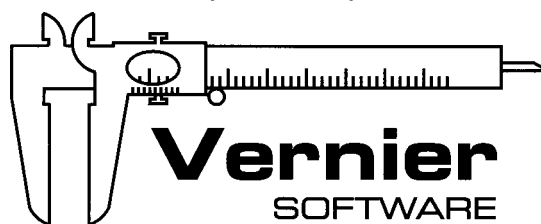


Physics Day



Equipment Construction

with sponsorship from

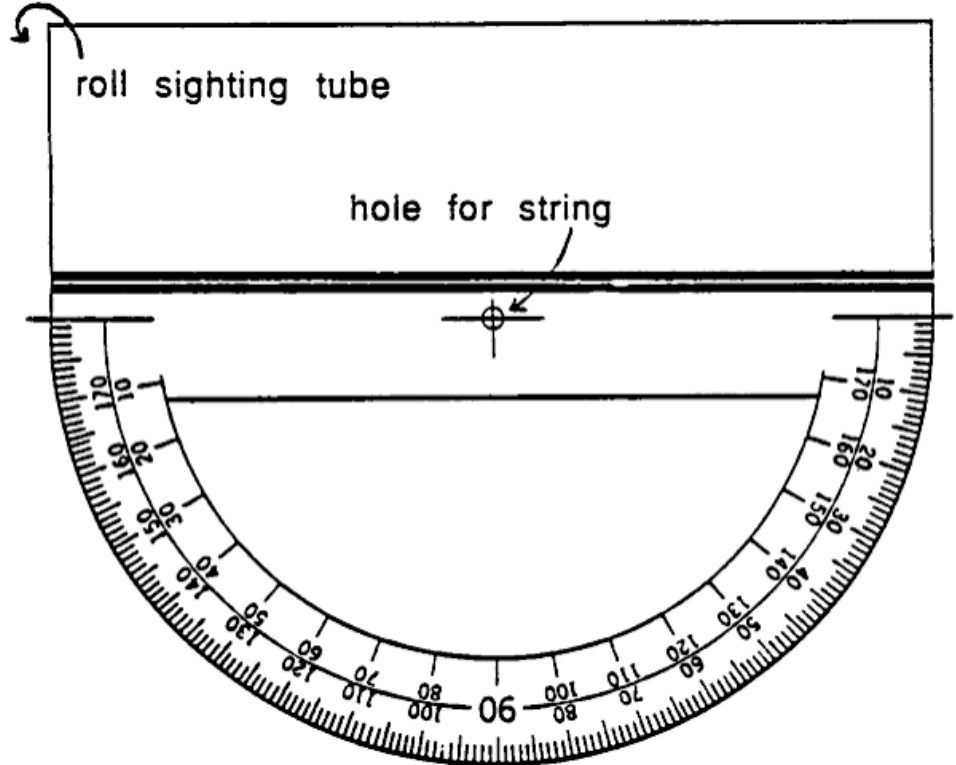


Equipment

Sextant

Triangulation Instrument

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.

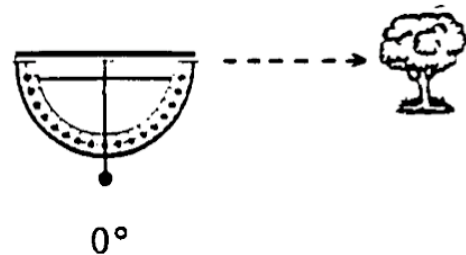


Examples of sextant use for measuring angles of elevation:

