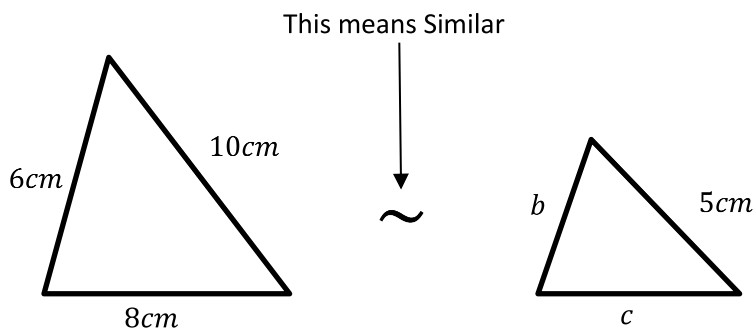
Section 5.2 – Similarity and Proportions

This booklet belongs to:______________________________Block: ______

Similarity

- So, when two objects are **SIMILAR**, we know they have **PROPORTIONATE SIDES**, which means that **ratio (fraction)** of each set of **corresponding sides** are **equal**.

Similarity Examples:



Since they are **Similar** we know that the sides are **PROPORTIONATE**

(Compare Big to Little)

$$\frac{10}{5} = \frac{6}{b} = \frac{8}{c} = 2$$

(Compare Little to Big)

$$\frac{5}{10} = \frac{b}{6} = \frac{c}{8} = \frac{1}{2}$$

- It doesn't matter with way you go; your answers will come out the same.
- Generally, $\frac{Big}{Little}$ is easier to work with. But it all depends where your unknown is.
- The algebra is easier when the unknown is in the numerator.

Let's **compare** the two and solve for our unknowns.

As you can see Little to Big versus Big to Little will not change the result, one is just easier to do.

$\frac{Little}{Big}$

$$\frac{1}{2} = \frac{b}{6} \quad \rightarrow \quad 6 \cdot \frac{1}{2} = \frac{b}{6} \cdot 6 \quad \rightarrow \quad \frac{6}{2} = \boldsymbol{b = 3}$$

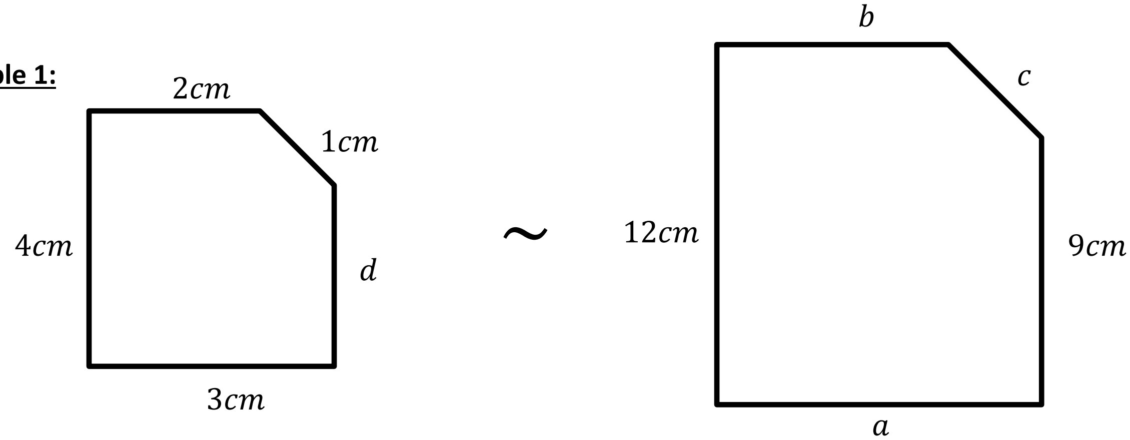
$$\frac{1}{2} = \frac{c}{8} \quad \rightarrow \quad 8 \cdot \frac{1}{2} = \frac{c}{8} \cdot 8 \quad \rightarrow \quad \frac{8}{2} = \boldsymbol{c = 4}$$

$\frac{Big}{Little}$

$$2 = \frac{6}{b} \rightarrow 2 \cdot b = \frac{6}{b} \cdot b \rightarrow 2b = 6 \rightarrow \boldsymbol{b = \frac{6}{2} = 3}$$

$$2 = \frac{8}{c} \rightarrow 2 \cdot c = \frac{8}{c} \cdot c \rightarrow 2c = 8 \rightarrow \boldsymbol{c = \frac{8}{2} = 4}$$

