STUDENT STUDY GUIDE
FOR
AEROSPACE DIMENSIONS

2000

Published by
National Headquarters Civil Air Patrol
Aerospace Education
Maxwell AFB, Alabama
# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>iii</td>
</tr>
<tr>
<td>Improving Study Skills</td>
<td>1</td>
</tr>
<tr>
<td>Developing Good Study Habits</td>
<td>3</td>
</tr>
<tr>
<td>Calculating Reading Time</td>
<td>3</td>
</tr>
<tr>
<td>Developing Good Reading Skills</td>
<td>4</td>
</tr>
<tr>
<td>Listen Effectively</td>
<td>4</td>
</tr>
<tr>
<td>Taking Notes</td>
<td>5</td>
</tr>
<tr>
<td>Improving Your Memory</td>
<td>5</td>
</tr>
<tr>
<td>Taking a Test</td>
<td>6</td>
</tr>
<tr>
<td>Module 1 - Introduction to Flight</td>
<td>9</td>
</tr>
<tr>
<td>Module 2 - Aircraft Systems &amp; Airports</td>
<td>14</td>
</tr>
<tr>
<td>Module 3 - Air Environment</td>
<td>18</td>
</tr>
<tr>
<td>Module 4 - Rockets</td>
<td>22</td>
</tr>
<tr>
<td>Module 5 - Space Environment</td>
<td>25</td>
</tr>
<tr>
<td>Module 6 - Spacecraft</td>
<td>29</td>
</tr>
<tr>
<td>Appendix 1 – Answers</td>
<td>32</td>
</tr>
<tr>
<td>- Module 1</td>
<td>32-34</td>
</tr>
<tr>
<td>- Module 2</td>
<td>34-36</td>
</tr>
<tr>
<td>- Module 3</td>
<td>36-38</td>
</tr>
<tr>
<td>- Module 4</td>
<td>38-39</td>
</tr>
<tr>
<td>- Module 5</td>
<td>39-41</td>
</tr>
<tr>
<td>- Module 6</td>
<td>41-42</td>
</tr>
</tbody>
</table>
INTRODUCTION

We designed this study guide to be used with the Phase I and II aerospace education program, *Aerospace Dimensions*. This study guide should help you review the material and reinforce your knowledge of the six modules that make up *Aerospace Dimensions*.

The study guide begins with a section on improving study skills. It includes sections on: developing good study habits, calculating reading time, developing good reading skills, listen effectively, taking notes, improving your memory and taking a test. These sections offer valuable information and tips that will help you with your CAP lessons or with your schoolwork. We hope you will find these sections useful.

The study guide contains lots of questions for each chapter of each module. When you answer the questions, try to respond without looking up the answer. This will be a good review and a way to find out how well you know the material. Also, spend a little time thinking about the main ideas and concepts of the modules. Notice also that the learning outcomes of each module are included. Studying these outcomes will help you prepare for the tests.

The answers to the questions can be found in the appendix of this guide, or you can look them up in the text. The reference page for each answer is also included in the appendix.

So, good luck, and we hope you find this guide interesting, helpful and worthwhile.
Improving Study Skills

The next few pages contain some helpful hints for studying. These hints apply whether you are involved with Civil Air Patrol books or with your schoolwork. Take a few minutes and look over these pages. They should help you work more efficiently.

Organizing Your Time

There never is enough time! How many times have we heard that or even said that ourselves. We are all busy, no question about it. However, some people seem to accomplish a lot more than others. How do they do it? Some people are more organized than others. Let's take a look at a couple of ideas to help you better organize your time.

