Physics Day

Equipment Construction

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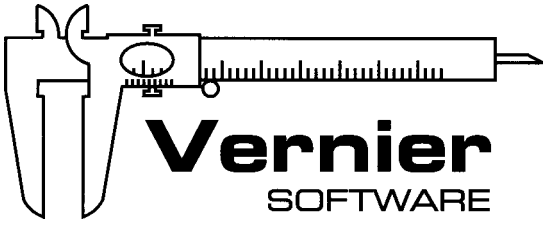


Equipment

Sextant

Making a simple paper Sextant

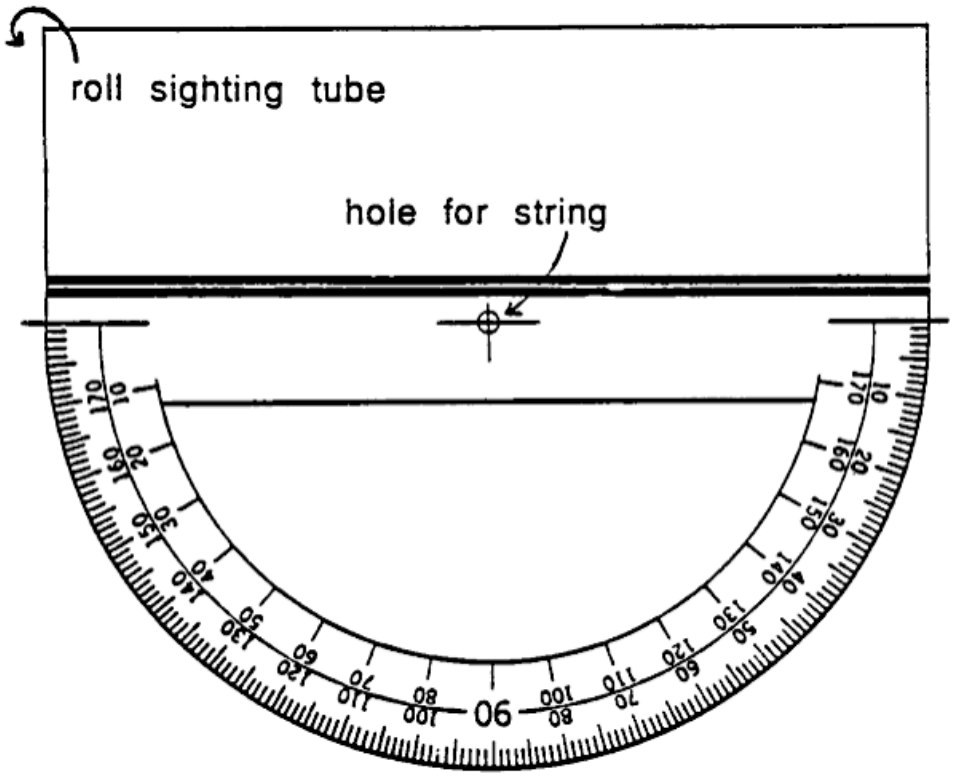
1. Cut out the Sextant pattern on the next page.

2. Fold the top section over a pencil and roll it down to the heavy double line to make a sighting tube.

3. Tape the rolled paper tube closed and then let the pencil slide out.

4. Glue the Sextant to a 5" x 8" index card and trim

5. Take about 20 cm of heavy thread and tie one end to a weight such as a rubber stopper. Tie the other end through the hole at the top of the sextant.

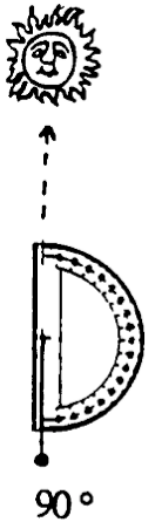


6. Let the thread hang free. The angle it marks off is the angular height of an object seen through the tube.

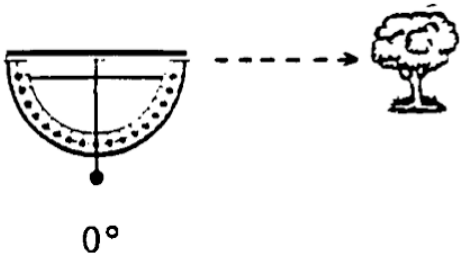
   Alternatively, a drinking straw can be attached to a plastic protractor to make a similar device.

