Using Triangulation

Topic

Determining distance

Time

2 hours

Safety

Please click on the safety icon to view safety precautions.

Materials

two empty duplicator paper boxes
two pieces of drawing paper the size of two duplicator paper boxes
protractor
pencil
straight pins
glue
graph paper
tape measure
one large ball

Procedure

1. Cut two pieces of drawing paper the size of the bottom of each box.
2. Draw a 90-degree angle with 8-in. sides on one of the pieces of paper (see figure 1).
3. Mark each 5 degrees using the protractor on the arc. Label the two ends of the base of the arc W and X (see figure 1).
4. Glue the paper to the bottom, outside of the box.
5. Insert a pin at every 5-degree mark on the arc.
6. Draw a 90-degree angle with 8-in. sides, *but reverse the angle,* on the other piece of paper (see figure 2).
7. Mark each 5 degrees using the protractor on the arc. Label the two ends of the base of the arc Y and Z (see figure 2).
8. Glue the paper to the bottom, outside of the box
9. Insert a pin at every 5-degree mark on the arc.
10. Place the boxes a distance from an object (like a large ball) so that the line WXYZ lines up in a straight line. The boxes should be 6 ft from W to Z.
11. Site the object from W. Record on the data table the angle between you and the object on the table.
12. Site the object from Z. Record on the data table the angle between you and the object on the table.

13. Make a scale drawing in the space on the data table, using line WXYZ as the base and the angles at W and at Z. Extend the lines until they cross. Then draw a line perpendicular from the crossing point to the base (see figure 3). Calculate the distance of this line.
14. What does this line represent?
15. How can you determine your accuracy?

Figure 1

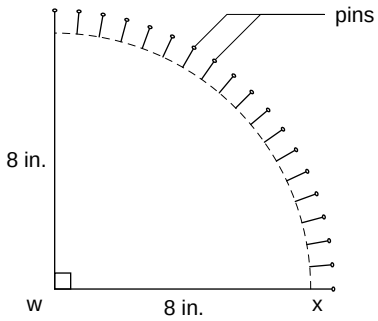


Figure 2

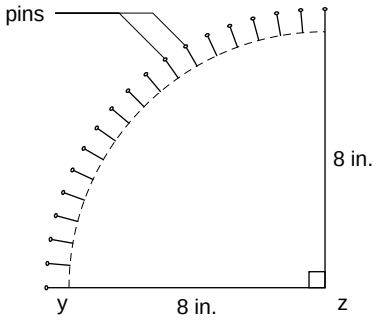
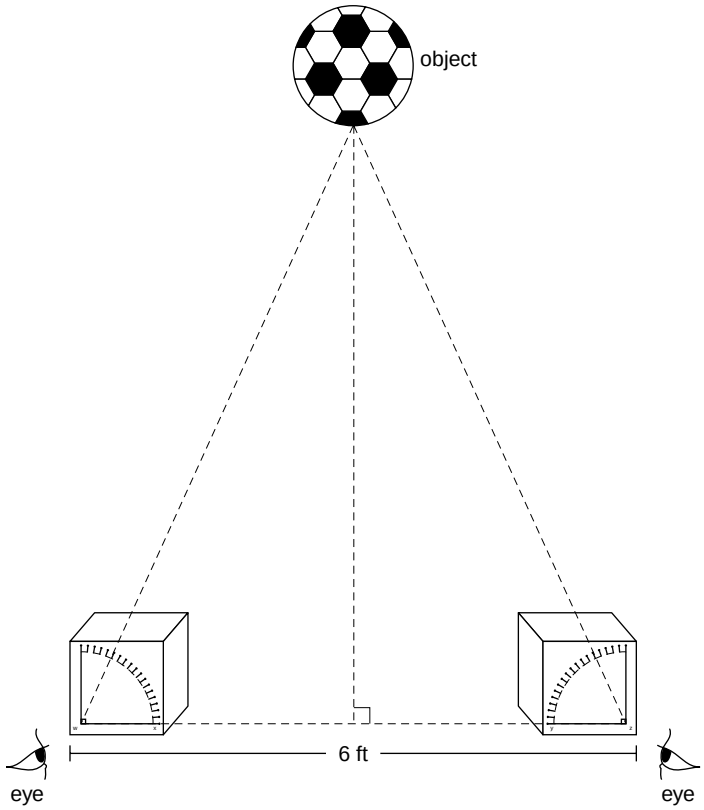


Figure 3



What's Going On

By indirectly measuring the angles and the distance of the boxes from each other, you can determine the distance of an object by using a scale drawing. The longer the distance from an object, the more parallel the lines of the triangle become.

Connections

Astronomers use another tool called the *parallax effect* to determine huge distances, like the distance from the earth to the moon. The premise of the parallax effect is that the farther the object is from the observer, the smaller the parallax, and vice versa. In order to demonstrate this, draw parallel lines 1 in. apart on a piece of paper. Stand about 2 ft away. Hold a pencil parallel to one of the lines in front of your eye. Close one eye, then open that eye and close the other eye. The pencil will seem to shift to another line. That is the parallax effect. Instead of using pencils, astronomers look at the moon (pencil) in relation to the stars (parallel lines).

DATA TABLE
Angle sited from W
Angle sited from Z
Scale drawing:

W —————————————————————————————— Z
X Y

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES