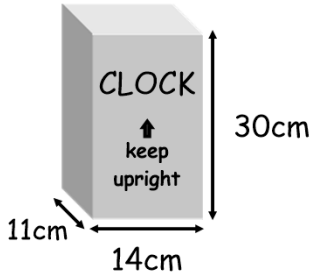
National 5 Applications of Maths: Container Packing

Section A: standard exam questions. Two ways of packing. Cuboids.

1. A large cuboid cardboard box is used to transport clocks. Its internal dimensions are shown in the diagram on the right.

   The clocks are in smaller cuboid boxes. Their external dimensions are shown in the diagram below.

   The clocks must be packed upright or they will break.

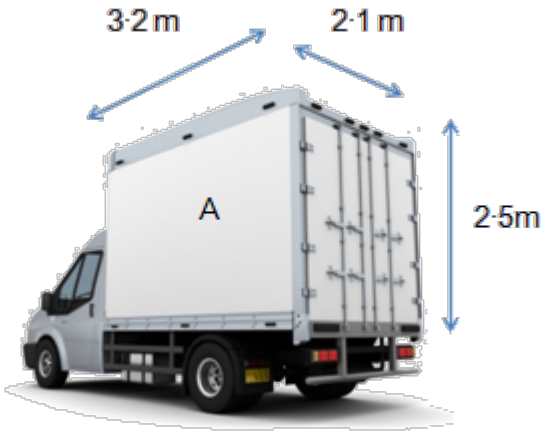


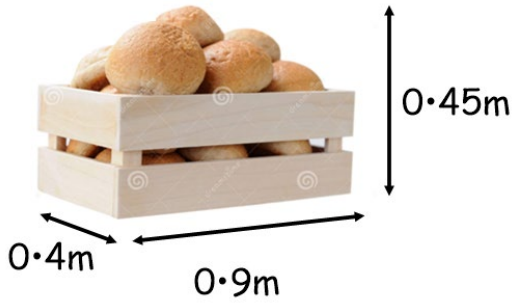
   All the clocks must be aligned in the same direction.
   Calculate the maximum number of clocks that can be fitted into one large cardboard box.

2. A lorry has internal dimensions as shown in the diagram on the right..

   The lorry transports crates of bread. Each crate Is a cuboid with external dimensions shown In the diagram below.

   The crates must be kept upright or the bread will fall out.

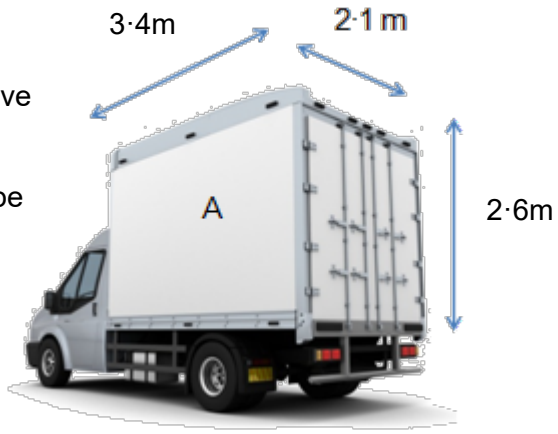




   All the crates of bread must be aligned in the same direction.
   Calculate the maximum number of crates that can be fitted into one lorry.

Source: Some of the pictures in this worksheet are from SQA exam papers

3. A lorry has internal dimensions as shown in the diagram on the right.



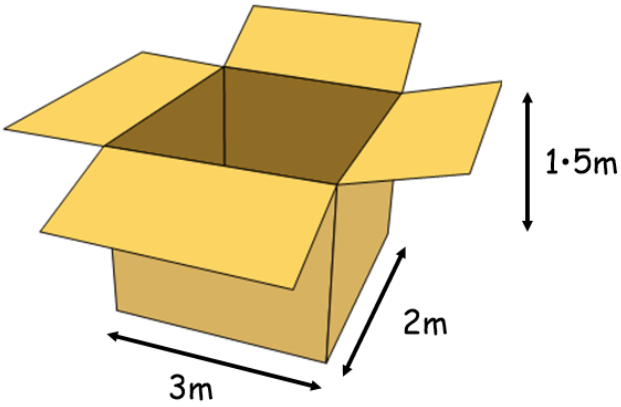
Expensive desks (along with protective packaging) have external dimensions as shown in the diagram below.

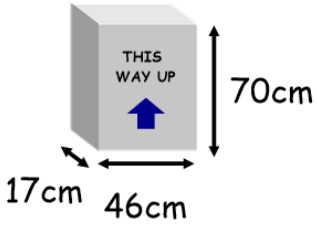
The desks must be kept upright. All the desks must be aligned in the same direction.

a) Calculate the maximum number of desks that can be packed into the lorry.

b) The company needs to send out 73 desks in total. What is the smallest number of lorries they could use to transport these?