The first step in organizing your time is making a To Do List. Be sure that you prioritize your list. Use any system that works for you, for instance, you could number each item based on ranking them in the order that you plan to complete them. i.e. 1, 2, 3, etc. Or you could use a 1 – for high priority, 2 – for medium, and 3 – for low, or simply H, M, L. Just be sure to classify them in some way. See charts below:

To Do List

<table>
<thead>
<tr>
<th>Priority</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>History – read chap 5</td>
</tr>
<tr>
<td>2</td>
<td>Math – complete homework</td>
</tr>
</tbody>
</table>

OR

<table>
<thead>
<tr>
<th>Priority</th>
<th>Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Write English paper</td>
</tr>
<tr>
<td>M</td>
<td>Read Science chap 9</td>
</tr>
</tbody>
</table>

Next, you need to make a time schedule. Two examples are listed on the next page. Either will work. The main idea is to fill out the schedule and use it. Be accountable for your time and then stick to it the best you can. If you have everything listed and you use your schedule, you are already on your way to being more organized.

The first example of a schedule is very general in nature. Just block the times you want to study that day. That part is up to you. So, this gives you the flexibility to fit the studying in when you can. This is fine, but you must be responsible to ensure that you do
actually study. You should remember that you may not be able to study for two hours straight and stay alert enough to get all you can from the lesson. A quick 5-10 minute break to get up and stretch or walk around can help clear your mind a little and refresh you. After the break, get back to work. This establishes a good routine, plus its better than studying for two hours straight. You will retain more.

Notice that the second example is much more specific. It even lists the hours of the days. This one isn’t nearly as flexible and requires some dedication and commitment. This one is easier to follow after you have already established good study habits and have proven to yourself that you can follow such a schedule.

Once you set your starting time, do your best to stick to it. Have your paper, pens, pencils, books and anything else you need with you when you begin studying. Be realistic with your priorities and adjust your schedule accordingly, if you must.

<table>
<thead>
<tr>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thur</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Time Schedule

Week of __________

<table>
<thead>
<tr>
<th>Hour</th>
<th>Mon</th>
<th>Tues</th>
<th>Wed</th>
<th>Thur</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12-1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5-6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6-7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7-8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8-9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9-10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Developing Good Study Habits

Another area where we should spend some time is in developing good study habits. If you have followed the tips from the Organizing Your Time section you are already on the right track to better studying habits. Here are a few more tips for your consideration.

Arrange a study area that has good lighting, a comfortable chair and comfortable temperature. Create a good environment for studying, one without distractions. Noise, whether from the radio or television, is a distracter. Some students like to study with the radio or television on, but in most cases, they could concentrate better and retain it longer without the noise.

Study while you are alert. Know when your best times are for studying. Some people study best in the morning, while others do best at night. Know what works for you. Don’t force yourself to stay awake. You must be alert to get the most out of your studying. Also, know where you study best. It might be at the library, your home, or somewhere else, but know where it is.

Set realistic amounts of time for studying. Know how long you can study before taking a break. When you find yourself daydreaming, stop, take a quick break and then get back at it. If you are fighting boredom and are unfocused, get up and move around, have a drink of water, or turn down the heat. It’s all right to take breaks. The key is to keep them short and get back to your studies.

Finally, work on one assignment at a time, and if you can, finish it before moving on to the next task.

These few pages on studying were meant to give you some ideas about how to study better and be more efficient with your time. They are not a comprehensive list of all the do’s and don’ts on studying. However, we do hope these tips are helpful to you.

Calculating Reading Time

Here is a quick way to figure how much time it should take you to read an assignment:

1. Count the number of pages you must read.
2. Use the following formula to calculate the number of pages you must read each day:

\[
\text{Total pages} \div \text{Number of days} \times 4 \text{ (average minutes per page)}
\]

3. Divide the total number of pages you must read by the number of days you have in which you have to read them.
Example: you have 40 pages of aerospace reading due in 4 days; divide 40 by 4 \((40 \div 4 = 10)\). You need to read 10 pages each day.

4. Multiply the number of pages you must read each day by the number of minutes it takes to read a page.

Example: \(10 \times 4 = 40\). You must read 40 minutes per day for 4 days to complete your assignment. Remember, this is an average. Your time may vary.

