4.17 Plans and Elevations: 2-hour Pack

EDEXCEL 1MA1 · Calculator allowed · about 120 minutes

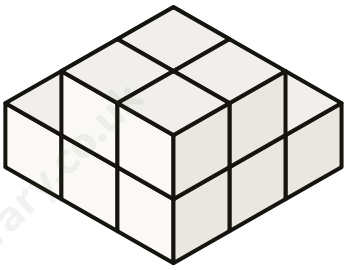
Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.
Front row: 1, 2, 2
Middle row: 1, 2, 2
Back row: 1, 0, 1
The plan is the view from above. How many squares are in the plan?

Diagram NOT accurately drawn



(Total for Question 1 is 2 marks)

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2 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

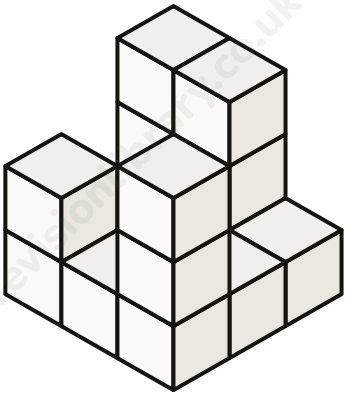
Front row: 2, 1, 3

Middle row: 0, 0, 1

Back row: 3, 3, 1

Cubes are added until the solid is a 3 by 3 block with the same height as the tallest stack. How many cubes are added?

Diagram NOT accurately drawn



(Total for Question 2 is 3 marks)

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3 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

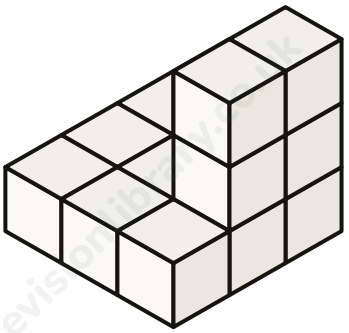
Front row: 1, 1, 1

Middle row: 1, 1, 3

Back row: 1, 2, 3

Work out the total surface area of the solid, including the base.

Diagram NOT accurately drawn



(Total for Question 3 is 4 marks)

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4 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

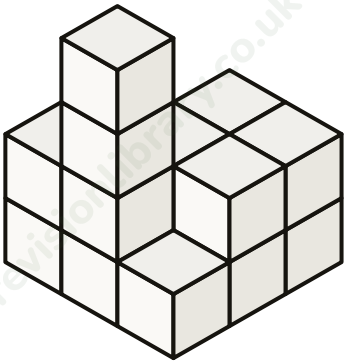
Front row: 2, 4, 1

Middle row: 2, 2, 2

Back row: 0, 2, 2

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 4 is 2 marks)

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5 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

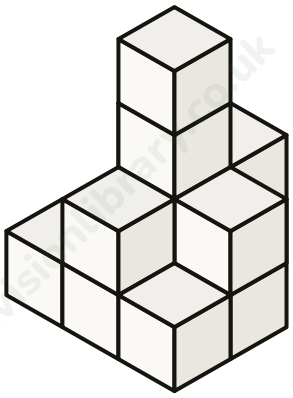
Front row: 1, 2, 1

Middle row: 0, 4, 2

Back row: 2, 2, 0

The front elevation is the view from the front. How many squares are in the front elevation?

Diagram NOT accurately drawn



(Total for Question 5 is 2 marks)

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6 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

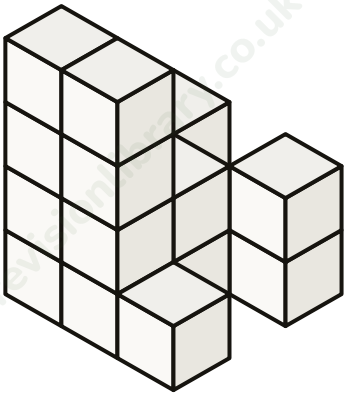
Front row: 4, 4, 1

Middle row: 1, 2, 0

Back row: 2, 1, 2

More cubes are added without changing the front elevation or the side elevation. What is the greatest number of cubes that can be added?

