Discovering AutoCAD® 2024

Mark Dix
Paul Riley
Lee Ambrosius
Pearson’s Commitment to Diversity, Equity, and Inclusion

Pearson is dedicated to creating bias-free content that reflects the diversity of all learners. We embrace the many dimensions of diversity, including but not limited to race, ethnicity, gender, socioeconomic status, ability, age, sexual orientation, and religious or political beliefs.

Education is a powerful force for equity and change in our world. It has the potential to deliver opportunities that improve lives and enable economic mobility. As we work with authors to create content for every product and service, we acknowledge our responsibility to demonstrate inclusivity and incorporate diverse scholarship so that everyone can achieve their potential through learning. As the world’s leading learning company, we have a duty to help drive change and live up to our purpose to help more people create a better life for themselves and to create a better world.

Our ambition is to purposefully contribute to a world where:

- Everyone has an equitable and lifelong opportunity to succeed through learning.
- Our educational products and services are inclusive and represent the rich diversity of learners.
- Our educational content accurately reflects the histories and experiences of the learners we serve.
- Our educational content prompts deeper discussions with learners and motivates them to expand their own learning (and worldview).

While we work hard to present unbiased content, we want to hear from you about any concerns or needs with this Pearson product so that we can investigate and address them.

Please contact us with concerns about any potential bias at https://www.pearson.com/report-bias.html.
Get Active with Discovering AutoCAD® 2024

Designed for introductory AutoCAD users, Discovering AutoCAD 2024 offers a hands-on, activity-based approach to the use of AutoCAD as a drafting tool—complete with techniques, tips, shortcuts, and insights designed to increase efficiency. Topics and tasks are carefully grouped to lead students logically through the AutoCAD command set, with the level of difficulty increasing steadily as skills are acquired through experience and practice. Straightforward explanations focus on what is relevant to actual drawing procedures, and illustrations show exactly what to expect on the computer screen when steps are correctly completed. Each chapter ends with drawing exercises that assess and reinforce the student’s understanding of the material.

Features

The book uses a consistent format for each chapter that includes the following:

• Chapter Objectives and Introduction
• Exercises that introduce new commands and techniques
• Exercise instructions clearly set off from the text discussion
• Lots of illustrations with drawings and screenshots
• Twenty end-of-chapter Review Questions
• Four to eight realistic engineering drawing problems—fully dimensioned working drawings

High-quality working drawings include a wide range of applications that focus on mechanical drawings but also include architectural, civil, plumbing, general, and electrical drawings. Appendix A contains 21 drawing projects for additional review and practice. Appendixes B, C, and D cover material not required for drawing practice but highly relevant for any beginning CAD professional. These include information on customization features, basic programming procedures, and a summary of Autodesk cloud-based and file-sharing features.

Acknowledgments

The authors thank the following reviewers for their feedback: John Irwin, Michigan Technological University; Tony Graham, North Carolina A&T State University; Beverly Jaeger, Northeastern University; Daniel McCall, Amarillo College; and Susan Freeman, Northeastern University. Lastly, we would like to thank Jon Page (and his family) for his time in reviewing the content changes made in this edition of the book.

From Lee Ambrosius: I would like to thank my family for being by my side throughout the many stages of my career and during the writing of this book. Along with my family, I would like to give special thanks to my
instructors (Gary Magee, Kenneth Schulz, and Tricia Croyle) of the architectural program at Northeast Wisconsin Technical College (NWTC), where it all began. Without them, my career would likely be very different today.

**Features New to This Edition**

1. Updated to reflect the latest changes to AutoCAD with the 2024 release
2. Updated illustrations representing the newest AutoCAD interface
3. Coverage of the workflow of measuring objects in Chapter 6
4. New sections on counting and replacing blocks in Chapter 10
5. Expanded Appendix D with coverage of design review workflows

**Style Conventions in Discovering AutoCAD® 2024**

<table>
<thead>
<tr>
<th>Text Element</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Key Terms</strong>—Boldface and italic on first mention (first letter lowercase, as it appears in the body of the text). Brief definition in margin alongside first mention. Full definition in Glossary available at peachpit.com/Discoverautocad2024.</td>
<td>Views are created by placing viewport objects in the paper space layout.</td>
</tr>
<tr>
<td><strong>AutoCAD commands</strong>—Bold and uppercase.</td>
<td>Start the LINE command.</td>
</tr>
<tr>
<td><strong>Ribbon and panel names, palette names, menu items, and dialog box names</strong>—Bold and follow capitalization convention in AutoCAD toolbar or pull-down menu. (Generally, the first letter is capitalized.)</td>
<td>The Layer Properties Manager palette</td>
</tr>
<tr>
<td><strong>Panel tools, toolbar buttons, and dialog box controls/buttons/input items</strong>—Bold and follow the name of the item or the name shown in the AutoCAD tooltip.</td>
<td>Choose the Line tool from the Draw panel. Choose the Symbols and Arrows tab in the Modify Dimension Style dialog box. Choose the New Layer button in the Layer Properties Manager palette. In the Lines and Arrows tab, set the Arrow size: to .125.</td>
</tr>
<tr>
<td><strong>AutoCAD prompts</strong>—Dynamic input prompts are set in a different font to distinguish them from the text. Command-line prompts are set to look like the text in the command line, including capitalization, brackets, and punctuation. Text following the prompt’s colon specifies user input in bold.</td>
<td>AutoCAD prompts you to specify first point: Specify center point for circle or [3P 2P Ttr (tan tan radius)]: 3.5</td>
</tr>
<tr>
<td><strong>Keyboard Input</strong>—Bold with special keys in brackets.</td>
<td>Type 3.5 &lt;Enter&gt;.</td>
</tr>
</tbody>
</table>

**Download Instructor Resources from the Instructor Resource Center**

Instructor materials are available from Pearson’s Instructor Resource Center. Go to https://www.pearson.com/en-us/highered-educators.html to register or to sign in if you already have an account.
## Part One  Basic Two-Dimensional Entities

### Chapter 1  Lines and Essential Tools  1

**Chapter Objectives**  1

**Introduction**  1

**Getting Started and Creating a New Drawing**  2

**Exploring the Application and Drawing Window**  5

**Interacting with the Drawing Window**  7

**Exploring Command Entry Methods**  13

**Drawing, Undoing, and Erasing Lines**  20

**Saving and Opening Your Drawings**  32

**Getting Started**  34

  - Chapter Summary  38
  - Chapter Test Questions  38
  - Chapter Drawing Projects  40

### Chapter 2  Circles and Drawing Aids  53

**Chapter Objectives**  53

**Introduction**  53

**Changing the Grid Setting**  54

**Changing the Snap Setting**  55

**Changing Units**  58

**Drawing Circles by Specifying a Center Point and a Radius**  60

**Drawing Circles by Specifying a Center Point and a Diameter**  63

**Accessing AutoCAD Online Help Features**  66

**Using the ERASE Command**  69

**Using Single-Point Object Snap**  77

**Using the RECTANG Command**  80

**Customizing Your Workspace**  81

**Plotting or Printing a Drawing**  84

  - Chapter Summary  88
  - Chapter Test Questions  88
  - Chapter Drawing Projects  90

### Chapter 3  Layers, Colors, and Linetypes  103

**Chapter Objectives**  103

**Introduction**  103

**Creating New Layers**  104

**Assigning Colors to Layers**  106

**Assigning Linetypes**  108

**Assigning Lineweights**  110

**Changing the Current Layer**  111

**Changing Linetype Scale**  114

**Editing Corners Using FILLET**  115

**Editing Corners Using CHAMFER**  118

**Zooming and Panning with the Scroll Wheel**  120

**Using the ZOOM Command**  121

**Entering Single-Line Text**  124

  - Chapter Summary  126
  - Chapter Test Questions  126
  - Chapter Drawing Projects  128

### Chapter 4  Templates, Copies, and Arrays  141

**Chapter Objectives**  141

**Introduction**  141

**Setting Drawing Limits**  142

**Creating a Drawing Template**  145

**Saving a Drawing Template**  146

**Using the MOVE Command**  149

**Using the COPY Command**  153

**Using the ARRAYRECT Command—Rectangular Arrays**  155

**Creating Center Marks**  161

**Changing Plot Settings**  163

  - Chapter Summary  167
  - Chapter Test Questions  167
  - Chapter Drawing Projects  170
### Chapter 5  Arcs and Polar Arrays  185
- **Chapter Objectives**  185
- **Introduction**  185
- **Creating Polar Arrays**  185
- **Drawing Arcs**  190
- **Using the ROTATE Command**  195
- **Using Polar Tracking at Any Angle**  198
- **Creating Mirror Images of Objects**  200
- **Creating Page Setups**  205
- **Chapter Summary**  209
- **Chapter Test Questions**  209
- **Chapter Drawing Projects**  212

### Chapter 6  Object Snaps and Resized Objects  225
- **Chapter Objectives**  225
- **Introduction**  225
- **Selecting Points with Object Snap (Single-Point Override)**  226
- **Selecting Points with Running Object Snaps**  228
- **Object Snap Tracking**  232
- **Using the OFFSET Command (Creating Parallel Objects with OFFSET)**  237
- **Shortening Objects with the TRIM Command**  239
- **Extending Objects with the EXTEND Command**  242
- **Using STRETCH to Alter Objects Connected to Other Objects**  244
- **Measuring Objects**  250
- **Creating Plot Layouts**  253
  - **Chapter Summary**  264
  - **Chapter Test Questions**  264
  - **Chapter Drawing Projects**  266

### Part Two  Text, Dimensions, and Other Complex Entities

#### Chapter 7  Text  281
- **Chapter Objectives**  281
- **Introduction**  281
- **Entering Single-Line Text with Justification Options**  282
- **Entering Text on an Angle and Text Using Character Codes**  288
- **Entering Multiline Text Using MTEXT**  289
- **Editing Text in Place with TEXTEDIT**  292
- **Modifying Text with the Quick Properties Palette**  294
- **Using the SPELL and FIND Commands**  298
- **Changing Fonts and Styles**  300
- **Changing Properties with MATCHPROP**  305
- **Scaling Previously Drawn Entities**  307
- **Creating Tables and Fields**  310
- **Using Drawing Templates, Borders, and Title Blocks**  316
  - **Chapter Summary**  320
  - **Chapter Test Questions**  320
  - **Chapter Drawing Projects**  322

#### Chapter 8  Dimensions  335
- **Chapter Objectives**  335
- **Introduction**  335
- **Creating and Saving a Dimension Style**  335
- **Drawing Linear Dimensions**  340
- **Drawing Multiple Linear Dimensions Using QDIM**  345
- **Drawing Ordinate Dimensions**  349
- **Drawing Angular Dimensions**  354
- **Dimensioning Arcs and Circles**  357
- **Annotating with Multileaders**  359
- **Changing Dimension Text**  366
- **Using Associative Dimensions**  368
- **Using the HATCH Command**  372
- **Scaling Dimensions Between Paper Space and Model Space**  377
  - **Chapter Summary**  388
  - **Chapter Test Questions**  388
  - **Chapter Drawing Projects**  390

