doubled

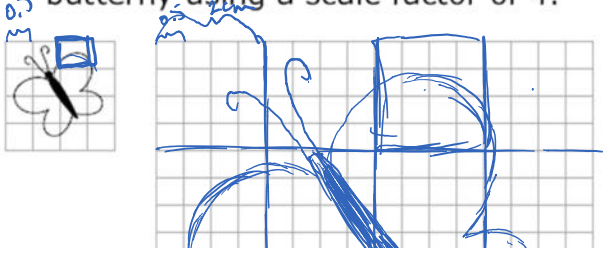


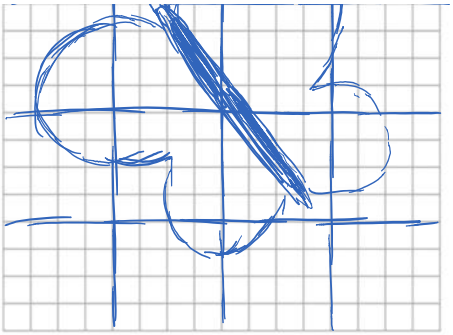
How could we use the grid paper below to reduce the letter N by a factor of 0.5? = $\frac{1}{2}$

every side length will be divided by 2



Draw an enlargement of the butterfly using a scale factor of 4.





Fill in the blanks with the words below

constant	enlargement	larger	reduction	scale factor	smaller

a) A scale factor greater than 1 indicates a(n) enlargement, which results in an image that is the same shape but proportionally larger than the original.

b) A scale factor less than 1 indicates a(n) reduction, which results in an image that is the same shape but proportionally smaller than the original.

c) The scale factor is the constant amount by which all dimensions of an object are enlarged or reduced in a scale drawing.

same

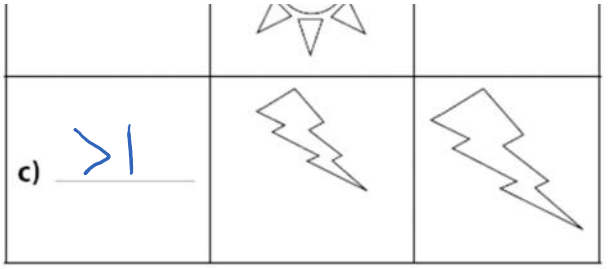
For each image in column A, state whether the image in column B has a scale factor

- greater than 1 >1
- less than 1 <1
- equal to 1 =1

	A	B
a) =1		
b) <1		

same size

reduction



c) >1 enlargement

ASSIGNMENT: 4.1 Extra Practice

pg 136 #4-12, 16

↑ pg 138

hand in 16c

4.2 Scale Diagrams

If you look at a map you may see something that says 1cm represents 12km.

Scale is a comparison between the actual size of an object and the size of its diagram. It can be expressed as a ratio, as a fraction, as a percent, in words, or in a diagram. In the above example of the map what is the scale as a ratio and a fraction?

A **scale diagram** is a drawing that is similar to the actual figure or object. It may be smaller or larger than the actual object, but must be in the same **proportions**.

Review of fractions and ratios

mult. decimal by 100 — divide fraction

Fraction	Ratio	Percent	Decimals
$\frac{1}{2}$	1 : 2	50%	0.5
$\frac{1}{4}$	1:4	25%	0.25
$\frac{75}{100} = \boxed{\frac{3}{4}}$	75 : 100 $\boxed{3:4}$	75%	0.75
$\frac{2}{10} = \frac{1}{5}$	1 : 5	20%	0.2
$\frac{1}{50}$	1:50	2%	0.02
$\boxed{\frac{1}{1}}$ $\frac{100}{100}$	1 : 1	100%	1.0

numerator ÷ denominator = 0.5

$\frac{1}{2} = 0.5$

$\frac{2}{4} = 0.5$

Review of equivalent fractions/ratios

equivalent fraction

$$\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \frac{4}{8} = \frac{100}{200} = \frac{25}{50} = \frac{72}{144} = \frac{10.5}{21}$$

equivalent ratios

$1:2 = 2:4 = 3:6 = 4:8 = \cdots 72:144 = 10.5:21$

How do you find out what x is in the proportion below

cross multiplying

$$\frac{1}{14} = \frac{5.5}{x}$$

$(14)\frac{1}{14} = \frac{5.5}{x}(14)$

$(x)1 = \frac{5.5(14)}{x}(x)$

$1x = 5.5(14)$

$x = 77$

$\frac{1}{14} \times \frac{5.5}{x}$

$1 \cdot x = 5.5(14)$

$x = 77$

Try these:

$$\frac{1}{4} = \frac{12.5}{x}$$

$1x = 12.5(4)$

$x = 50$

$$\frac{1}{1200} = \frac{x}{6000}$$

$\frac{1(6000)}{1200} = \frac{x(1200)}{1200}$

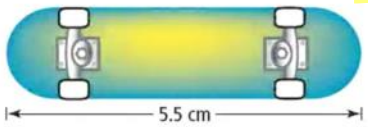
$= x$

pg 140

Using Scale to determine the actual length of an object

The scale diagram of a skateboard uses a scale of 1 : 14. What is the actual length of the skateboard?