Diagram NOT accurately drawn



(Total for Question 6 is 3 marks)

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7 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

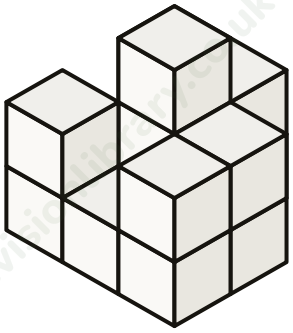
Front row: 2, 1, 2

Middle row: 1, 3, 2

Back row: 2, 2, 0

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 7 is 2 marks)

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8 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

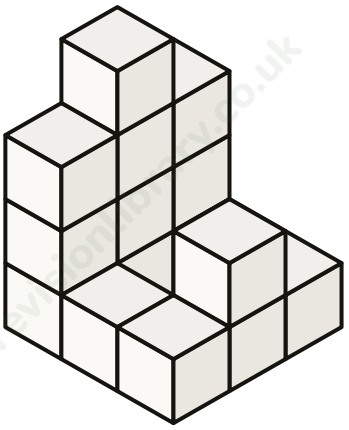
Front row: 3, 1, 1

Middle row: 4, 0, 2

Back row: 3, 1, 1

The plan is the view from above. How many squares are in the plan?

Diagram NOT accurately drawn



(Total for Question 8 is 2 marks)

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9 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

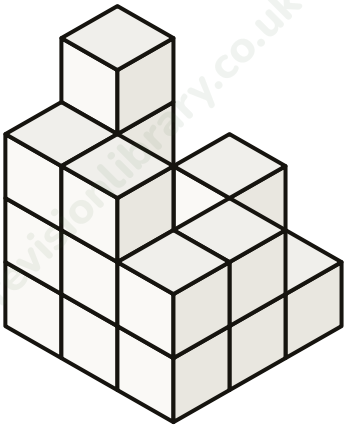
Front row: 3, 3, 2

Middle row: 4, 1, 2

Back row: 0, 2, 1

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 9 is 2 marks)

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10 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

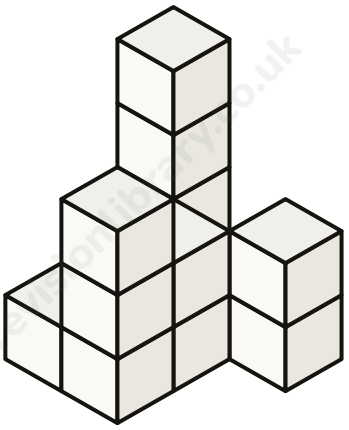
Front row: 1, 3, 0

Middle row: 0, 2, 0

Back row: 4, 0, 2

Work out the total surface area of the solid, including the base.

Diagram NOT accurately drawn



(Total for Question 10 is 4 marks)

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11 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

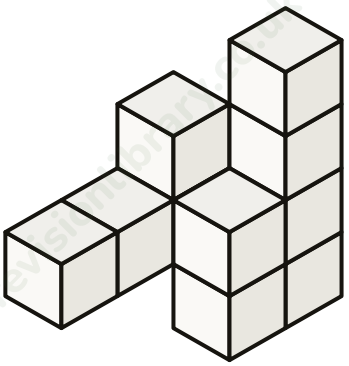
Front row: 1, 0, 0

Middle row: 1, 0, 2

Back row: 2, 1, 4

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 11 is 2 marks)

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12 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

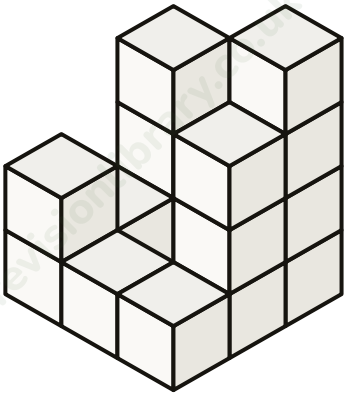
Front row: 2, 1, 1

Middle row: 1, 0, 3

Back row: 3, 1, 4

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 12 is 2 marks)

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13 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

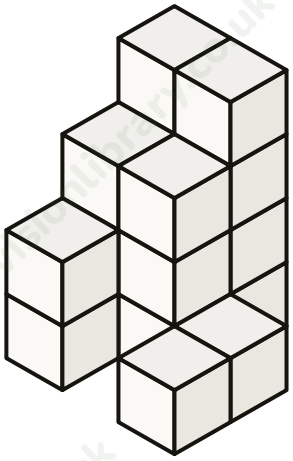
Front row: 2, 0, 1

Middle row: 3, 3, 1

Back row: 4, 4, 0

More cubes are added without changing the front elevation or the side elevation. What is the greatest number of cubes that can be added?

