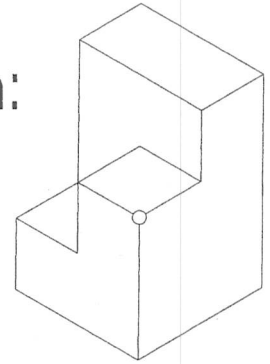


Excerpts from :

# Introduction to 3D Spatial Visualization: An Active Approach



Workbook by: Sheryl A. Sorby

Software by: Anne F. Wysocki

Based on work by: Beverly Baartmans and Shery Sorby

**THOMSON**



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## Preface

The ability to visualize in three dimensions has been shown to be an important skill for people who intend to study in scientific and technical fields. Well-developed spatial skills have been linked to success in engineering, computer science, chemistry, medicine, mathematics, and architecture to name just a few. Design is central to engineering and well-developed spatial skills have been shown to be critical to a person's ability to develop creative design solutions to problems. Well-developed spatial skills have also been linked to a person's ability to interact with a computer in performing database manipulations and to a person's ability to understand various aspects of structural chemistry. Doctors, who must learn to use modern-day laparoscopy tools, require well-developed 3-D spatial skills. Architects must often visualize how a new structure will look as well as how it interacts with its surroundings when designing a new building.

In educational psychology research, the distinction is often made between "spatial ability" and "spatial skills." The difference between the two is described briefly in the following. Spatial ability is defined as the innate ability to visualize that a person has before any formal training has occurred, i.e., a person is born with ability. However, spatial skills are learned or are acquired through training. As with any other type of skill (writing, mathematics, etc.) some people may have a higher degree of innate ability than others, however, most people can eventually acquire the skill through patience and practice. The materials in this text will assist you in developing your 3-D spatial visualization skills.

These materials contain nine separate modules to help you develop your 3-D spatial visualization skills. For each module, there is a software as well as a workbook component. To maximize your skill development, we suggest that you first work through the appropriate software module on the CD-ROM. After you complete the software module, work through the pages for that module in the workbook. Because sketching with pencil and paper have been shown to be particularly helpful in the development of 3-D spatial skills, you will find considerable benefit in completing the workbook pages, many of which require hand sketching. You should probably work through the modules in the order they are presented on the CD-ROM and in this workbook, but you can do them in any order if you like. One exception to this is that you should complete and understand Module 4 (Rotation of Objects about a Single Axis) before you attempt Module 5 (Rotation of Objects about Two or More Axes) since these two modules are meant to be completed sequentially.

The multimedia software found on the CD-ROM works on either a PC or a Macintosh platform and requires no additional software to run.

Good luck and have fun!

An isometric view of an object is shown below along with its top and front views. Circle the letter corresponding to the correct side view from the choices given.

1.

A

B

C

2.

A

B

C

3.

A

B

C

4.

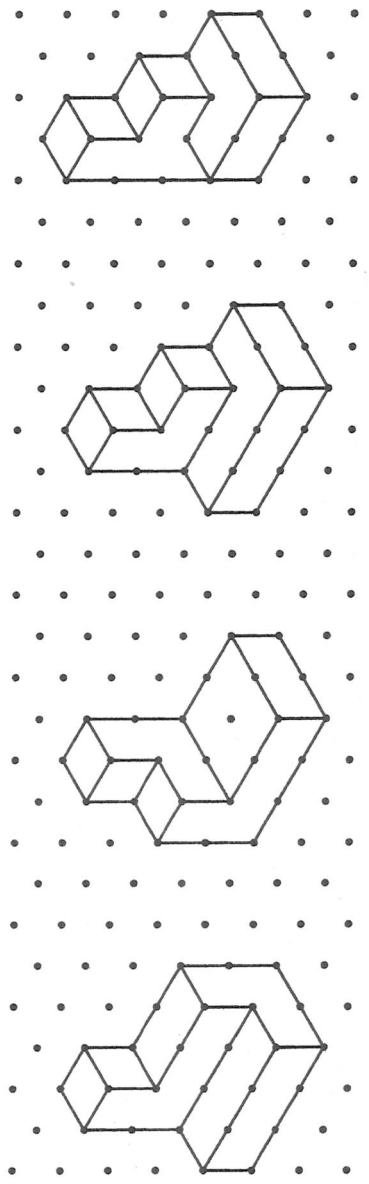
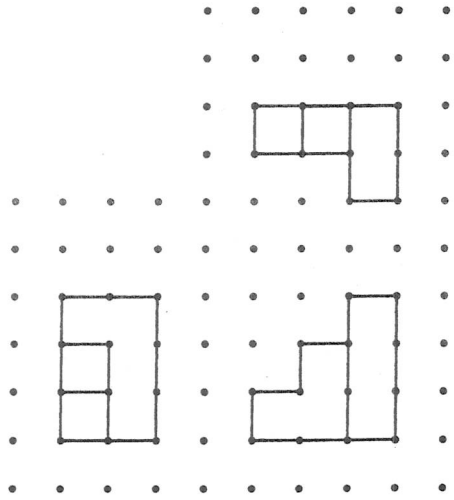
A

