ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL TWO

INSTRUCTIONAL GUIDE

SECTION 6

EO C240.03 – IDENTIFY PARTS OF A ROCKET

Total Time: 30 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-802/PG-001, Chapter 4. Specific uses for said resources are identified throughout the Instructional Guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Photocopy the handout located at Annex A for each cadet.

Photocopy and cut out the rocket puzzle pieces located at Annex B to be used in TP2.

PRE-LESSON ASSIGNMENT

N/A.

APPROACH

An interactive lecture was chosen for TP1 to orient the cadets to the parts of a rocket, to generate interest and to present basic material.

An in-class activity was chosen for TP2 as it is an interactive way to confirm the cadet's comprehension of the material.

INTRODUCTION

REVIEW

N/A.

OBJECTIVES

By the end of this lesson the cadet shall be expected to identify parts of a rocket to become familiar with its components.

IMPORTANCE

It is important for cadets to know the parts of a rocket so that they can understand how they are constructed. Identifying the parts of a rocket may develop an interest in the components that make up a rocket, which may lead to future aerospace opportunities in the Air Cadet Program.

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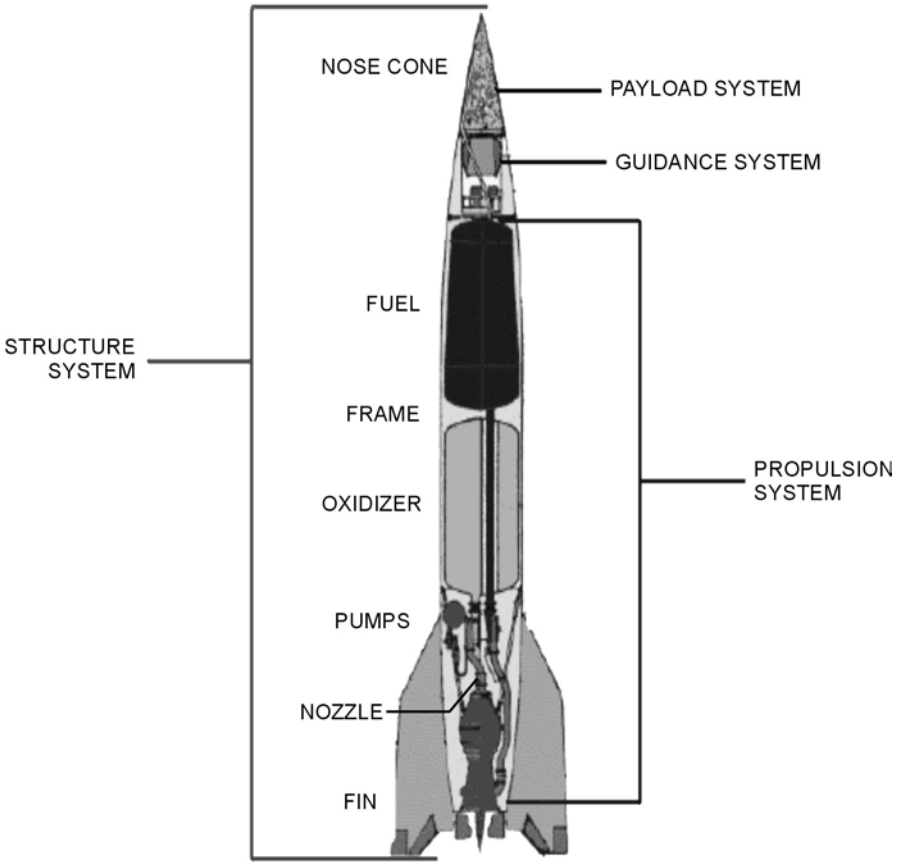
Teaching point 1 **Explain the Parts of a Rocket**

Time: 15 min Method: Interactive Lecture

In flight, a rocket is subjected to the forces of weight, thrust, and aerodynamics. There are many parts that make up a rocket. For design and analysis, engineers group parts that have the same function into systems.



NASA, 2007, Rocket Parts, Retrieved 26 February 2007, from http://exploration.grc.nasa.gov/education/rockerpart.html#

Figure 1 Parts of a Rocket

ROCKET PARTS

Structural System. Also known as the frame, it is similar to the fuselage of an airplane. The frame is made from very strong but light-weight materials, like titanium or aluminum. The frame employs long “stringers” that run from the top to the bottom, which are connected to “hoops” that run around the circumference. The “skin” is then attached to the stringers and hoops to form the basic shape of the rocket. The skin may be coated with a thermal protection system to keep out the heat of air friction during flight and to keep in the cold temperatures needed for certain fuels and oxidizers. Fins are attached to rockets at the bottom of the frame to provide stability during flight.