Diagram NOT accurately drawn



(Total for Question 13 is 3 marks)

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14 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

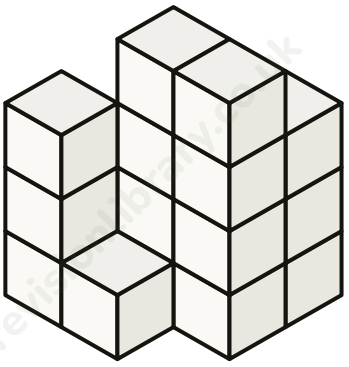
Front row: 3, 1, 0

Middle row: 0, 4, 4

Back row: 1, 1, 3

The front elevation is the view from the front. How many squares are in the front elevation?

Diagram NOT accurately drawn



(Total for Question 14 is 2 marks)

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15 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

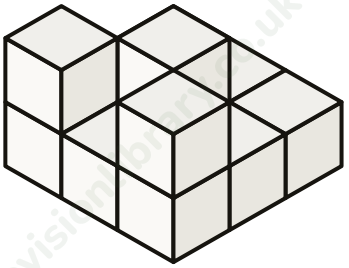
Front row: 2, 1, 2

Middle row: 1, 2, 1

Back row: 1, 1, 1

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 15 is 2 marks)

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16 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

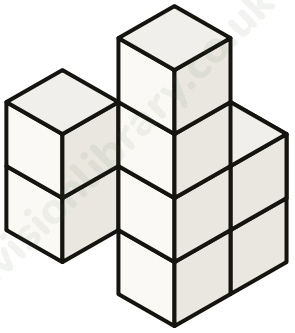
Front row: 2, 0, 4

Middle row: 1, 2, 2

Back row: 1, 1, 0

The side elevation is the view from the left-hand side. How many squares are in the side elevation?

Diagram NOT accurately drawn



(Total for Question 16 is 2 marks)

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17 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.

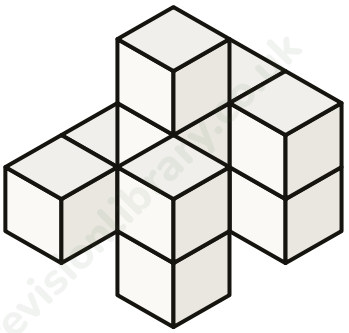
Front row: 1, 0, 2

Middle row: 1, 3, 0

Back row: 1, 2, 2

Work out the total surface area of the solid, including the base.

Diagram NOT accurately drawn

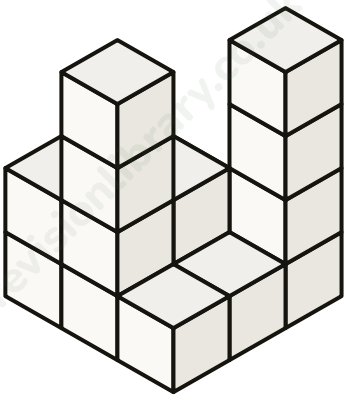


(Total for Question 17 is 4 marks)

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18 A solid is made from 1 cm cubes on a 3 by 3 base. The numbers show how many cubes are in each stack, with the columns listed from left to right.
Front row: 2, 4, 1
Middle row: 2, 2, 1
Back row: 1, 1, 4
More cubes are added without changing the front elevation or the side elevation. What is the greatest number of cubes that can be added?

Diagram NOT accurately drawn



(Total for Question 18 is 3 marks)

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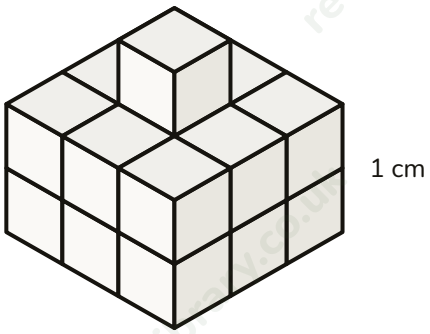
19 A model uses unit cubes on a 2 by 3 grid (2 rows front to back, 3 columns left to right). The plan has a cube in every cell. The front elevation (columns left to right) shows heights 1, 3, 2. The side elevation (rows front to back) shows heights 3, 2. Give heights for each cell (front row left to right, then back row left to right) that satisfy these views, and find the total number of unit cubes in the model.

