

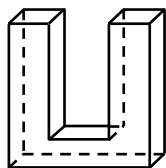
Book 3A Chapter 4 More about 3-D Figures

4.1 Symmetries in Solids

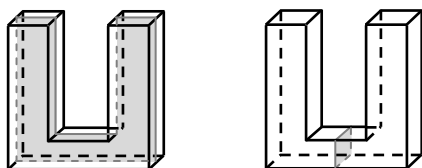
Level 1

Demonstration 1

The figure shows a right prism with U-shaped base. Draw all its planes of reflection and write down the number of planes of reflection.



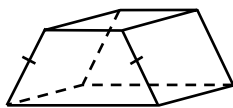
Solution



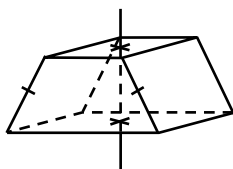
The solid has 2 planes of reflection.

Demonstration 2

The figure shows a right prism whose base is a trapezium. Draw all its axes of rotational symmetry and write down the order of rotational symmetry about each axis.

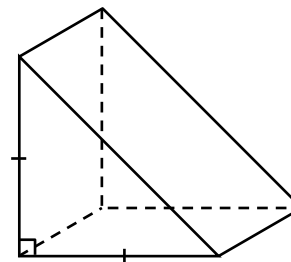


Solution

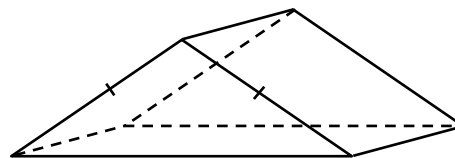


The solid has 1 axis of 2-fold rotational symmetry.

- The figure shows a right prism whose base is a right-angled isosceles triangle. Draw all its planes of reflection and write down the number of planes of reflection.



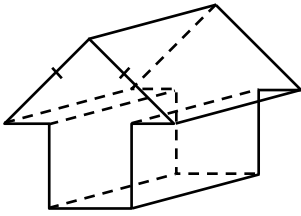
- The figure shows a right prism whose base is an isosceles triangle. Draw all its axes of rotational symmetry and write down the order of rotational symmetry about each axis.



Level 2

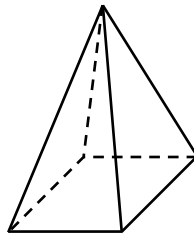
Draw all the planes of reflection in each of the following solids. (3 – 5)

3.



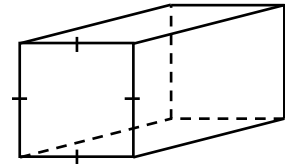
A right prism with arrow-shaped base

4.



A right pyramid whose base is a rectangle

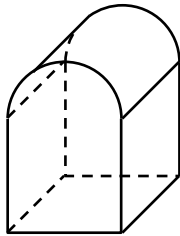
5.



A cuboid

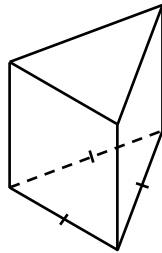
Determine the number of planes of reflection of each of the following solids. (6 – 8)

6.



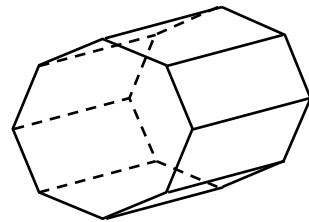
A solid made up of a half cylinder and a cube

7.



A right prism whose base is an equilateral triangle

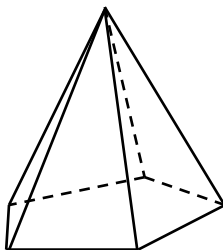
8.



A right prism whose base is a regular octagon

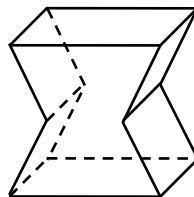
Draw all axes of rotational symmetry in each of the following solids. (9 – 11)

9.



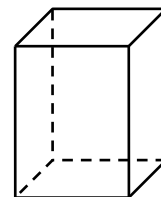
A right pyramid whose base is a regular pentagon

10.



A right prism

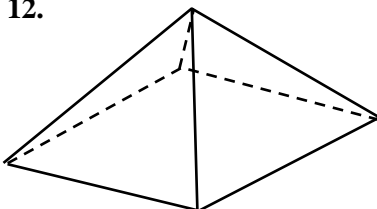
11.



A cuboid

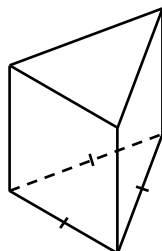
Determine the number of axes of rotational symmetry and write down the order of rotational symmetry about each axis of each of the following solids. (12 – 14)

12.



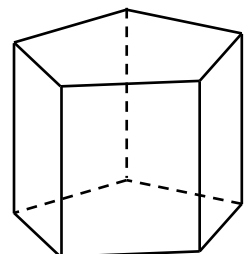
A right pyramid whose base is a square

13.



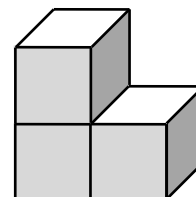
A right prism whose base is an equilateral triangle

14.

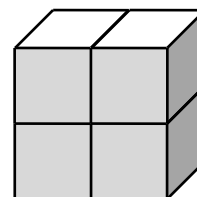


A right prism whose base is a regular pentagon

15. The figure shows a solid made up of 3 identical cubes.
- Determine the number of planes of reflection of the solid.
 - Determine the number of axes of rotational symmetry of the solid and write down the order of rotational symmetry about each axis.