The structure system includes the following parts:

- the nose cone,
- fuel,
- the frame,

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- the oxidizer,
- the pumps,
- the nozzle, and
- the fins.

Propulsion System. Most of a full-scale rocket is made up of the propulsion system. There are two main classes of propulsion systems, liquid rocket engines and solid rocket engines. The V2 used a liquid rocket engine consisting of fuel and oxidizer (propellant) tanks, pumps, a combustion chamber with nozzle, and the associated plumbing. The Space Shuttle, Delta II, and Titan III all use solid external rockets.

Payload System. Payload systems depend on the rocket's mission. The earliest examples of payloads on rockets were fireworks for celebrating holidays. The payload of the German V2, shown in Figure 1, was several thousand pounds of explosives. Following World War II, many countries developed guided ballistic missiles armed with nuclear warheads for payloads. The same rockets were modified to launch satellites with a wide range of missions; communications, weather monitoring, spying, planetary exploration, and observatories, like the Hubble Space Telescope. Special rockets were developed to launch people into Earth's orbit and onto the surface of the Moon.

Guidance System. Guidance systems include very sophisticated sensors, on-board computers, radars, and communication equipment to manoeuvre the rocket in flight. Many different methods have been developed to control rockets in flight. The V2 guidance system included small veins in the exhaust of the nozzle to deflect the thrust from the engine. Modern rockets typically rotate the nozzle to manoeuvre the rocket. The guidance system must also provide some level of stability so that the rocket does not tumble in flight.



Distribute a handout of the parts of a rocket located at Annex A to each cadet.

CONFIRMATION OF TEACHING POINT 1

QUESTIONS

Q1. How do engineers group parts of rockets and why?

Q2. What rocket parts make up the structure system?

Q3. What are the systems in a rocket?

ANTICIPATED ANSWERS

A1. Engineers group rocket parts that have the same function into systems for design and analysis purposes.

A2. The structure system includes the following parts:

- the nose cone,
- fuel,
- the frame,
- the oxidizer,
- the pumps,

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- the nozzle, and
- the fin.

A3. The systems of a rocket include:

- the structure system,
- the propulsion system,
- the payload system, and
- the guidance system.

Teaching point 2 **Name the Parts of a Rocket**

Time: 10 min Method: In-Class Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to help cadets become familiar with the parts of a rocket.

RESOURCES

- The puzzle located at Annex B, and
- Tape.

ACTIVITY LAYOUT

N/A.

ACTIVITY INSTRUCTIONS

1. Provide the cadets with the puzzle parts and shapes of a rocket.

2. Request a cadet to volunteer and select a shape and place it on the board in front of the class.

3. Repeat the steps until all the shapes are up on the board and the rocket is built. Then repeat the steps using the words and pictures to label the rocket.



Allow cadets to make corrections if the parts of the puzzle are in the wrong place.

4. Use the handout located at Annex A as a guide to confirm if the puzzle is correct.

SAFETY

N/A.

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CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the parts of a rocket activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in identifying the parts of a rocket will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK/READING/PRACTICE

N/A.

METHOD OF EVALUATION

N/A.

CLOSING STATEMENT

Knowing the parts of a rocket will help cadets understand how rockets are constructed. Identifying the parts of a rocket will help cadets understand the components that make up the rocket, which may develop an interest in rocket technology that may lead to future aerospace opportunities in the Air Cadet Program.

INSTRUCTOR NOTES/REMARKS

N/A.

REFERENCES

C3-106 NASA. (2006). *Rocket Parts.* Retrieved 22 February 2007, from http://exploration.grc.nasa.gov/education/rocket/rockpart.html#.