<u>Examples of sextant use for measuring angles of elevation:</u>

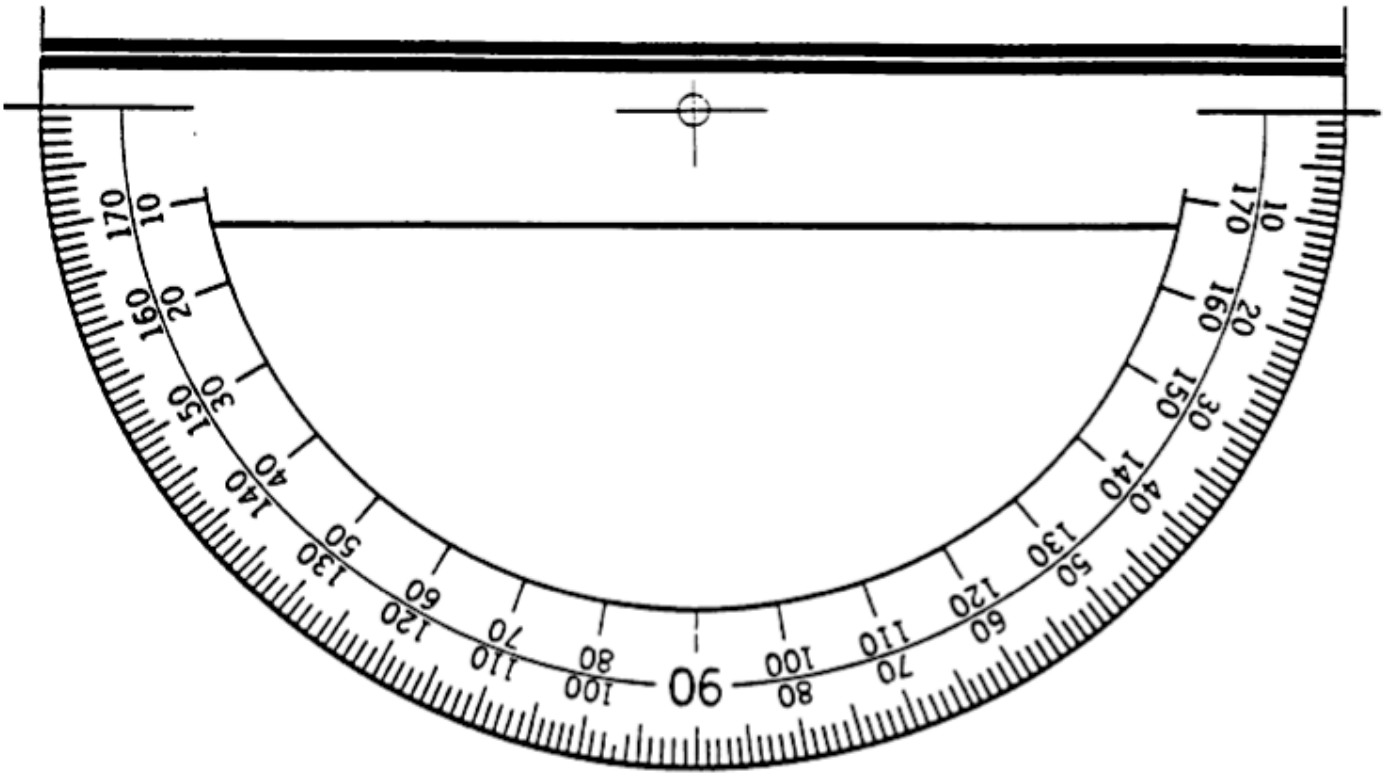
An object directly overhead has an angle of elevation of 90°.