16. The figure shows a solid made up of 4 identical cubes.
- Determine the number of planes of reflection of the solid.
 - Determine the number of axes of rotational symmetry of the solid and write down the order of rotational symmetry about each axis.



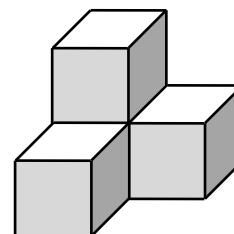
17. Draw a solid which has exactly three planes of reflection.

18. Draw a solid which has exactly four axes of rotational symmetry.

19. Draw a solid which has exactly one plane of reflection and one axis of rotational symmetry.

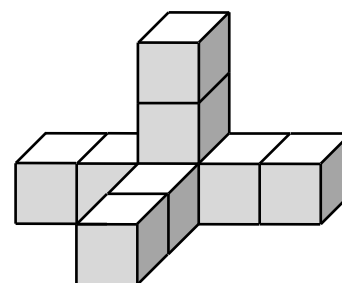
Level 3

20. The figure shows a solid made up of 4 identical cubes.
- Determine the number of planes of reflection of the solid.
 - Determine the number of axes of rotational symmetry of the solid and write down the order of rotational symmetry about each axis.



Multiple Choice Questions

21. The solid shown is made up of 9 identical cubes. The solid has
- 1 plane of reflection and no axis of rotational symmetry.
 - 1 plane of reflection and 1 axis of rotational symmetry.
 - 2 planes of reflection and no axis of rotational symmetry.
 - 2 planes of reflection and 1 axis of rotational symmetry.

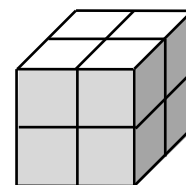


22. The solid shown is made up of 8 identical cubes.

Which of the following must be true?

- I. The solid has 6 axes of rotational symmetry.
- II. The solid has at least 1 axis of 3-fold rotational symmetry.
- III. The solid has at least 1 axis of 4-fold rotational symmetry.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III



23. Which of the following statements about a regular tetrahedron must be true?

- I. It has 6 planes of reflection.
- II. It has 3 axes of 4-fold rotational symmetry.
- III. It has 4 axes of 3-fold rotational symmetry.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

4.2 Nets of Solids

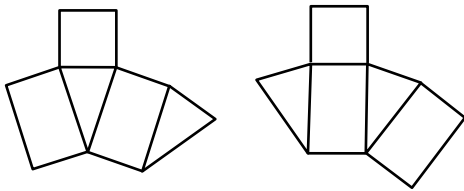
Level 1

Demonstration 1

The figure shows a right prism whose base is an isosceles triangle. Sketch two of its nets.

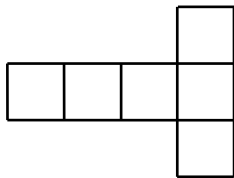


Solution



Demonstration 2

Name the solid that can be formed by folding the following net.



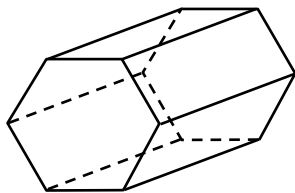
Solution

The net can be folded into a cube.

Level 2

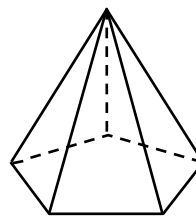
Sketch two nets of each of the following solids. (3 – 6)

3.



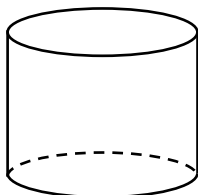
A right prism whose base is a regular hexagon

4.



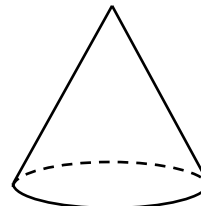
A right pyramid whose base is a regular pentagon

5.



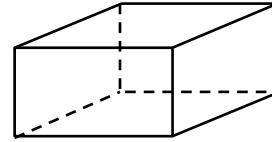
A cylinder

6.

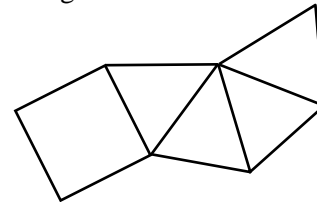


A right circular cone

1. The figure shows a cuboid. Sketch two of its nets.

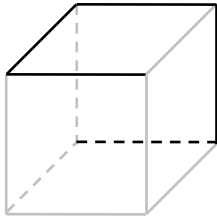


2. Name the solid that can be formed by folding the following net.

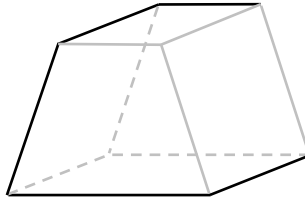


Imagine each of the following solids is cut along the grey edges to obtain a net. Sketch the net. (7 – 9)

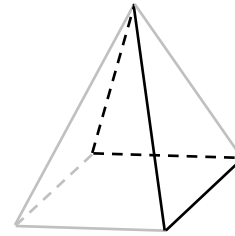
7.



8.

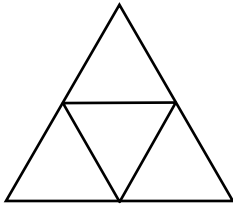


9.