**Developing Good Reading Skills**

Let's go over a few steps which can improve your reading skills. First of all, you should understand how the text is organized. You can do this by going over the table of contents. This will give you a chapter-by-chapter listing. Then read the introduction, which is written by the author and usually gives a detailed overview of the book.

The next step should be to skim over your reading. Skimming includes reading subheadings and illustrations, as well as thoroughly reading introductory paragraphs and summaries at the end of the chapters. Be sure also to read the first sentence of every paragraph, which usually includes the main idea of the paragraph.

Next, go back over the material and read for details. Read one chapter at a time. Don’t go on to the next chapter until you’ve written definitions of key terms and written some questions and answers to clarify the material.

To increase your reading speed, focus your attention and concentration. Eliminate outside distractions and provide a comfortable environment. Finally, try to grasp general concepts rather than every detail.

To increase your comprehension try to learn sequentially by building on what you already know. Review the main points and test yourself to see what you remember. Summarize what you’ve studied, writing it in your own words.

**Listen Effectively**

Here are a few things to help you listen more effectively:

Sit in front of the class or auditorium, if possible.

Pay close attention to the first and last 5 minutes of the lecture. Listen for what the instructor is going to talk about and then for the summary of what was discussed.

Concentrate on what the speaker is saying, not what he/she looks like or how he/she is dressed.

Listen with your mind, not your emotions.

Be prepared by reading your assignment ahead of time.
Relate ideas from the lecture to any previous lectures or personal experiences.

Seek answers to information you don't understand.

Avoid conduct distracting to others.

Participate constructively in discussions.

**Taking Notes**

Be sure to list the date of the lecture and the chapter of the material being covered.

When a lecturer writes on the board it is usually important, so take notes on it.

When reading, watch for key phrases like: “There are three main reasons…”, “This is important because...”, or “The main point is...”.

Use your own system for abbreviations, symbols, underlining, etc. Highlight or mark important information.

Compress sentences into shorter phrases using your own words.

Write down facts accurately.

Summarize the main points of a lecture or chapter.

Study the text and the lecture notes together.

**Improving Your Memory**

Don't study when you are hungry, disorganized or upset.

Make sure your facts are correct before trying to remember them.

Get the proper amount of sleep. At least 4 to 6 hours is necessary for good memory retention the next day. Many people require 6 hours or more.
Build your memory with several shorter study sessions over several days. Five hours spread out over a few days is better than five hours straight in the same day.

After a lecture, review your notes for 5-10 minutes. Then do it again the next day.

Consider joining a study group. It can help you obtain a complete understanding of the material.

**Taking a Test**

Before discussing taking a test, let’s look at getting ready for a test. Many students experience test anxiety. This is very common, and it includes everything from just being a little nervous, to some students becoming very ill. Many students will get sweaty palms and feel like their mind is going blank. Probably all of us have experienced some of this at one time or another. Once you realize you have this problem, for the most part, there are things you can do to help.

One way to help is to be prepared; study. Conduct regular reviews of the material for up to a week before the test. Ask yourself questions from the text and your notes. This will help with the problem of cramming and pulling all-nighters. Regular studying will help you feel you are ready for the test, and will give you some added confidence which should help with your anxiety. Be confident, think positively, and relax. Take a deep breath. Actually, take a few deep breaths, lean back in your chair and try to relax your muscles.

Another thing, don’t be in a hurry to take a test. Take your time, think while you are answering the questions. However, don’t be slow and methodical either, but work at a steady, comfortable pace and keep moving. Don’t worry about being the first one done, or about being one of the last students still working. Being the first one done doesn’t insure a good grade, it just means you have turned your paper in and can’t go over it anymore. When you are finished with your test, go back over it, and make sure you’ve answered all of the questions.

