Rocket Altitude Tracking

Federation of Galaxy Explorers

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Materials Required

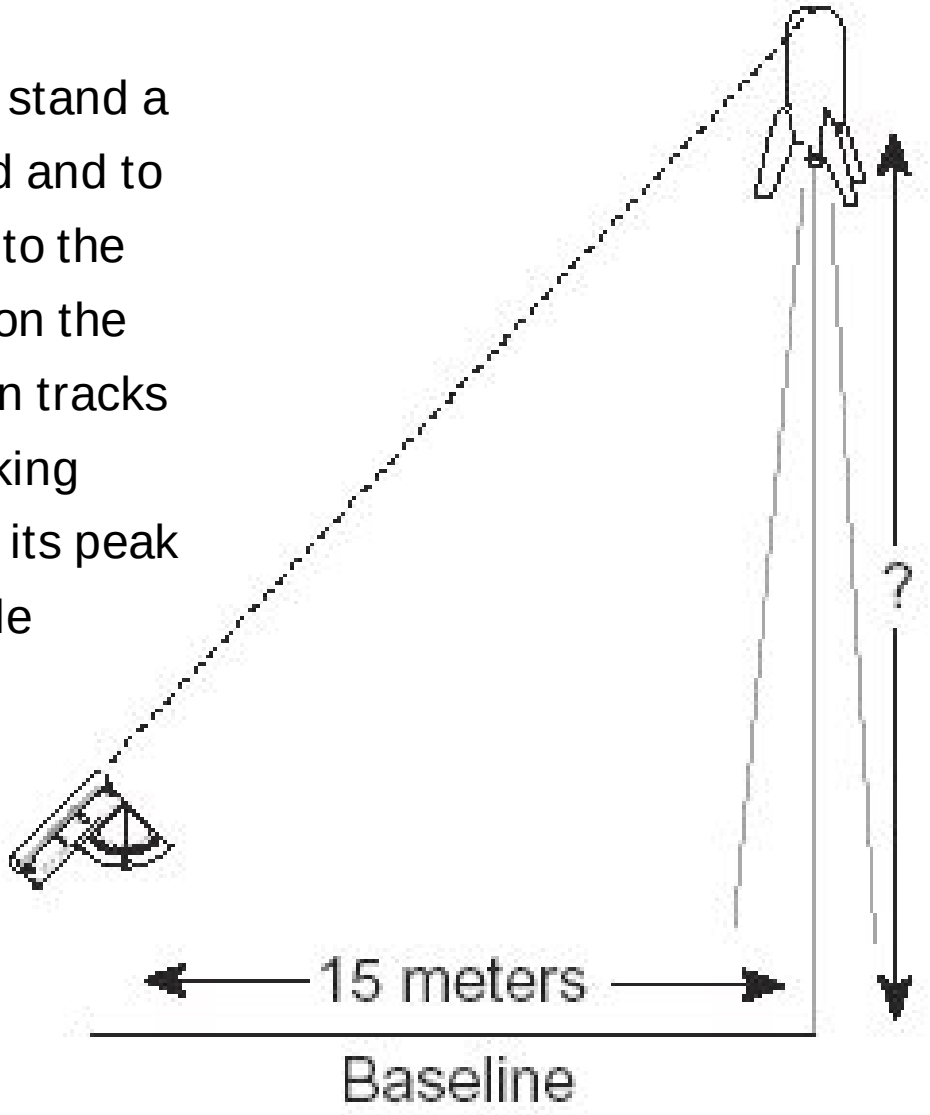
- 2 - 8 ½ x 11 inch construction paper
- Stapler
- String
- Metal washer
- Scotch tape
- scizzers

Altitude Tracking

- There are two methods for determining the altitude of a model rocket. One method is to use an altimeter and the second is visual tracking.
- The altimeter is an electronic device that uses an air pressure sensor to detect the air pressure difference between the launch pad and in flight. As the rocket flies up in the air, the air pressure decreases. The electronics records the maximum altitude by detecting the minimum air pressure measurement. The downside of the altimeter is that it adds weight to the rocket which changes the rockets flight characteristics. Altimeters generally cost anywhere between $70 and $200.

