Surface area to volume ratio

Worked solutions

GCSE science calculations

This topic online

1 In a diffusion practical, Bethany cuts a cube of agar jelly with sides of 2 cm.

a. Calculate the surface area of the cube.

b. Calculate the volume of the cube.

c. Write the surface area : volume ratio in the form n : 1

(3 marks)

a)

Area of one face = $(\text{side})^2$

one face = $2^2 = 4\ cm^2$

surface area = 6×4

$24\ cm^2$

b)

Volume = $(\text{side})^3$

volume = $2^3 = 2 \times 2 \times 2$

$8\ cm^3$

c)

$24 : 8$

Divide both sides by the volume, 8

$3:1$

2 A cube of potato has sides of 3 cm.

Calculate the surface area : volume ratio of the cube. Give your answer in the form n : 1

(3 marks)

Surface area = $6 \times (\text{side})^2$

surface area = 6×3^2

surface area = $6 \times 9 = 54\ cm^2$

Volume = $(\text{side})^3$

volume = $3^3 = 27\ cm^3$

$54 : 27$

Divide both sides by 27

$2:1$

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3 A tiny pond organism has a surface area of 150 mm^2, a volume of 25 mm^3 and a mass of 0.03 g.
Calculate its surface area : volume ratio in the form n : 1 (1 mark)

Only surface area and volume are needed, not the mass

150 : 25

Divide both sides by 25

150 ÷ 25 = 6

6:1

4 A block of agar is a cuboid that measures 4 cm by 2 cm by 1 cm.
Calculate the surface area : volume ratio of the block. Give your answer in the form n : 1 (3 marks)

A cuboid has 3 pairs of matching faces

surface area = 2 × (4 × 2 + 4 × 1 + 2 × 1)

surface area = 2 × (8 + 4 + 2) = 28 cm^2

Volume = length × width × height

volume = 4 × 2 × 1 = 8 cm^3

28 : 8

Divide both sides by 8

3.5:1

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5 A single cell is modelled as a cube with sides of 0.02 mm.

a. Write the side length in μm.

b. Calculate the surface area : volume ratio of the cell, using lengths in μm. Give your answer in the form n : 1

(3 marks)

a)

1 mm = 1000 μm

$0.02 \text{ mm} = 0.02 \times 1000$

20 μm

b)

$\text{surface area} = 6 \times 20^2$

$\text{surface area} = 6 \times 400 = 2400 \ \mu m^2$

$\text{volume} = 20^3 = 8000 \ \mu m^3$

2400 : 8000

Divide both sides by 8000

0.3:1

6 A piece of carrot is a cuboid that is 2 cm long, 5 mm wide and 5 mm high.

Calculate its surface area : volume ratio, working in mm. Give your answer in the form n : 1

(3 marks)

Same units first: 1 cm = 10 mm

$2 \text{ cm} = 2 \times 10 = 20 \text{ mm}$

$\text{surface area} = 2 \times (20 \times 5 + 20 \times 5 + 5 \times 5)$

$\text{surface area} = 2 \times (100 + 100 + 25)$

$\text{surface area} = 2 \times 225 = 450 \ mm^2$

$\text{volume} = 20 \times 5 \times 5 = 500 \ mm^3$

450 : 500

Divide both sides by 500

0.9:1

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7 A model organism has a volume of 64 cm^3. Its surface area : volume ratio is 1.5 : 1

Calculate the surface area of the model. (2 marks)

Ratio = surface area ÷ volume

$1.5 = \text{surface area} \div 64$

Multiply both sides by 64

$\text{surface area} = 1.5 \times 64$

$96\ cm^2$

8 **Higher tier**

A cube of beetroot has a volume of 125 mm^3.

Calculate the surface area : volume ratio of the cube. Give your answer in the form n : 1 (3 marks)

Volume = $(\text{side})^3$

$(\text{side})^3 = 125$

$\text{side} = \sqrt[3]{125} = 5\ mm$

$\text{surface area} = 6 \times 5^2 = 150\ mm^2$

150 : 125

Divide both sides by 125

1.2 : 1

9 **Higher tier**

A cube of agar has a total surface area of 216 cm^2.

Calculate the surface area : volume ratio of the cube. Give your answer in the form n : 1 (3 marks)

Surface area = 6 × $(\text{side})^2$

$216 = 6 \times (\text{side})^2$

Divide both sides by 6

$(\text{side})^2 = 36$

Square root both sides

$\text{side} = \sqrt{36} = 6\ cm$

$\text{volume} = 6^3 = 216\ cm^3$

216 : 216

1 : 1

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10 Femi places agar cubes with sides of 1 cm and 4 cm in acid. The acid diffuses into the cubes and changes their colour.

a. Calculate the surface area : volume ratio of the 1 cm cube.

b. Calculate the surface area : volume ratio of the 4 cm cube.

c. How many times bigger is the ratio for the 1 cm cube than for the 4 cm cube?

Give the ratios in the form n : 1. Show your working. (5 marks)

a)

surface area $= 6 \times 1^2 = 6\ cm^2$

volume $= 1^3 = 1\ cm^3$

6:1

b)

surface area $= 6 \times 4^2 = 6 \times 16 = 96\ cm^2$

volume $= 4^3 = 64\ cm^3$

96 : 64

Divide both sides by 64

1.5:1

c)

$6 \div 1.5 = 4$

4

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11 A flatworm is modelled as a cuboid 16 mm long, 8 mm wide and 0.5 mm thick.

a. Calculate the surface area : volume ratio of the flatworm. Give your answer in the form n : 1, with n to 2 significant figures.

b. A different animal with the same volume is modelled as a cube with sides of 4 mm. Calculate its surface area : volume ratio in the form n : 1

Show your working. (5 marks)

a)

Cuboid: 3 pairs of faces

surface area = $2 \times (16 \times 8 + 16 \times 0.5 + 8 \times 0.5)$

surface area = $2 \times (128 + 8 + 4) = 280$ mm^2

volume = $16 \times 8 \times 0.5 = 64$ mm^3

ratio = $280 \div 64 = 4.375$

4.4:1

b)

surface area = $6 \times 4^2 = 96$ mm^2

volume = $4^3 = 64$ mm^3

ratio = $96 \div 64 = 1.5$

1.5:1

12 Olivia models a beech leaf as a thin cuboid. The leaf is 6 cm long, 4 cm wide and 0.25 mm thick. Its mass is 0.45 g.

Calculate the surface area : volume ratio of the leaf, working in cm. Give your answer in the form n : 1, with n to 2 significant figures.

Show your working. (5 marks)

The mass is not needed

Same units first: 1 cm = 10 mm

0.25 mm = $0.25 \div 10 = 0.025$ cm

surface area = $2 \times (6 \times 4 + 6 \times 0.025 + 4 \times 0.025)$

surface area = $2 \times (24 + 0.15 + 0.1)$

surface area = 48.5 cm^2

volume = $6 \times 4 \times 0.025 = 0.6$ cm^3

ratio = $48.5 \div 0.6 = 80.83...$

81:1

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