4. A large cuboid box has internal dimensions as shown in the diagram below. It is used to pack smaller cuboid boxes containing fragile electronic items. Their external dimensions are also shown in the diagram.





The smaller boxes must be kept upright.
The smaller boxes must all be aligned in the same direction.

a) Calculate the maximum number of smaller boxes that can be packed inside the larger box.

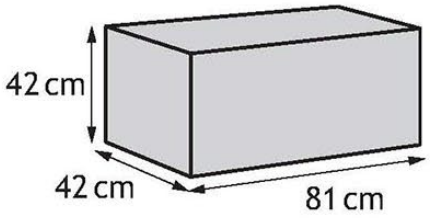
b) The company have 583 smaller boxes that need to be transported. What is the minimum number of large boxes that they need?

Source: Some of the pictures in this worksheet are from SQA exam papers

5. SQP exam question

Donna makes tartan handbags.

She puts the bags into boxes. The boxes have the dimensions shown below.



Donna exports her handbags to the USA in a container. The container has the internal dimensions shown below.

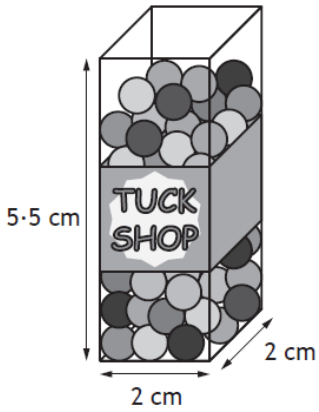
All the boxes must be aligned in the same direction.

(a) Calculate the maximum number of boxes that can fit in the container.
Use your working to justify your answer.

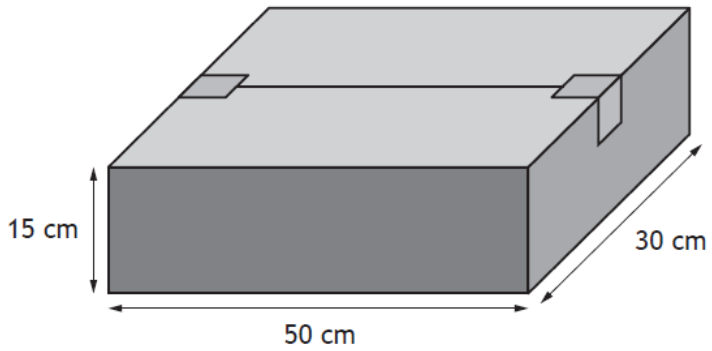
(b) The rental and shipping of the container costs £1755.
Each box costs £2·99.
Each box holds 4 handbags.
Calculate the cost of shipping per handbag.

Section B: examples where there are more than two ways of packing, and/or where the smaller shapes may be cylinders. You have to work out what the different methods are.

6. 2021 exam question, adapted.
   Packets of sweets have external dimensions as shown in the diagram on the right.

   For delivery, the packets of sweets are packed in to a box with internal dimensions as shown below.

   All the packets of sweets must be aligned in the same direction.
   They do not have to remain upright. There are **three** possible ways of aligning them.
   Calculate the maximum number of packets that can fit in the box.

7. A storage room has internal dimensions 6 metres × 8 metres × 7 metres.

   Cardboard storage boxes have external dimensions 81cm × 72cm × 48cm.

   The storage boxes can be placed any way up. They must all be aligned in the same direction.

   There are **six** possible ways of packing the storage boxes into the room.

   Investigate all six ways and calculate the maximum number of storage boxes that can be fitted into the room.

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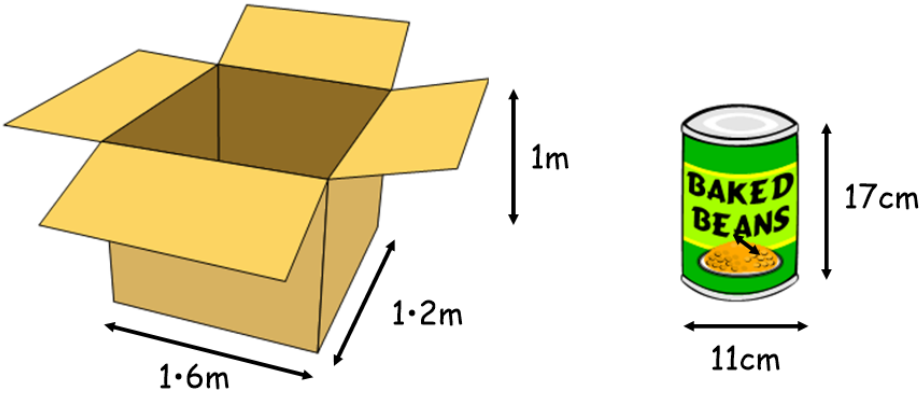
8. A large box has internal dimensions as shown in the diagram below.