#### Chapter 9  Polylines  407
- **Chapter Objectives**  407
- **Introduction**  407
- **Drawing Polygons**  408
- **Drawing Donuts**  410
- **Using the FILL Command**  412
<table>
<thead>
<tr>
<th>Chapter 13 More Modeling Techniques and Commands</th>
<th>645</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter Objectives</td>
<td>645</td>
</tr>
<tr>
<td>Introduction</td>
<td>645</td>
</tr>
<tr>
<td>Drawing Polysolids</td>
<td>646</td>
</tr>
<tr>
<td>Drawing Cones</td>
<td>650</td>
</tr>
<tr>
<td>Drawing Pyramids</td>
<td>652</td>
</tr>
<tr>
<td>Drawing Torus</td>
<td>653</td>
</tr>
<tr>
<td>Slicing and Sectioning Solids</td>
<td>654</td>
</tr>
<tr>
<td>Mesh Modeling</td>
<td>659</td>
</tr>
<tr>
<td>Adjusting Viewpoints with 3DORBIT</td>
<td>672</td>
</tr>
<tr>
<td>Creating 3D Solids from 2D Outlines</td>
<td>680</td>
</tr>
<tr>
<td>Walking Through a 3D Landscape</td>
<td>687</td>
</tr>
<tr>
<td>Creating an Animated Walk-Through</td>
<td>692</td>
</tr>
<tr>
<td>Chapter Summary</td>
<td>696</td>
</tr>
<tr>
<td>Chapter Test Questions</td>
<td>696</td>
</tr>
<tr>
<td>Drawing Problems</td>
<td>697</td>
</tr>
<tr>
<td>Chapter Drawing Projects</td>
<td>698</td>
</tr>
</tbody>
</table>

**Appendix A Drawing Projects** 711

**Appendix B Creating Custom Ribbon Panels** 733
- Creating a Customized Ribbon Panel 734
- Creating Customized Tools 737

**Appendix C Menus, Macros, and the CUI Dialog Box** 745
- The CUI Dialog Box 745
- Characters Used in Menus and Macros 748
- Index 751

Appendix D and Glossary are available online at peachpit.com/Discoverautocad2024.

**Appendix D (Online only)**
- Additional Tools for Collaboration

**Glossary (Online only)**
**Introduction**

Learning to create isometric drawings should be a pleasure at this point. There are very few new commands to learn, and anything you already know about manual isometric drawing makes it that much easier on the computer. Once you know how to get into the isometric mode in AutoCAD and change from plane to plane, you can rely on previously learned skills and techniques. Many of the commands from early chapters in this book will work readily, and you will find that using the isometric drawing planes is an excellent warm-up for 3D wireframe and solid modeling.

**Using Isometric Snap**

To begin drawing isometrically, you need to switch to the isometric snap style. You will find the grid and crosshairs behaving in ways that might seem odd at first, but you will quickly get used to them.

---

**CHAPTER OBJECTIVES**

- Use isometric snap
- Switch isometric planes
- Use COPY and other edit commands
- Draw isometric circles with ELLIPSE
- Draw text aligned with isometric planes
- Draw ellipses in orthographic views
- Save and restore displays with VIEW
Begin a new drawing using decimal units and 18 × 12 limits. Use the 1B template if you have it; otherwise, be sure to use the acad.dwt template.

Check to see that the Grid Mode and Snap Mode tools are on.

Click the ISODRAFT tool from the status bar, as shown in Figure 11-1.

At this point, your grid and crosshairs are reoriented, resembling Figure 11-2. This is the 2D model space grid in isometric mode. Gridlines are drawn at 30°, 90°, and 150° angles from the horizontal, depending on which isoplane is being represented. The crosshairs are initially turned to define the left isometric plane, and gridlines are drawn to represent the left isoplane, with lines at 90° and 150°. The three isoplanes are discussed in the “Switching Isometric Planes” section.

To get a feeling for how this snap style works, start the LINE command and draw some boxes, as shown in Figure 11-3. Make sure Ortho is off and Snap is on, or you will be unable to draw the lines shown.
Switching Isometric Planes

If you tried to draw the boxes in the preceding section with Ortho on, you discovered that it is impossible. Without changing the orientation of the crosshairs, you can draw in only two of the three isometric planes. To utilize Ortho for accuracy and speed, you have to be able to switch planes. There are several ways to do this, but the simplest, quickest, and most convenient way is to use the <F5> key (or <Ctrl>+E).

Before beginning, take a look at Figure 11-4, which shows the three planes of a standard isometric drawing. These planes are often referred to as top, front, and right. However, AutoCAD’s terminology is top, left, and right. While there are differences in the naming of the isometric planes, in this chapter, the AutoCAD terminology is used when referring to the isometric planes.
Now look at Figure 11-5, you can see how the isometric crosshairs are oriented to draw in each of the planes. The gridlines change for each isoplane as well. They will be at 90° and 150° for the left isoplane, 30° and 150° for the top isoplane, and 30° and 90° for the right isoplane.

Figure 11-4
Isometric planes

Figure 11-5
Isometric crosshairs

✓ Press <F5> (or <Ctrl>+E) to switch from left to top.
   You can also open the Isoplane drop-down menu to the right of the ISODRAFT tool on the status bar to switch among the planes. The advantage of <F5> is that you can switch while drawing without moving your cursor away from the object you are drawing.

✓ Press <F5> again to switch from top to right.

✓ Press <F5> once more to switch back to left.

✓ Now turn Ortho on and draw a box outline like the one in Figure 11-6. You need to switch planes several times to accomplish this. Notice that you can switch planes using <F5> without interrupting the LINE command. If you find that you are in the wrong plane to construct a line, switch planes. Because every plane allows movement in two of the three directions, you can always move in the direction you want with one switch. However, you may not be able to hit the snap point you want. If you cannot, switch planes again.
Chapter 11

Using COPY and Other Edit Commands

Most commands work in the isometric planes just as they do in standard orthographic views. In this exercise, you construct an isometric view of a bracket using LINE and COPY. Then you draw angled corners using CHAMFER. In the next exercise, you will draw a hole in the bracket with ELLIPSE, COPY, and TRIM.

- Erase the boxes you previously drew and check to see that Ortho mode is on.
- Switch to the left isoplane.
- Click the Line tool on the ribbon.
- Draw the L-shaped object shown in Figure 11-7. Notice that this is drawn in the left isoplane and that it is 3.00 units high by 4.00 units long by 1.00 unit wide.
- Next, you copy this object 4.00 units back to the right to create the back surface of the bracket.
- Click the Copy tool on the ribbon.
- Select all the lines in the L.
- Right-click to end object selection.
- Specify a base point at the inside corner of the L. It is a good exercise to keep Ortho on, switch planes, and move the object around in each plane. You can move in two directions in each isoplane. To move the object back to the right, as shown in Figure 11-8, you must be in either the top or the right isoplane.
Switch to the top or right isoplane and specify a second point of displacement 4.00 units back to the right, as shown in Figure 11-8.

Press <Enter> to exit COPY.

Enter the LINE command again and draw the connecting lines in the right plane, as shown in Figure 11-9.
Creating Chamfers in an Isometric View

Keep in mind that inclined edges in an isometric view do not show true lengths. Edges of inclined planes must be drawn between endpoints located along vertical or horizontal paths in one of the three drawing planes. In this exercise, you create inclined edges by using the `CHAMFER` command to cut the corners of the bracket. This is no different from using `CHAMFER` in orthographic views.

1. Click the Chamfer tool from the Fillet/Chamfer drop-down menu on the Modify panel on the ribbon’s Home tab.
2. Right-click and select Distance from the shortcut menu. AutoCAD prompts for a first chamfer distance.
3. Type 1 <Enter>.
4. Press <Enter> to accept 1.00 as the second chamfer distance.
5. Select the top and left back edges of the bracket to create a chamfer, as shown in Figure 11-10.
6. Repeat the CHAMFER command.
7. Chamfer the other edges so that your drawing resembles Figure 11-10.
8. To complete the bracket, start the LINE command and draw lines between the new chamfer edges.
9. Finally, erase the two unseen lines on the back surface and the two corner lines left “in space” from the creation of the chamfers to produce what’s shown in Figure 11-11.
Isometric circles in AutoCAD. In this exercise, you use the latter capability to construct a hole in the bracket.

To begin, you should have the bracket shown in Figure 11-11 in your drawing.

To draw an isocircle, you need a center point. Often, it is necessary to locate this point carefully using temporary lines, object snap tracking, or point filters. You must be sure that you can locate the center point before entering the ELLIPSE command.

In this case, it is easy because the center point is on a snap point.
Type `ellipse <Enter>` at the Command prompt. 

*There is an Ellipse tool on the ribbon, but this automates an initial option and does not give you access to the Isocircle option.*

**AutoCAD prompts:**

Specify axis endpoint of ellipse or [Arc/Center/Isocircle]:

*The option you want is Isocircle. Ignore the others for the time being.*

Select **Isocircle** from the command line, or right-click and select **Isocircle** from the shortcut menu.

**AutoCAD prompts:**

Specify center of isocircle:

*If you could not locate the center point, you would have to exit the command now and start over.*

Use the **Snap Mode** and **Grid Mode** tools to specify the center of the ellipse, as shown in Figure 11-12. If you have drawn your object with the suggested dimensions, the center point will be over 2 units and back 2 units from the top-front corner of the bracket.

**Figure 11-12**

Ellipse isocircle

*AutoCAD presents you with an isocircle to drag, as in the CIRCLE command. The isocircle you see depends on the isoplane you are in. To understand this, try switching planes to see how the preview changes.*

Drag the cursor to define the radius of the isocircle and then press `<F5>` to switch isoplanes. Observe the isocircle. Try this two or three times.

Switch to the top isoplane before moving on.

**AutoCAD prompts for a radius or diameter:**

Specify radius of isocircle or [Diameter]:

*A radius specification is the default here, as it is in the CIRCLE command.*
Specify a point so that your isocircle resembles the one in Figure 11-12.

Next, you use the **COPY** and **TRIM** commands to create the bottom of the hole.

Start the **COPY** command.

Select the isocircle.

Right-click to end object selection.

Specify the top-front corner of the bracket.

*Any point can be used as the base point. By specifying the top-front corner, the bottom-front corner gives you the exact thickness of the bracket.*

Specify the bottom-front corner. Make sure you are in an isoplane that allows movement from top to bottom (the left or right isoplanes).

Your drawing should now resemble Figure 11-13. The last thing you must do is trim the hidden portion of the bottom of the hole.

Press `<Enter>` to exit **COPY**.

Start the **TRIM** command.

Select **cutting edges** from the command line, or right-click and select **cutting edges** from the shortcut menu.

Select the first isocircle as a cutting edge.

*It may help to turn off snap to make these selections.*

Right-click to end cutting edge selection.

Select the hidden section of the lower isocircle.

Press `<Enter>` to exit **TRIM**.

*The bracket is now complete, and your drawing should resemble Figure 11-14.*
Adding text to isometric drawings has some challenges you may not have encountered previously. To create the appearance that text aligns with an isometric plane, it needs to be altered in two ways. First, the whole line of text needs to be rotated to align with one side of the plane. Second, the obliquing angle of individual characters needs to be adjusted to match the plane’s tilt. Rotation angle, you recall, is handled through the command sequence of the TEXT command. Obliquing angle is set as a text style characteristic using the STYLE command.

Typically, text in an isometric drawing aligns with one of the three isometric planes. In order to demonstrate how this works, you add a single-line text object to each of the planes of the bracket, as shown in Figure 11-15. Though you will be drawing on three planes, you can accomplish this with only two new text styles. These will be simple variations of the Standard text style, with the oblique angles needed for isometric alignment. The right isoplane will use a 30° oblique angle, while the top and left planes will use a −30° angle.

To begin, you should be in the bracket drawing created in the previous sections. Isometric snap and grid modes should be enabled.

Click the Home tab, expand the Annotation panel, and then click the Text Style tool in the top left, next to the name of the current text style (Standard).

This opens the Text Style dialog box. The first new text style you create will be used for drawing text on the right isoplane. If you look at Figure 11-15, you can see that this text (the word Right) is rotated along the 30° X-axis of the isoplane. What may be less obvious is that the individual characters are also drawn at a 30° oblique angle. You enter the rotation angle when creating the text. Here, you set the oblique angle for this plane.
In the **Text Style** dialog box, click the **New** button.

- In the **New Text Style** dialog box, type **isotext30**.
- Click **OK**.
- Change the **Oblique Angle** to **30**.
- Click **Apply**.

You repeat these steps to create a style with a 30° obliquing angle.

- Click the **New** button.
- In the **New Text Style** dialog box, type **isotext-30**.
- Click **OK**.
- Change the **Oblique Angle** to **-30**.
- Click **Apply**.

- Highlight **isotext30** in the **Styles** list.
- If you see a message saying the current text style has been modified, click **Yes**.

You should now be back in the drawing with **isotext30** as the current text style. You are now ready to add the single-line text.

- Click the **Set Current** button.
- Click **Close**.

- Make sure to be on the right isoplane. Press <F5> to cycle through the isoplanes until you get to the right isoplane.

- On the **Annotation** panel, click the **Multiline Text/Single-line** text drop-down menu and choose the **Single Line** text tool.

- Use the **Justify** option and set the justification for the new text to **Middle Center (MC)**.

---

*Figure 11-15*

Drawing text in isometric view
Specify the middle point on the right front of the bracket, as shown by the placement of the word Right in Figure 11-15.

Specify a text height of .30.

Type 30 <Enter> for the rotation angle.

Type Right <Enter>.

Press <Enter>.

The word Right should be drawn on the bracket, as shown in Figure 11-15. Now draw the word Left on the left isoplane, as shown. This will use the isotext-30 style and a rotation angle of –30°.

Expand the Annotation panel and select isotext-30 from the Text Style drop-down list.

Press <F5> to set the left isoplane current.

Click the Single Line text tool from the Annotation panel.

Specify the middle point on the left side of the bracket, as shown by the placement of the word Left in Figure 11-15.

Specify a text height of .30.

Type –30 <Enter> for the rotation angle.

Type Left <Enter>.

Press <Enter>.

Finally, for text in the top isoplane, use isotext-30 with a rotation angle of +30°.

Press <F5> to set the top isoplane current.

Click the Single Line text tool from the Annotation panel.

Specify the middle point on the top of the bracket, as shown by the placement of the word Top in Figure 11-15.

Press <Enter> for a text height of .30.

Type 30 <Enter> for the rotation angle.

Type Top <Enter>.

Press <Enter>.

Your drawing should resemble Figure 11-15.

This completes the present discussion of isometric drawing. You can find more in the drawing suggestions at the end of this chapter.

Next, you go on to exploring the nonisometric use of the ELLIPSE command and saving named views with the VIEW command.

Drawing Ellipses in Orthographic Views

The ELLIPSE command is important not only for drawing isocircles but also for drawing true ellipses in orthographic views. There is also an option to create elliptical arcs.
An ellipse is determined by a center point and two perpendicular axes of differing lengths. In AutoCAD, these specifications can be shown in two nearly identical ways, each requiring you to show three points (see Figure 11-16). In the default method, you show two endpoints of an axis and then show half the length of the other axis, from the midpoint of the first axis out. (The midpoint of an axis is also the center of the ellipse.) The other method allows you to specify the center point of the ellipse first, then the endpoint of one axis, followed by half the length of the other axis.

✓ In preparation for this exercise, return to the standard Snap mode and Grid mode by clicking the ISODRAFT tool on the status bar to turn off the Isometric Snap mode.

Your grid is returned to the standard pattern of lines, and the cross-hairs are horizontal and vertical again. Notice that this does not affect the isometric bracket you have just drawn.

You briefly explore the ELLIPSE command and draw some standard ellipses.

![Figure 11-16](image-url)

**Figure 11-16**
Ellipse axis and center

✓ Ortho should be off for this exercise.

✓ On the Home tab, click the Ellipse drop-down menu on the Draw panel and then select the Axis, End tool, as shown in Figure 11-17.

AutoCAD prompts:

Specify axis endpoint of ellipse or [Arc/Center]:

✓ Specify the axis endpoint, as shown by P1 on the ellipse at the lower left in Figure 11-18.

AutoCAD prompts for the other endpoint:

Specify other endpoint of axis:
Specify the second endpoint, as shown by P2.

As you drag the rubber band, a preview of the ellipse is updated to show the length of the other axis. Only the length of the rubber band is significant; the angle is already determined to be perpendicular to the first axis. Because of this, the third point falls on the ellipse only if the rubber band happens to be exactly perpendicular to the first axis.

**Figure 11-17**
Ellipse Axis, End tool

**Figure 11-18**
Drawing standard ellipses

As before, the following prompt allows you to specify the second axis distance or a rotation around the first axis:

Specify distance to other axis or [Rotation]:

The Rotation option is awkward to use and is not explored here; see the AutoCAD Command Reference for more information.

Specify P3 as shown.

This point shows half the length of the other axis.
The first ellipse should now be complete. Next, you draw one by specifying the center point first, using the Center ellipse tool from the ribbon.

- Click the Center tool from the Ellipse drop-down menu on the ribbon’s Draw panel.
  
  *This uses the Center option.*
  
  AutoCAD prompts you for a center point:
  
  Specify center of ellipse:

- Specify the center point, as shown by P1 at the middle left in Figure 11-18.
  
  *Now, you have a rubber band stretching from the center to the end of an axis and the following prompt:*
  
  Specify endpoint of axis:

- Specify an endpoint, as shown by P2 in Figure 11-18.
  
  *The prompt that follows allows you to specify the second axis distance as before, or a rotation around the first axis:*
  
  Specify distance to other axis or [Rotation]:

- Specify an axis distance, as shown by P3.
  
  *Here again, the rubber band is significant for distance only. The point you specify falls on the ellipse only if the rubber band is stretched perpendicular to the first axis. Notice that it is not so in Figure 11-18.*

### Drawing Elliptical Arcs

Elliptical arcs can be drawn by trimming complete ellipses or using the ELLIPSE command’s Arc option. Using the Arc option, you first construct an ellipse using one of the two methods shown previously and then define the arc of the ellipse that you want to keep.

- Click the Elliptical Arc tool from the Ellipse drop-down menu on the ribbon’s Draw panel.

- Specify the first axis endpoint, as shown by P1 at the upper left in Figure 11-18.

- Specify the second endpoint, P2 in the figure.

- Specify P3 to indicate the second axis distance.
  
  AutoCAD draws an ellipse as you have specified, but the object is only temporary. Now, you need to show the arc you want drawn.
  
  *The two options are Parameter and Included angle. Parameter takes you into more options that allow you to specify your arc in different ways, similar to the options of the ARC command. Stick with the default option here.*

- Specify P4 to indicate the angle at which the elliptical arc begins.
  
  *Move the cursor slowly along the ellipse’s preview, and you can see all the arcs that are possible, starting from this angle.*

- Specify P5 to indicate the end angle and complete the ellipse.
Chapter 11

Isometric Drawing

Saving and Restoring Displays with VIEW

The word view in connection with the VIEW command has a special significance in a drawing. It refers to any set of display boundaries that have been named and saved using the VIEW command. It also refers to a defined 3D viewpoint that has been saved with a name. Saved views can be restored by direct reference rather than by redefining the location, size, or viewpoint of the area to be displayed. VIEW can be useful in creating drawing layouts and when you know you will be returning frequently to a certain area of a large drawing. It saves you from having to zoom out to look at the complete drawing and then zoom in again on the area you want. It can also save time in creating a 3D viewpoint. In this chapter, you learn to use 2D views only.

Imagine that you have to complete some detail work on the area around the hole in the bracket and also on the top corner. You can define each of these as a view and jump back and forth at will.

✔ To begin this exercise, you should have the bracket in your drawing, as shown in Figure 11-19.

✔ Type view <Enter> or click View > Named Views > View Manager from the ribbon, as shown in Figure 11-20.

This displays the View Manager dialog box shown in Figure 11-21. At the left is a list of views, including Current, Model Views, Layout Views, and Preset Views. In this chapter, you only work with the Current view, which you define and name.

Figure 11-19
Defining views
Click the **New** button.

This takes you to the **New View/Shot Properties** dialog box shown in Figure 11-22. Notice that the **Current Display** option is selected in the **Boundary** panel. All you have to do is give the current display a name to save it as a named view.

Type **bracket** in the **View Name** edit box.

Click **OK**.

The **View Manager** dialog box reappears, with **bracket** now showing under the **Model Views** heading. All views defined in model space will be listed as **Model Views**. Views defined in paper space will be listed as **Layout Views**. Next, you use a window to define a model space with a smaller area as a view.
Click the **New** button to return to the **New View/Shot Properties** dialog box.

Type **hole** in the **View Name** edit box.  

*This view zooms in on the hole.*

Select the **Define Window** option in the **Boundary** panel.  

*The dialog box closes, giving you access to the drawing area where the current view is outlined. The rest of the drawing is grayed out.*

Specify the first and second corners to define a window around the hole in the bracket, as shown previously in Figure 11-19.  

*A window outline of the new view is shown, with the rest of the drawing grayed out.*

Press **<Enter>** to return to the **New View/Shot Properties** dialog box.  

Click **OK** to save the named view.  

*You are now back in the View Manager dialog box with bracket and hole in the list of Model Views. Define one more view to show the upper-left corner of the bracket, as shown in Figure 11-19.*

Click the **New** button.

Type **corner** for the view name.

Select the **Define Window** option.

Define a window, as shown in Figure 11-19.

Press **<Enter>** to return to the dialog box.

Click **OK** to close the **New View/Shot Properties** dialog box.  

*You have now defined three model views. To see the views in action, you must set them as current. Notice that the new view names are now displayed in a list on the Views panel, as shown in Figure 11-23.*
Double-click **hole** in the **Views** list.

Click **OK**.  
*Your drawing should resemble Figure 11-24.  
Now, switch to the corner view.*

Instead of using the **View Manager** again to set a view current, click the **Views** drop-down list on the ribbon’s **Named Views** panel.

Select **corner** from the **Views** list.  
*Your drawing should resemble Figure 11-25.*
Figure 11-25
Corner view
Chapter Summary

In this chapter, you were introduced to using the grid display and Snap mode to facilitate drawing geometry other than the standard orthographic 2D representation. You learned the use of the isometric grid to create an isometric drawing. In this mode, grid lines were shown at 30°, 90°, and 150° angles, and the crosshairs were oriented to the top, left, and right iso-planes. You used the <F5> key to switch among these planes, and the LINE, COPY, and TRIM commands to draw simple objects in isometric ori-entation. You also drew single-line text aligned with each of the three iso-planes. You also learned the use of the ELLIPSE command to create ellipses that appear as circles in isometric planes and also drew ellipses in standard orthographic views. Finally, you were introduced to the VIEW command, which allows you to define any display as a named view that can be restored at any time.

Chapter Test Questions

Multiple Choice

Circle the correct answer.

6. Change to this to align the grid with isometric planes:
   a. Change grid to polar  
   b. Change grid to isometric  
   c. Change grid to 2D model space  
   d. Change snap to 2D model space

7. Which of these does not name an isoplane in AutoCAD?
   a. Right  
   b. Left  
   c. Front  
   d. Top

8. The command used to draw circles in isometric views is
   a. ISOCIRCLE  
   b. ELLIPSE  
   c. ISOPLANE  
   d. CIRCLE

9. To align text with isometric planes, make changes to
   a. Rotation and oblique angles  
   b. Text style and alignment  
   c. Alignment style and rotation  
   d. Rotation angle and grid style

10. The minimum number of points required to define an elliptical arc are
    a. 2  
    b. 3  
    c. 4  
    d. 5
Matching

Write the number of the correct answer on the line.

a. Isoplane switch ______
b. Isocircle ______
c. Right isoplane text ______
d. Top isoplane text ______
e. Default view ______

1. Ellipse
2. 30°, 30°
3. 30°, –30°
4. <F5>
5. Current display

True or False

Circle the correct answer.

1. True or False: Isometric drawings are two-dimensional.
2. True or False: Isometric drawings show no true distances.
3. True or False: To draw an isometric circle, it is necessary to specify a center point.
4. True or False: To switch isoplanes, you must open the Drafting Settings dialog box.
5. True or False: Drawing isocircles is the same as drawing ellipses in orthographic views.

Questions

1. What are the angles of the crosshairs and grid lines in an isometric grid?
2. What are the names for the isometric planes in AutoCAD?
3. What is an isocircle? Why are isocircles drawn with the ELLIPSE command?
4. How many different isocircles can you draw with the same radius and the same center point?
5. What rotation angle and oblique angle are used to align text with each of the three isoplanes?

Drawing Problems

1. Using the isometric grid, draw a 4 × 4 square in the right isoplane.
2. Copy the square back 4.00 units along the left isoplane.
3. Connect the corners of the two squares to form an isometric cube. Erase any lines that would be hidden in this object.
4. Use text rotation and obliquing to draw the word Top in the top plane of the cube so that the text is centered on the face and aligned with its edges. The text should be 0.5-unit high.
5. In a similar manner, draw the word Left at the center of the left side and the word Right at the center of the right side. All text should align with the face on which it is located.
Chapter Drawing Projects

Drawing 11-1: Isometric Projects
[INTERMEDIATE]

This drawing is a direct extension of the exercises in the chapter. It gives you practice in basic AutoCAD isometrics and in transferring dimensions from orthographic to isometric views.

Drawing Suggestions

- Set your grid to .50 and your snap to .25 to create all the objects in this project. Your grid should match the grid of this drawing. Notice that some lines do not fall on grid points, but halfway between.

- There is no Arc option when you use ELLIPSE to draw isocircles, so semicircles such as those at the back of the holes must be constructed by first drawing isocircles and then trimming or erasing unwanted portions.

- To draw the portion of the isocircle that shows the depth of a circle, copy the isocircle down or back, snapping from endpoint to endpoint of other lines in the view that show the depth.

- Often, when you try to select a group of objects to copy, there are many crossing lines that you do not want to include in the copy. This is an ideal time to use the Remove option in object selection. First, window the objects you want along with those nearby that are unavoidable, and then remove the unwanted objects one by one.

- Sometimes, you may get unexpected results when you try to trim an object in an isometric view. For example, AutoCAD divides an ellipse into a series of arcs and trims only a portion. If you do not get the results you want, use a Nearest object snap to control how the object is trimmed.
Drawing 11-1
Isometric projects
This drawing introduces text and combines a complete set of 2D views with an isometric representation of the object. Placing objects on different layers so they can be turned on and off during TRIM and ERASE procedures makes things considerably less messy.

**Drawing Suggestions**

- Use the box method to create the isometric view of this drawing. That is, begin with an isometric box according to the overall outside dimensions of the MP3 player. Then trim and add the details.
- The dial is made from isocircles with copies to show thickness. You can use the Tangent object snap to draw the front-to-back connecting lines.
- Use a gradient hatch for the video window area.
- Use the *isotext30* and *isotext-30* text styles created in this chapter for drawing the text on the left and right isoplanes, as shown.
Drawing 11-2
MP3 player
Drawing 11-3: Fixture Assembly [ADVANCED]

This is a difficult drawing. It takes time and patience but teaches you a great deal about isometric drawing in AutoCAD.

Drawing Suggestions

• This drawing can be completed either by drawing everything in place as you see it or by drawing the parts and moving them into place along the common centerline that runs through the middle of all the items. If you use the former method, draw the centerline first and use it to locate the center points of isocircles and as base points for other measures.

• As you go, look for pieces of objects that can be copied from other objects. Avoid duplicating efforts by editing before copying. In particular, when one object covers part of another, be sure to copy it before you trim or erase the covered sections.

• To create the chamfered end of Item 4, begin by drawing the 1.00-diameter cylinder 3.00 long with no chamfer. Then, copy the isocircle at the end forward 0.125. The smaller isocircle is 0.875 (7/8) because 0.0625 (1/16) is cut away from the 1.00 circle all around. Draw this smaller isocircle and trim away everything that is hidden. Then draw the slanted chamfer lines using `LINE`, not `CHAMFER`. Use the same method for Item 5.

• In both the screw and the nut, you need to create hexes around isocircles. Use the dimensions from a standard bolt chart.

• Use three-point arcs to approximate the curves on the screw bolt and the nut. Your goal is a representation that looks correct. It is impractical and unnecessary to achieve exact measures on these objects in the isometric view.
Chapter 11
Isometric Drawing
Drawing 11-4: Flanged Coupling [ADVANCED]

The isometric view in this three-view drawing must be completed working off the centerline.

Drawing Suggestions

- Draw the major centerline first. Then, draw vertical centerlines at every point where an isocircle is to be drawn. Make sure to draw these lines extra long so they can be used to trim the isocircles in half. By starting at the back of the object and working forward, you can take dimensions directly from the right-side view.

- Draw the isocircles at each centerline and then trim them to represent semicircles.

- Use the Endpoint, Intersection, and Tangent object snaps to draw horizontal lines.

- Trim away all obstructed lines and parts of isocircles.

- Draw the four slanted lines in the middle as vertical lines first. Then, with Ortho off, change their endpoints, moving them 0.125 closer.

- Remember, MIRROR does not work in the isometric view, although it can be used effectively in the right-side view.

- Use HATCH to create the crosshatching.

- If you have made a mistake in measuring along the major centerline, STRETCH can be used to correct it. Make sure Ortho is on and you are in an isoplane that lets you move the way you want.
Drawing 11-4
Flanged coupling
Drawing 11-5: *Garage Framing* [ADVANCED]

This is a fairly complex drawing that takes lots of trimming and careful work. Changing the **SNAPANG** (snap angle) variable so that you can draw slanted arrays is a method that can be used frequently in isometric drawing.

**Drawing Suggestions**

- You will find yourself using **COPY**, **ZOOM**, and **TRIM** a great deal. **OFFSET** also works well.

- You may want to create some new layers with different colors. Keeping different parts of the construction walls, rafters, and joists on different layers allows you to have more control over them and adds a lot of clarity to what you see on the screen. Turning layers on and off can considerably simplify trimming operations.

- You can cut down on repetition in this drawing by using arrays on various angles. For example, if the **SNAPANG** variable is set to 150°, the 229 wall in the left isoplane can be created as a rectangular array of studs with 1 row and 17 columns set 160 apart. To do so, follow this procedure:

  1. Type `snapang` and press `<Enter>`.
  2. Enter a new value so that rectangular arrays are created at isometric angles (30° or 150°).
  3. Enter the **ARRAY** command and create the array. Use negative values where necessary.
  4. Trim the opening for the window.

- One alternative to this array method is to set your snap to 16" temporarily and use **COPY** to create the columns of studs, rafters, and joists. Another alternative is to use the grip edit offset snap method beginning with an offset snap of 16" (i.e., press `<Shift>` when you show the first copy displacement and continue to hold down `<Shift>` as you make other copies).

- The cutaway in the roof that shows the joists and the back door is drawn using the standard nonisometric **ELLIPSE** command. Then, the rafters are trimmed to the ellipse, and the ellipse is erased. Do this procedure before you draw the joists and the back wall. Otherwise, you will need to trim these as well.

- Use **CHAMFER** to create the chamfered corners on the joists.
Drawing 11-5
Garage framing
The objective of this exercise is to complete the isometric view of the tee using dimensions from the three-view drawing. Begin this isometric by working off the centerline.

Drawing Suggestions

- Be sure Ortho is on and you are in an isoplane that is correct for the lines you want to draw. Take full advantage of object snaps as you complete this drawing.

- First, draw the two major centerlines to exact length, as shown in the isometric view. Then, draw vertical centerlines at every point where an isocircle is to be drawn. These centerlines should be drawn longer so the isocircles can be trimmed more easily. Notice that OFFSET and MIRROR do not work very well in isometric drafting.

- After establishing the centerlines, draw the isocircles for the three flanges.

- When you have completed the flanges, draw the isocircles for the wall of the tee.

- Draw all horizontal and vertical lines and trim away all nonvisible lines and parts of the isocircles. Fillet the required intersections.

- After completing the outline of the tee, use HATCH to create the cross-hatching.
Drawing 11-6
Cast iron tee

Ø8 THRU 4 HOLES
EQ SPACED
ON Ø5 3/4
BOLT CIRCLE
TYP 3 FLANGES

ALL FILLETS & ROUNDS 1/8R

3/4 TYP

1 1/2 TYP
Drawing 11-7: Valve [ADVANCED]

For the purposes of this chapter, the isometric view is most important. The three detail views, the title block, and the border can be included or not, as assigned.

Drawing Suggestions

- Use the box method to create the isometric view in this drawing. Begin with an isometric box according to the overall outside dimensions of the valve. Then go back and cut away the excess so the drawing becomes half the valve, exposing the interior details of the object.