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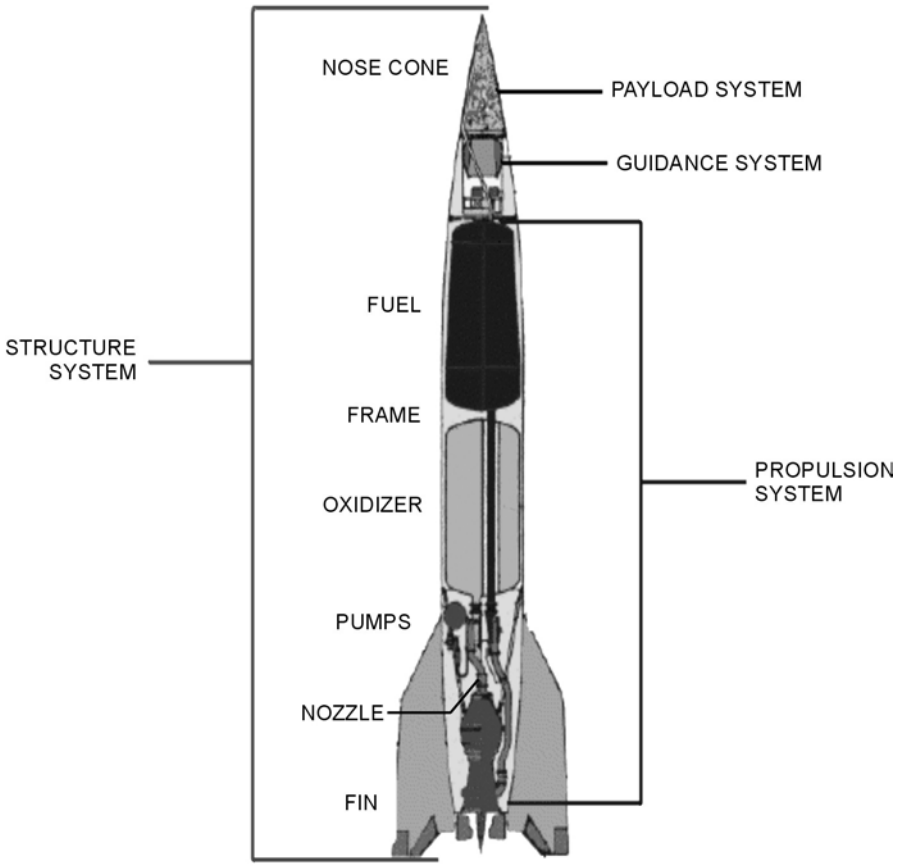
PARTS OF A ROCKET



"NASA", Parts of a Rocket. Retrieved 23 April 2007, from http://exploration.grc.nasa.gov/education/rocketpart.html#

Figure A-1 Parts of a Rocket

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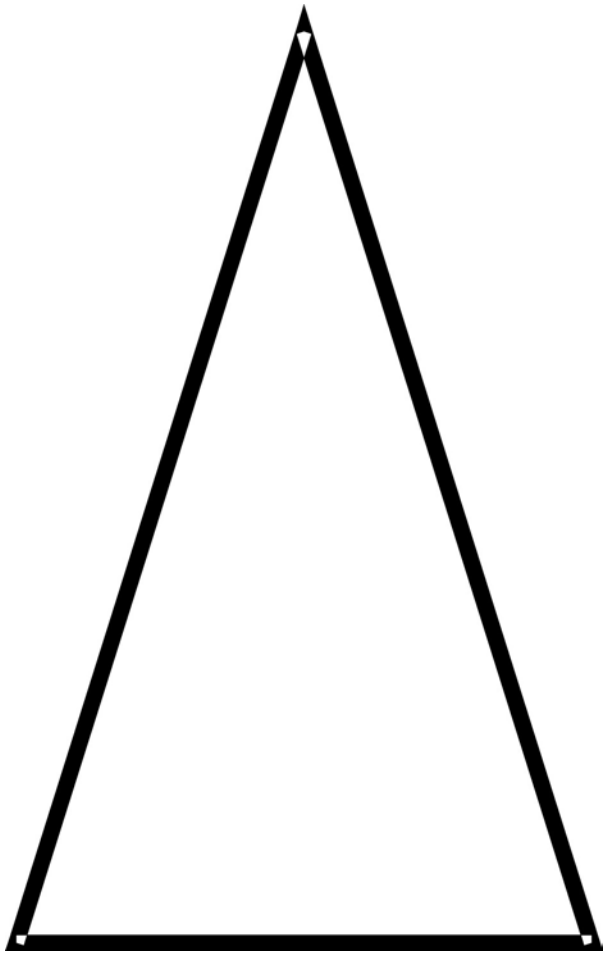
ROCKET PUZZLE PIECES



D Cdts 3, 2006, Ottawa, ON: Department of National Defence

Figure B-1 Nose Cone (Part A)

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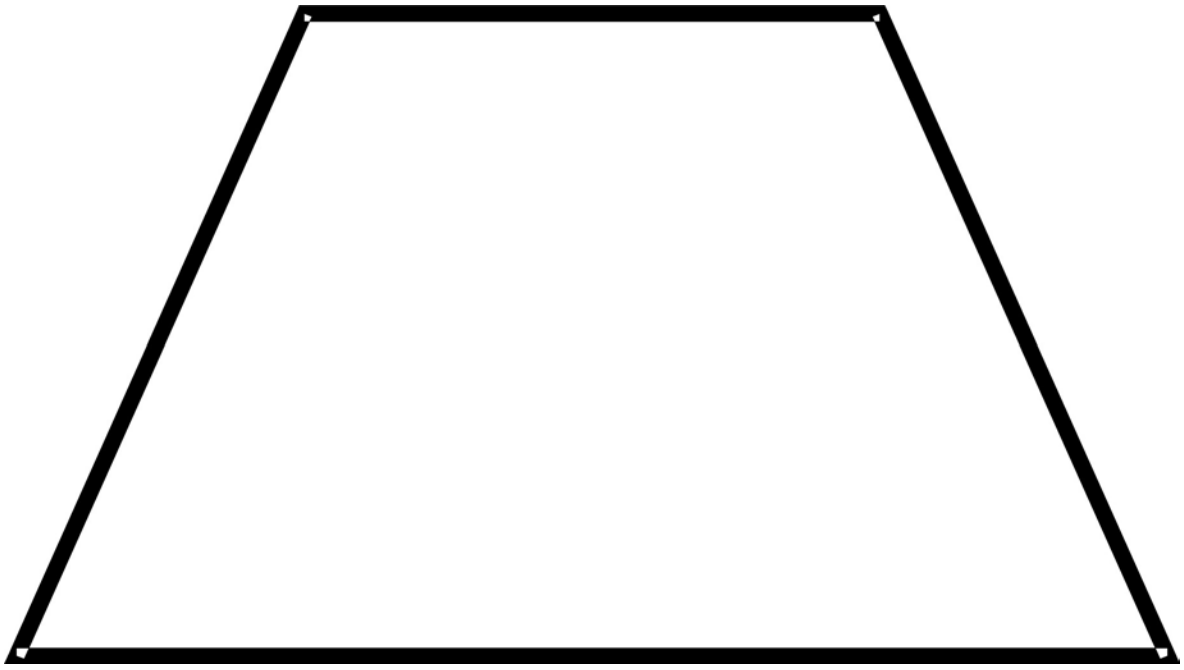

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Figure B-2 Nose Cone (Part B)