B

C

For the object shown in orthographic projection on the left, circle the letter of the correct corresponding isometric view.

1.



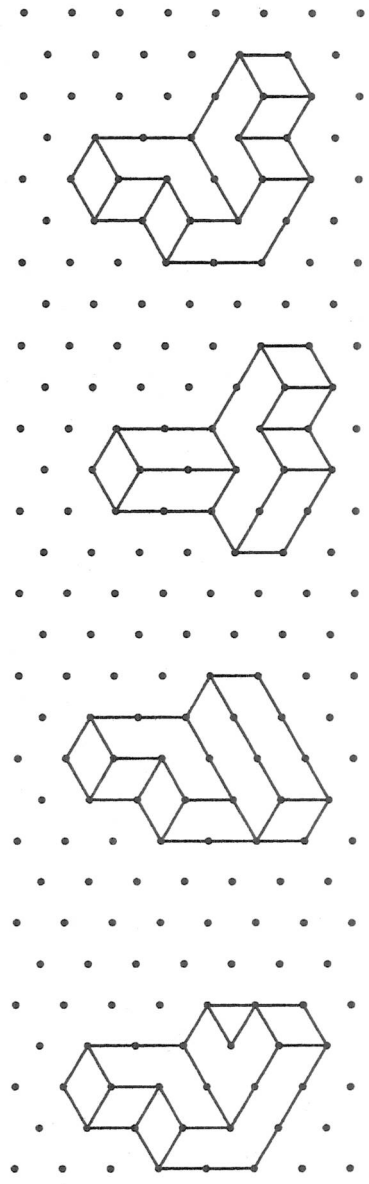
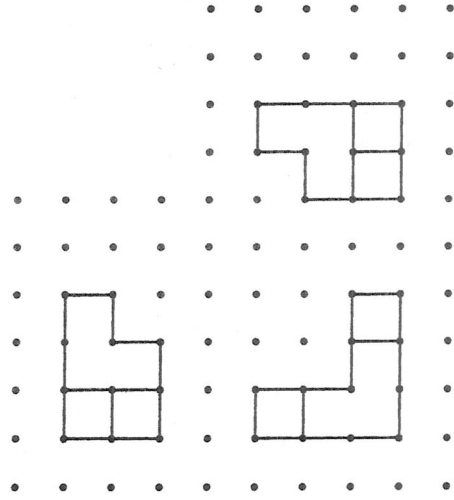
A

B

C

D

2.



A

B

C

D

Name:

Class:

Section:

Date:

Introduction to 3-D  
Spatial Visualization

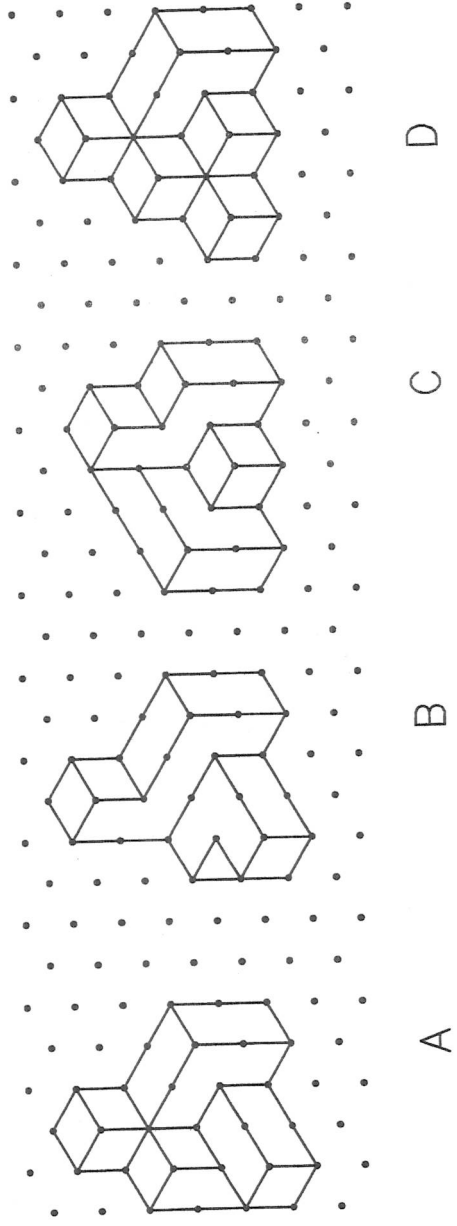
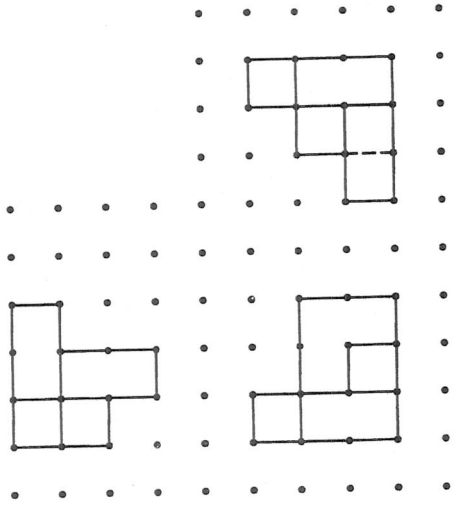
Grade:

Page

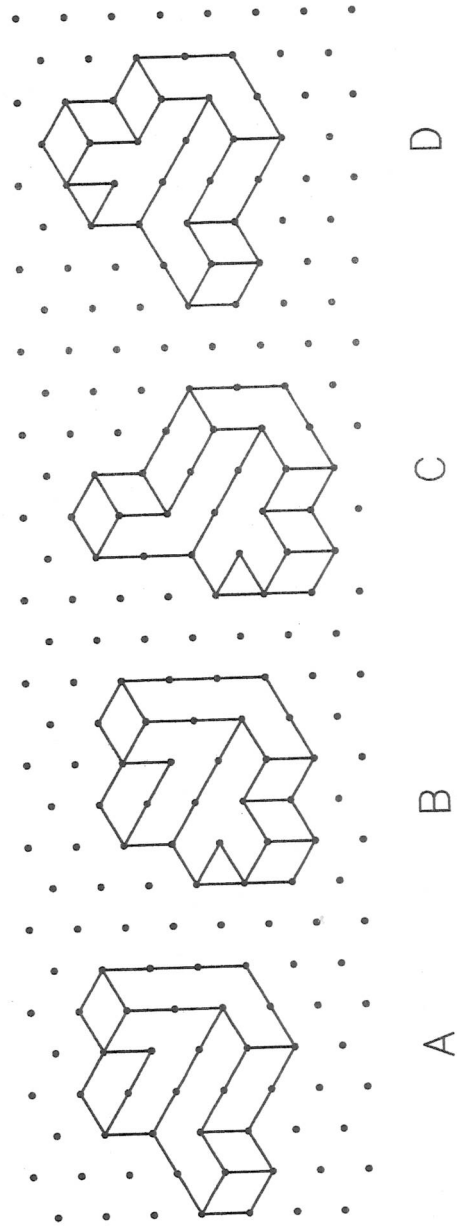
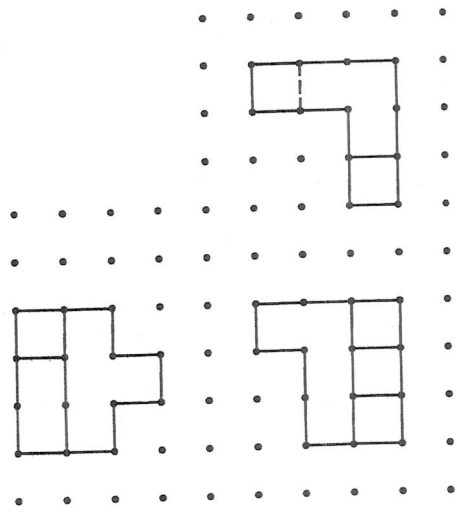
23

For the object shown in orthographic projection on the left, circle the letter of the correct corresponding isometric view.