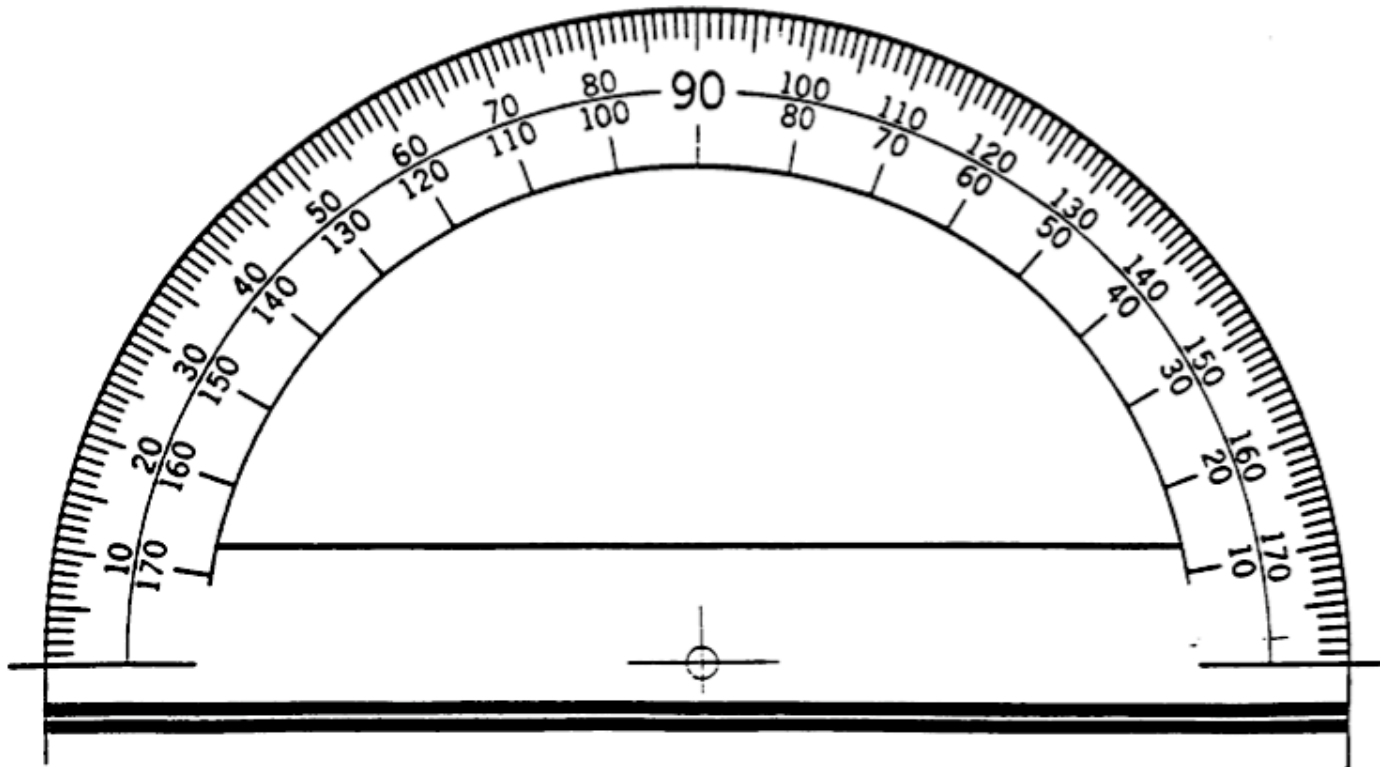
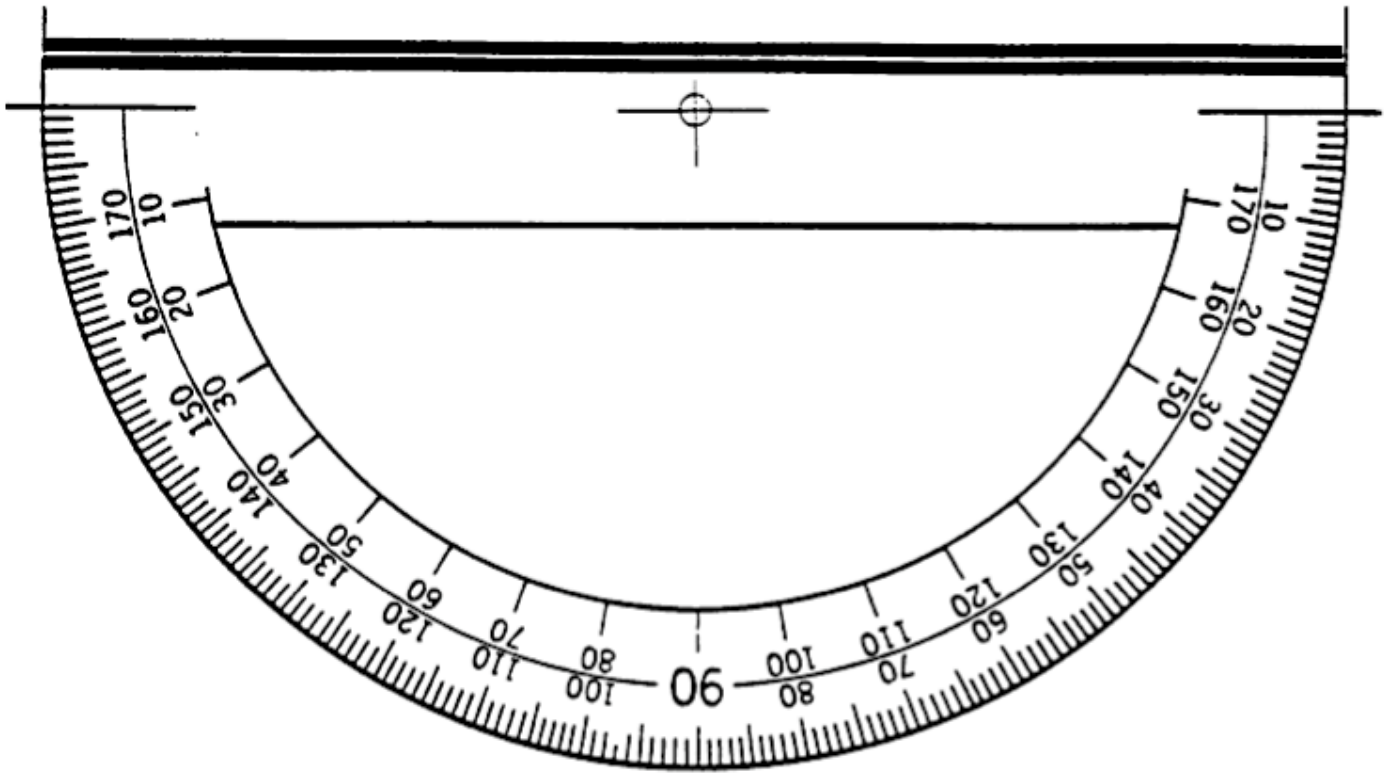
An object directly overhead has an angle of elevation of 90° .