- As in all section drawings, no hidden lines are shown.

- In addition to flat surfaces indicated by hatching, the interior is made up of isocircles of different sizes on different planes.

- Keep all construction lines and centerlines until the drawing is complete. (Draw them on a separate layer, and you can turn off that layer when you no longer need them.)

- The tapped holes are drawn with a series of isocircles that can be arrayed. This is only a representation of a screw thread, so it is not drawn to precise dimensions. Draw one thread, and copy it to the other side.
**Drawing 11-7**
Valve

![Valve Diagram]
This page intentionally left blank
## Index

### Symbols

#### 2D outlines
- 3D solids from, 680–681
  - extruding, 680–681
  - helixes, 685–686
  - helixes, sweep and, 686–687
  - revolving, 682–684

#### 3D Basics workspace, 4, 589

#### 3DFLY command, 689–691

#### 3DFORBIT command, 673–676

#### 3D modeling
- chamfers, 605–606
- chapter test questions, 634–635
- coordinates, entering, 581
- DUCS (dynamic user coordinate system), 596–599
- fillets, 607–608
- gizmos, 609–611
- multiple view layouts, 629–633
- Object Snap, 583–584
- point filters, 582–583
- rectangle, 585–586
- rendering models, 611
  - adding materials, 612–613
  - background, 618–619
  - geographic location, lighting and, 627
  - Lights in Model palette, 624–625
  - naming views, 618–619
  - point light, 625
  - presets, 614–618
  - render window, 614–618
  - spotlight, 620–622
  - sunlight editing, 626–627
- solid modeling
  - 3D Basics workspace, 589
  - boxes, 590–593
  - SUBTRACT, 599
  - wedges, 590–593
- UCS (user coordinate system), 584–588
  - moving, 588
  - origin, moved, 586
  - rectangle, 587
  - rotating, 588

### ViewCube and, 628
- visual styles, 594
- wireframe model, 578

#### 3D Modeling workspace, 4, 629

#### 3DORBIT command, 672–677

#### 3D solids from 2D outlines, 680
- extruding, 680–681
- helixes, 685–686
- helixes, sweep and, 686–687
- PRESSPULL, 681
- REVOLVE, 682–684

#### 3DWALK command, 689–691

#### 3-point arcs, 191–192
- # sign, absolute coordinates, 28

### A

- absolute coordinates, 9, 23–24
  - # sign, 28
- acad3D template, 589
- acquired points, 232
- Add-a-Plotter Wizard, 164
- Add-ins tab, 6
- aliases, 14
- Aligned dimensional constraint tool, 436–437
- aligned text, 286–287
- alignment paths, 232
- alignment wheel drawing project, 218
- angled text, 288
- angles, polar tracking and, 198
  - copy and, 199–200
  - rotate and, 199–200
- angular dimensions, 354–356
  - arcs, 356
  - circles, 356
- Angular dimension tool, 354–356
- animated walk-through, 692, 694
- ANIPATH command, 692–694
- Annotate tab, 6
- annotation
  - multileaders, 359–361
  - Leaders tool palette, 362–366
  - scale, visibility, 381–383
Annotation panel, 6, 300–304
Annotation Visibility tool, 383
Annotative dimension style, 381–383
annotative objects, scales, 383–386
Annotative Object Scale dialog box, 385
Annotative property, 300, 380–381, 464
ANSI (American National Standards Institute) standard, 147
aperture wheel drawing project, 90
application button, 6
application menu, 6
opening, 17
application window, 5
drawing file tabs, 6
InfoCenter, 6
Quick Access toolbar, 6
ribbon, tabs, 6
arcball, 673–676
ARC command, 190–194
Archimedes spiral drawing, 268
arcs, 190–191
3-point, 191–192
angular dimensions, 356
chapter test questions, 209–211
dimensioning, 357
diameter dimensions, 357–358
radius dimensions, 359
donuts, 410
drawing projects
alignment wheel, 218
dials, 216
flanged bushing, 214
hearth, 212
index guide, 222
mallet, 220
elliptical, 554
lengthening, 249
segments, 417–419
shortening, 249
Start, Center, Angle tool, 194
Start, Center, End tool, 192–193
three point, rotating, 195–196
ARRAYPOLAR command, 188
ARRAYRECT command, 155–161
arrays
associativity, 161
chapter test questions, 167–169
contextual tab and, 157–158
drawing projects
classroom floor plan, 182
floor framing, 178
grill, 172
pin trailer wiring diagram, 170
test bracket, 176
wall framing, 180
weave, 174
grips, multifunctional, 158–161
polar, 156
polar arrays, 186, 188
defining, 185
preview array, 187
row count, 188
rectangular, 156
associative arrays, 161
associative dimensions, 368–369
changing associativity, 370–371
Attach External Reference dialog box, 498
Attribute Definition dialog box, 507
attributes
block definitions, 506
Block Definition panel, 507–511
Define Attributes tool, 507–511
blocks, 464
definitions, editing, 512
inserting, 511
values, editing, 512
chapter test questions, 526–527
definition, 464
extracting data, 516–520
AutoComplete
cmdommand entry and, 14
cmdommand line and, 16–17
AutoConstraint tool, 441-444
AutoCorrect, command line and, 16–17
Autodesk App Stores, 6
Autodesk Assistant, 69
Auto-hide feature, 504–505
Axis, End tool, 552
B
baseline dimensions, 347
DIMBASELINE command, 348
base plate drawing project, 132
Base Point, 198, 308
BEDIT command, 476–478
bill of materials, 534
Block Definition dialog box, 467
Block Editor, 475
Block panel, 6
Block Properties Table dialog box, 488–489
blocks
  Annotative property, 464
  attributes, 464, 506
    Block Definition panel, 507–511
    Define Attributes tool, 507–511
    definitions, editing, 512
    inserting, 511
    values, editing, 512
chapter test questions, 526–527
commands, 470
constraints, 483–487
counting, data extraction, 520–521
creating, 467–470
definition, 463
dynamic, 467
  constraints, 483–487
  creating, 475–480
exploding, 523–524
  purging content, 524–525
inserting, 470
  AutoPlacement option, 474
  Blocks palette, 474–475
  Insertion Point, 474
  Insert tool, 471–474
parameters, 475
parts, multiple use, 534
replacing, 522
Test Block window, 480–482
workstation, 506
Blocks palette, 472–475
  Insertion Point, 474
block tables, data access, 487–491
Block Table tool, 488–489
Boolean operations, 590, 667–670
  cylinders, 668
  ViewCube, 667–669
borders, viewport, 318
BOX command, 591–592
boxes, 3D modeling, 590–593
BREAKATPOINT command, 249–250
BREAK command, 249–250
BREPLACE commands, 522
buttons
  Customization, 7
  Maximize Viewport button, 262
  mode buttons, 7
C
camera
  locations, 688–689
  position, 674–676
  target, 674–676, 688–689
Cartesian coordinate system, 9
  absolute coordinates, 9
  dynamic input display, 10–11
  ordered pairs, 9
cells (tables), 315
centered text, 285
CHAMFER command, 103, 118–119
chamfers
  chamfered corners, 115
  isometric view, 545
  solid modeling, 605–606
chapter test questions
  3D modeling, 634–635
  arcs, 209–211
  blocks, attributes, and external references, 526–527
  circles and drawing aids, 88–89
  dimensions, 388–389
  isometric drawing, 560–561
  layers, colors, and linetypes, 126–127
  modeling techniques, 696–697
  object snaps, 264–265
  polar arrays, 209–211
  polylines, 445–446
  resized objects, 264–265
  templates, copies, and arrays, 167–169
characters
  in macros, 748
  in menus, 748
Check Spelling dialog box, 298
Check Spelling tool, 298
CIRCLE command, 53, 317
3P option, 191–192

circles, 53, 60
angular dimensions, 356
center point, 60–64
chapter test questions, 88–89
diameter, 60–64
dimensioning, 357
diameter dimensions, 357, 358
radius dimensions, 359
drawing projects
aperture wheel, 90
center wheel, 92
fan bezel, 94
gasket, 98
sheet metal stamping, 100
switch plate, 96
isocircles, 546-548
radius, 60–61
Circle tool, 61
classroom floor plan drawing project, 182

Clipboard panel, 6
closing drawings, 34
Collaborate tab, 6
color
chapter test questions, 126–127
drawing projects
base plate, 132
half block, 136
mounting plate, 128
packing flange, 138
stepped shaft, 130
template, 134
Layer Properties Manager palette, 106–108
layers, 106–108

command entry
application menu, 17
AutoComplete and, 14
command line, 14
AutoComplete and, 16–17
AutoCorrect and, 16–17
transparency, 15
heads-up design and, 14
keyboard, 14
ribbon, 18
tooltips, 18–20

command line, 6
AutoComplete and, 16–17
AutoCorrect and, 16–17
command entry, 14–15
options, selecting, 54–55

commands
3DFLY, 689–691
3DFORBIT, 673–676
3DORBIT, 672–677
3DWALK, 689–691
aliases, 14
ANIPATH, 692–694
ARC, 190–194
ARRAYPOLAR, 188
ARRAYRECT, 155–161
BEDIT, 476–478
BOX, 591–592
BREAK, 249–250
BREAKATPOINT, 249–250
BREPLACE, 522
CENTERMARK, 162
CHAMFER, 103, 118–119
CIRCLE, 53, 191–192, 317
COPY, 149, 153–155, 543–545
DIMALIGNED, 344
DIMANGULAR, 355–356
DIMBASELINE, 348
DIMCONTINUE, 348
DIMDISASSOCIATE, 370
DIMEDIT, 367
DIMLINEAR, 343
DIMORDINATE, 351–353
DIMREASSOCIATE, 370–371
DONUT, 411–412
ELLIPSE, 546–548
ERASE, 53, 69–77
EXPLODE, 523–524
EXTEND, 240–244
FILL, 412–413
FILLET, 103, 115–116
FIND, 299
GROUP, 464–466
HATCH, 372–373
HELIX, 685–686
HELP, 66–69
INSERT, 470, 496–499
JOIN, 249–250
LENGTHEN, 249
LIMITS, 141, 143–144
LINE, 20, 544
LTSCALE, 114
MATCHPROP, 305–307
MEASUREGEOM, 250–253
MIRROR, 200–204
MOVE, 149–152
OFFSET, 289–291
OFFSET, 237–238
PAN, 103, 120
PEDIT, 419–421
PLINE, 413–419
POINT, 430–432
POLYGON, 408–410, 652
PRESSPULL, 681
PSETUPIN, 208
PURGE, 524–525
QDIM, 345–348
RECTANG, 53, 80–81, 441–442
repeating, 42
REVOLVE, 682–684
ribbon, 18
ROTATE, 195–198
SCALE, 307–310
SLICE, 654–655
SPELL, 298–299
SPLINEDIT, 425
STRETCH, 244–249
SUBTRACT, 590–604
Sweep, 686–687
TEXT, 282–551
TEXTALIGN, 284
TEXTEDIT, 292–293
tools, custom, 737–743
TRIM, 239–242
UCS, 351–584
Undo tool and, 28–29
UNITS, 58–59
WEDGE, 593
XCLIP, 515
Zoom, 12
ZOOM, 103, 120–121, 259–262