Example 1:



Solution 1:

- The ratio we are able to compare is: $\frac{Small}{Big} = \frac{4}{12} = \frac{1}{3}$ or $\frac{Big}{Small} = \frac{12}{4} = 3$

- We can compare either way, so set it up so the **unknown** is in the **numerator**

$\frac{small}{big}$ works best for this one: $\frac{1}{3} = \frac{d}{9} \quad \rightarrow \quad 9 \cdot \frac{1}{3} = \frac{d}{9} \cdot 9 \quad \rightarrow \quad \frac{9}{3} = \boldsymbol{d = 3}$

$\frac{big}{small}$ works best for these three:

$$3 = \frac{a}{3} \quad \rightarrow \quad 3 \cdot 3 = \frac{a}{3} \cdot 3 \quad \rightarrow \quad \boldsymbol{a = 9}$$

$$3 = \frac{b}{2} \quad \rightarrow \quad 2 \cdot 3 = \frac{b}{2} \cdot 2 \quad \rightarrow \quad \boldsymbol{b = 6}$$

$$3 = \frac{c}{1} \quad \rightarrow \quad 1 \cdot 3 = \frac{c}{1} \cdot 1 \quad \rightarrow \quad \boldsymbol{c = 9}$$

You can flip your ratios when solving. As long as you flip both.

If:

$$\frac{4}{x} = \frac{7}{3}$$

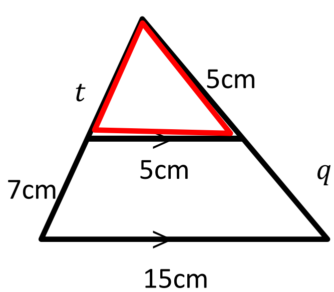
Then:

$$\frac{x}{4} = \frac{3}{7}$$

Example 2: Solve for the unknown information (there are a number of ratios you can use)

Solution 2: Be aware that there is a smaller similar triangle that makes up the top of the larger triangle

$$\frac{Big}{Little} = \frac{15}{5} = 3$$



$$3 = \frac{t+7}{t} \quad \rightarrow \quad t \cdot 3 = \frac{t+7}{t} \cdot t \quad \rightarrow \quad 3t = t + 7 \quad \rightarrow \quad 2t = 7 \quad \rightarrow \quad \boldsymbol{t = \frac{7}{2}}$$

$$3 = \frac{q+5}{5} \quad \rightarrow \quad 5 \cdot 3 = \frac{q+5}{5} \cdot 5 \quad \rightarrow \quad 15 = q + 5 \quad \rightarrow \quad \boldsymbol{q = 10}$$

- Remember that in order for two shapes to be Similar they must have two important features:

  1. **Corresponding Angles are Equal**
  2. **Corresponding Sides are Proportionate**

Once we know this we are really just solving a proportion.

- A proportion is when we have two things equal to one anther and one piece of information is unknown, ALGEBRA all over again

Example 3: Solve the following proportions for a

a) $ab = c$

b) $\frac{a}{b} = \frac{c}{d}$

c) $\frac{b}{a} = \frac{d}{c}$

Solution 3:

a) $ab = c \rightarrow \frac{ab}{b} = \frac{c}{b} \rightarrow \boldsymbol{a = \frac{c}{b}}$

Divide both sides by b

b) $\frac{a}{b} = \frac{c}{d} \rightarrow b \cdot \frac{a}{b} = \frac{c}{d} \cdot b \rightarrow \boldsymbol{a = \frac{cb}{d}}$

Multiply both sides by b

c) $\frac{b}{a} = \frac{d}{c} \rightarrow a \cdot \frac{b}{a} = \frac{d}{c} \cdot a \rightarrow \boldsymbol{b = \frac{da}{c}} \rightarrow \frac{c}{d} \cdot b = \frac{c}{d} \cdot \frac{da}{c} \rightarrow \boldsymbol{a = \frac{cb}{d}}$

Multiply both sides by a

Multiply both sides by c
and
Divide both sides by d

Essentially,

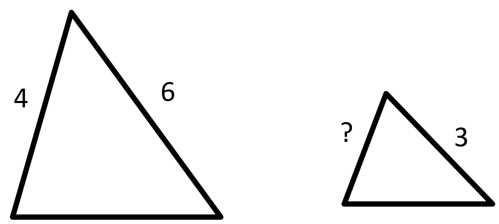
$Multiply\ by \frac{c}{d}$

Section 5.2 – Practice Questions

EMERGING LEVEL QUESTIONS

Assume the following are all similar shapes, find the desired information.