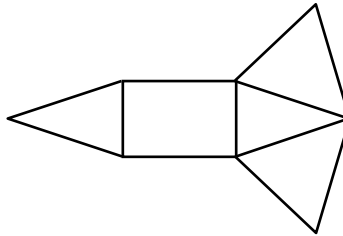


Name the solid that can be formed by folding each of the following nets. (10 – 12)

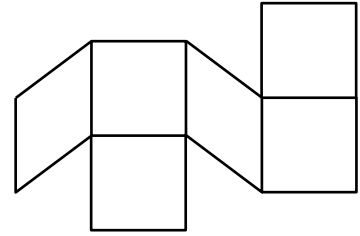
10.



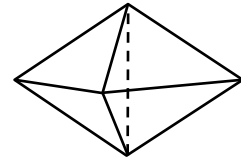
11.



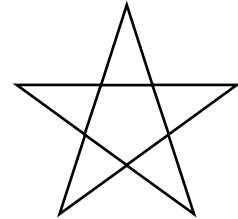
12.



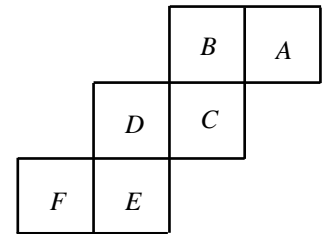
13. The figure shows a solid made up of two regular tetrahedra. Sketch two nets of the solid.



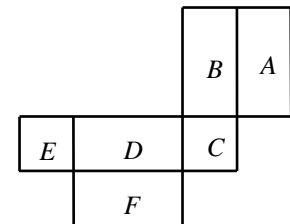
14. Sketch the solid formed by folding the net on the right.



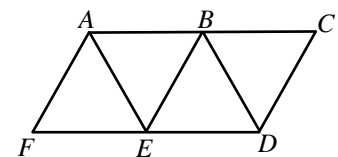
15. If the net on the right is folded into a cube, which letter will be shown on the face opposite to the face with 'C'?



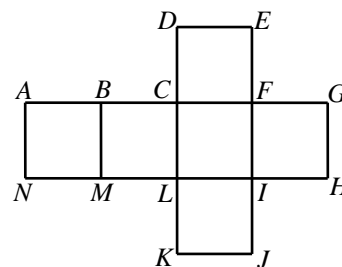
16. If the net on the right is folded into a cuboid, which letter will be shown on the face opposite to the face with 'D'?



17. If the net on the right is folded into a tetrahedron,
 (a) which vertex will coincide with A?
 (b) which edge will coincide with EF?

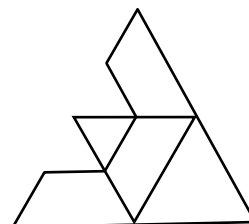


18. If the net on the right is folded into a cube,
 (a) which vertices will coincide with E ?
 (b) which edge will coincide with MN ?



Level 3

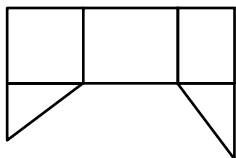
19. Sketch the solid formed by folding the net on the right.
 [Hint: sketch a regular tetrahedron first.]



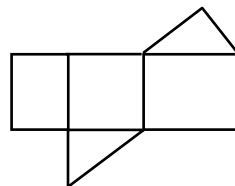
Multiple Choice Questions

20. Which of the following figures can be folded into a prism?

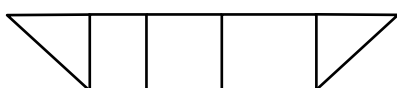
A.



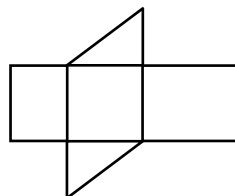
B.



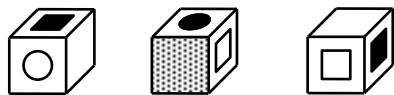
C.



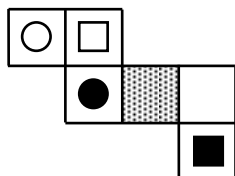
D.



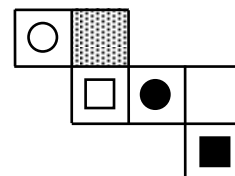
21. The figure shows three different views of a cube. Which of the following is a net of the cube?



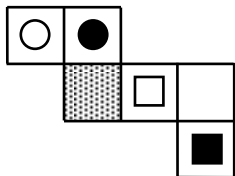
A.



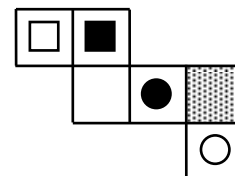
B.



C.



D.

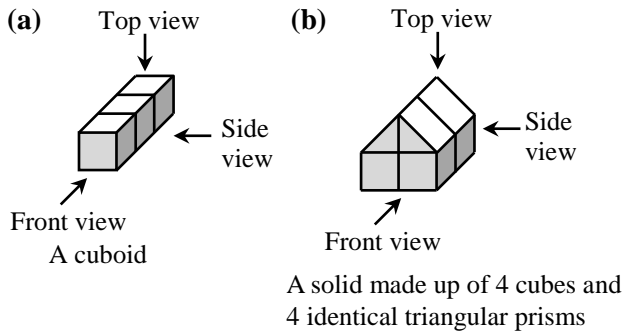


4.3 Orthographic Views of Solids

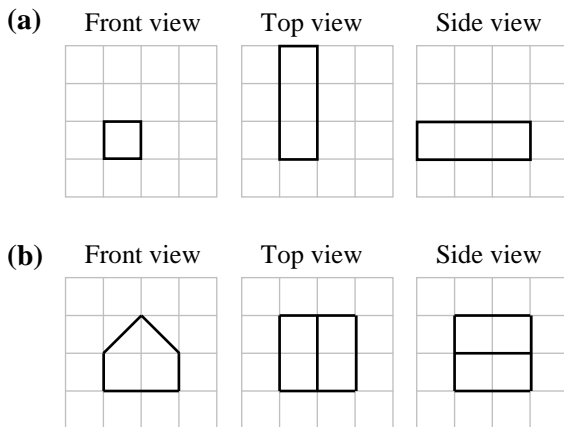
Level 1

Demonstration 1

Draw the orthographic views of each of the following solids.