= ?



Method 1: Use the scale 1:14

This means the actual dimensions are 14 times those in the diagram.

$14 \times 5.5\text{ cm} = 77\text{ cm}$

Method 2: Use a Proportion $\frac{1}{14} = \text{scale} = \frac{\text{diagram measurement}}{\text{actual measurement}}$

$$\frac{1}{14} = \frac{5.5\text{cm}}{x}$$

$$1 \cdot x = (5.5\text{cm})(14)$$

$$x = 77\text{ cm}$$

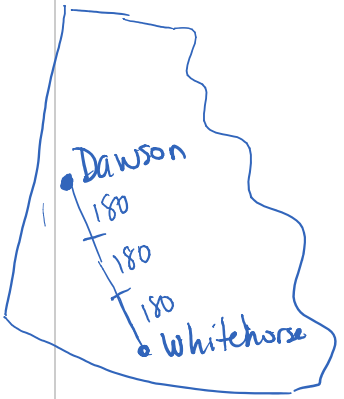
Determining Scale Factor

The flying distance from Dawson City to Whitehorse is 540 km. The distance shown on the map is 3 cm.

a) Complete the following to express the map scale in words.

scale: 1 cm represents ■ km

b) What is the scale factor?
Hint: 1 km = 100 000 cm.



Scale = diagram measurement divided by actual measurement

a) 3cm : 540km
1cm : ? km

$\frac{3cm}{540km} = \frac{1cm}{x\ km}$

$d = 540km$
$d_{map} = 3cm$

$\frac{3x}{3} = \frac{1(540)}{3}$

$x = 180$

1 cm represents 180 km

ASSIGNMENT: p. 142 #2, 5-10, 12, 15, 18

$180\text{km} \times \frac{1000\text{m}}{1\text{km}} \times \frac{100\text{cm}}{1\text{m}}$

$= 18,000,000$

b) 1 cm : 180km

same units

1 cm : 18,000,000 cm

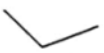
1 : 18 000 000

4.3 Similar Triangles

GEOMETRY VOCABULARY

Angle Properties


Acute ∠ $< 90°$

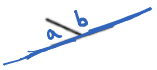

Obtuse ∠ $> 90°, < 180°$


Right ∠ $= 90°$


Straight ∠ = line $= 180°$


Complementary ∠s add to 90°
$\angle x + \angle y = 90°$


Angles at a point add to 360°
$p + q + r + s + t = 360°$


Supplementary ∠s add to 180°
$\angle a + \angle b = 180°$

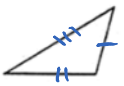

Vertically opposite ∠s are equal


Angles on a line add to 180°
$\angle a + \angle b + \angle c + \angle d = 180°$

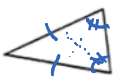
Triangle Properties

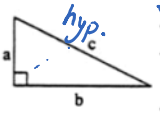
∠ sum of a triangle is 180°

$x + x + x = 180°$
$3x = 180°$
$x = \frac{180°}{3} = 60°$


Scalene triangle
— no sides equal
— no ∠s equal


Equilateral triangle
— 3 sides equal
— 3 ∠s equal (each 60°)


Isosceles triangle
— at least 2 sides equal
— ∠s opposite the equal sides are equal

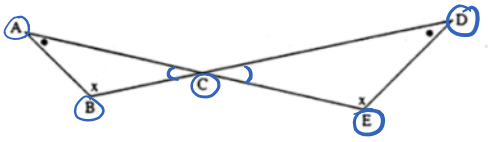

Right triangle
— 1 right angle $= 90°$
— hypotenuse is opposite the right angle (longest side)
— Property of Pythagoras
$a^2 + b^2 = c^2$

$\triangle ABC \sim \triangle DEC$

Similar Figures

2 figures are similar if
— corresponding ∠s are equal
— corresponding sides are in proportion

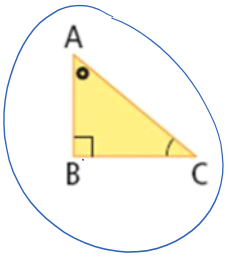
$\angle A = \angle D$
$\angle B = \angle E$
$\angle C = \angle C$

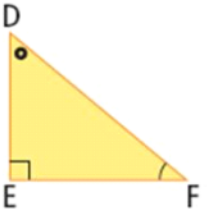


$\triangle ABC \sim \triangle DEC$ AAA

scale factor $= \frac{AB}{DE} = \frac{BC}{EC} = \frac{AC}{DC}$ corresponding sides of similar figures are in proportion

SIMILAR TRIANGLES





These two triangles are similar. What do you think this means?

