

Area and Volume Scale Factor

Questions created by Dr. Hamilton's S3 (Year 10) maths class

1. *Graeme MacDonald* is spraying a bonsai tree with water.
A small sprayer has a height of 24 cm and a large sprayer has a height of 32 cm.
The volume of the small sprayer is 1.3 litres.
If they are mathematically similar, what is the volume of the large sprayer?



2. *Ewan Forbes* is suffering from hay fever.
A yellow pill has length 2 cm and a blue pill has length 3 cm.
The yellow pill has a surface area of 4 cm^2 .
Assuming the pills are mathematically similar, find the surface area of the blue pill.

3. *Morgan Ritchie* is packing her lunch bag for school.
A large bag has a volume of 729 cm^3 and a small bag has a volume of 216 cm^3 .
The bags are mathematically similar.

- (a) The small bag has a front pouch with an area of 30 cm^2 .
Find the area of the front pouch on the large bag.
- (b) The small bag has a height of 10 cm.
Find the height of the large bag.



4. *David Devlin* is celebrating Christmas.
A red Christmas bauble has a diameter of 5 cm and a volume of 65 cm^3 .
A green Christmas bauble has a diameter of only 3 cm.

- (a) Find the volume of the green bauble, assuming the two baubles are mathematically similar.
- (b) The company are making savings by reducing the size of all baubles.
Find the new volume of the green bauble, if its radius is reduced by 15%, giving your answer to three significant figures.

5. *Catriona Robb* is putting some rubbish in the bin.
A small bin is 35 cm tall, and a large bin is 105 cm tall.
The small bin can hold 3 litres of rubbish.
The bins are mathematically similar.

- (a) How much rubbish can the large bin hold?
- (b) A third bin is also mathematically similar.
It can hold $2\frac{1}{3}$ times the small bin, and is one third full.
What is the volume of rubbish in the third bin?



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- The length scale factor (LSF) is $\frac{32}{24} = \frac{4}{3}$
 So the volume scale factor (VSF) is $\left(\frac{4}{3}\right)^3 = \frac{64}{27}$
 Hence the volume of the large sprayer is $1.35 \times \frac{64}{27} = 3.2 \text{ litres}$
- The LSF is $\frac{3}{2}$
 So the area scale factor (ASF) is $\left(\frac{3}{2}\right)^2 = \frac{9}{4}$
 So the area of the blue bill is $3 \times \frac{9}{4} = 6.75 \text{ cm}^3$
- The VSF is $\frac{729}{216} = \frac{27}{8}$
 So the LSF is $\sqrt[3]{\frac{27}{8}} = \frac{3}{2}$
 So the ASF is $\left(\frac{3}{2}\right)^2 = \frac{9}{4}$

(a) $30 \times \frac{9}{4} = 67.5 \text{ cm}^2$
 (b) $10 \times \frac{3}{2} = 15 \text{ cm}$
- The LSF is $\frac{3}{5}$
 The VSF is $\left(\frac{3}{5}\right)^3 = \frac{27}{125}$

(a) The volume of the green bauble is $65 \times \frac{27}{125} = 14.04 \text{ cm}^3$
 (b) The reduction of radius by 15% reduces the radius by a LSF of 0.85
 Hence the reduction in volume is 0.85^3
 So the new volume is $14.04 \times 0.85^3 = 8.622315 = 8.62 \text{ cm}^3 (3 \text{ sf})$
- The LSF is $\frac{105}{35} = 3$.
 The VSF is therefore $3^3 = 27$.

(a) $3 \times 27 = 81 \text{ litres}$
 (b) The capacity of the third bin is $3 \times \frac{7}{3} = 7 \text{ litres}$
 If the third bin is one third full, the volume of rubbish is $7 \times \frac{1}{3} = 2\frac{1}{3} \text{ litres}$