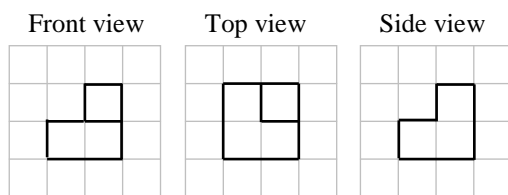


Solution

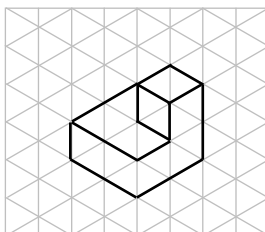


Demonstration 2

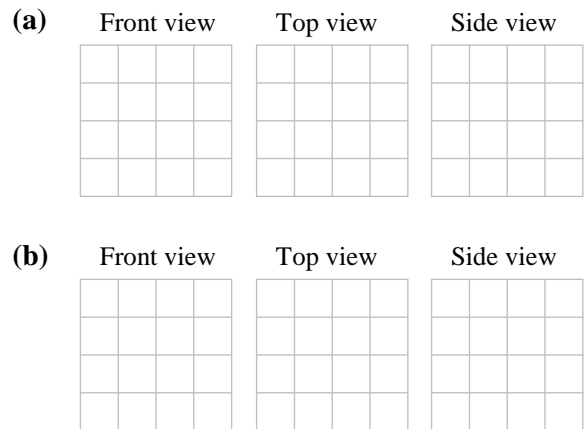
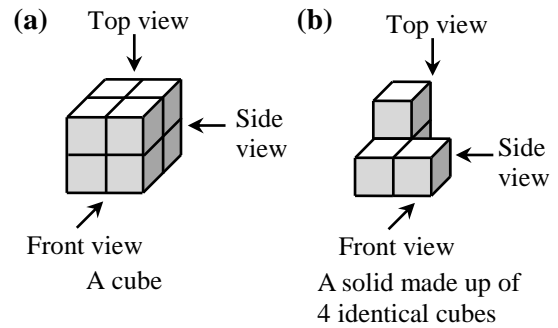
The orthographic views of a solid are shown below. Draw the solid on isometric grid paper.



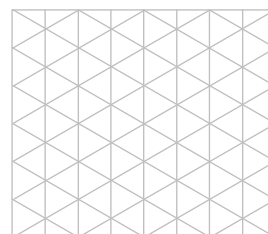
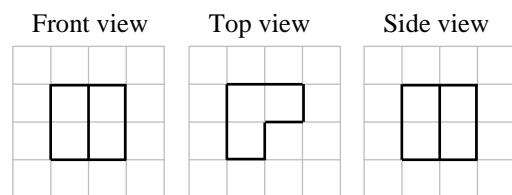
Solution



1. Draw the orthographic views of each of the following solids.

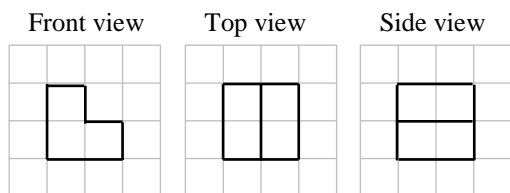


2. The orthographic views of a solid are shown below. Draw the solid on isometric grid paper.

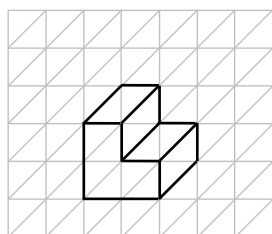


Demonstration 3

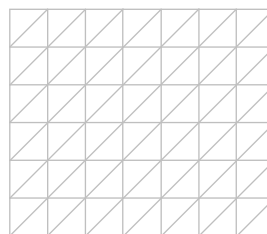
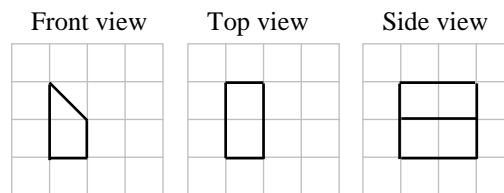
The orthographic views of a solid are shown below. Draw the solid on oblique grid paper.