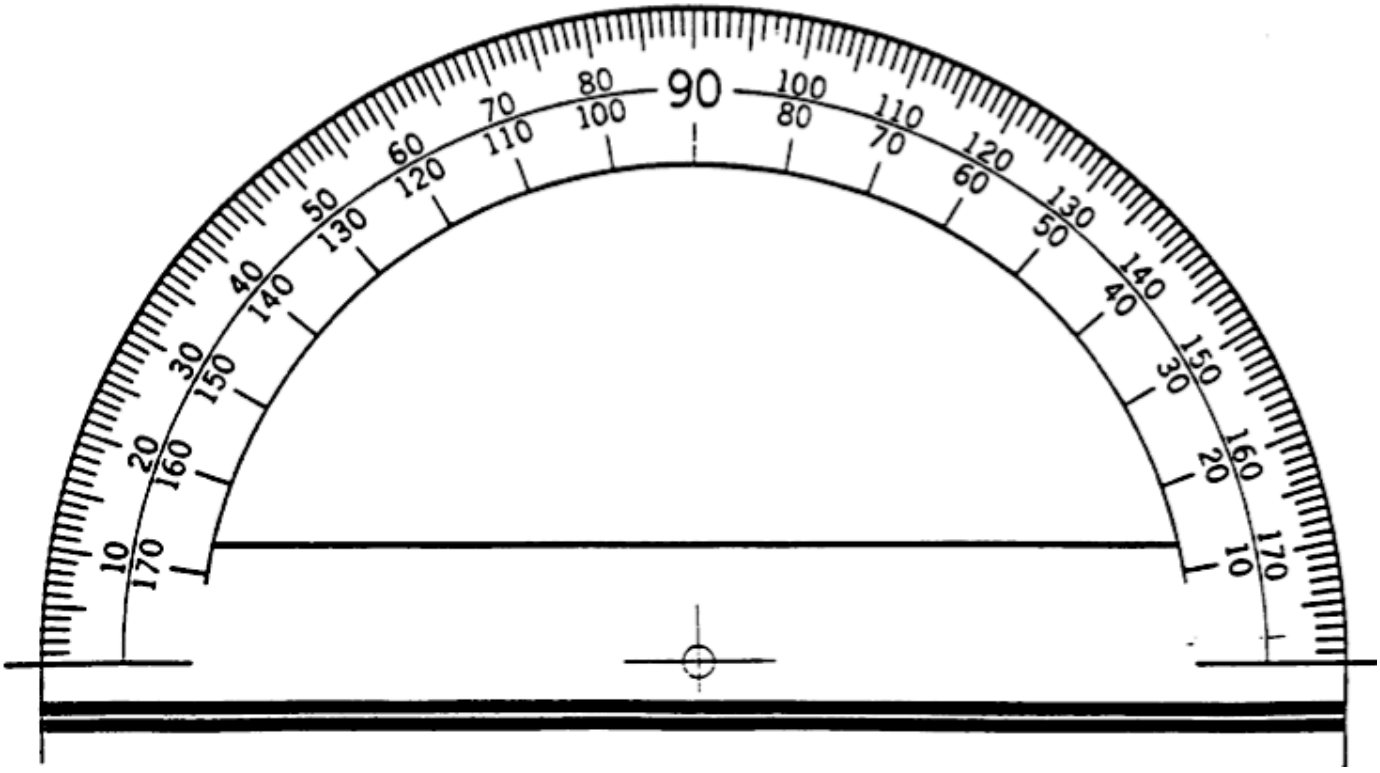


An object on the horizon has an angular height of 0°.



Sextant Pattern





Equipment

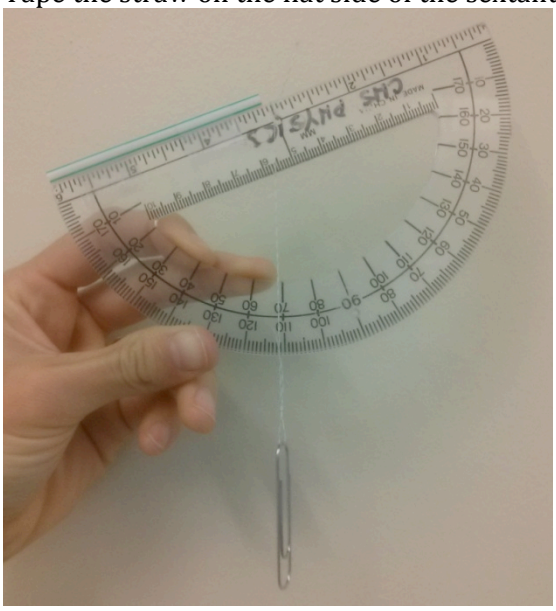
Making a Sextant out of a Protractor

A protractor can also be used to make a sextant. When made this way sextants can be dissembled and used as protractors during the year and then made into sextants for Six Flags day. These sextants are also more durable for use in the park and for rainy weather.

