

Chapter 6 Parent Guide

Shapes in Space

We live in a three-dimensional world, however, it is necessary to represent it in a two-dimensional space.

Some students and even adults struggle to interpret two-dimensional drawings of three-dimensional figures. This chapter will help students develop better perception while learning the geometry of solid figures.

One way to improve this perception is to learn to draw three-dimensional figures. Chapter 6 will teach students three unique ways to represent solid figures in two-dimensions. Students will learn properties of solid figures and develop a deeper understanding of lines and planes in space.

Lesson 6.1 shows students how to use isometric dot paper to represent cubes and other rectangular prisms. They will also use dot paper to determine the volume of rectangular prisms.

Lesson 6.2 discusses polyhedra, or solid figures, and their parts. Lesson 6.3 develops a clearer understanding of prisms and their parts. Lessons 6.4 and 6.5 use coordinate geometry with a third axis to explore figures in space. Lesson 6.6 will show your child how to use a vanishing point to create a perspective drawing.

Students who have studied shop or artistic drawing will have an advantage over other students in this chapter. Their spatial awareness is probably already keen. If this is the case with your child, encourage her or him to coach others who do not share the same background. Otherwise, you may want to pair your child with one of these spatially talented students. Both students will gain from the experience.

You may want to determine your child's spatial awareness by doing the following activity together.

PROBLEM FOR DISCUSSION (See textbook page 379)

A closed spatial figure made up of polygons is called a polyhedron (plural, polyhedra or polyhedrons). Closed spatial figures are also known as solids.

1. Discuss the definition of polyhedron. Describe the faces of a polyhedron. How do they differ from an edge or a vertex? If a line represents an edge of a polygon, what geometric figures represent vertices?

A polyhedra is a closed spatial figure composed of polygons.

The polygons of the polyhedra are called faces.

Faces differ from edges and vertices because polygons are 2-dimensional planes where edges and vertices are 1-dimensional lines and points.

A point represents a vertex.

2. How many faces does the polygon on page 379 have? How many vertices does it have? How many edges does it have?

The figure has 10 faces, 7 vertices, and 15 edges.

3. Locate the hexahedron (cube) on page 387. How many faces, edges, and vertices does it have?

The hexahedron has 6 faces, 12 edges, and 8 vertices.

4. On page 387 is a picture of a tetrahedron and its net. Which diagram do you prefer to use to count the vertices? the edges? the faces? Why?

To count faces, it is easier to see them in the net because each face is laid out in front of you.

To count vertices and faces, it is easier to see them in the 3-dimensional picture because in the net, some of the shared edges and vertices are shown to be 2 different edges or vertices.

5. On the net for the tetrahedron on page 387, if the base of the tetrahedron is the lower left triangle, which point on the net represents its uppermost vertex? If the base of the net is the center triangle, why is the uppermost vertex represented by more than one point?

The point that represents its uppermost vertex is the far right point in the middle of the net.

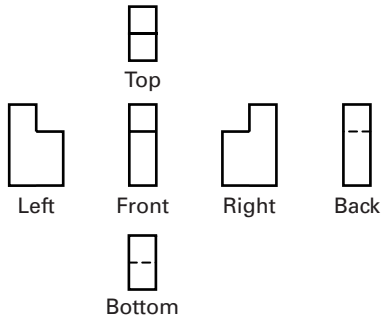
The uppermost vertex is represented by more than one point because it is the point where the three outer triangles come together.

The following are complete worked out solutions to selected exercises in the student textbook. These solutions are provided to you so that you can help your child with their homework. Your child's classroom notes, example problems in the text, and these worked out solutions are all useful tools to help you and your child work through their assignment.

Lesson 6.1

19. Five cubes are used thus the volume is 5 cubic units.

21.



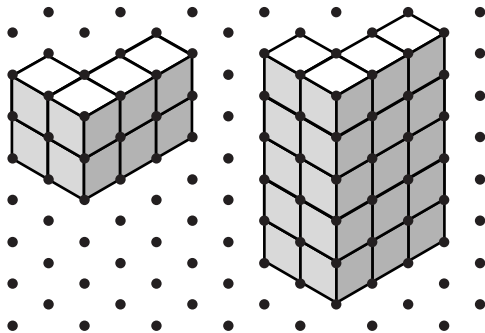
28. a. 18 square units

b. 16 square units

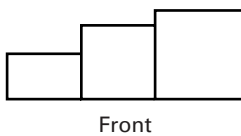
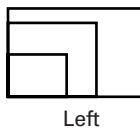
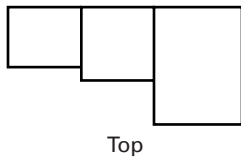
c. 18 square units

Shape b has the least surface area.

