Air Rocket Assignment.

Background

These rockets are propelled by an air rocket launcher which is like an air-powered cannon. However, the rocket surrounds the launch rod (similar to a cannon barrel). High-pressure air fills the rocket. If the rocket were firmly attached to the rod, the nose cone and the forward end of the rocket would blow apart. Instead, the rocket begins sliding along the rod as it continues to fill with air. Immediately after clearing the end of the rod, air inside the rocket expands backward out the lower end. The action-reaction effect (Newton's third law) adds thrust to the already moving rocket. If the rocket is well-designed and constructed, flights of more than 100 meters are possible. The primary determining factor for performance is drag or friction with the air. Rockets with very big floppy fins have a great amount of drag, and flights are usually short. Very squat nose cones also increase drag. The idea is to design a rocket that is streamlined so that it slices cleanly through the air.

Your task is to produce the air rocket with the longest range and document, with drawings and instructions, its construction.

Discussion.

There are many factors affecting the flight of the rocket including:-

- the length of the rocket, A5, A4, A3?
- volume of the rocket, tapered to ensure a large volume of air is initially trapped?
- tight or loose fitting onto the launch tube?
- the mass of the rocket, how many turns of paper are used? Too much mass and the rocket does not fly. Too little mass and the rocket does not fly!
- the position of the centre of mass of the rocket, adding mass to the nose cone?
- straight flight or rifled?
- the position of and type of fins fitted to the rocket?
- the launch pressure, very high initial speeds could lead to high drag forces. Too much pressure and your rocket could explode on take off!
- the launch volume or air, 600 or 1000ml?
- the launch angle?
- rocket or rocket propelled glider?

Safety

Do a risk assessment to minimise dangers to yourself and others.
Consider:-

- paper cuts,
- cuts from scissors
- burns from hot melt glue
- shrapnel from exploding rockets
- injury from being hit by a rocket.

Constructing the Rocket

1). Begin construction by rolling a cylinder of paper around the 15mm PVC pipe. Keep the pipe inside the rocket until it is completely finished Glue the seam with paper glue and ensure that it is sealed. The paper tube needs to move freely over the PVC pipe. If it doesn't then you may need to remake this section.

2). The nose cone is made from a circle of paper folded like filter paper but with an extra fold. Fold the circle in half, then into quarters and then into eighths. Open the base of the cone so that there are three pieces of paper on one side and five on the other. Glue the paper to hold it in this form.

3). Carefully apply glue all around the sides of the top 5-8mm of the paper body tube. Withdraw the PVC pipe so that the top 10mm of the tube is not supported. Push the nose cone onto this end of the paper tube and hold it in place until the glue has taken effect. If there are any gaps between the nose cone and the paper tube then carefully use hot melt glue to seal these all around the join between the nose cone and paper body tube. DANGER – the glue will be HOT!!

4). Cut rocket fins and glue them to the lower end of the body tube. Use paper glue. Ensure that the glue is dry.

5). Put your name/team name onto the side of the rocket and decorate as appropriate. The rocket is ready for launch.

6). Document any alterations that you have done to the basic design. Include measurements and drawings.

7). Test your rocket with a low pressure launch by blowing air through the PVC tube or by using the rocket launcher at low pressure. Take care when launching as the rocket can cause harm and damage.

8). Consider how to improve the performance of your rocket – remake, redesign as necessary to ensure that you can achieve the longest range. Document your changes

Further Ideas

How can air rockets be modified to improve their flight performance?
How loose or tight the tube is in relation to the launch rod affects air flow.
The size and shapes of the fins affect air drag.
Having fins mounted straight on the body of the rocket also affects drag.
The length of the cone, squat or slender, affects how the rocket slices through the air.

Double-Long Rocket

1. Overlap, end-to-end, two sheets of paper.
   Use tape to secure the sheets to each other and roll them around a long PVC tube.
2. Tape the tube and add a nose cone and fins.

Glue Reinforced Rocket

1. Construct a double-long rocket but do not seal the long edges.
   When the paper is partially rolled, squeeze a bead of white glue from one end of the tube to the other. Spread the glue and continue rolling the tube. Add more glue as you roll.
   Be careful not to get any glue on the PVC tube.
2. After the tube is dry, smear glue over the entire tube to strengthen it.
   Several coatings of glue will yield a very strong body tube

Heavy Duty Fins

1. Extra strong fins can be made by folding and gluing multiple layers of paper together.
2. Cut out the desired fin shape and small flaps for mounting the fins to the body.
3. Smear glue inside the fin and press with a weight to keep the fin flat during

Payload Stage

1. Roll a rocket body tube. Use paper and tape to close off the upper end of the tube.
2. Roll a second piece of paper around the upper end of the body tube to make a payload stage. Tape it in place. Cut a small window and slip a tube of thin, clear plastic into the payload stage.
3. Insert the payload and close off the upper end with a standard nose cone.

Parachute Recovery System

1. Build a payload stage rocket (without a window). Construct a parachute from a thin plastic bag, string, tape, and a metal washer.
2. Place the washer inside the payload stage. Lightly fold and place the parachute on top.
3. Make a nose cone that slips over the payload stage. Do not tape it to the rocket. When the rocket noses over, the weight will separate the nose cone and push out the parachute. (The weight and parachute must slide easily out of the tube or they will get stuck.)

For a real challenge, construct a rocket with a parachute recovery system for a payload.