The large box is used for packing tins of beans with a diameter of 11cm and a height of 17cm.

The cans of beans can be aligned in any direction. They must all be aligned in the same direction. There are <u>three</u> possibilities.

a) Calculate the maximum number of cans of beans that can be packed inside the larger box.

b) The company have 20 000 cans of beans that need to be transported. Calculate the minimum number of large boxes needed to hold them all.

c) The dimensions of the **cans** (not the box) have been measured with a tolerance of ±0·5cm. Repeat parts (a) and (b) for the **largest** possible size of can.

9. Rubbers for a school classroom are being packed into a cardboard box.

The cardboard box measures 27cm by 15cm by 14cm.
Each rubber measures 16mm by 11mm by 7mm.
The rubbers can be aligned in any direction. They must all be aligned in the same direction.

Calculate the maximum number of rubbers that can be fitted into the box.

10. A storage warehouse has internal dimensions 120 metres × 90 metres × 75 metres.

Shipping containers with external dimensions 315cm × 264cm × 233cm have to be stacked inside the warehouse.

They can be aligned in <u>any</u> direction. They must all be aligned in the same direction.

(a) Calculate the maximum number of containers that can be stored in the warehouse.
(b) The lengths of the **warehouse** are measured correct to ±2%. Repeat part (a) for the **largest** possible size of the warehouse.

Answers

(remainders aren't written in answers to divide sums for brevity. All answers have been rounded down to the nearest whole number. In an exam situation, full working including decimal places should have been shown).

1) 200 ÷ 30 = 6; 180 ÷ 11 = 16; 250 ÷ 14 = 17. 6 × 16 × 17 = 1632
200 ÷ 30 = 6; 180 ÷ 14 = 12; 250 ÷ 11 = 22. 6 × 12 × 22 = 1584
Maximum number is 1632

2) 2·5 ÷ 0·45 = 5; 3·2 ÷ 0·4 = 8; 2·1 ÷ 0·9 = 2. 5 × 8 × 2 = 80
2·5 ÷ 0·45 = 5; 3·2 ÷ 0·9 = 3; 2·1 ÷ 0·4 = 5. 5 × 3 × 5 = 75
Maximum number is 80.

3) a)
260 ÷ 82 = 3; 340 ÷ 45·5 = 7; 210 ÷ 136 = 1. 3 × 7 × 1 = 21
260 ÷ 82 = 3; 340 ÷ 136 = 2; 210 ÷ 45·5 = 4. 3 × 2 × 4 = 24
Maximum number is 24.

b) 4 lorries are needed

4) a)
150 ÷ 70 = 2; 300 ÷ 17 = 17; 200 ÷ 46 = 4. 2 × 17 × 4 = 136
150 ÷ 70 = 2; 300 ÷ 46 = 6; 200 ÷ 17 = 11. 2 × 6 × 11 = 132
Maximum number is 136.

b) 5 larger boxes are needed

5) a) The two methods of packing give 210 and 252. Therefore the maximum is 252.

6) The three methods of packing give 750, 875 and 945. Therefore the maximum is 945.

7) 7 × 11 × 14 = 1078 7 × 16 × 9 = 1008 8 × 9 × 14 = 1008
8 × 16 × 8 = 1024 12 × 11 × 8 = 1056 12 × 9 × 9 = 972
a) The maximum is 1078.
b) £2508·42 ÷ 252 ÷ 4 = £2·49

8) a)
160 ÷ 17 = 9; 120 ÷ 11 = 10; 100 ÷ 11 = 9. 9 × 10 × 9 = 810
160 ÷ 11 = 14; 120 ÷ 17 = 7; 100 ÷ 11 = 9. 14 × 7 × 9 = 882
160 ÷ 11 = 14; 120 ÷ 11 = 10; 100 ÷ 17 = 5. 14 × 10 × 5 = 700
Maximum number is 882

b) 23 boxes
c)
160 ÷ 17·5 = 9; 120 ÷ 11·5 = 10; 100 ÷ 11·5 = 8. 9 × 10 × 8 = 720
160 ÷ 11·5 = 13; 120 ÷ 17·5 = 6; 100 ÷ 11·5 = 8. 13 × 6 × 8 = 624
160 ÷ 11·5 = 13; 120 ÷ 11·5 = 10; 100 ÷ 17·5 = 5. 13 × 10 × 5 = 650
Maximum number is now 720.
28 boxes are now needed.

9) The possible totals are 4160, 4032, 4320, 4032, 4104 and 3952. The maximum number is 4320.

10) Answers still be written

Source: Some of the pictures in this worksheet are from SQA exam papers