Solution

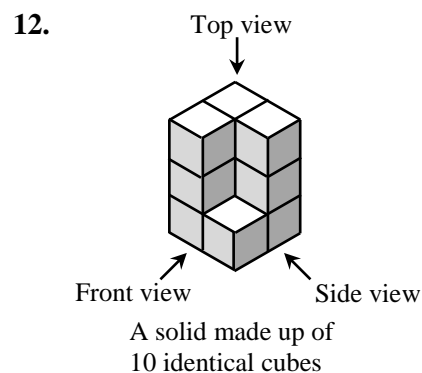
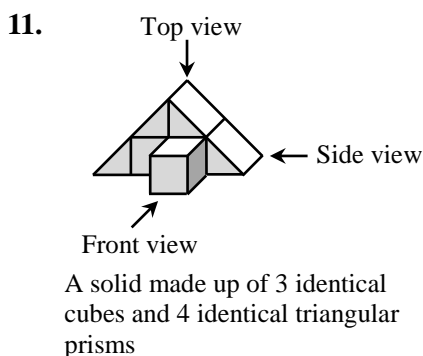
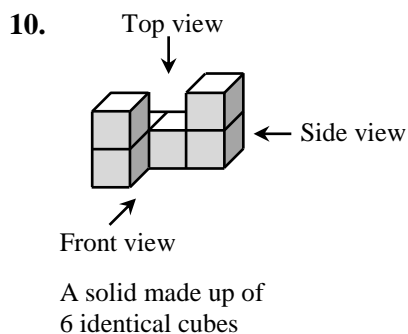
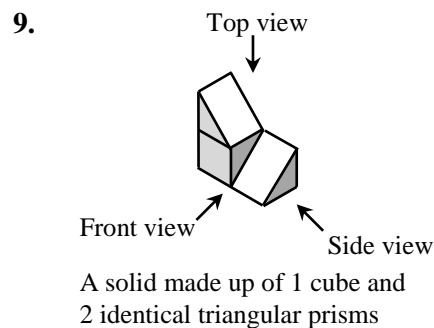
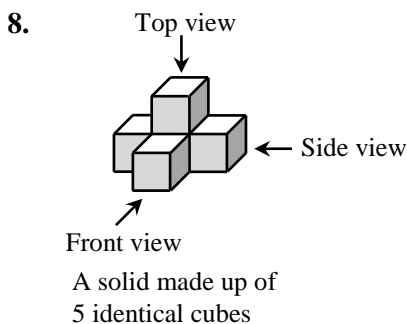
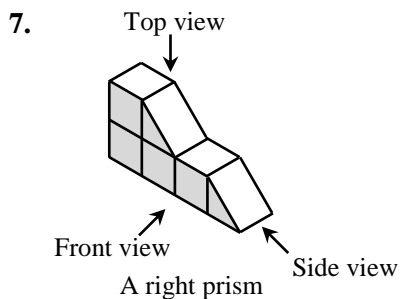
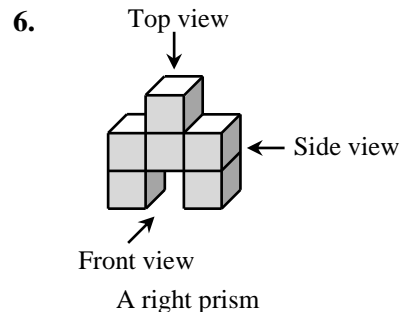
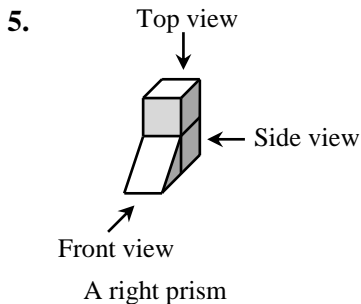
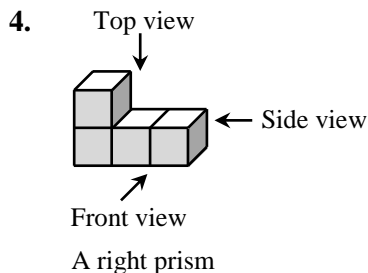


3. The orthographic views of a solid are shown below. Draw the solid on oblique grid paper.

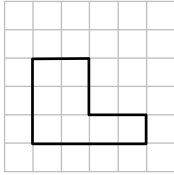
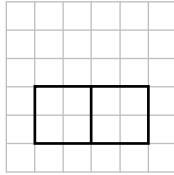
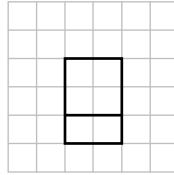


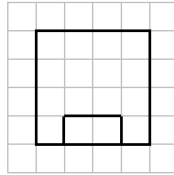
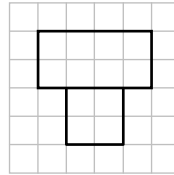
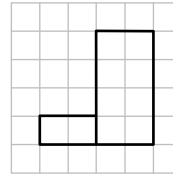
Level 2

Draw the orthographic views of each of the following solids. (4 – 12)

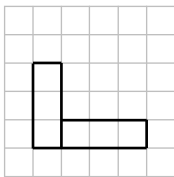
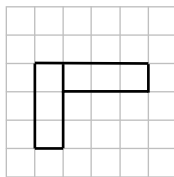
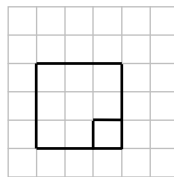


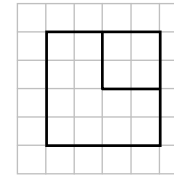
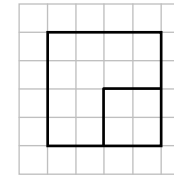
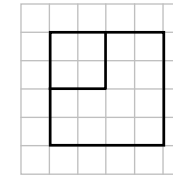
In each of the following, the orthographic views of a solid are shown. Draw the solid on oblique grid paper.
(13 – 14)

13. Front view:  Top view:  Side view: 

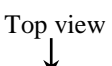


14. Front view:  Top view:  Side view: 

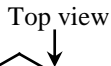
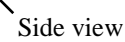
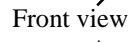
In each of the following, the orthographic views of a solid are shown. Draw the solid on isometric grid paper.
(15 – 16)