1.



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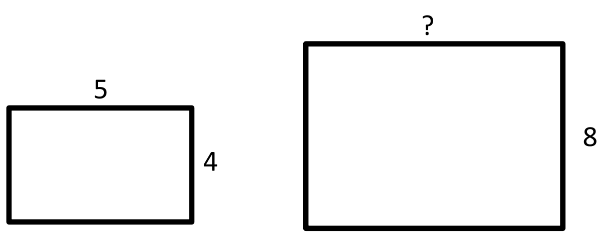
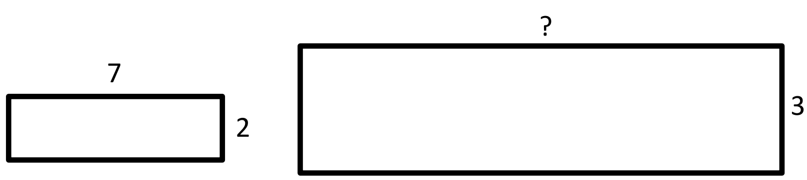


3.



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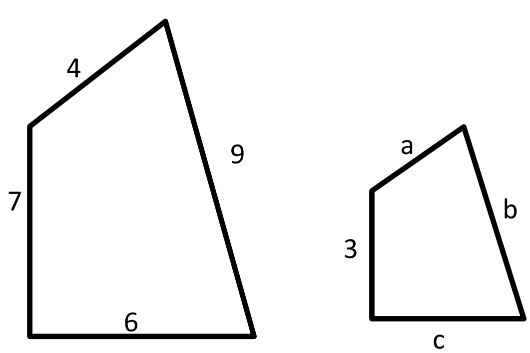


PROFICINET LEVEL QUESTIONS

Solve the following proportions, this is about manipulating equations.

5. If $\frac{x}{y} = \frac{2}{5}$, then: $5x =$

6. If $\frac{a}{b} = \frac{3}{7}$, then: $\frac{a}{3} =$

7. If $\frac{m}{n} = \frac{9}{5}$, then: $\frac{n}{m} =$

8. If $\frac{y}{z} = \frac{4}{11}$, then: $\frac{y+z}{z} =$

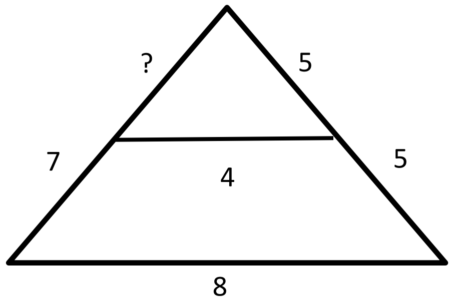
9. If $\frac{c}{4} = \frac{d}{3}$, then: $\frac{c}{d} =$

10. If $\frac{x}{y} = \frac{11}{4}$, then: $\frac{11}{x} =$

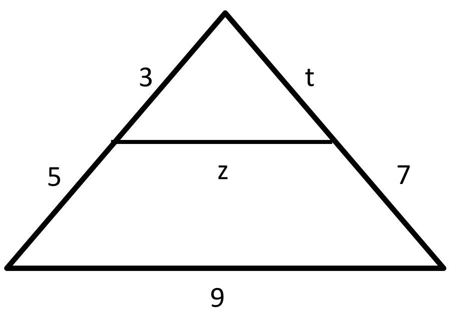
11. If $\frac{a}{5} = \frac{b}{12}$, then: $\frac{a+5}{5} =$

12. If $\frac{x-y}{y} = \frac{3}{7}$, then: $\frac{x}{y} =$

13.



14.



15. Which figure is more coloured in? Why?

16. Eric thinks that $\frac{8}{8}$ is bigger than $\frac{4}{4}$ because there are more pieces. Sylvia says it's the other way around because the pieces are bigger. That do you think and why?

17. Which car is going faster? Explain your answer.

120km/hour

60km/30 minutes

40km/20 minutes

Find the value of x

18. $\frac{x}{7} = \frac{3}{4}$

19. $\frac{x+3}{4} = \frac{9}{2}$

20. $\frac{9}{x} = \frac{5}{7}$

EXTENDING LEVEL QUESTIONS

21. $\frac{x+4}{3} = \frac{x+8}{5}$

22. $\frac{x-2}{3} = \frac{x+4}{7}$

23. $\frac{x-4}{5} = \frac{x-3}{7}$