(Total for Question 19 is 4 marks)

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20 A model is built from 1 cm cubes. The plan is a 3 by 3 square. The heights at each plan position are as follows: the central position has height 3; every other position (the 8 surrounding cells) has height 2.

Diagram NOT accurately drawn



(a) Work out the total number of small cubes used. **(3)**

.....

(b) Work out the volume of the model in cubic centimetres. **(1)**

.....

(c) Work out the total external surface area of the model in cm^2. Show your method. **(6)**

.....

(Total for Question 20 is 10 marks)

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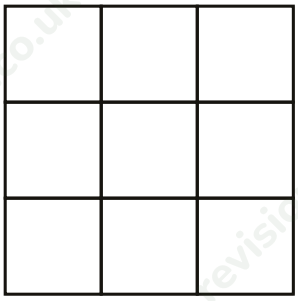
21 A block has a plan that is a 4 cm by 2 cm rectangle. Seen from one end, its elevation is two columns, each 1 cm wide: the left column is 3 cm high and the right column is 2 cm high. The block has this same shape along its whole 4 cm length.
Show a short method and work out the total volume of the block in cm^3.

(Total for Question 21 is 4 marks)

---

22 A model is built from cuboids on a 1 cm grid. From above (plan) it appears as a 3 by 3 square. From the front elevation it appears as a 3 by 2 rectangle. From the right-side elevation it appears as a shape with three columns of heights 1 cm, 2 cm and 1 cm (from left to right). What is the total volume, in cubic centimetres, of the model?

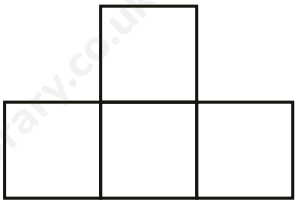
Plan



Front elevation



Right-side elevation



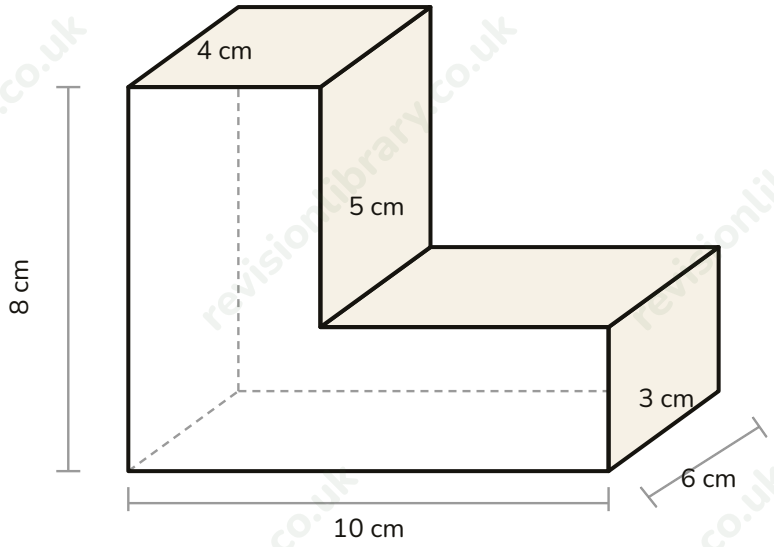
left to right

(Total for Question 22 is 3 marks)

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23 The front elevation of a step-shaped prism is an L-shape, with these measurements: overall width 10 cm, overall height 8 cm, the height of the lower step (across the full width) is 3 cm, the width of the upper part is 4 cm, and the upper part rises a further 5 cm above the lower step. The prism is 6 cm deep (front to back).

Diagram NOT accurately drawn



(a) Work out the area of the front elevation. **(2)**

.....

(b) Work out the perimeter of the front elevation. **(2)**

.....

(c) The prism is 6 cm deep. Work out the total surface area of the solid. **(3)**

.....

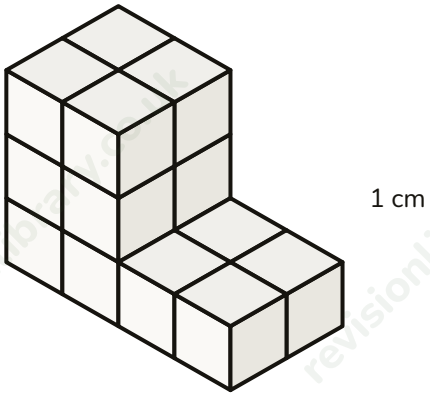
(Total for Question 23 is 7 marks)

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24 A solid is built from unit cubes on every cell of a 2 by 2 plan. The front elevation (columns left to right) is 2 and 2. The side elevation (rows front to back) is 2 and 2. What is the minimum and the maximum possible total number of unit cubes the solid could contain? Explain briefly.