36. Answers may vary. Sample answer:



42.

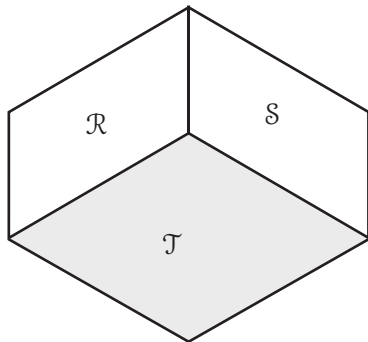


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Lesson 6.2

16. No, we would only be able to draw a conclusion if we knew that $m \parallel n$.

20. False. $\mathcal{R} \perp \mathcal{T}$ and $\mathcal{S} \perp \mathcal{T}$, but \mathcal{R} is not perpendicular to \mathcal{S} .



24. The insert in \overline{CD} .

28. skew

Lesson 6.3

12. Triangular prism.

16. \overline{AD} and \overline{CF}

22. Parallelogram.

32. $d = \sqrt{a^2 + a^2 + (2a)^2} = \sqrt{6a^2} = a\sqrt{6}$

	Number of faces	Number of vertices	Number of edges
35.	6	8	12

43. Let x be the length of a side of a unit-cell cube.

$$d = 4a = \sqrt{x^2 + x^2 + x^2} = x\sqrt{3}$$

$$x = \frac{4a}{\sqrt{3}} = \frac{4a\sqrt{3}}{3}$$

Chapter 6

Lesson 6.4

19. x - z plane

$$31. \sqrt{(-5-2)^2 + (-6-0)^2 + (-5-1)^2} = \sqrt{121} \\ = 11$$

34. (6, 10, 7)

37. $A(0, 0, 0)$ and $D(6, 0, 0)$

$$AD = \sqrt{(6-0)^2 + (0-0)^2 + (0-0)^2} \\ = \sqrt{36} \\ = 6$$

46. $x_1 = 2, y_1 = -1, z_1 = 0$

$$x_2 = 0, y_2 = 0, z_2 = 1$$

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}, \frac{z_1 + z_2}{2}\right)$$

$$\left(\frac{2+0}{2}, \frac{-1+0}{2}, \frac{0+1}{2}\right)$$

$$\left(\frac{2}{2}, \frac{-1}{2}, \frac{1}{2}\right)$$

$$\left(1, \frac{-1}{2}, \frac{1}{2}\right)$$

Lesson 6.5

13. $2x - 4y + z = -2$

x -intercept:

$$\text{Let } y = 0 \text{ and } z = 0$$

$$2x - 4(0) + 0 = -2$$

$$2x = -2$$

$$x = -1$$

$$(-1, 0, 0)$$

y -intercept:

$$\text{Let } x = 0 \text{ and } z = 0.$$

$$2(0) - 4y + 0 = -2$$

$$-4y = -2$$

$$y = \frac{1}{2}$$

$$\left(0, \frac{1}{2}, 0\right)$$

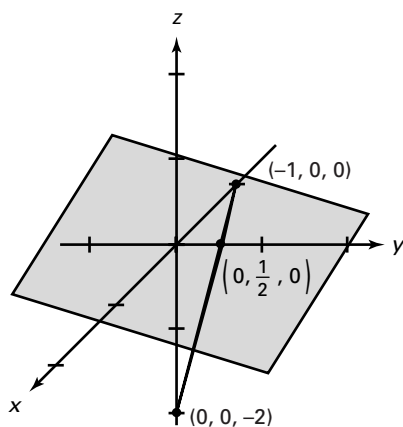
z -intercept:

$$\text{Let } x = 0 \text{ and } y = 0.$$

$$2(0) - 4(0) + z = -2$$

$$z = -2$$

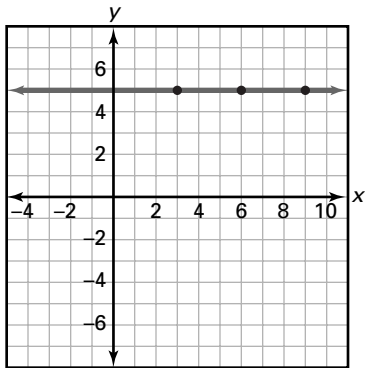
$$(0, 0, -2)$$



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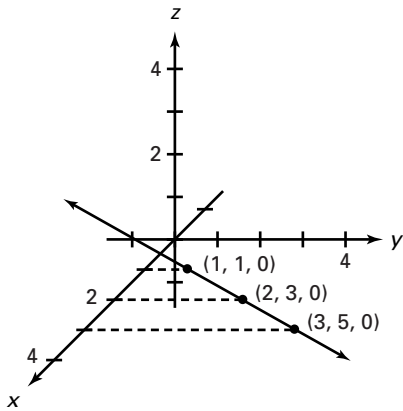
20.

t	x	y
1	3	5
2	6	5
3	9	5



23.

t	x	y	z
0	1	1	0
1	2	3	0
2	3	5	0



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28. $2x + 7y + 3z = 2$

To find trace, let $z = 0$.

$$2x + 7y + 3(0) = 2$$

$$2x + 7y = 2$$

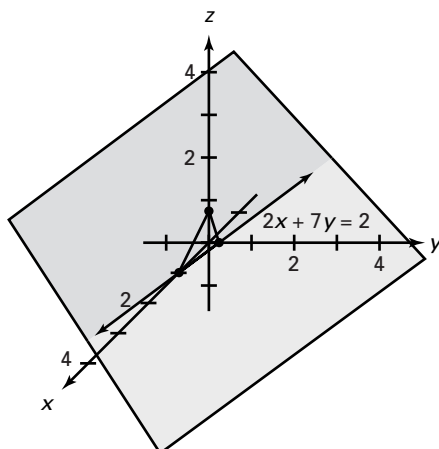
trace: $2x + 7y = 2$

Sketch the plane by using the intercepts.

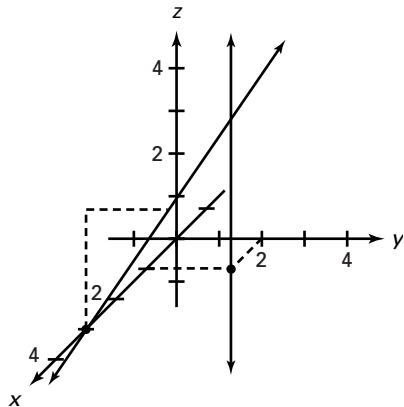
x -intercept: $(1, 0, 0)$

y -intercept: $(0, \frac{2}{7}, 0)$

z -intercept: $(0, 0, \frac{2}{3})$



34.



The lines are skew.

Line 1 always has x -coordinate 1 and line 2 always has x -coordinate 3. Because the x -coordinates are always different, the lines do not intersect.

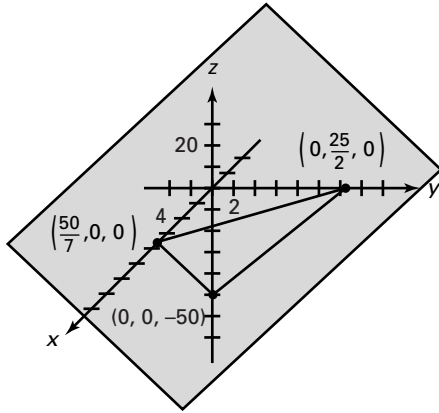
Chapter 6

37. $z = 7x + 4y - 50$ in standard form is
 $7x + 4y - z = 50$
 Sketch the plane using the intercepts.

x-intercept: $(\frac{50}{7}, 0, 0)$

y-intercept: $(0, \frac{25}{2}, 0)$

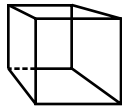
z-intercept: $(0, 0, -50)$



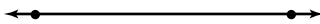
Find the trace by letting $z = 0$.
 The trace of the plane is $7x + 4y = 50$.
 $z = 0$ for points in the trace thus the profit is \$0.

Lesson 6.6

12.



18.



26. Segments radiating from point P divide \overleftrightarrow{AB} into a number of congruent segments.
 \overleftrightarrow{CD} is drawn parallel to \overleftrightarrow{AB} . Diagonals \overline{AW} and \overline{BY} are drawn through points C and D , respectively. The intersections of the diagonals with the segments from point P determine the vertical placement of the parallel lines.