BC Math 9 Proportional Reasoning 1 (solutions)
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- a given 2D shape
- Solving a scale diagram problem by applying the properties of similar triangles, including measurements
- Integration of scale for First Peoples mural work, use of traditional design in current First Peoples fashion design, use of similar triangles to create longhouses / models

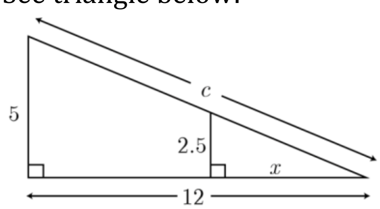
1. How many cm in 2 meters?
   200

2. How many mm in a km?
   $1 \text{ km} = 1000 \text{ m} = 1000 \times 100 \text{ cm} = 100{,}000 \text{ cm} = 1{,}000{,}000 \text{ mm}$

3. If a 10 cm long toy car is at a scale of 1:20 how long is the car in real life?
   $10 \text{ cm} \times 20 = 200 \text{ cm} = 2 \text{ m}$

4. A picture of the COVID virus is 5 cm long. If the virus is 100 nanometers long in real life, what is the scale of this picture? (ex. 200:1, 1:2000, etc.)
   Nanometers means one-billionth of a meter.
   picture : real
   5 cm : 100 nanometres
   50 mm : 100 nanometres:
   50 000 micrometers : 100 nanometers
   50 000 000 nanometers : 100 nanometers
   500 000 : 1

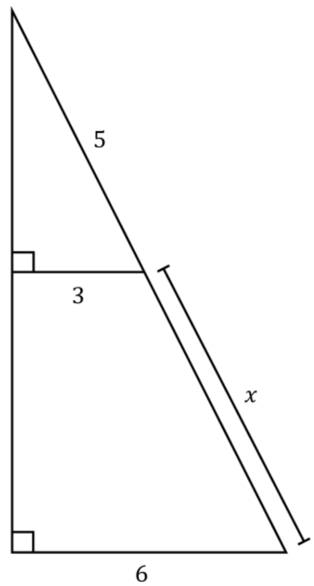
5. See triangle below:



   a. Find c
      13

   b. Find x
      $\frac{x}{2.5} = \frac{12}{5}$
      $5x = 30$
      $x = 6$

6. Find x in the diagram below:



Small triangle: 3-4-5

Compare to larger triangle

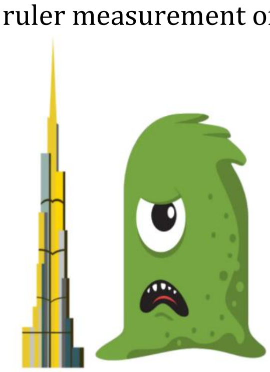
$\frac{3}{6} = \frac{5}{5+x}$

$30 = 15 + 3x$

$3x = 15$

$x = 5$

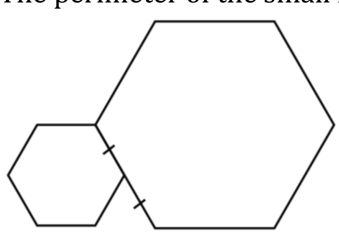
7. The Burj Khalifa is about 830 m tall. The ruler measurement of a picture of this building is 6 cm. The ruler measurement of the picture of the monster is 4.25 cm. How tall is the monster in real life?



$\frac{830}{6} = \frac{h}{4.25}$

$6h = 3527.5 \rightarrow h \approx 587.9$ m

8. The perimeter of the small hexagon in the diagram below is 12 m.



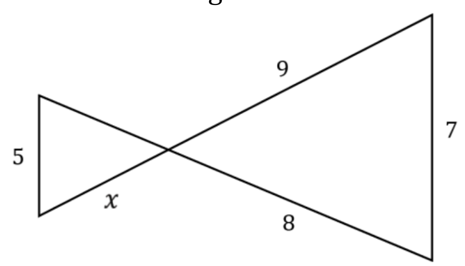
a. Find the side length of the large hexagon.