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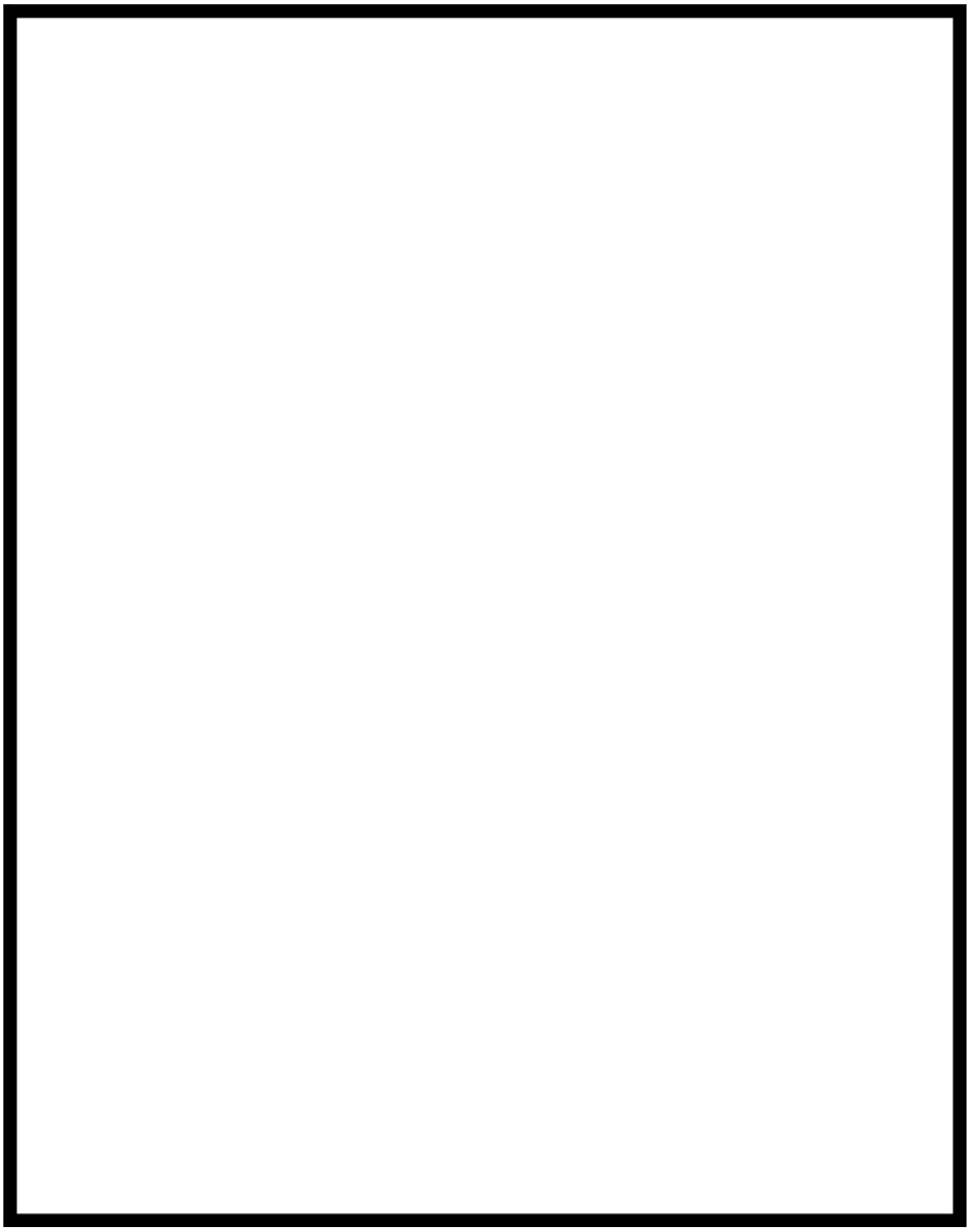

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Figure B-3 Frame (Fuel Section)

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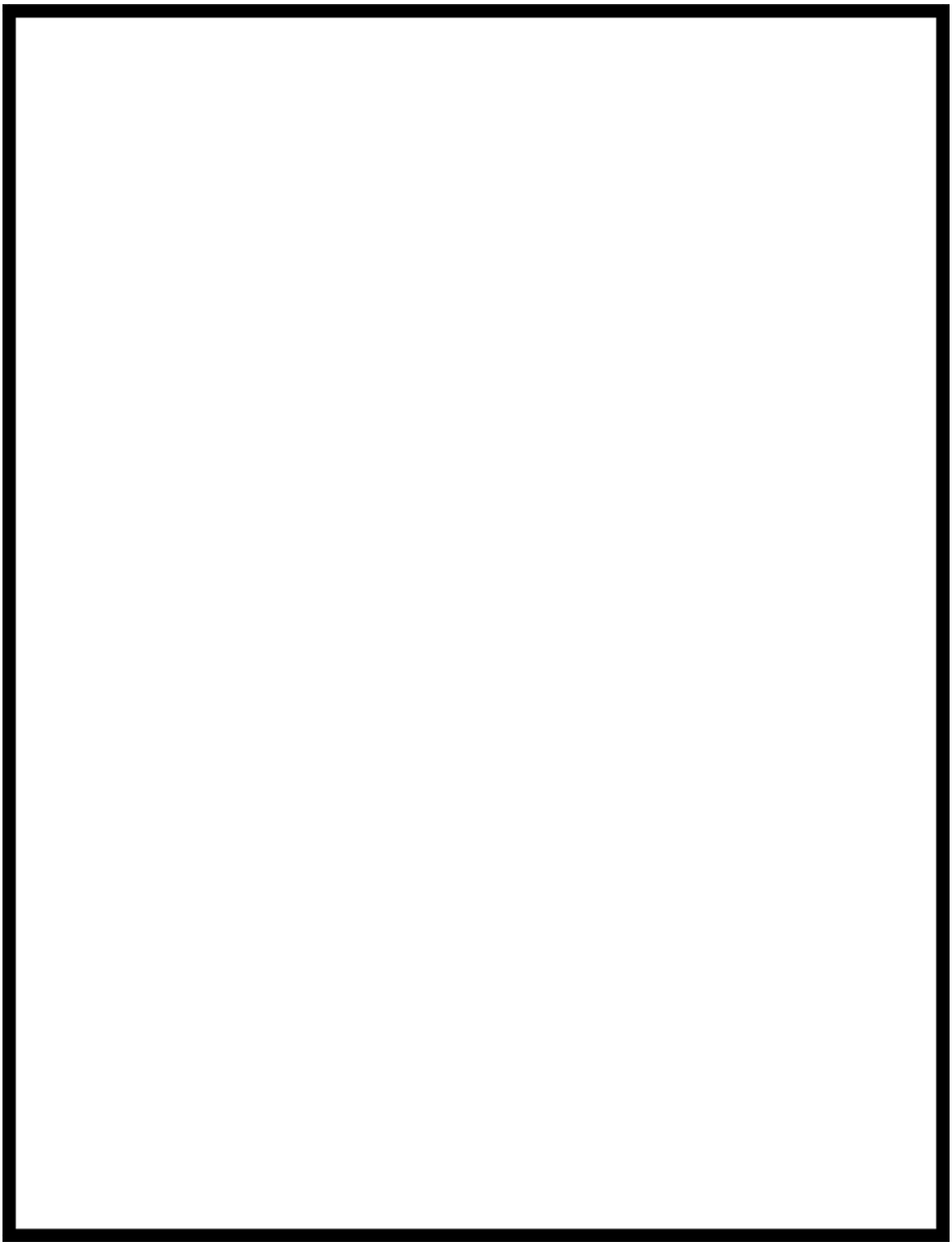

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Figure B-4 Frame (Oxidizer Section)

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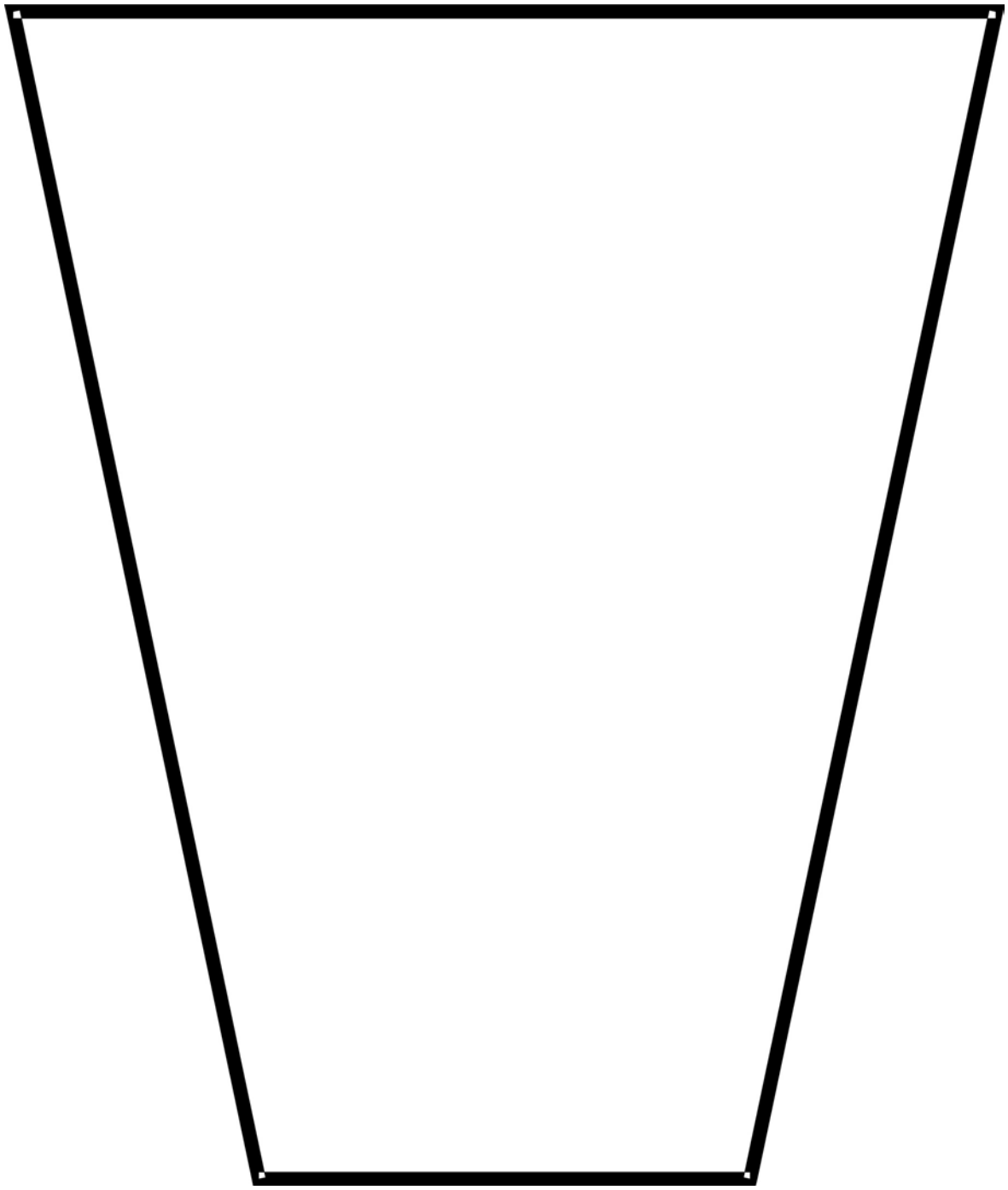

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Figure B-5 Frame (Pumps and Nozzle Section 0)

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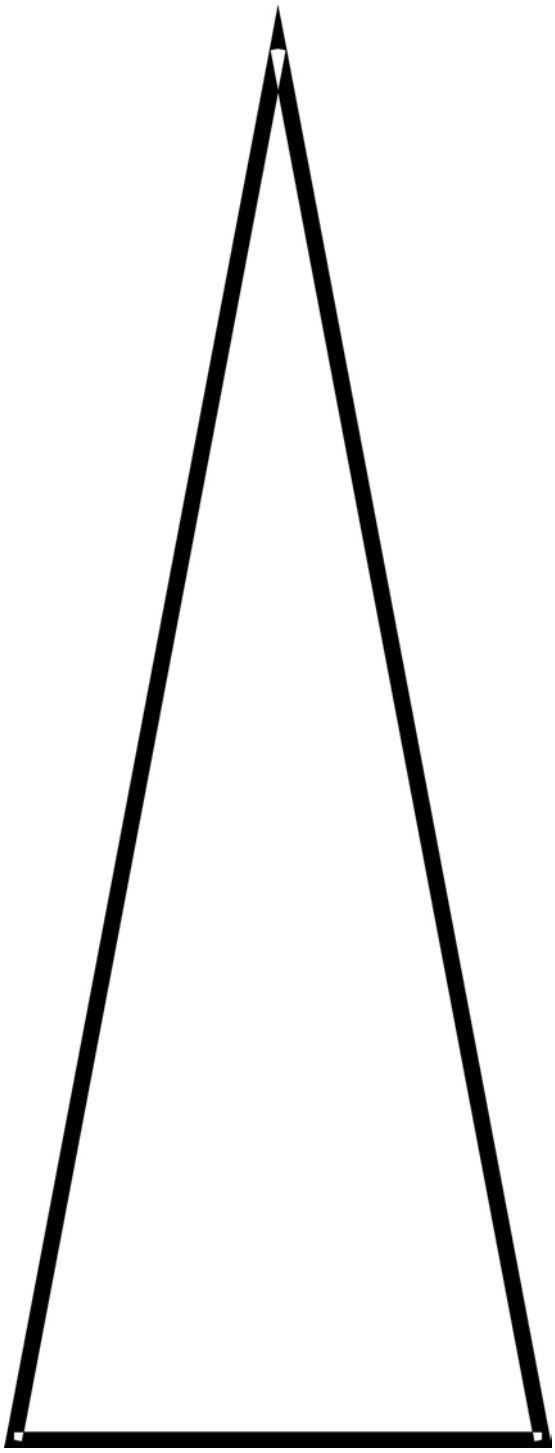

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Figure B-6 Fin (Section 1)