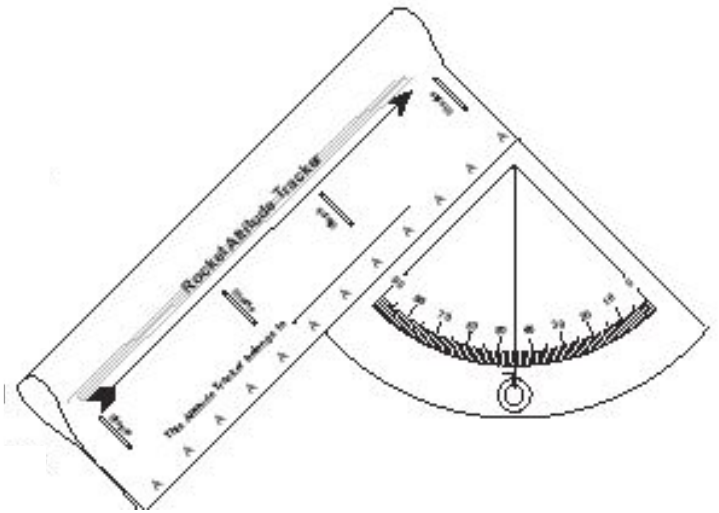
Visual Tracking

- Visual tracking requires a person to stand a certain distance from the launch pad and to measure the angle from the horizon to the highest altitude sighted. The figure on the right shows how it works. The person tracks the rocket by looking through a tracking device and when the rocket reaches its peak altitude, the person records the angle measured with the tracking device.



Altitude Tracker

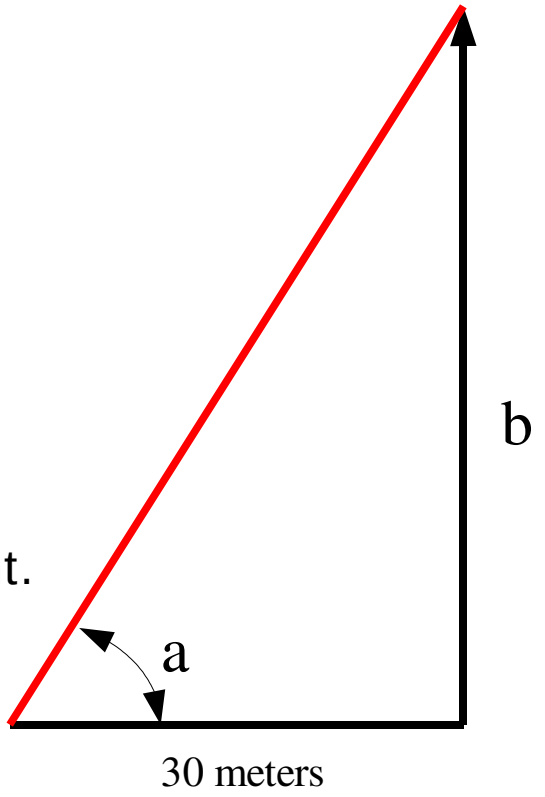
- The tracking device is an altitude tracker. It has two parts. One part is the site which is a tube that a person looks through to track the rocket. The second part is a what looks like half of a protractor. It provides angle measurements from when pointing to the horizon to pointing straight up. This covers 90 degrees which is a quarter of a circle.
- Trigonometry is used to calculate the altitude of the rocket. With single station tracking, it has to be assumed the rocket will fly straight up. This is done to keep the math simple.



Calculating the Altitude

- Assuming the rocket flies straight up allows the calculations to be based on the right angle triangle.
- What is known is the base line from the observer to the launch pad which is 30 meters. The angle from the horizon to the rocket at its peak altitude is measured. With both pieces of information, the altitude 'b' can be calculated using a trigonometric function called tangent. The equation is

  b = 30 * tan(a)



- The result is the altitude in meters.
- To determine the distance between the observer and the rocket in the air, another equation can be used:

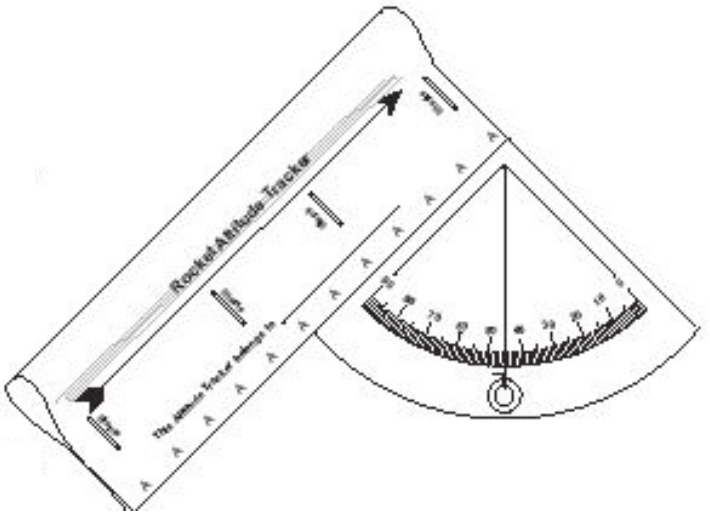
  range = 30 / cos(a)

Sources of Errors

- Single station tracking is not perfect. There are some sources of error. One is the fact that rockets generally do not fly straight up. Wind can push the rocket off the straight line and the rocket can arc into the wind. The other source of error is the observer not tracking the rocket exactly. The rocket moves very quickly so it may be hard to determine the tallest point the rocket reaches.