**composite solid, 591–593**
SUBTRACT, 599–604

**cones, 650**
frustum cones, 650–652
pyramids, 652–653

**Cone tool, 650**
connected objects, 244–249
constraint bars, 434
constraint parameters, 433
dimensional constraints, 436–438
geometric constraints, 434–436
Parameters Manager, 438–440
constraints
AutoConstrain tool, 441–442
generic constraints, 443–444
geometric, 443–444
inferred, 441–442
**Constraint Settings dialog box, 444**
**constructive solid geometry, 590**
context menus, 7
contextual tabs, 157–158
continuous dimensions, 346
DIMCONTINUE command, 348
**continuous orbit, 678–679**
control codes, 289
coordinate display, 8
absolute coordinates, 9, 23–24
Cartesian coordinate system, 9
dynamic input display, 10–11
ordered pairs, 9
polar coordinates, 23–24
Snap mode and, 21
coordinates
entering, 3D modeling, 581
point filters, 582–583
UCS, 3D modeling, 584–588
coordinate system
absolute coordinates, 28
DUCS (dynamic user coordinate system), 596–599
polar coordinates, 23
relative coordinates, 25
versus viewpoint, 584
copies
chapter test questions, 167–169
drawing projects
classroom floor plan, 182
floor framing, 178
grill, 172
pin trailer wiring diagram, 170
test bracket, 176
wall framing, 180
weave, 174
data extraction, 516–520
  counting blocks, 520–521
Data Extraction – Refine Data dialog box, 519
Data Extraction – Select Objects dialog box, 517
Data Extraction tool, 516
Data Extraction wizard, 516
dates, tables, 312–313
datum point, ordinate dimensions, 349–351
deck framing drawing, 276
degree symbol, 289
Design #1, 42
DesignCenter, 464, 499–505
  Auto-hide feature, 504–505
  tool palette creation, 522–523
  palette, 500
  Open Drawings tab, 500–503
dialog boxes
  Annotative Object Scale, 385
  Attach External Reference, 498
  Attribute Definition, 507
  Block Definition, 467
  Block Properties Table, 488–489
  Check Spelling, 298
  Constraint Settings, 444
  Create New Dimension Style, 337
  CUI, 745
  Data Extraction – Refine Data, 519
  Data Extraction – Select Objects, 517
  Drafting Settings, 55–57
  Drawing Units, 58–59
  Edit Attributes, 363–364
  Field, 314
  Find and Replace, 299
  Hatch and Gradient, 373
  Insert Table, 311
  Motion Path Animation, 694
  New Dimension Style, 338
  New View/Shot Properties, 556–557
  Override Current Style, 382
  Page Setup, 205–208
  Page Setup Manager, 256
  Path Name, 694
  Plot, 84, 163–166
  Plot Model, 36
  Point Style, 431
copy, polar tracking and, 199–200
COPYCLIP, 491–493
COPY command, 149, 153–155
  isometric drawing, 543–545
corners
  chamfered, 115
  editing, 118–119
  fillets, 115–116
  rounded, 115
  Trim mode, 117
Count mode, 520–521
Count palette, 520–521
Create Camera tool, 688–689
Create Light drop-down, 620
Create New Dimension Style dialog box, 337
crosshairs
  drawing window, 8
  Snap mode and, 21
crossing window, 73–74
CUI (Customize User Interface), 733–736
  Command List pane, 735
  Create a new command, 737
CUI dialog box, 745
  double-click actions, 747
  keyboard shortcuts, 747
  legacy, 748
  LISP files, 748
  menus, 747
  mouse buttons, 748
  partial customization files, 748
  Quick Access toolbar, 746
  Quick Properties palette, 747
  ribbon, 746
  rollover tooltips, 747
  shortcut menus, 747
  toolbars, 746
  workspaces, 746
current layer
  changing, 111–112
  managing, 113
custom workspace, 81–82
Customization button, 7
CUTCLIP, 491–493
cylinders, 602, 660–662
  Boolean operations, 668
  subobject filters, 662–664
Cylinder tool, 602
Property Settings, 306
Purge, 525
Save As, 146–147
Save Drawing As, 33
Select File, 34
Select Reference File, 497
Select template, 317
Template Options, 148
Text Style, 301–303
View Manager, 555–556, 579–618
dials drawing project, 216
diameter dimensions, 357–358
DIMALIGNED command, 344
DIMANGULAR command, 355–356
DIMBASELINE command, 348
DIMCONTINUE command, 348
DIMDISASSOCIATE command, 370
DIMEDIT command, 367
dimensional constraints, 436–438
dimensioning
arcs, 357
diameter dimensions, 357–358
radius dimensions, 359
center marks, 161–162
circles, 357
diameter dimensions, 357–358
radius dimensions, 359
dimensions
Aligned tool, 344
angular, 354, 355–356
arcs, 356
circles, 356
associative, 368–369
changing associativity, 370–371
baseline, 347
chapter test questions, 388–389
continuous, 346
diameter dimensions, 357–358
drawing projects
angle support, 402
flanged wheel, 392
knob, 394
mirror-mounting plate, 404
nose adapter, 396
panel, 400
plot plan, 398
tool block, 390
linear, 339–344
baseline, 347
continuous, 346
multiple, 345–348
Quick Dimension tool, 346
Linear tool, 344
multileaders, 359–366
ordinate, 349–353
datum point, 349–351
QDIM and, 349–351
series, 351–353
Quick Dimension tool, 346
radius dimensions, 359
scaling
model space, 377–386
paper space, 377–386
vertical, 343
Dimensions panel, 336
Dimensions Style Manager, 337, 382
dimension styles
creating, 335–336
primary units, 338
dimension text
DIMEDIT, 367
Properties palette, 368
Quick Properties palette, 368
DIMLINEAR command, 343
DIMORDINATE command, 351–353
direct distance entry, 26–27
displacement, moving objects and, 152
distance tool, 250
documents, 2. See also drawings
DONUT command, 411–412
donuts
drawing, 410–412
FILL command, 412–413
double tracking tooltip, 237
Drafting & Annotation workspace, 4, 578
Drafting Settings dialog box, 55–557
Draft Settings dialog box, 230
drawing aids
chapter test questions, 88–89
drawing projects
aperture wheel, 90
base plate, 132
center wheel, 92
fan bezel, 94
gasket, 98
half block, 136
mounting plate, 128
packing flange, 138
sheet metal stamping, 100
stepped shaft, 130
switch plate, 96
template, 134
drawing file tabs, 6
drawing points, 430–432
drawing projects
  3D solids from 2D drawings, 706
Archimedes spiral, 268
arcs and polar arrays
  alignment wheel, 218
dials, 216
  flanged bushing, 214
hearth, 212
  index guide, 222
mallet, 220
backgammon board, 448
base assembly, 534
CAD room, 530–531
cast iron tee, 572
circles and drawing aids
  aperture wheel, 90
center wheel, 92
  fan bezel, 94
gasket, 98
  sheet metal stamping, 100
switch plate, 96
clock face, 460
dartboard, 450
deck framing, 276
dimensions
  angle support, 402
  flanged wheel, 392
  knob, 394
  mirror mounting plate, 404
  nose adapter, 396
  panel, 400
  plot plan, 398
  tool block, 390
fixture assembly, 566
flanged coupling, 568
garage framing, 570
gazebo, 456
Globe, 702
grooved hub, 272
isometric projects, 562
layers, colors and linetypes
  base plate, 132
  half block, 136
  mounting plate, 128
  packing flange, 138
  stepped shaft, 130
  template, 134
link design, 270
MP3 player, 564
multiple-view layout, 273
office building, 458
office plan, 532
Pivot Mount, 704
printed circuit board, 452
race car, 454
Revolve Designs, 698
scooter assembly, 537
slotted flange, 274
sprocket, 266–267
suggestions, 711
Tapered Bushing, 700
templates, copies and arrays
  classroom floor plan, 182
  floor framing, 178
  grill, 172
  pin trailer wiring diagram, 170
  test bracket, 176
  wall framing, 180
  weave, 174
tool block, 278
valve, 574
drawings, 2. See also documents
  closing, 34
  example session, 34–36
    plotting drawing, 36–37
    printing drawing, 36–37
  new, 317–319
  opening, 32
  orientation, 164–165
  saved, opening, 34
  saving, 32
    Save As tool, 33
    Save tool, 33
templates, 317–319
drawing styles, templates, 336

drawing suggestions
  bushing mount, 640
  flange, 636
  link mount, 638
  picnic table, 642

Drawing Units dialog box, 58–59
drawing window, 6
  command line, 6
  crosshairs, 8
  Customization button, 7
  mode buttons, 7
  mouse actions, 7, 8
  navigation bar, 6
  status bar, 6
  UCS icon, 6
  ViewCube, 6

Draw panel, 20
DUCS (dynamic user coordinate system),
  596–599
.dwt extension, 3
dynamic blocks
  constraints, 483–487
  creating, 475–480
dynamic input, 8
Dynamic Input button, 13
dynamic input display, 10–11

E

Edit Attributes dialog box, 363–364
edit
  noun/verb, 69–71
  verb/noun, 69
Edit Polyline tool, 419
ELLIPSE command, 546–548
ellipses, orthographic views, 551–554
elliptical arcs, 554
Endpoint object snap, 227
<Enter> key, 24
  right-click mouse button, 24–25
ERASE command, 53, 69–77
  Add option, 76
  lassos, 74–76
  noun/verb editing, 70–71
  OOPS, 71

Remove option, 76
Select Similar, 77
verb/noun editing, 69
erasing lines, 30–31
<Esc> key, 24
EXPLODE command, 523–524
exploding blocks, 523–524
  purging content, 524–525
Express Tools tab, 6
EXTEND command, 240–244
  shifting to, 241
extents, 121
External Manager, 496–499
external references, 513–514
  chapter test questions, 526–527
  clipping, 515
  comparing, 515
  editing in place, 514
  inserting, 495–499
  reloading, 514

External References palette, 523–524

Extrude tool, 680–681
extruding, 680–681

F

fan bezel drawing project, 94
Favorites, Blocks palette, 472
Featured Apps tab, 6
Field dialog box, 314
fields (tables)
  inserting, 313–315
  updating, 316
FILL command, 412–413
FILLET command, 103, 115–116
fillets, 115–116
  multiple, 116
  solid modeling, 607, 608
  Trim mode, 117
fills, 375–377
filters
  objects, subobject, 662–664
  point filters, 582–583
Find and Replace dialog box, 299
FIND command, 299
flanged bushing drawing, 253–255
flanged bushing drawing project, 214
floor framing drawing project, 178
fonts, 300
    Annotation panel, 300–304
Free Orbit mode, 673–674
frozen layers, 113
frustum cones, 650–652