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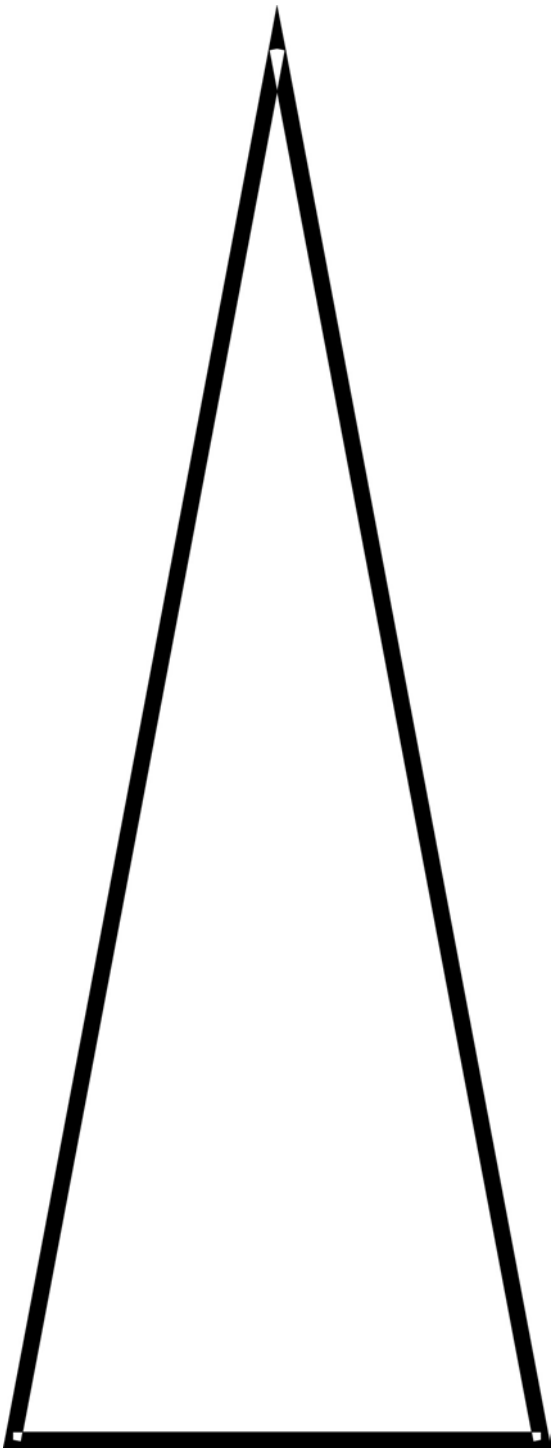

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Figure B-7 Fin (Section 2)

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PARTS OF A ROCKET: LABELS



Cut out the following boxes and figures to be used to label the rocket puzzle.

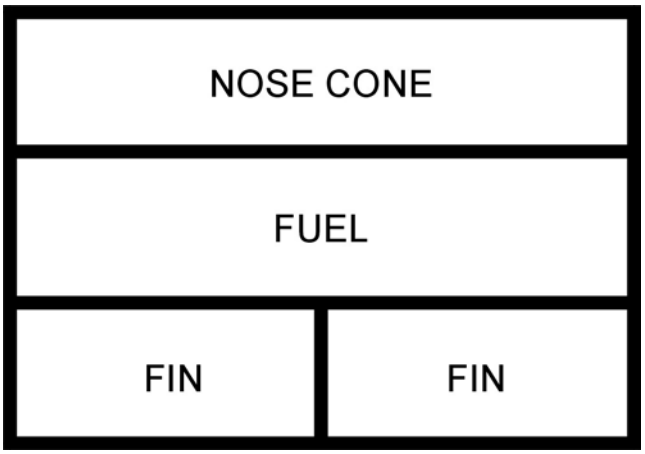

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Figure B-8 Rocket Labels

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GUIDANCE SYSTEM

"Clip Art", Microsoft Corporation, 2003 , Santa Rosa: CA: Impreza Systems, Copyright 2000, Impresa Systems

Figure B-9 Guidance System



PAYLOAD SYSTEM

"Clip Art", Microsoft Corporation, 2003 , Santa Rosa: CA: Impreza Systems, Copyright 2000, Impresa Systems

Figure B-10 Payload

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FUEL PUMP

"Google Images", New Philadelphia, Ohio, Fuel Pump. Retrieved 18 April 2007, from http://www.neohiotravel.com/images/gaspump.gif

Figure B-11 Fuel Pump



OXIDIZER

"Google Images", California State University, Oxidizer Label. Retrieved 18 April 2007, from http://www.csudh.edu/oliver/chemdata/warnlabs/oxidizer.jpg

Figure B-12 Oxidizer

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NOZZLE

"Google Images", Airwork Aviation Images, Engines. Retrieved 18 April 2007, from http://www.airwork-images.com/details.php?gid=278&sgid=&pid=456

Figure B-13 Nozzle

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