Materials:
Protractor with a hole in the center of the circle
Straw – 3-6 inches long
String – about 6 inches long
Weight – many things can be used: washer, stopper, paperclip

Directions:

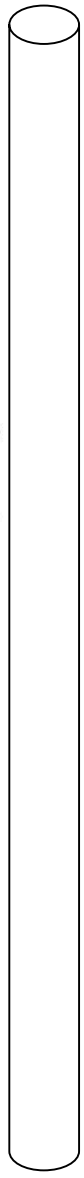
1. Thread the string through the hole in the protractor that is located at the center of the circle and tie a knot.
2. Tie the weight on the other end of the string. Be sure that the weight hangs down past the curve of the protractor so that the string can be used to make the angle measurement.
3. Tape the straw on the flat side of the sextant.



Force Factor Meter

A very nice Force Factor meter can be made using parts like those shown to the right. The necessary parts include are listed below with the quantities given being per meter.

FIGURE 1



1. (1) rigid clear plastic tube, at least 1.2 cm inside diameter and about 30 cm long. Some thermometer cases are a suitable size. You can also obtain plastic mailing tubes in a variety of suitable sizes.

2. (2) plastic end caps or rubber stoppers.

3. (1) small spring (approximately 1.5 cm/g). If you make the multidirectional Force Factor meter you will need 2 of these. Rubber bands may be substituted for the springs, but have a distinct disadvantage. The force constant of the rubber bands will change if they are left under tension for very long. Consequently the calibration of the accelerometer will change with use. Springs are highly recommended.

4. (1) fishing weight (sinker) with a mass of about 10 g.

5. (2) paper clips. You will need three of these if you make the multidirectional accelerometer.

6. Narrow tape, approximately 1/8" wide for marking acceleration calibrations. Vinyl automotive pinstriping tape works well. Some correction tape may also be a suitable width.

7. 1" wide tape for securing all connections.

8. 7" rubber band for a wrist strap.

Constructing the Force Factor Meter

1. Attach the sinker to the spring and glue, tape and/or crimp the connection so that they will not detach.

2. Make two small holes through the end cap or stopper large enough to insert the ends of a paper clip.

3. Unbend a paper clip and suspend the spring/sinker combination. Push the paper clip through the holes in the end cap or stopper. Place the end cap or stopper on one end of the tube.

4. With the tube held horizontally, mark the position of the weight when the spring is relaxed with a ring of striping tape. This is the 0 “g” mark.

5. Hold the tube vertically with the weight hanging. Mark the position of the sinker. This is the 1" mark.

6. Assuming that the spring obeys Hooke’s Law and stretches linearly, mark off positions for 2 and 3 “g” the same distance away.