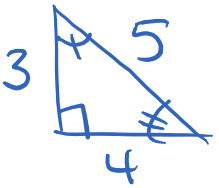
$\angle B = \angle E$
$\angle C = \angle F$
$\angle A = \angle D$

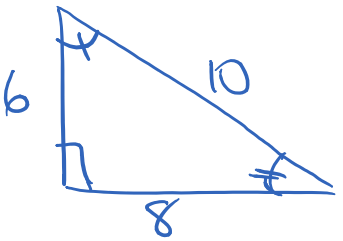
Comparable angles are equal

$\frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$

sides are proportional

Ex





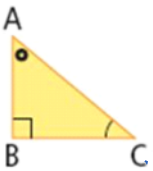
$\frac{6}{3} = \frac{8}{4} = \frac{10}{5}$

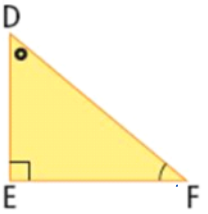
$2 = 2 = 2$

$\frac{3}{6} = \frac{4}{8} = \frac{5}{10}$

$= 0.5$

2 = 2 = 2 =0.5





corresponding angles:
∠A and ∠D
∠B and ∠E
∠C and ∠F

corresponding sides:
AB and DE
BC and EF
AC and DF

$\triangle ABC \sim$ △DEF

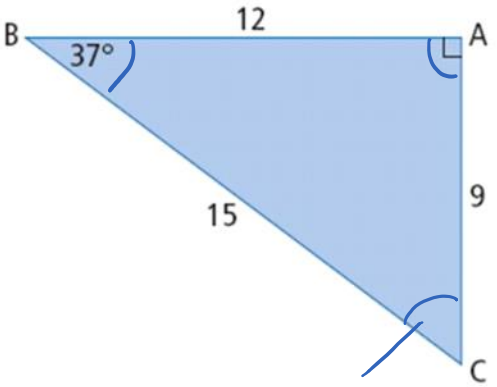
How can you determine if two triangles are similar?

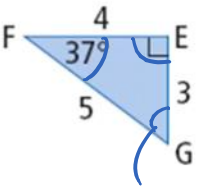
1. The 3 pairs of angles must be equal
2. The 3 pairs of sides must be in proportion (have equal ratios)

One of the 2 conditions is enough to prove similarity.

Ex

Determine if △ABC is similar to △EFG.





180-90-37 = 53°

180-90-37 = 53°

Yes, similar, since corresponding angles are equal

Try this one

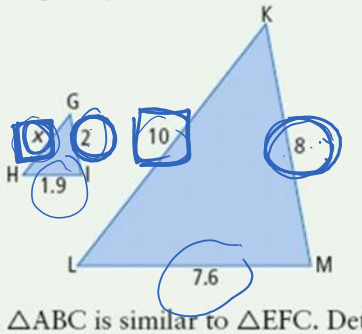
$\frac{2.8}{4.2} \stackrel{?}{=} \frac{1.1}{1.65} \stackrel{?}{=} \frac{3}{4.5}$

$0.\overline{6}$ $0.\overline{6}$ $0.\overline{6}$

Use Similar Triangles to Determine a Missing Side Length

Solve using a method of your choice.

a) △GHI is similar to △KLM. What is the missing side length? Express your answer to the nearest tenth.



$\frac{2}{8} = \frac{x}{10}$

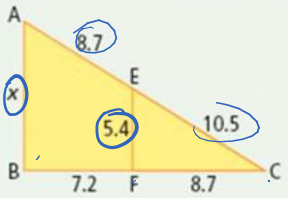
$\frac{20}{8} = \frac{8x}{8}$

$2.5 = x$

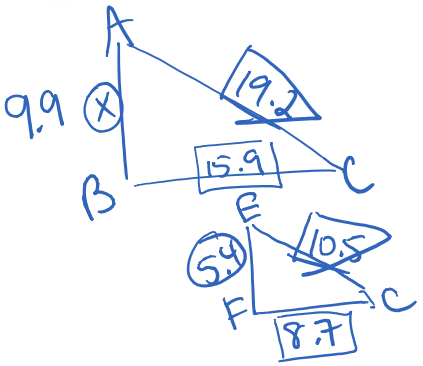
$\frac{x}{10} = \frac{1.9}{7.6}$

$x = 2.5$

b) △ABC is similar to △EFC. Determine the missing side length. Express your answer to the nearest tenth.



$\frac{x}{5.4} = \frac{19.2}{10.5} = \frac{15.9}{8.7}$



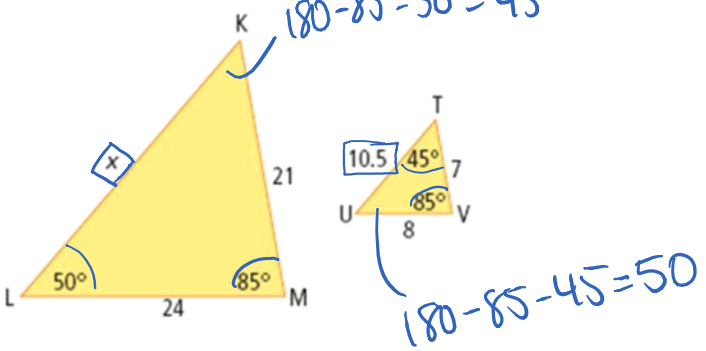
$\frac{x}{5.4} = \frac{19.2}{10.5}$

$10.5x = 5.4(19.2)$

$\frac{10.5x}{10.5} = \frac{103.68}{10.5}$

$x = 9.87$

Try this one- find the missing side length



$$\frac{x}{10.5} = \frac{24}{8}$$

$$\frac{8x}{8} = \frac{10.5(24)}{8}$$

$$x = \frac{10.5(24)}{8}$$

$$= 31.5$$

ASSIGNMENT: p. 150 #4-10, 12, 13, 14

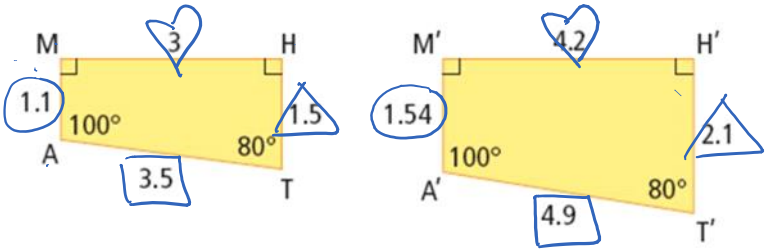
4.4
~~4.3~~ Similar Polygons

polygon

- a two-dimensional closed figure made of three or more line segments

The angles inside a 4-sided polygon add to 360°

Show how the two polygons below are similar:



1. Compare corresponding angles
2. Compare the ratio of the corresponding sides

① Corresponding angles are equal

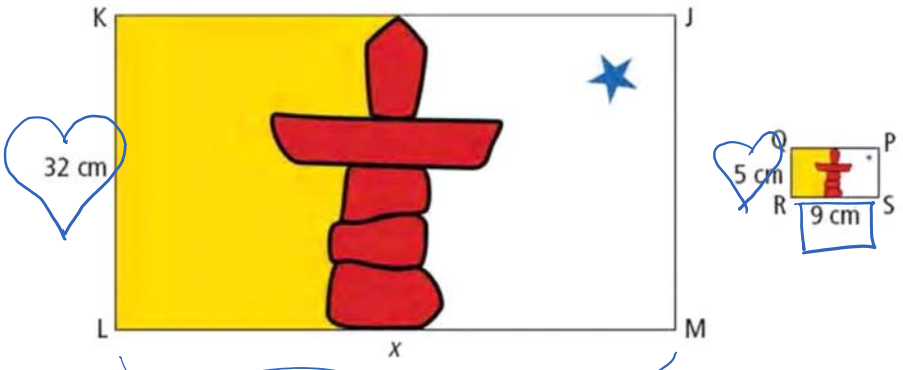
$M = M'$ $A = A'$ $T = T'$ $H = H'$ ∴ similar polygons

$90° = 90°$ $100° = 100°$ $80° = 80°$ $90° = 90°$

② $\frac{1.1}{1.54} = \frac{3.5}{4.9} = \frac{1.5}{2.1} = \frac{3}{4.2}$ ∴ similar polygons

$0.714 = 0.714 = 0.714 = 0.714$

Ex 1 Determining the length of a missing side



The two drawings of the Nunavut flag are similar. What is the length of the side LM in the larger rectangle?

large : $\frac{LM}{9\text{ cm}} = \frac{32\text{ cm}}{5\text{ cm}}$

$5\text{cm}(LM) = 9\text{cm}(32\text{cm})$

$\frac{5(LM)}{5} = \frac{288\text{cm}^2}{5\text{cm}}$

$LM = 57.6\text{ cm}$

* pg 157 # 3, 5, 10a, 12

Review * pg 160 # 1-5, 8-18

pg 162 # 1-6, 12, 15

ASSIGNMENT: p. 157 #3, 5, 10a, 12

Chapter 4 Review p.160 #1-5, 8-18
p. 162 # 1-6, 12, 15