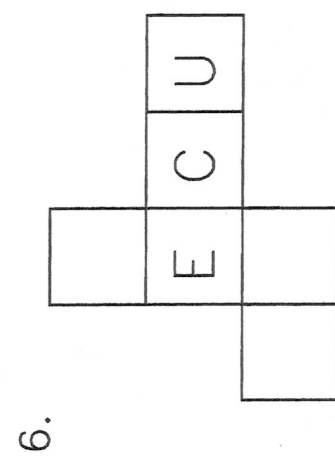
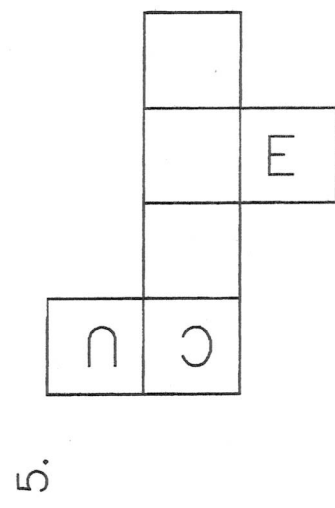
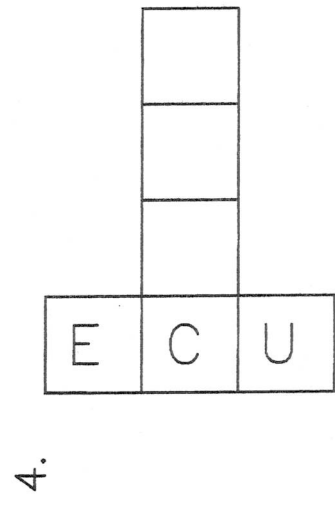
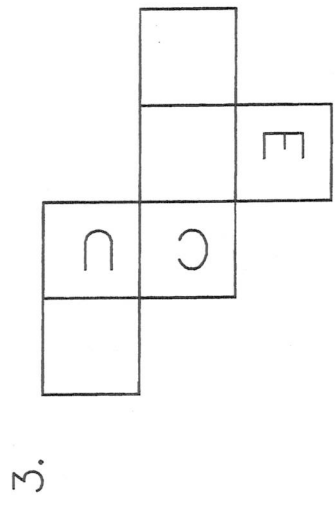
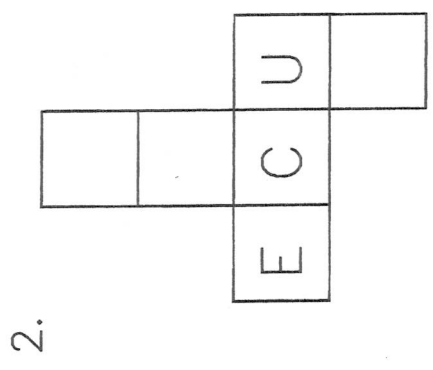
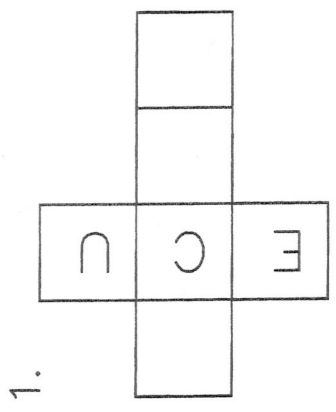
1.



2.

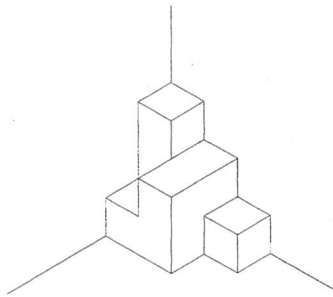


The patterns shown below fold up to form a cube with the word "CUBE" spelled around its four sides. Complete each pattern by placing the "B" on it in the correct orientation.

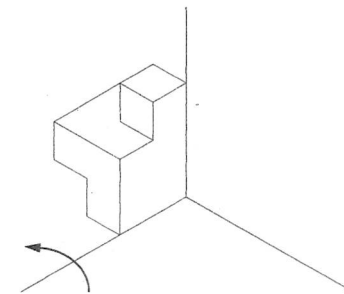
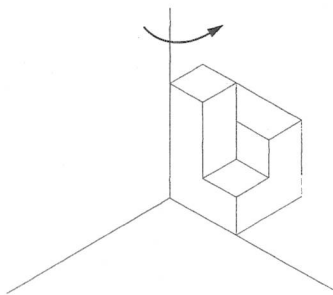
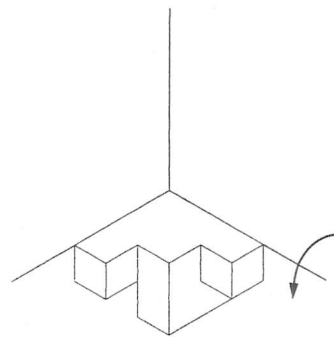


