### Review Questions

1. How is the tool-work relationship in turning different from that in facing?
2. What different kinds of surfaces can be produced by turning versus facing?
3. How does form turning differ from ordinary turning?
4. What is the basic difference between facing and a cutoff operation?
5. Which machining operations shown in Figure 22-2 do not form a chip?
6. Why is it difficult to make heavy cuts if a form turning tool is complex in shape?
7. Show how equation 22-5 is an approximate equation.
8. Why is the spindle of the lathe hollow?
9. What function does a lathe carriage have?
10. Why is feed specified for a boring operation typically less than that specified for turning if the MRR equations are the same?
11. What function is provided by the leadscrew on a lathe that is not provided by the feed rod?
12. How can work be held and supported in a lathe?
13. How is a workpiece that is mounted between centers on a lathe driven (rotated)?
14. What will happen to the workpiece when turned, if held between centers, and the centers are not exactly in line?
15. Why is it not advisable to hold hot-rolled steel stock in a collet?
16. How does a steady rest differ from a follow rest?
17. What is the advantage and disadvantages of a four-jaw independent chuck versus a three-jaw chuck?
18. Why should the distance a lathe tool projects from the tool holder be minimized?
19. What is the difference between a ram- and a saddle-turret lathe?
20. How can a tapered part be turned on a lathe?
21. Why might it be desirable to use a heavy depth of cut and a light feed at a given speed in turning rather than the opposite?
22. If the rpm for a facing cut (assuming given work and tool materials) is being held constant, what is happening during the cut to the speed? To the feed?
23. Why is it usually necessary to take relatively light feeds and depths of cut when boring on a lathe?
24. How does the corner radius of the tool influence the surface roughness?
25. What effect does a BUE have on the diameter of the workpiece in turning?
26. How does the multiple-spindle screw machine differ from the single-spindle machine?
27. Why does a boring ensure concentricity between the hole axis and the axis of rotation of the workpiece (for boring tool), whereas drilling does not?
28. Why are vertical spindle machines better suited for machining large workpieces than horizontal lathes?
29. What is the principal advantage of a horizontal boring machine over a vertical boring machine for large workpieces?
30. In which figures in this chapter is a workpiece being held in a three-jaw chuck?
31. How is the workpiece in Figure 22-14 being held?
32. In which figures in this chapter is a dead center shown?
33. In which figures in this chapter is a live center shown?
34. In which figures in this chapter showing setups do you find the following being used as a workholding device?
   a. Three-jaw chuck
   b. Collet
   c. Faceplate
   d. Four-jaw chuck
35. How many form tools are being utilized in the process shown in Figure 22-15 to machine the part?
36. From the information given in Figure 22-20, start with a piece of round bar stock and show how it progresses, operation by operation, into a finished part—a threaded shaft.

### Problems

1. A cutting speed of 100 sfpm has been selected for a turning cut. At what rpm should a 3-in.-diameter bar be rotated?
2. Assume that the workpiece in Problem 1 is 8 in. (203.2 mm) long and a feed of 0.020 in. (0.51 mm) per revolution is used. What is the machining time for a cut across its entire length? Don’t forget to add an allowance.
3. If the depth of cut in Problem 2 is 0.05 in., what is the metal removal rate (MRR) exactly? What is the MRR approximately?
4. Using the same recommended cutting speeds and feeds, calculate the machining time to cut off the bar in Problem 2.
5. The following data apply for machining a part on a turret lathe and on an engine lathe:

<table>
<thead>
<tr>
<th>Engine Lathe</th>
<th>Turret Lathe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Times, in minutes, to machine part</td>
<td>30 min</td>
</tr>
<tr>
<td>Cost of special tooling</td>
<td>$0</td>
</tr>
<tr>
<td>Time to set up the machine</td>
<td>30 min</td>
</tr>
<tr>
<td>Labor rates</td>
<td>$8/hr</td>
</tr>
<tr>
<td>Machine rates (overhead)</td>
<td>$10/hr</td>
</tr>
</tbody>
</table>

6. A finish cut for a length of 10 in. on a diameter of 3 in. is to be taken in 1020 steel with a speed of 100 fpm and a feed of 0.005 ipr. What is the machining time?
7. A workpiece 10 in. in diameter is to be faced down to a diameter of 2 in. on the right end. The CNC lathe (see Chapter 26) controls the spindle speed and maintains the cutting speed at 100 fpm throughout the cut by changing the rpm. What should be the time for the cut? Now suppose the spindle rpm for the workpiece is set to give a speed of 100 fpm for the 10-in. diameter and is not changed during the cut. What is the machining time for the cut now? The feed rate is 0.005 ipr.
8. A hole 89 mm in diameter is to be drilled and bored through a piece of 1340 steel that is 200 mm long, using a horizontal boring, drilling, and milling machine. High-speed tools will be used. The sequence of operations will be center drilling; drilling with an 18-mm drill followed by a 76-mm drill; then boring to size in one cut, using a feed of 0.50 mm/rev. Drilling feeds will be 0.25 mm/rev for the smaller drill and 0.64 mm/rev for the
larger drill. The center drilling operation requires 0.5 min. To set or change any given tool and set the proper machine speed and feed requires 1 min. Select the initial cutting speeds, and compute the total time required for doing the job. (Neglect setup time for the fixture.) This is often referred to as the run time or the cycle time. (Hint: Check in Chapter 21 for recommended speeds for turning.)

9. Figure 22-A shows the fixed and variable costs for a part being produced on an engine lathe. Figure 22-B has three plots of unit production cost ($/unit) versus production volume ($ = build quantity). (Note that this plot is made on log-log paper.) Cost per unit for a particular process decreases with increased volume as fixed costs are spread out over more units. For a particular process there is no minimum cost but rather production volumes within which particular processes are most economical.

a. Each of these curves is a plot of the equation for total cost divided by quantity, which means each is the sum of the fixed cost per unit (mainly setup and tooling costs) and the variable costs per unit (direct labor, direct material). From the data on the plots, estimate the fixed costs for the engine lathe, the NC lathe, and the single-spindle automatic.

b. For what build quantities is the NC lathe most economical (approximately)?

c. What cost per unit does the NC lathe approach as the build quantity becomes very large?

d. Explain how to go from a cost per quantity plot to a cost/unit vs. quantity plot?

e. What happens to these plots if you plot them on regular Cartesian coordinates? Try it and comment on what you find.

f. Many Japanese manufacturers have found innovative ways to eliminate setup time in many of their processes. What is the impact of this on these kinds of plots, on cost per unit economics, and on job shop inventories?

10. The derivation of the approximate equation 22-5 for the MRR for turning process requires an assumption regarding the diameters of the parts being turned. Determine the error in the equation for Problem 3. What is the assumption?