15. Front view:  Top view:  Side view: 

16. Front view:  Top view:  Side view: 

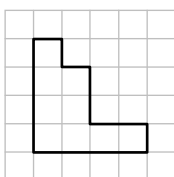
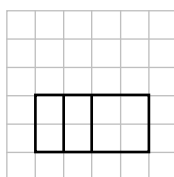
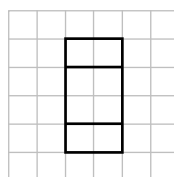
Draw the orthographic views of each of the following solids. (17 – 19)

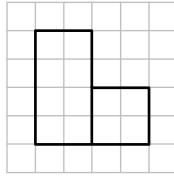
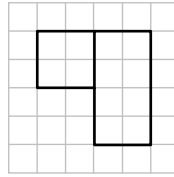
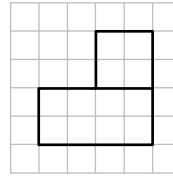
17. Top view:  Side view:  Front view: 
A solid made up of 3 identical cubes and 3 identical triangular prisms

18. Top view:  Side view:  Front view: 
A solid made up of 8 identical cubes

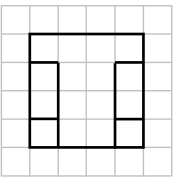
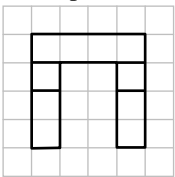
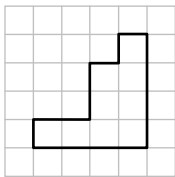
19. Top view:  Side view:  Front view: 
A solid made up of 9 identical cubes

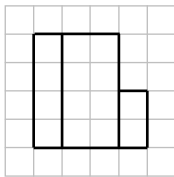
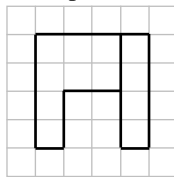
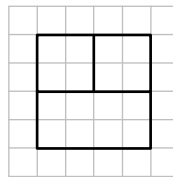
In each of the following, the orthographic views of a solid are shown. Draw the solid on oblique grid paper.
(20 – 21)

20. Front view:  Top view:  Side view: 

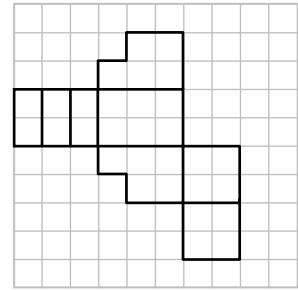
21. Front view:  Top view:  Side view: 

In each of the following, the orthographic views of a solid are shown. Draw the solid on isometric grid paper.
(22 – 23)

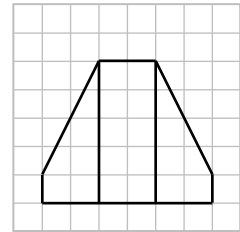
22. Front view:  Top view:  Side view: 

23. Front view:  Top view:  Side view: 

- 24.** The figure shows the net of a solid. Draw a possible set of orthographic views of the solid.

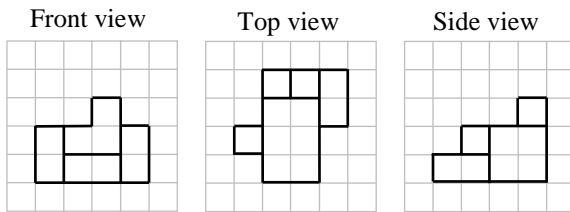


- 25.** The figure shows the front view of a solid.
 (a) Draw a possible set of top view and side view of this solid.
 (b) Draw this solid on isometric grid paper.

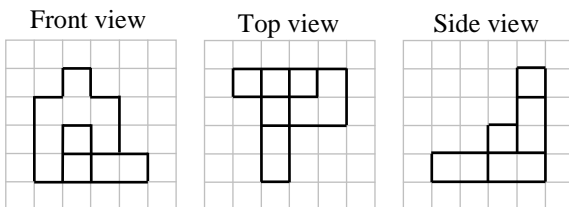


Level 3

- 26.** The following shows the orthographic views of a solid. Draw the solid on isometric grid paper.

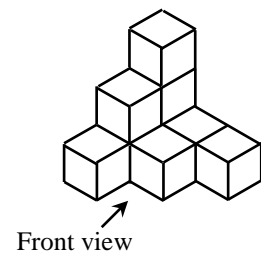
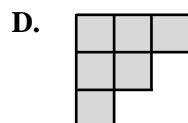
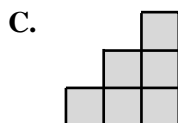
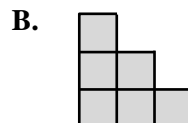
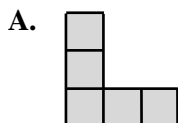


- 27.** The orthographic views of a solid are shown below. Someone claims that the solid can be made up of 17 identical cubes. Do you agree? Explain your answer.



Multiple Choice Questions

- 28.** The figure shows a solid made up of 9 identical cubes. Which of the following is the side view of the solid?



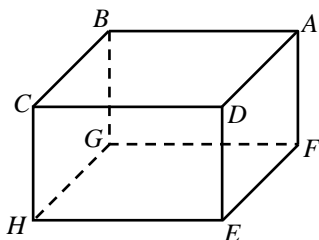
4.4 Lines and Planes in Solids

Level 1

Demonstration 1

The figure shows a cuboid $ABCDEFGH$.

- Name the projection of AB on plane $EFGH$.
- Name the angle between AG and plane $EFGH$.
- Name the angle between AH and plane $EFGH$.