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



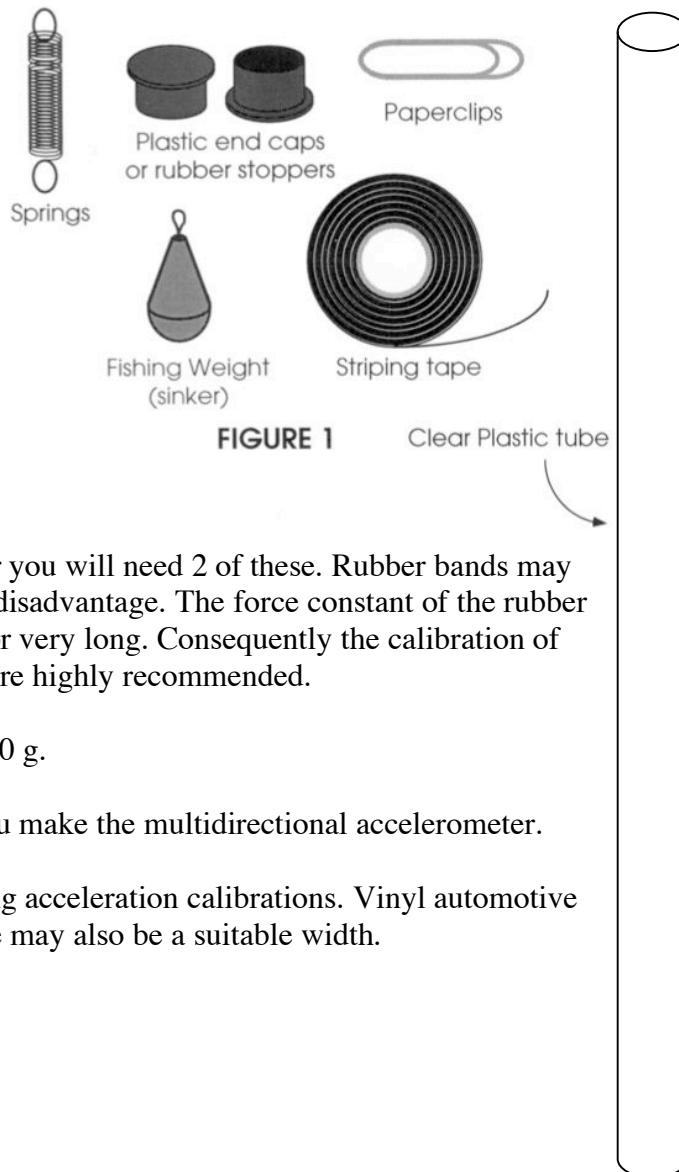
Sextant Pattern



Equipment

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.



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.

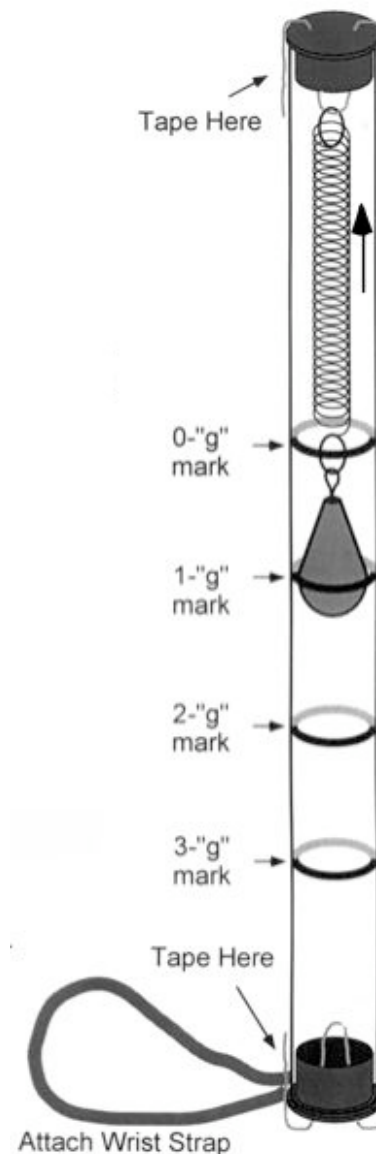


FIGURE 2

Equipment

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.