## Rotation of Objects about a Single Axis

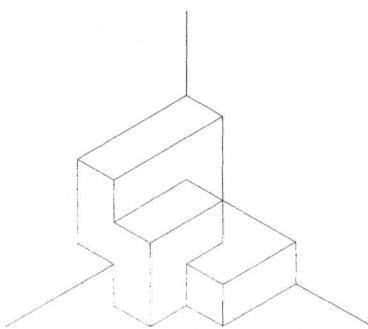
A rotation of an object is a turning of it about a straight line. The line about which the object rotates is called the *axis of rotation*.



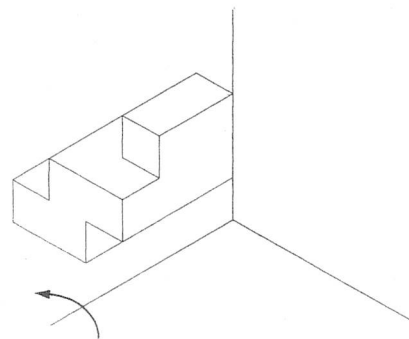
Original Object Position



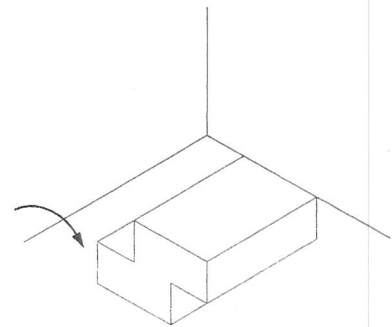
An object can rotate either positively or negatively about an axis. If you look down the axis of rotation, a *positive* rotation is counterclockwise and a *negative* rotation is clockwise.



Original Object Position

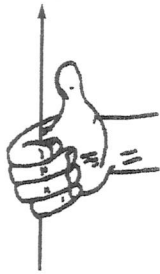


Positive Rotation



Negative Rotation

The direction of the rotation is determined by the right hand rule. For a positive rotation, if you point the thumb of your right hand along the positive direction of the axis of rotation, your fingers will curl in the direction of the rotation. For a negative rotation, if you point the thumb of your right hand along the negative axis of rotation, your fingers will curl in the direction of the rotation.

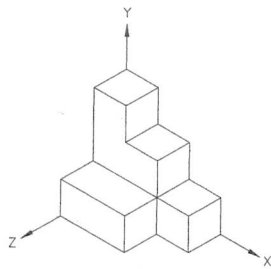


Positive Rotation

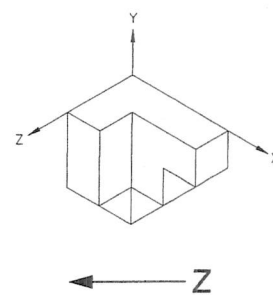
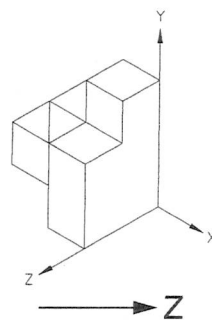
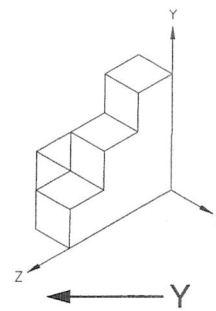
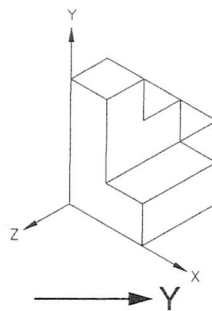
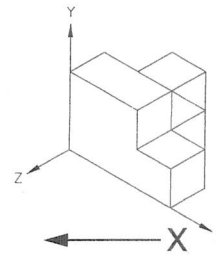
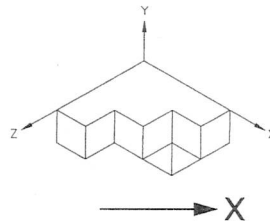


Negative Rotation

Object rotations can be represented by the following arrow coding scheme: A single arrow represents a 90 degree rotation about an axis. An arrow to the right indicates a positive rotation and an arrow to the left indicates a negative rotation. The axis about which the object rotates is given at the right end of the arrow.



Original Object Position





The objects shown below have been rotated positively about the given axis. In the space provided, indicate the amount of rotation (either  $90^\circ$ ,  $180^\circ$ , or  $270^\circ$ ).