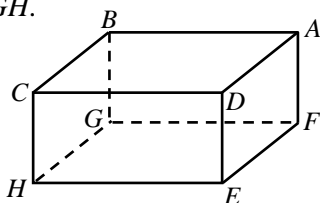
Solution

- FG is the projection of AB on plane $EFGH$.
- $\angle AGF$ is the angle between AG and plane $EFGH$.
- $\angle AHF$ is the angle between AH and plane $EFGH$.

Demonstration 2

In the figure, $ABCDEFGH$ is a cuboid.

- Name the angle between planes $ADEF$ and $EFGH$.
- Name the angle between planes $ABHE$ and $EFGH$.

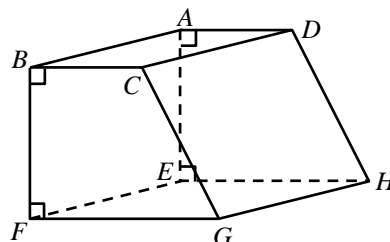


Solution

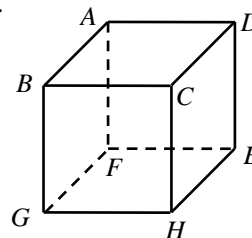
- The angle between planes $ADEF$ and $EFGH$ is $\angle AFG$ (or $\angle DEH$).
- The angle between planes $ABHE$ and $EFGH$ is $\angle AEF$ (or $\angle BHG$).

Level 2

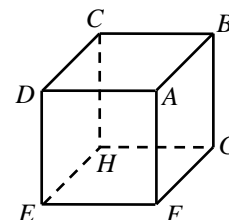
- In the figure, $ABCDEFGH$ is a right prism.
 - Name a normal to plane $EFGH$.
 - Name the projection of C on plane $ADHE$.



- The figure shows a cube $ABCDEFGH$.
 - Name the projection of BC on plane $EFGH$.
 - Name the angle between CG and plane $EFGH$.
 - Name the angle between BE and plane $EFGH$.

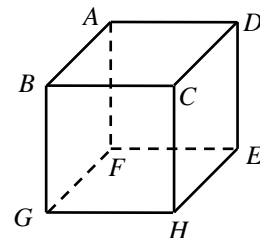


- In the figure, $ABCDEFGH$ is a cube.
 - Name the angle between planes $ADEF$ and $ABGF$.
 - Name the angle between planes $CDFG$ and $ABCD$.



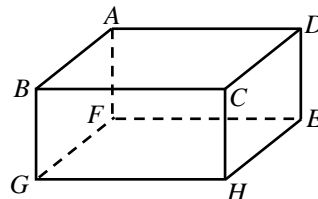
4. In the figure, $ABCDEFGH$ is a cube.

- (a) Name the projection of B on plane $CDEH$.
- (b) Name the projection of CD on plane $ABGF$.
- (c) Name the projection of AF on plane $BCHG$.



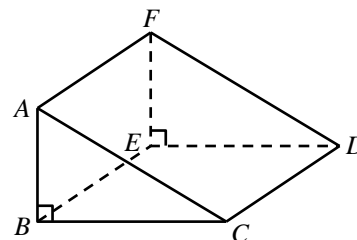
5. In the figure, $ABCDEFGH$ is a cuboid.

- (a) (i) Name the projection of AH on plane $EFGH$.
- (ii) Name the angle between AH and plane $EFGH$.
- (b) (i) Name the projection of BH on plane $CDEH$.
- (ii) Name the angle between BH and plane $CDEH$.



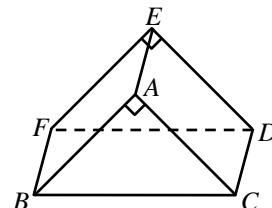
6. In the figure, $ABCDEF$ is a right triangular prism.

- (a) (i) Name the projection of AD on plane $BCDE$.
- (ii) Name the angle between AD and plane $BCDE$.
- (b) (i) Name the projection of CE on plane $ABEF$.
- (ii) Name the angle between CE and plane $ABEF$.



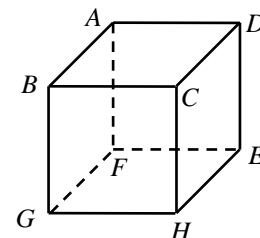
7. In the figure, $ABCDEF$ is a right triangular prism.

- (a) Name the angle between planes $ABFE$ and $BCDF$.
- (b) Name the angle between planes $ABFE$ and $ACDE$.



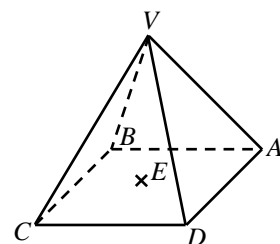
8. In the figure, $ABCDEFGH$ is a cube.

- (a) Name the angle between planes $BCHG$ and $CDEH$.
- (b) Name the angle between planes $AGHD$ and $EFGH$.
- (c) Name the angle between planes $BDEG$ and $CDEH$.



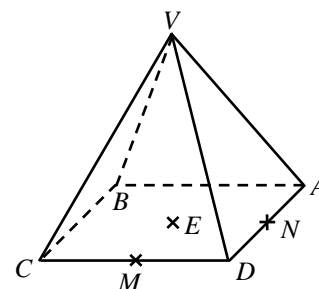
9. In the figure, $VABCD$ is a right pyramid whose base is a square.

- E is the projection of V on plane $ABCD$.
- (a) Name the projection of VB on plane $ABCD$.
- (b) Name the angle between VD and plane $ABCD$.
- (c) Name the angle between planes VAE and VDE .