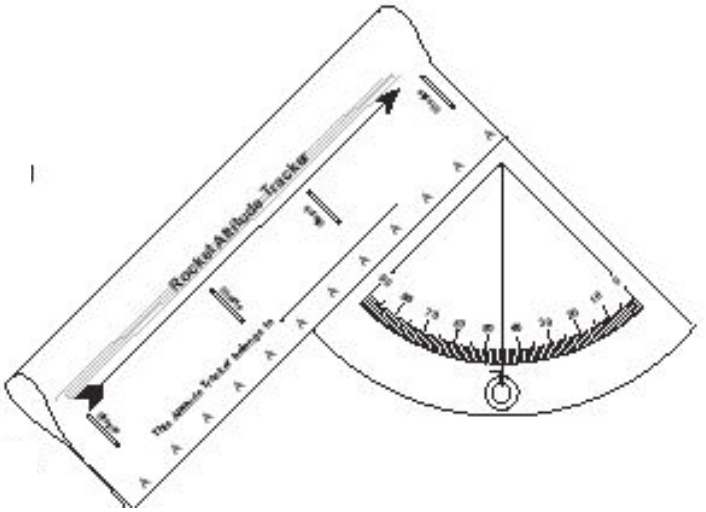
Constructing the Altitude Tracker

- You will need to sheets of heavy construction paper. One sheet will be used to make the sight and the other will be for measuring the angle.
- Cut out the angle pattern from the page in the back of the lesson. Take a sheet of construction paper and cut it to the same size. Use a glue stick and glue the angle pattern to the construction paper.
- Take the next sheet of construction paper and bring one long side to the other and staple the two sides together leaving a loop down the center of the sheet as seen in the drawing on the right.



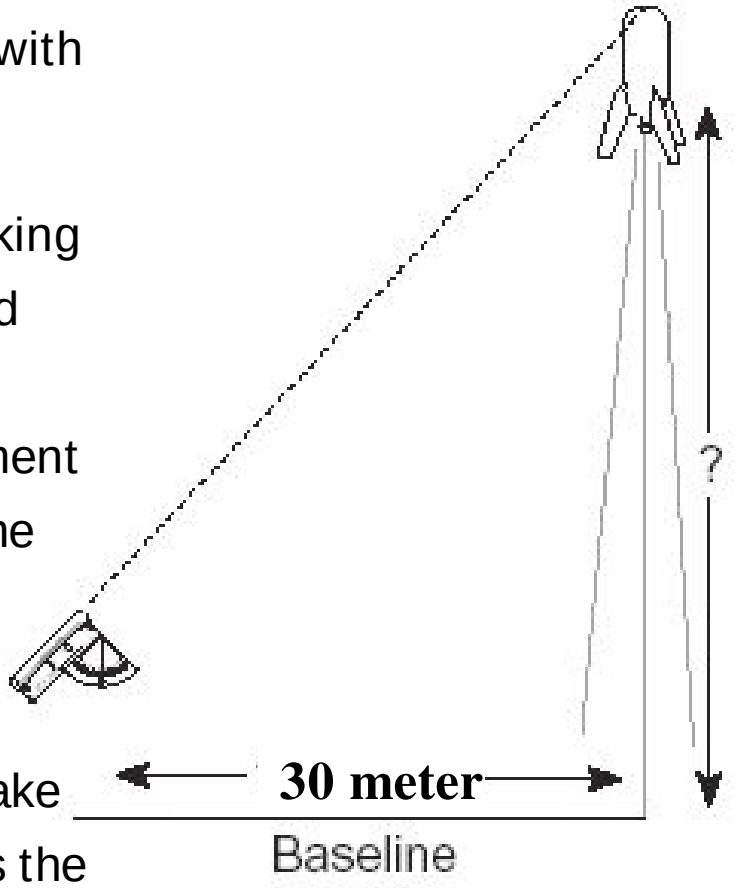
Construction Continued

- Staple the angle pattern to the sight tube. The 90 degree line must be in line with the sight.
- Punch a small hole in the corner of the angle pattern and insert one end of the string. Secure it on the back side with a piece of tape.
- At the other end of the string, tie a metal washer to the string. The washer should rest just after the outer line.
- You now have a complete instrument.



Using the Altitude Tracker

- Out at the field, Measure thirty meters from the launch pad. This point is where you will stand with your instrument.
- When the rocket launches, track the rocket looking through the site. The instrument should be held like a pistol aiming at the rocket. When the maximum altitude is detected, hold the instrument at that position. Have another person look at the angle pattern and record the angle.
- Now to calculate the altitude. Look up the multiplication factor for the angle observed. Take that number and multiply it by 30. The result is the altitude in meters.
- If you want to measure in feet. Use a baseline of 100 feet and it by the multiplication factor.