G
gasket drawing project, 98
GDrawing 1-1, 40
GDrawing 1-2, 42
GDrawing 1-3, 44
GDrawing 1-4, 46
GDrawing 1-5, 48
GDrawing 1-6, 50
geographic location, lighting and, 627
geometric constraints, 434–444
gizmos, 609–611
gradient fills, 375–377
grid, 11
    centering, Zoom command, 12
    settings, 54–55
    turning off, 318
Grid Mode button, 11, 13
grill drawing project, 172
grips, 70
    Base Point, 198
    copying and, 154–155
    mirroring and, 203–204
    moving objects and, 151–152
    multifunctional, arrays, 158–161
    rotating and, 197–198
    scaling with, 310
    section plane and, 657–658
    stretching and, 247–249
grooved hub drawing, 272
GROUP command, 464–466
groups
    creating, 464–466
    definition, 463
Groups panel, 6
Group tool, 466

H
half block drawing project, 136
Hatch and Gradient dialog box, 373
HATCH command, 372–373
hatching, automated, 372–373
Hatch tool, 372
heads-up design, 14
hearth drawing project, 212
HELIX command, 685–686
HELP command, 66–69
highlighting, rollover highlighting, 30
Home tab, 6

I
in-canvas property preview, 296
incremental (grid) snap, 20
index guide drawing project, 222
inferred constraints, 441–442
InfoCenter, 6
INSERT command, 470, 496–499
Insert Field tool, 313
Insert tab, 6
Insert Table dialog box, 311
Insert tool, 471–474
ISODRAFT tool, 540, 552
isometric drawing
    chamfers, 545
    chapter test drawing, 560–561
    COPY command, 543–545
    isocircles, 546–548
    isocircles, 546–548
    isoplanes, 541–542
    LINE command, 544
    Snap Mode tool, 539–540
isometric drawings
    drawing projects, 562
text, 549–551

J
JOIN command, 249–250
justified text, 282–284, 287
    aligned, 286–287
    centered, 285
    left-justified, 282
middle text, 286
multiline, 297
right-justified, 285

K

keyboard
command entry, 14
shortcuts, CUI dialog box, 747

L

lassos, 74–75
Last option, 74
Layer drop-down list, 113–114
Layer Properties Manager palette, 105–106
  colors, 106–108
  linetype, 108–110
  lineweights, 110–111
  properties, 113–114
layers, 103
  chapter test questions, 126–127
  colors, 106–108
  creating, 104–145
  current, 111–112
  managing, 113
  deleting, 114
drawing projects
  base plate, 132
  half block, 136
  mounting plate, 128
  packing flange, 138
  stepped shaft, 130
  template, 134
frozen, 113
linetypes, 108–110
locked, 114
properties, 113–114
regeneration, 113
text, 282
thawing, 113
unlocked, 114
Layers panel, 6
layouts, 142. See also plot layouts
  multiple views, 629–633

Layout tab, 7
Leaders tool palette, 362–366
  styles, 362
left-justified text, 282
legacy items, CUI dialog box, 748
LENGTHEN command, 249
lighting
  geographic location and, 627
  Lights in Model palette, 624–625
  point lights, 625
  spotlight, 620–622
  sunlight editing, 626–627
Lights in Model palette, 624–625
limits, 142
  setting, 143–144
LIMITS command, 141, 143–144
linear dimensions, 339–344
  baseline, 347
  continuous, 346
  multiple, 345–348
  ordinate, 349
    datum point, 349–351
    QDIM, 349–351
  Quick Dimension tool, 346
LINE command, 20
  <Esc> key, 24
  isometric drawing, 544
lines
  coordinate system
    absolute coordinates, 23
    polar coordinates, 23
  erasing, 30–31
  lengthening, 249
  Ortho mode, 31
  points, 20
    direct distance entry, 26–27
  Polar tracking, 31–32
  polylines, 119
  rubber band, 22
  shortening, 249
  Snap mode, 20
    coordinate display, 21
    crosshairs, 21
    grid snap, 20
    incremental snap, 20
Line tool (Draw panel), 20
linetypes
  chapter test questions, 126–127
drawing projects
  base plate, 132
  half block, 136
  mounting plate, 128
  packing flange, 138
  stepped shaft, 130
  template, 134
layers, 108–110
scale, 114
lineweights, 110–111
link design drawing, 270
Linking & Extracting panel, 516
LISP files, CUI dialog box, 748
locked layers, 114
LTSIZE command, 114

M
macros, 748
mallet drawing project, 220
Manager tab, 6
MATCHPROP command, 305–307
Match Properties tool, 305
Materials Browser tool, 612, 613
Maximize Viewport button, 262
MEASUREGEOM command, 250–253
measuring objects, 250–253
  closed area, 252
  distance between, 250
menu bar, 82
menus
  application, opening, 17
  application menu, 6
  characters in, 748
  context menus, 7
  CUI dialog box, 747
  shortcut menus, 24–25
  Workspace, 4
mesh modeling, 659–662
  Boolean operations, 667–670
  converting meshes to solids, 671–672
  cylinder, 660–664
  smoothing, 665–666
middle text, 286
midstring AutoComplete, 16–17
MIRROR command, 200–204
mirror images, 200–202
grips and, 203–204
MIRRTTEXT system variable, 530
mode buttons, 7
modeling, mesh modeling, 659–662
  Boolean operations, 667–670
  converting meshes to solids, 671–672
  cylinder, 660–664
  smoothing, 665–666
model space, 13, 142–143
  scaling dimensions, 377–386
  switching with paper space, 255–256
  text, 378–379
Model tab, 7
Modify panel, 6
Motion Path Animation dialog box, 694
mounting plate drawing project, 128
mouse
  context menus, 7
  drawing window, 7–8
  pick button, 7
  right-click button, 24–25
  scroll wheel
    panning, 120
    zooming, 120
mouse buttons, 748
MOVE command, 149–152
MTEXT command, 289–291, 293
multileaders, dimensions, 359–361
  Leaders tool palette, 362–366
Multileader tool, 360
multiline text, 289–291
  insertion point, 290
multiline text justification, 297
Multiline Text tool, 289
Multiple Points tool, 430
multiple-view layout, creating, 273
Multi-wrench drawing, 50

N
Named Views, 648–649
navigation bar, 6
New Dimension Style dialog box, 338
New View/Shot Properties dialog box, 556–557
nonrectangular viewports, 386
noun/verb editing, 69–71
NURBS (nonuniform rational B-spline), 422

O

objects
annotative, multiple scales, 383–386
blocks, 463
connected, 244–249
copying, 149, 153
grips and, 154–155
extending, 242–244
groups, 463
layers, 112
measuring, 250–253
closed object area, 252
distance between, 250
mirror images, 200–202
grips and, 203–204
moving, 149–152
parallel, OFFSET command, 237–238
revision clouds, creating, 428–430
selection methods, 71
Last option, 74
Previous option, 74
selection by crossing window, 73–74
selection by window, 72
shortening, 239–242
stretching, 244–246
grips and, 247–249
subjects, filters, 662–664
object selection window, 11
Object Snap, 226–228
3D modeling, 583–584
Object Snap button, 228
object snaps
chapter test questions, 264–265
Endpoint, 227
running, 228–232
single point, 77–79
Tangent, 227
tracking, 232
acquired points, 232
alignment paths, 232
point acquisition, 233–237

Object Snap shortcut menu, 229
OFFSET command, 237–238
offset distances, 238
OOPS, 71
opening drawings, 32
options, command line, 54–55
ordered pairs, coordinate system, 9
ordinate dimensions, 349–353
datum point, 349–351
QDIM, 349–351
series, 351–353
Ordinate dimension tool, 352
orientation of drawings, 164–165
Ortho, isometric planes, 541–542
orthographic views, ellipses in, 551–554
Ortho Mode, 31, 151
Output tab, 6
Override Current Style dialog box, 382

P

packing flange drawing project, 138
page setup, 205
creating, 205–208
importing, 208
Page Setup dialog box, 205–208
Page Setup Manager dialog box, 256
PAN command, 103, 120
panning, 120
scroll wheel, 120
paper size, 164
paper space, 13, 142
scaling dimensions, 377–386
switching with model space, 255–256
text, 378–379
Parallel geometric constraint tool, 434
parallel objects, OFFSET command, 237–238
parallel projection, 588
torus, 654
parameters, 438
blocks, 475
Parameters Manager, 438–440
Parameters Manager palette, 439–440
Parameters Manager tool, 486–487
parametric design, 433
  AutoConstrain tool, 441–442
    geometric constraints, 443–444
  dimensional constraints, 436–438
  geometric constraints, 434–436
  Parameters Manager, 438–440
Parametric tab, 6
partial customization files CUI dialog box, 748
PASTECLIP, 493–495
path arrays, 425–427
Path Array tool, 426–427
Path Name dialog box, 694
Pattern panel, 374–377
patterns
  gradient fill, 375–377
  predefined, 374–375
PEdit command, 419–421
perspective projection, 588
pin trailer wiring diagram, 170
plan view (WCS), 579
PLINE command, 413–419
plot area, 166
Plot dialog box, 84, 163
  Add-a-Plotter Wizard, 164
  drawing orientation, 164–165
  paper size, 164
  plot area, 166
  plot offset, 166
  Printer/plotter panel, 163
plot layouts, 253
  model space, 255–256
  modifying, 256–257
  multiple-view, 273
  opening, 254–255
  paper space, 255–256
  viewport creation, 258–259
Plot Model dialog box, 36
plot offset, 166
plot preview, 86
plotting, 36–37, 84
  area, 85
  multiple viewpoint drawing, 263
  page setup, 205–208
Plot tool, 36
point acquisition, 233–237
POINT command, 430–432
point filters, 582–583
point lights, 625
points
  drawing points, 430–432
  in lines, 20
  selecting
    Object Snap and, 226–228
    running object snaps, 228–232
text between, 287
Point Style dialog box, 431
Point Style tool, 431
polar arrays, 156, 186–188
  chapter test questions, 209–211
  defining, 185
  drawing projects
    alignment wheel, 218
    dials, 216
    flanged bushing, 214
    hearth, 212
    index guide, 222
    mallet, 220
  preview array, 187
  row count, 188
Polar Array tool, 186
polar coordinates, 23–24
polar tracking, 31–32, 198
  copy and, 199–200
  rotate and, 199–200
POLYGON command, 408–410, 652
polygons, 408
  circumscribed option, 409–410
drawing, 408–410
  edge option, 409–410
  pyramids, 652
polylines, 119
  arc segments, 417–419
  chapter test questions, 445–446
decurved, 421
  donuts, 410–412
  editing, 419–421
FILL command, 412–413
  lengthening, 249
  path arrays, 425, 427
  polygons, 408–410
  rectangle, 415
  segments, 413–417
  shortening, 249
  splines, 422–425
  width, 420
Polyline tool, 414–415
polysolids, 646
Position Locator palette, 689–691
Preset Views, 677
PRESSPULL command, 681
preview array, 187
Previous option, 74
printing, 84
    Plot area, 85
    plot preview, 86
    selecting a printer, 85
printing drawings, 36–37
projection
    parallel, 588
    perspective, 588
properties
    changing, 305–307
    definition, 294
    layers, 113–114
    text, 294–297
Properties palette, 368
Properties panel, 6
Property Settings dialog box, 306
PSETUPIN command, 208
PURGE command, 524–525
Purge dialog box, 525
pyramids, 652–653
rendering 3D models, 611
    adding materials, 612–613
    background, 618–619
    geographic location, lighting and, 627
    Lights in Model palette, 624–625
    Lights in point light, 625
    multiple view layouts, 629–633
    naming views, 618–619
    presets, 614–618
    rendering window, 614–618
    spotlight, 620–622
    sunlight editing, 626–627
    ViewCube, 628
Render Presets Manager, 615
Render tool, 617
Render to Size tool, 614
replacing blocks, 522
Reset Views, 677
restoring, VIEW command and, 555–558
revision clouds, 427–430
Revision Cloud tool, 427–428
REVOLVE command, 682–684
ribbon, 6, 18
    Add-ins tab, 6
    Annotate tab, 6
    Annotation panel, 300–304
    Collaborate tab, 6
    CUI dialog box, 746
    Express Tools tab, 6
    Featured Apps tab, 6
    Home tab, 6
    Insert tab, 6
    Manager tab, 6
    maximizing, 18
    minimizing, 18
    Output tab, 6
    Parametric tab, 6
    View tab, 6
ribbon pane, customized, 734–736
right-justified text, 285
rollover highlighting, 30
rollover tooltips, CUI dialog box, 747
ROTATE command, 195–198
Rotate Gizmo tool, 670
Rotate tool, 196
Q
QDIM command, 345–348
    datum point, 349–351
quadrants, 78
Quick Access toolbar, 6, 746
Quick Dimension tool, 346
Quick Properties palette, 294–297, 368, 747
R
radius dimensions, 359
Recent tab, 4
RECTANG command, 53, 80–81, 441–442
rectangular arrays, 156
reference, scaling by, 309
regeneration, 113, 134
relative coordinates, 25
rotating, 195–196
grips, 197–198
polar tracking and, 199–200
Reference option, 196
UCS, 588
rounded corners, 115
rubber band, 22
running object snaps, 228–232