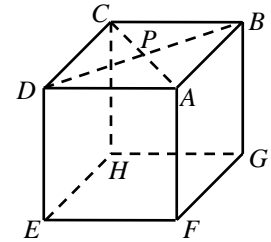


10. In the figure, $VABCD$ is a right pyramid whose base is a rectangle.

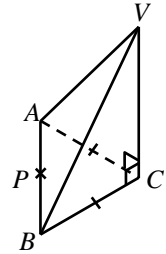
- M and N are the mid-points of CD and AD respectively. E is the projection of V on plane $ABCD$.
- (a) Name the angle between planes VCD and $ABCD$.
- (b) Name the angle between planes VAD and plane $ABCD$.



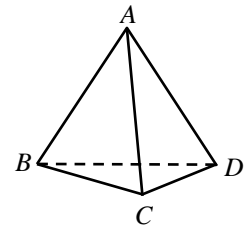
11. In the figure, $ABCDEFGH$ is a cube. AC meets BD at P .
- Name the angle between planes ACE and ACD .
 - Name the angle between planes BDF and BDH . Explain your answer.



12. In the figure, $VABC$ is a triangular pyramid. P is the mid-point of AB . $\angle VCA = \angle VCB = 90^\circ$ and $AC = BC$.
- Name the projection of VA on plane VBC .
 - Name the angle between VB and plane VAC .
 - Name the angle between planes VAB and ABC . Explain your answer.

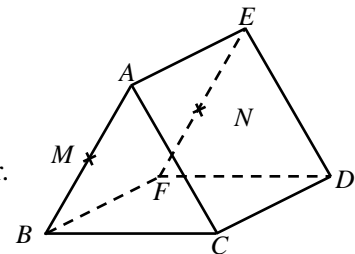


13. In the figure, $ABCD$ is a regular tetrahedron. Mark the angle between planes ABC and ACD .



Level 3

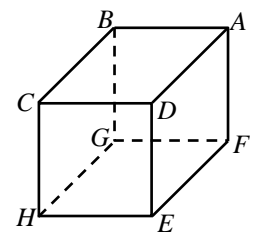
14. In the figure, $ABCDEF$ is a right prism whose base is an equilateral triangle. M and N are the mid-points of AB and EF respectively.
- Name the projection of CE on plane $ABFE$.
 - Name the angle between AD and plane $CDNM$.
 - Name the angle between planes CME and CMF . Explain your answer.



Multiple Choice Questions

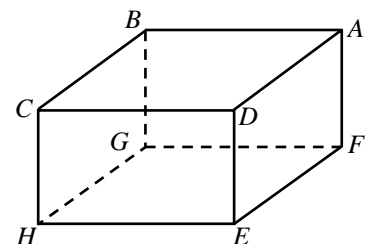
15. In the figure, $ABCDEFGH$ is a cuboid. The angle between BE and plane $ABGF$ is

- $\angle ABE$.
- $\angle BEF$.
- $\angle EBF$.
- $\angle EBG$.



16. The figure shows a cuboid $ABCDEFGH$. Which of the following are right angles?

- $\angle BDE$
 - $\angle DCG$
 - $\angle FBH$
- I and II only
 - I and III only
 - II and III only
 - I, II and III



Answers

3A Chapter 4

Section 4.1

Level 1

1. 2
2. 1 axis of 2-fold rotational symmetry

Level 2

6. 2
7. 4
8. 9
12. 1; 1 axis of 4-fold rotational symmetry
13. 4; 1 axis of 3-fold rotational symmetry, 3 axes of 2-fold rotational symmetry
14. 6; 1 axis of 5-fold rotational symmetry, 5 axes of 2-fold rotational symmetry
15. (a) 2
(b) 1; 1 axis of 2-fold rotational symmetry
16. (a) 5
(b) 5; 1 axis of 4-fold rotational symmetry, 4 axes of 2-fold rotational symmetry

Level 3

20. (a) 3
(b) 1; 1 axis of 3-fold rotational symmetry

Multiple Choice Questions

21. D
22. C
23. B

Section 4.2

Level 1

2. pyramid

Level 2

10. tetrahedron
11. pyramid
12. prism
15. *F*
16. *A*
17. (a) *C* (b) *ED*
18. (a) *A, G* (b) *KJ*

Multiple Choice Questions

20. B
21. C

Section 4.3

Level 3

27. yes

Multiple Choice Questions

28. C

Section 4.4

Level 1

1. (a) GH (b) $\angle CGH$
(c) $\angle BEG$
2. (a) $\angle BAD$ (or $\angle GFE$)
(b) $\angle ADF$ (or $\angle BCG$)

Level 2

3. (a) BF (or AE) (b) D
4. (a) C (b) BA
(c) BG
5. (a) (i) FH (ii) $\angle AHF$
(b) (i) CH (ii) $\angle BHC$
6. (a) (i) BD (ii) $\angle ADB$
(b) (i) BE (ii) $\angle CEB$
7. (a) $\angle ABC$ (or $\angle EFD$)
(b) $\angle BAC$ (or $\angle FED$)
8. (a) $\angle BCD$ (or $\angle GHE$)
(b) $\angle AGF$ (or $\angle DHE$)
(c) $\angle BDC$ (or $\angle GEH$)
9. (a) EB (b) $\angle VDB$
(c) $\angle AED$
10. (a) $\angle VME$ (b) $\angle VNE$
11. (a) $\angle DPE$ (b) $\angle FPH$
12. (a) VC (b) $\angle BVC$
(c) $\angle VPC$

Level 3

14. (a) ME (b) $\angle ADM$
(c) $\angle EMF$

Multiple Choice Questions

15. C

16. A