(Total for Question 24 is 4 marks)

25 A solid is made by stacking cuboids on a base of 4 squares by 2 squares (each square is 1 cm by 1 cm). The height is the same all the way through the 2 cm depth: from left to right, the first two columns (columns 1 and 2) are 3 cm tall and the last two columns (columns 3 and 4) are 1 cm tall, in both rows of the depth. Give the right-side elevation and then work out the total surface area of the solid (including all faces), in cm^2.



(a) State the right-side elevation, given that the height is the same throughout the depth. **(1)**

(b) Calculate the total surface area including areas of top faces, all visible side faces and the base. **(3)**

(Total for Question 25 is 4 marks)

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26 A stepped block sits on a 5 by 1 base (five positions in a row). The front elevation (looking along the row) shows heights 1, 2, 3, 2, 1 (left to right). From the plan there is only one row so the plan is 5 by 1 and all five cells are present. Show working.

(a) Work out the total volume in unit cubes. **(2)**

.....

(b) Find the total external surface area including the base. **(4)**

.....

(c) How many cubes have at least one face on the base? **(2)**

.....

(Total for Question 26 is 8 marks)

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Mark scheme · 4.17 Plans and Elevations: 2-hour Pack

Question 1

counts the stacks that are not empty	**M1**
8	**A1**

Answer: 8

Question 2

9 x 3 = 27	**M1**
27 - 14	**M1**
13	**A1**

Answer: 13

Question 3

top and bottom faces counted	**M1**
front, back, left and right faces counted	**M1**
no faces hidden between touching stacks counted	**M1**
44 cm²	**A1**

Answer: 44 cm^2

Question 4

tallest stack in each row: 4, 2, 2	**M1**
8	**A1**

Answer: 8

Question 5

tallest stack in each column: 2, 4, 2	**M1**
8	**A1**

Answer: 8

Question 6

front and side elevation heights found	**M1**
each stack can rise to the smaller of its column and row height	**M1**
5	**A1**

Answer: 5

Question 7

tallest stack in each row: 2, 3, 2	**M1**
7	**A1**

Answer: 7

Question 8

counts the stacks that are not empty	**M1**
8	**A1**

Answer: 8

Question 9

tallest stack in each row: 3, 4, 2	**M1**
9	**A1**

Answer: 9

Question 10

top and bottom faces counted	**M1**
front, back, left and right faces counted	**M1**
no faces hidden between touching stacks counted	**M1**
52 cm²	**A1**

Answer: 52 cm^2

Question 11

tallest stack in each row: 1, 2, 4	**M1**
7	**A1**

Answer: 7

Question 12

tallest stack in each row: 2, 3, 4	**M1**
9	**A1**

Answer: 9

Question 13

front and side elevation heights found	**M1**
each stack can rise to the smaller of its column and row height	**M1**
3	**A1**

Answer: 3

Question 14

tallest stack in each column: 3, 4, 4	**M1**
11	**A1**

Answer: 11

Question 15

tallest stack in each row: 2, 2, 1	**M1**
5	**A1**

Answer: 5

Question 16

tallest stack in each row: 4, 2, 1	**M1**
7	**A1**

Answer: 7

Question 17

top and bottom faces counted	**M1**
front, back, left and right faces counted	**M1**
no faces hidden between touching stacks counted	**M1**
46 cm²	**A1**

Answer: 46 cm^2

Question 18

front and side elevation heights found	**M1**
each stack can rise to the smaller of its column and row height	**M1**
8	**A1**

Answer: 8

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Question 19

use maxima constraints for each column and each row oe **M1**

deduce that the middle front cell must be 3 to satisfy column and row maxima oe **M1**

complete a consistent set of heights for the remaining cells oe **M1**

any valid arrangement satisfying both elevations with its correct total; for example, front row 1, 3, 2; back row 1, 2, 1 and total = 10. Accept other valid arrangements with totals 9, 10 or 11. **A1**

Answer: One possible arrangement (front row then back row): 1, 3, 2; 1, 2, 1. Total cubes = 10 (1+3+2+1+2+1 = 10). Accept any valid arrangement with its correct total, which can be 9, 10 or 11.