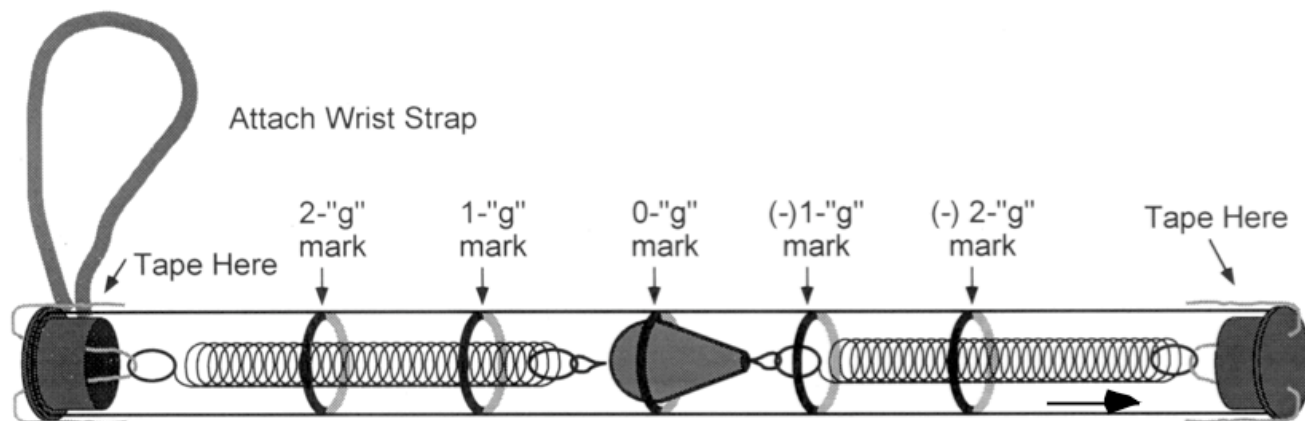


FIGURE 3

POSSIBLE SOURCES FOR EQUIPMENT**SOURCES FOR PARTS****Plastic mailing tubes and end caps:**

National Bag Company, Incorporated
 2233 Old Mill Rd.
 Hudson, OH 44236
 1-800-247-6000
 1-330 425-9800 (FAX)

5/8 " x 6 ft - \$4.30 (Part No. 86-004A2)
 100 end caps - \$5.07 (Part No. 86-667A2)

Springs:

Sargent-Welch, VWR Scientific Products
 P.O. Box 5229
 Buffalo Grove, IL 60089-5229
 1-800-SARGENT (1-800-727-4368)
www.sargentwelch.com

Pkg/30 - \$32.03 (Cat. No. WL0569R)

AMUSEMENT PARK PHYSICS CLASSROOM KITS

Several scientific companies are now selling complete amusement part physics kits which have all of the parts to make multiple vertical and horizontal accelerometers. The Force Factor meters in these kits are very similar to those shown in this manual. Only the Pasco kit uses springs. The other two substitute rubber bands. The following companies sell such kits:

Pasco Scientific
 10101 Foothills Blvd
 P.O. Box 619011
 Roseville, CA 95661-9011
 1-800-772-8700
 1-916-786-8905 (FAX)
www.pasco.com

The Pasco kit includes materials for 15 Force Factor meters and 15 sextants. The Pasco equipment is very similar to the Force Factor meter described in this manual and uses springs rather than rubber bands—a desirable choice.

\$61.00 for 15 student groups
 Catalog number ME-9426

Equipment

POSSIBLE SOURCES FOR EQUIPMENT (continued)

Science Kit & Boreal Laboratories
777 East Park Drive
P.O. Box 5003
Tonawanda, NY 14150-5003
1-800-828-7777
1-800-828-3299 (FAX)
www.sciencekit.com
email: sk@sciencekit.com

This kit includes materials for 15 Force Factor meters and 15 sextants. Note that this kit substitutes rubber bands for springs on the Force Factor meter which can be a source of calibration problems.

\$84.50 for 15 student groups
Catalog number 65672-00

Sargent-Welch, VWR Scientific Products
P.O. Box 5229
Buffalo Grove, IL 60089-5229
1-800-SARGENT (1-800-727-4368)
www.sargentwelch.com

This kit appears to be nearly identical to the one carried by Science Kit. This kit uses rubber bands instead of springs for the Force Factor meter.

\$75.39 for 15 student groups
Catalog number CP32514-00.