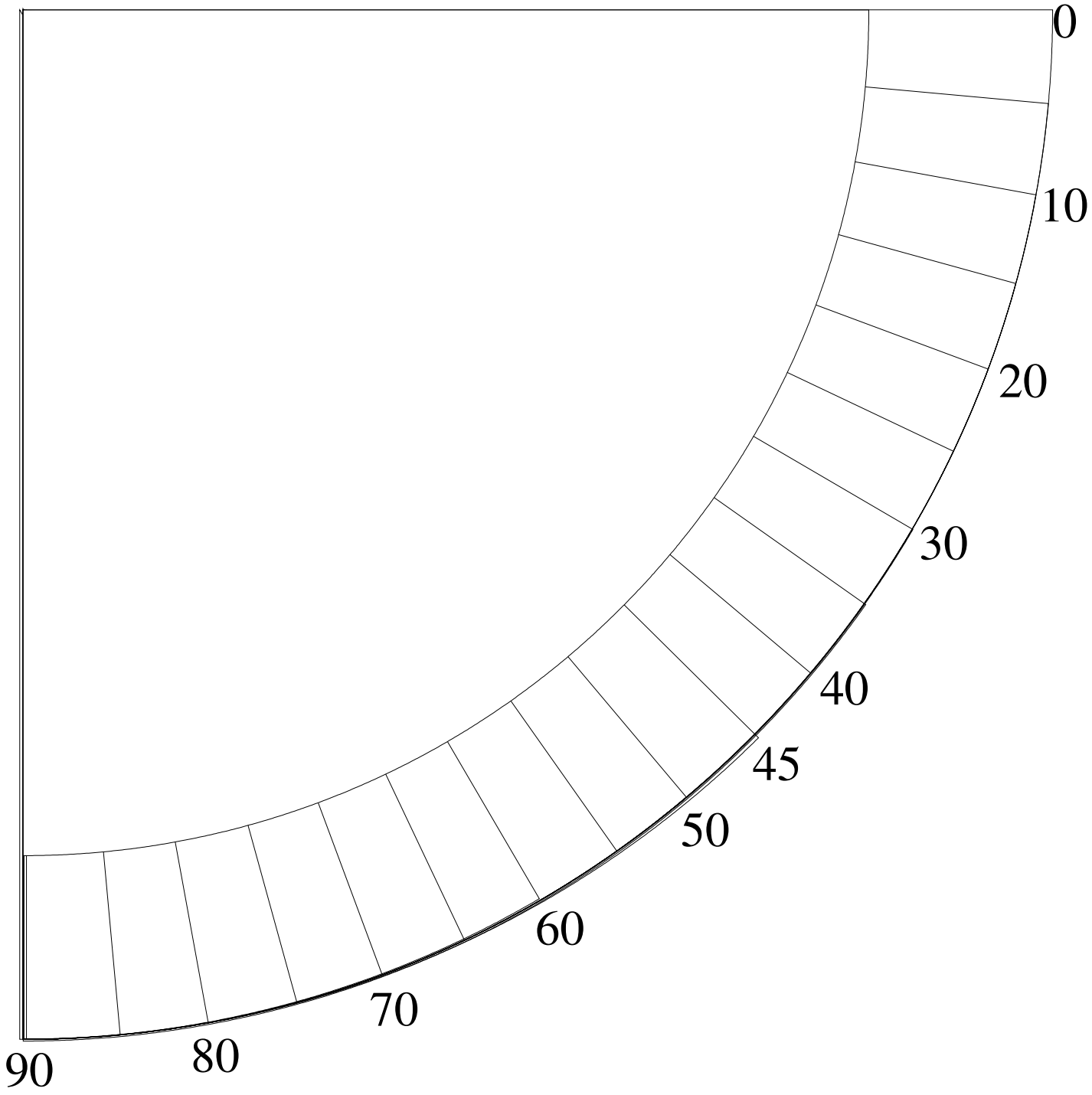


Angle Multiplication Factor Table

Angle	Factor
0	0.000
5	0.087
10	0.176
15	0.268
20	0.364
25	0.466
30	0.577
35	0.700
40	0.839
45	1.000
50	1.192
55	1.428
60	1.732
65	2.145
70	2.747
75	3.732
80	5.671
85	11.430
90	Infinity

Use:

1. Measure the angle of the rocket at its highest altitude.
2. Use the table and look up the factor for the angle measured.
3. Use a calculator and multiply the factor by the baseline. The result is the altitude. You can use meters or feet.



Cut along this line

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