7. Tape the paper clip ends so that they are not exposed.

8. Insert the other end cap and attach the large rubber band as a wrist strap.

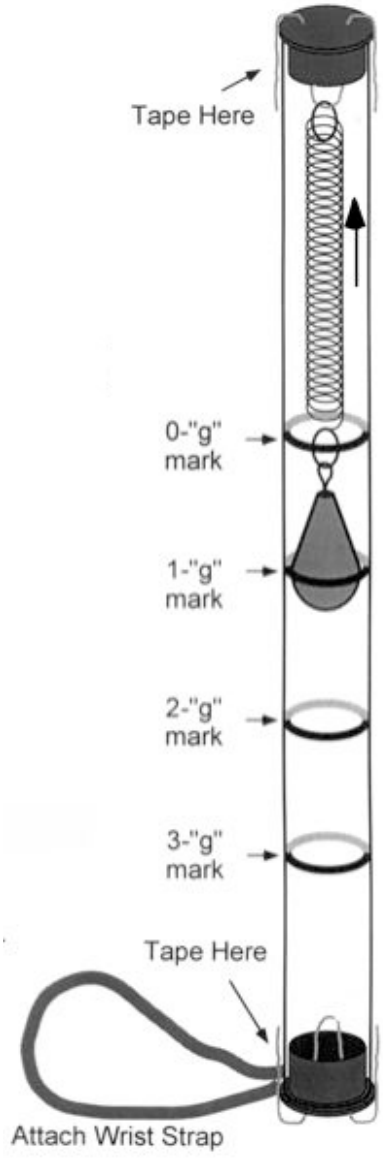


FIGURE 2

A Multidirectional Force Factor Meter

The Force Factor meter shown in figure 2 can be easily modified so that it can be used to measure Force Factors horizontally as well as vertically. This multidirectional Force Factor meter is shown in figure 3. This modification involves simply attaching a spring to the other end of the sinker and in turn attaching the second spring to the other end of the plastic tube.

1. Cut the brass loop off of the sinker. Unbend a paper clip and pass it through the hole in the sinker.

2. Bend the end of the paper clip into loops at both ends of the sinker. Wrap the wire on itself several times to make a secure loop.

3. Attach a spring to each end of the sinker.

4. Attach each remaining end of a spring to an end cap or stopper at the end of the tube with paper clips as described in the vertical accelerometer directions.

5. With the tube held horizontally, mark the position of the weight. This is the 0 “g” mark. Hold the tube vertically. Mark the position of the weight. This is the 1 “g” mark. Invert the tube and mark the position of the weight. This is the negative 1 “g” mark Other positions, 2 “g”, -2 “g”, 3 “g”, -3 “g”, etc. can be marked the same distances along the tube.

6. Secure the ends of the tube with tape and attach a rubber band wrist strap.

7. Draw an arrow with a permanent marker in the direction shown to indicate the direction the Force Factor meter should be pointed.

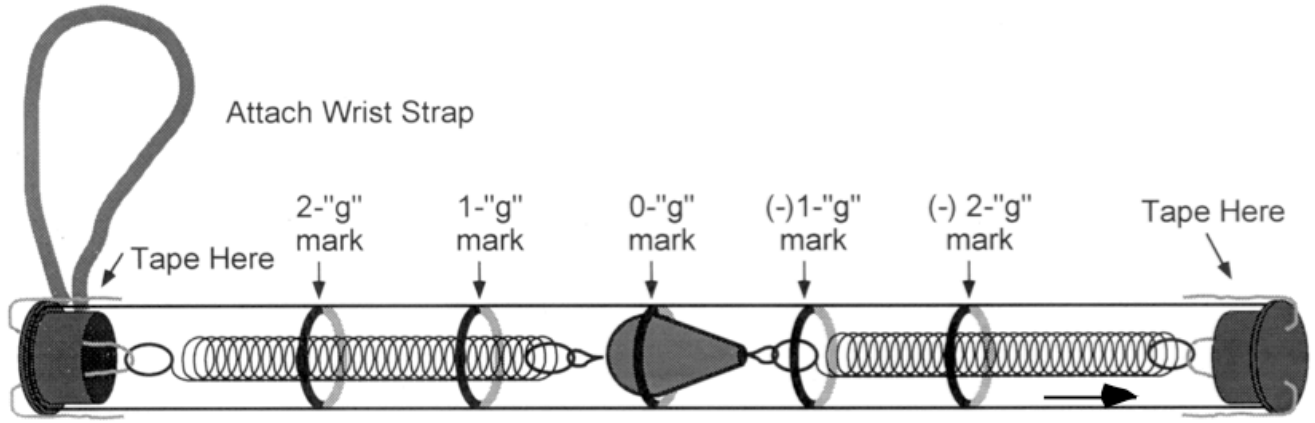


FIGURE 3

POSSIBLE SOURCES FOR EQUIPMENT

SOURCES FOR PARTS
Possible Sources for Equipment

Amusement Park Physics Kits:
Kits that contain classroom sets of materials for making the equipment described above are available from several sources. Consult the website for current pricing and availability. Search for "amusement park physics kit."

Pasco
www.pasco.com

Sargent-Welch
www.sargentwelch.com

Ward's Science
www.wardsci.com