S

Save As dialog box, 146–147
Save Drawing As dialog box, 33
Save tool, 33
saving drawings, 32
opening saved, 34
Save As tool, 33
Save tool, 33
VIEW command and, 555–558
scale, annotation, 381–383
SCALE command, 307–309
scaling by reference, 309
scaling with grips, 310
Scale tool, 307
scaling
base point, 308
dimensions
  model space, 377–386
  paper space, 377–386
entities, 307–309
  by reference, 309
  with grips, 310
sectioning, 656–658
Section Plane tool, 656
Select File dialog box, 34
selections
  Select Similar, 77
  undoing, 76
Select Reference File dialog box, 497
Select template dialog box, 317
Set Base Point tool, 496
sheet metal stamping drawing project, 100
Shim drawing, 44
shortcut menus, 24–25
  CUI dialog box, 747
single-line text, 124–125
single point object snap, 77–79
single-point override, 226–228

SLICE command, 654–655
slicing, 654–655
slotted flange drawing, 274
smoothing meshes, 665–666
Smooth More tool, 665–666
snap
  Drafting Settings dialog box, 55–57
  object snap, single point, 77–79
  object snap tracking, 232–237
  setting, 55
Snap mode, 20
  coordinate display, 21
crosshairs and, 21
grid snap, 20
incremental snap, 20
isometric drawing, 539, 540
viewports, 258–259
Snap mode button, 13, 20–21
solid modeling
  3D
    3D Basics workspace, 589
    boxes, 590–593
    from 2D outlines, 680–685
    rendering, 611–618
    wedges, 590–593
  Boolean operations, 667–670
  chamfers, 605–606
  composite solid, 591–593
    SUBTRACT, 599–604
  constructive solid geometry, 590
  converting meshes to, 671–672
  DUCS (dynamic user coordinate system), 596–599
  fillets, 607–608
  gizmos, 609–611
  mesh modeling and, 659–662
    cylinder, 660–664
    sectioning, 656
    grips and, 657–658
  slicing, 654–655
  unions, 595
solid primitives
  cones, 650
    frustum cones, 650–652
    pyramids, 652–653
torus, 653
    parallel projection, 654
Solid, Subtract tool, 671
spacebar, 24
special characters
  control codes, 289
  degree symbol, 289
SPELL command, 298–299
SPLINEDIT command, 425
Spline Fit tool, 424
splines, 422–425
  editing, 425
  NURBS (nonuniform rational B-spline), 422
  path arrays, 425, 427
Split Fit tool, 423
spotlight, 3D modeling and, 620–622
sprocket drawing, 266–267
Stamp drawing, 46
Start, Center, Angle tool, 194
Start, Center, End tool, 192–193
Start tab, 2–4
status bar, 6
stepped shaft drawing project, 130
straight polyline segments, 413–417
STRETCH command, 244–249
stretching, 244–246
  grips and, 247–249
Stretch mode, 244
styles
  Annotative, 300
  switching, 305
  text, 300
    Annotation panel, 300–304
Styles list, 337
SUBTRACT command, 590–604
Subtract tool, 601
sunlight, 626–627
Sun & Location panel, 626
Sun Status tool, 622
SWEEP command, 686–687
switch plate drawing project, 96

T

tables
  cells, 315
  date and time, 312–313
  fields
    inserting, 313–315
    updating, 316

Insert Table dialog box, 311
  rows, settings, 312
  styles, 312
  text height, 312
Table tool, 311
tabs
  Add-ins, 6
  Annotate, 6
  Collaborate, 6
  contextual, 157–158
  drawing file tabs, 6
  Express Tools, 6
  Featured Apps, 6
  Home, 6
    panels, 6
  Insert, 6
  Layout, 7
  Manager, 6
  Model, 7
  Output, 6
  Parametric, 6
  View, 6
Tangent object snap, 227
tangents, 78
template drawing project, 134
Template folder, 147
Template Options dialog box, 148
templates, 3
  acad3D, 589
  browsing, 3
  chapter test questions, 167–169
  creating, 145–146
  drawing projects
    classroom floor plan, 182
    floor framing, 178
    grill, 172
    pin trailer wiring diagram, 170
    test bracket, 176
    wall framing, 180
    weave, 174
  drawings, new, 317–319
  drawing styles, 336
  saving, 146–148
  selecting, 3
  Select template box, 317
Test Block window, 480–482
test bracket drawing project, 176
text
angled, 288
Annotation panel, 300–304
character codes, 288
dimension text
   DIMEDIT command, 367
   Properties palette, 368
   Quick Properties palette, 368
editing in place, 292–293
fit between points, 287
fonts, 300
isometric drawings, 549–551
justification, 282–284, 287
   aligned, 286–287
   centered, 285
   left-justified, 282
   middle, 286
   multiline, 297
   right-justified, 285
layers, 282
model space, 378–379
multiline, 289–291
   insertion point, 290
paper space, 378–379
single-line, 124–125
special characters
   control codes, 289
   degree symbol, 289
styles, 300
   switching, 305
tables, height, 312
TEXTALIGN command, 284
TEXT command, 282–283, 549–551
   Align option, 287
   justified text, 284–287
   aligned text, 286–287
   centered, 285
   middle text, 286
   right-justified, 285
TEXTEDIT command, 292–293
text editor, resizing arrows, 360
Text Style dialog box, 301–303
Text Style tool, 301
thawing layers, 113
three-point arc, rotating, 195–196
tiled viewports, 646
   Named views, 648–649
   Viewport Configuration, 646–647
Tiles drawing, 48
time, tables, 312–313
tool block drawing, 278
tool palette creation, 522–523
tools, custom, 737–743
tooltips, 18–20
   double tracking, 237
torus, 653
   parallel projection, 654
transparency, 15
TRIM command
   cutting edges option, 241
   shortening objects, 239–242
Trim/Extend drop-down menu, 243
Trim mode, 117

U
UCS command, 351–584
UCS (user coordinate system), 9
   3D modeling, 584–588
      moving, 588
      origin, moved, 586
      rectangle, 587
      rotating, 588
   icon, 6, 584–585
undo selections, 76
Undo tool, 28–29
unions, 595
Union tool, 596
units, 58–59
UNITS command, 58–59
unlocked layers, 114
Update Fields tool, 316
user coordinate system, ordinate dimensions, 351–353
Utilities panel, 6

V
values, direct distance entry, 26–27
verb/noun editing, 69
vertical dimensions, 343
VIEW command, 555–558
ViewCube, 6, 628
  Boolean operations and, 667, 669
View Manager dialog box, 555–556, 579–580, 618
View panel, 6
viewpoints
  3DFORBIT command, 673–674
  3DORBIT command, 672–673
  3D wireframe mode
    changing, 579–580
    isometric view, 580
  arcball, 673–676
  camera position, 674–676
  continuous orbit, 678–679
  versus coordinate system, 584
  layouts, multiple, 629–632
    view details, 632–633
  multiple, 263
  Preset Views option, 677
  Reset Views option, 677
  target, camera, 674–676
  ViewCube, 628
  Visual Aids, 677
  Visual Styles, 677
Viewport Configuration, 646–647
viewports
  border, 318
    turning off, 386
  creating, 258–259
  maximizing, 262
  nonrectangular, 386
  section planes, 657
  tiled, 646
    Named views, 648–649
    Viewport Configuration, 646–647
Viewport Scale tool, 384–385
View tab, 6
Visual Aids, 677
Visualize tab, 612
visual styles, 3D modeling, 594
Visual Styles, 677

W
walk-throughs
  3DFLY command, 689–691
  3DWALK command, 689–691
  animated, 692–694
  camera, 688–689
  target, 688–689
wall framing drawing project, 180
WCS (world coordinate system), 578
  plan view, 579
weave drawing project, 174
WEDGE command, 593
wedges, 3D modeling, 590–593
windows
  application window, 5
  crossing window, 73–74
  drawing window, 6
    cross hairs, 8
  Test Block, 480–482
  Zoom, 122–123
Windows Clipboard, 491–493
  COPYCLIP, 491–493
  CUTCLIP, 491–493
  PASTECLIP, 493–495
wireframe model
  3D modeling, 578
  viewpoint
    changing, 579–580
    Isometric view, 580
Workspace menu, 4
workspaces, 4
  3D Basics, 4
  3D Modeling, 4
  CUI dialog box, 746
  customizing, 81–82
  Drafting & Annotation, 4
  menu bar, 82
  predefined, 4
Workspace Switching tool, 4
workstation, 506

X–Y–Z
XCLIP command, 515
XP, zooming, 259–262
xref, 464
Xref Compare tool, 515
X/Y/Z point filters, 582

  Zoom All, 123
  Zoom command, 12
ZOOM command, 103, 120–121, 259–262
zooming, 120–121
   to extents, 121
   scroll wheel, 120
   XP, 259–262
   Zoom window, 122–123
Zoom Previous, 123
Zoom to Extents, 121
Zoom window, 122–123