

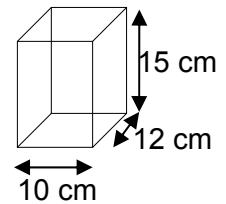
Main task	Foundation/Higher GCSE and Level 2 Functional Skills students
Suggested uses	1 Independent starter 2 Whole lesson on volumes and surface areas
Must previously cover	Volume and surface area of a cuboid
Extension	Foundation/Higher GCSE and Level 2 Functional Skills students

Starter (Worksheet)

One mug is packed in a 10 cm by 12 cm by 15 cm plastic box.

Two mugs are put in a larger cardboard box.

- Give three sets of possible dimensions for the larger box?
- Which of your boxes uses the least cardboard?


Answers

- 24 cm by 10 cm by 15 cm; 12 cm by 20 cm by 15 cm; 12 cm by 10 cm by 30 cm

- Areas of cardboard used are:

- $2(24 \times 10) + 2(24 \times 15) + 2(10 \times 15) = 1500 \text{ cm}^2$
- $2(12 \times 20) + 2(12 \times 15) + 2(20 \times 15) = 1440 \text{ cm}^2$
- $2(12 \times 10) + 2(12 \times 30) + 2(10 \times 30) = 1560 \text{ cm}^2$

So the 12 cm by 20 cm by 15 cm uses the least cardboard.

Links to Level 2 Skills Standards

		Skills standard	Evidence
(a)	Ra	Understands problem and starts to access it	Works out one possible set of dimensions
	Aa	Uses mathematics to find a solution	States all three possible solutions
(b)	Ra	Understands problem and starts to access it	Uses correct method to work out SA for one of their boxes
	Rc	Chooses mathematics to find a solution	Uses correct method to work out SA for all of their boxes
	Aa	Uses mathematics to find a solution	Calculates correct surface areas
	Ia	Interprets solutions to multistage problems	Selects the box that has the least surface area

Links to GCSE

	Assessment Objectives			GCSE 4360			GCSE 4365	Linked Pair Pilot Methods and Applications			
	AO1	AO2	AO3	Unit 1	Unit 2	Unit 3	Linear	M1	A1	M2	A2
(a)	✓					G4.4	G4.4			G20	
(b)		✓				G4.1	G4.1			G18	

Extension (Worksheet)

A large box needs to hold 36 mugs.
Design a box that uses as little cardboard as possible.

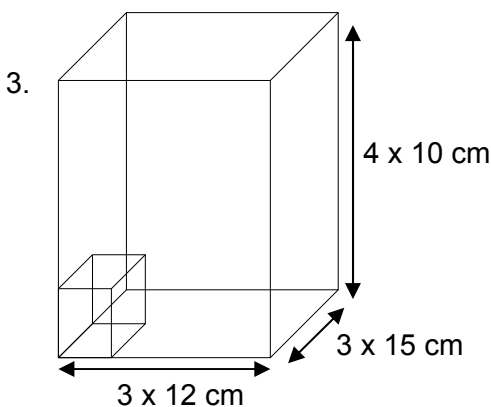
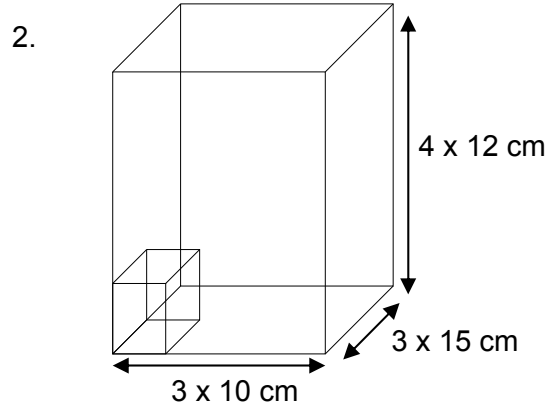
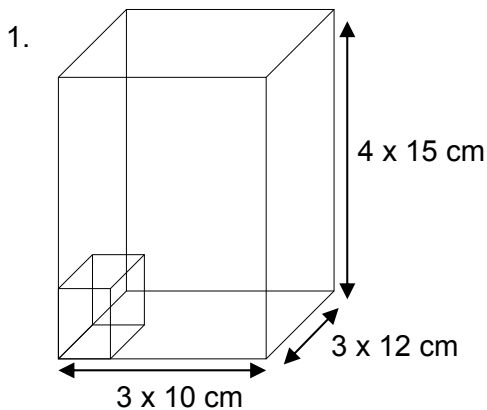
Answers

There are eight different ways to pack 36 mugs.

$$\begin{array}{cccccc}
 1 \times 1 \times 36 & 1 \times 2 \times 18 & 1 \times 3 \times 12 & 1 \times 4 \times 9 & 1 \times 6 \times 6 & \\
 2 \times 2 \times 9 & 2 \times 3 \times 6 & 3 \times 3 \times 4 & & &
 \end{array}$$

The most efficient design is the box that's nearest a cube: $3 \times 3 \times 4$.

You can position the mugs in six different orientations but because the chosen box has a repeated dimension, there are only three distinct results.



Areas of cardboard used are:

$$\begin{array}{l}
 1 \quad 2(30 \times 36) + 2(30 \times 60) + 2(36 \times 60) = 10\,080 \text{ cm}^2 \\
 2 \quad 2(30 \times 45) + 2(30 \times 48) + 2(45 \times 48) = 9900 \text{ cm}^2 \\
 3 \quad 2(36 \times 45) + 2(36 \times 40) + 2(45 \times 40) = 9720 \text{ cm}^2
 \end{array}$$

So a 36 cm by 45 cm by 48 cm is the best.

Links to Level 2 Skills Standards

		Skills standard	Evidence
Extension	Ra	Understands problem and starts to access it	Works out at least two ways to pack 36 mugs
	Rc	Chooses the mathematics needed to find a solution	Chooses most efficient of their ways
	Rb	Identifies the problem and decides on methods to use	Works out three (or more) sets of dimensions for their choice
	Rc	Chooses the mathematics needed to find a solution	Uses correct method to attempt to find areas of cardboard needed
	Aa	Uses mathematics to find a solution	Correctly calculates surface areas
	la	Interprets solutions to multistage problems	Selects the box with the least surface area
	Ab	Checking	Checks have chosen the best

Links to GCSE

	Assessment Objectives			GCSE 4360			GCSE 4365	Linked Pair Pilot Methods and Applications			
	AO1	AO2	AO3	Unit 1	Unit 2	Unit 3	Linear	M1	A1	M2	A2
Extension			✓			N1.3 G4.1 G4.4	N1.6 G4.1 G4.4			N5 G18 G20	