Small side is x. $6x = 12 \rightarrow x = 2$

Then one side of large is $2x = 4$.

b. Express the perimeter of the smaller hexagon to the perimeter of the larger hexagon as a simplified ratio.
Perimeter of smaller is $6 \times 2 = 12$
Perimeter of larger is $6 \times 4 = 24$
$24:12 \rightarrow 1:2$

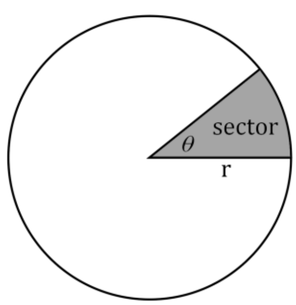
9. Find x in the diagram below:



$\frac{7}{9} = \frac{5}{x}$
$7x = 45$
$x = \frac{45}{7}$

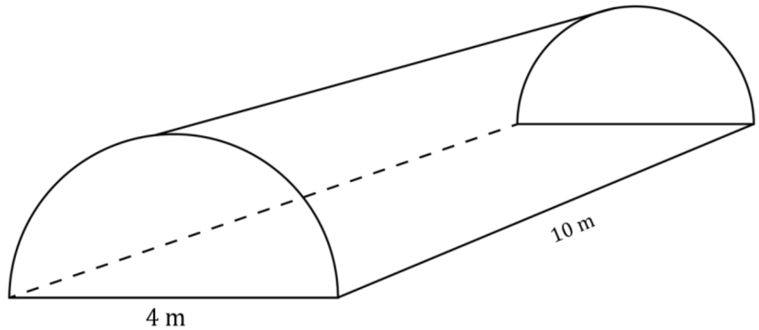
10. Challenge 1: 360 degrees is equal to 2π radians. The formula for the circumference of a circle is $C = 2\pi r$ and the area of a circle is $A = \pi r^2$. Show that the arc length of a sector of a circle is $arc = \theta r$.
$\frac{arc}{\text{circumference}} = \frac{\theta \text{ in radians}}{\text{1 full revolution}}$
$\frac{arc}{2\pi r} = \frac{\theta}{2\pi \text{ radians}}$
Multiply both sides by $2\pi r$
$\text{arc} = \theta r$

11. Challenge 2: Why is the area of the sector below $A_{sector} = \frac{\theta r^2}{2}$?



Set up a proportion:
$\frac{A_{sector}}{A_{circle}} = \frac{\theta}{2\pi}$
$\frac{A_{sector}}{\pi r^2} = \frac{\theta}{2\pi}$
Multiply both sides by πr^2
$A_{sector} = \frac{\theta \pi r^2}{2\pi} = \frac{\theta r^2}{2}$

12. Challenge 3: See the Pit House below:



a. How many times does the volume of the Pit House grow by doubling the dimensions?
$V_1 = \frac{1}{2}\pi r^2 \times 10 = \frac{\pi(4)}{2} \times 10 = 20\pi$
$V_2 = \frac{1}{2}\pi r^2 \times 20 = \frac{\pi(16)}{2} \times 20 = 160\pi$
$160\pi: 20\pi = 8$ (the volume is 8 times larger)

b. How many times does the area of the Pit House grow by doubling the dimensions?
$A_1 = \pi r^2 + lw + \frac{2\pi r}{2} = \pi(4) + (4)(10) + \pi(2) = 6\pi + 40$
$A_2 = \pi r^2 + lw + \frac{2\pi r}{2} = \pi(16) + (8)(20) + \frac{2\pi(8)}{2} = 24\pi + 160$
The area is 4 times larger

c. How large does the Pit House's area scale up by increasing the dimensions by a factor of n?
The area increases by a factor of n^2

d. How large does the Pit House's volume scale up by increasing the dimensions by a factor of n?
The volume increases by a factor of n^3

e. Does this scaling ratio increase for all types of shapes?
Yes