Question 20

(a) identify central height 3 and eight others height 2 **M1**

(a) calculate 3 + 8 x 2 **M1**

(a) 19 cao **A1**

(a) Answer: 19

(b) 19 cm³ cao **B1**

(b) Answer: 19 cm^3

(c) count top faces 9 and bottom faces 9 (top and bottom area = 9 + 9) **M1**

(c) calculate outer side faces: corners (4 corners x 2 outside sides x height 2) = 16 and edge non-corners (4 edges x 1 outside side x height 2) = 8, total outer side area = 24 **M1**

(c) calculate internal side faces from height differences: centre (height 3) adjacent to 4 neighbours height 2 gives 4 exposed unit faces **M1**

(c) combine side areas: outer 24 + internal 4 = 28 cm² **M1**

(c) sum top, bottom and side: 9 + 9 + 28 **M1**

(c) 46 cm² cao **A1**

(c) Answer: 46 cm^2

Question 21

recognise plan has 4 x 2 = 8 positions **M1**

use the end elevation to assign heights across the width: for each length position the two columns are 3 and 2, so heights sum = 3 + 2 = 5 **M1**

calculate total = 4 x 5 = 20 **M1**

20 cm³ cao **A1**

Answer: 20

Question 22

interpret side elevation heights as giving column heights across the 3 columns and multiply by plan depth per column **M1**

calculate volumes of three columns: columns have widths 1,1,1 and depths 3 each, heights 1,2,1 so volumes 3,6,3 **M1**

12 cm³ cao **A1**

Answer: 12 cm^3

Question 23

(a) splitting into two rectangles, e.g. 10 x 3 (= 30) and 4 x 5 (= 20) **M1**

(a) 50 cm² cao **A1**

(a) Answer: 50 cm^2

(b) identifying the missing horizontal length, 10 - 4 = 6 cm, and attempting to sum all six sides (10 + 3 + 6 + 5 + 4 + 8) **M1**

(b) 36 cm cao **A1**

(b) Answer: 36 cm

(c) 2 x 50 ft (their area from part a), the two L-shaped faces (= 100) **M1**

(c) 36 x 6 ft (their perimeter from part b, x depth) (= 216) **M1**

(c) 316 cm² cao (ft) **A1**

(c) Answer: 316 cm^2

Question 24

explain minima: need at least one 2 in each row and each column; other stacks at least 1 oe **M1**

calculate minimum total 6 (for example 2,1;1,2) oe **M1**

explain maxima: all four stacks can be 2 so maximum is 8 oe **M1**

minimum 6 and maximum 8 cao **A1**

Answer: Minimum = 6, Maximum = 8. Example for minimum: heights 2,1 in first row and 1,2 in second row gives total 6; maximum if every stack is 2 gives total 8.

Question 25

(a) right-side elevation is a rectangle 2 cm wide and 3 cm tall (both depth positions reach the maximum column height of 3 cm, since the tall columns run the full depth) **M1**

(a) Answer: A rectangle 2 cm wide and 3 cm tall.

(b) calculate top + base area: footprint is 4 by 2 = 8, so top 8 + base 8 = 16 **M1**

(b) calculate front + back area: each equals the sum of the four column heights (3+3+1+1=8), so front 8 + back 8 = 16; calculate left/right end and internal step area: depth * (leftmost height + |3-3| + |3-1| + |1-1| + rightmost height) = 2* (3+0+2+0+1) = 12 **M1**

(b) 44 cm² cao **A1**

(b) Answer: 44 cm^2

Question 26

(a) add column heights: 1+2+3+2+1 **M1**

(a) 9 cubes cao **A1**

(a) Answer: 9

(b) calculate top area = number of columns with height > 0 = 5 and base = 5 **M1**

(b) calculate end faces: two ends each with height 1 so area 2 **M1**

(b) calculate vertical faces between columns: sum of absolute differences between adjacent heights = |1-2|+|2-3|+|3-2|+|2-1| = 1+1+1+1 = 4, multiply by face width 1 gives 4, add perimeter faces giving total vertical 2+4+? combine correctly **M1**

(b) 34 cm² cao **A1**

(b) Answer: 34 cm^2

(c) recognise each column contributes exactly its height number of cubes touching the base only for the lowest layer **M1**

(c) 5 cao **A1**

(c) Answer: 5

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