When it comes to actually taking the test, always read the instructions carefully. Read or listen for any special rules, such as extra penalties for guessing or for certain questions being worth more points than others. If either of these occur, it should impact on your test strategy. For instance, if you lose additional credit for guessing, you must stop and decide if you are relatively sure, or making an educated guess, or whether it’s a wild guess. If there is no additional penalty for guessing, make sure you answer every question. If some questions count more points you’ll probably want to spend more time on them, so gage your time accordingly.

Some students will begin with the first question and go right through the test in order. Others will start with number one, but will skip ones they are unsure of and save them for later. If you subscribe to this philosophy, be sure you allow enough time at the end to go back and answer the ones you left. Also, be sure to mark them somehow so you can find
them quickly. Either one of these strategies work fine, just remember not to spend too much time on any one question. Always be aware of the time factor so you can pace yourself. If the teacher doesn’t remind you in some way, you might jot the time down on a piece of paper every 10 minutes or so.

Here are a few tips for **multiple-choice tests**.

Read the question carefully and look for any key qualifying words such as: not, never, none, always, all or every.

Watch for answers which state “all of the above” or “none of the above”; give them careful consideration. If you find that two of the responses are correct, then they all are.

Watch for one response being longer and more detailed than the rest; many times this will be the right answer.

Here are a few tips for **essay questions**.

If there is more than one question, read or at least skim all of the questions.

Underline important phrases, words, or facts within the question. Be able to emphasize what is important and what you have to address in your answer.

Off to the side or on a separate sheet of paper, jot down pertinent facts and key ideas that should be included in your answer, so when you begin answering the question you can refer to your notes, and you won’t forget. Don’t take a lot of time, use short phrases or single words that will trigger your memory. Take a moment and organize these facts and ideas in order so you will know how to move through the question.

Most importantly with essay questions, make sure you are answering the question and are addressing what the teacher wants.

Care about your spelling, grammar and legibility; these things can affect your grade.
AEROSPACE DIMENSIONS

MODULE 1

INTRODUCTION TO FLIGHT

Instructions: This STUDY GUIDE is designed to help you prepare for the examinations after each module. This guide is designed for self-study; however, it is suggested that cadets use the study guide to quiz each other in a group session. This is fun and very often, will help promote a better understanding of concepts.

Chapter 1 – Flight

Learning Outcomes
Upon completion of this chapter, the cadet should know:
- The relationship between Bernoulli’s Principle, Newton’s three laws of motion and how they were used to develop a machine that could fly.
- The coefficient of lift and the parameters involved.
- The parts of an airplane and an airfoil.
- The four forces affecting an airplane in flight.
- The three axes, movement around those axes and the control surfaces that create the motion.

Chapter 2 – To Fly By The Lifting Power of Rising Air

Learning Outcomes
Upon completion of this chapter, the cadet should know:
- How gliders use the environment to obtain altitude.
- Why gliders look differently than powered airplanes.
- How gliders can achieve great distances without power.

Chapter 3 – Balloons, They Create Their Own Thermals

Learning Outcomes
Upon completion of this chapter, the cadet should know:
- The principle of buoyancy and how this relates to the flight of a balloon.
- The components of a balloon and how each works in the flight profile.
- The history of the balloon and why it’s recognized as the first powered, manned flight.

Why Aerospace Education?
1. Aerospace education is defined as that branch of _________ _________ _________ concerned with communicating _________, _________ and _________ about aerospace activities and the total _________ of air and space vehicles upon society.
2. Aerospace education is a mission of the Civil Air Patrol. It was derived from a Public Law that was signed into existence on what date? 

3. What nation leads the world in aerospace technology?

Chapter 1 -- Flight

4. An ________ is any machine that is capable of flying through the air.

5. This aircraft is kept aloft by the aerodynamic forces upon its wings and is thrust forward by a propeller, or other means of propulsion such as a jet or rocket.

6. The word aerospace is a combination of __________ and __________.

7. Air is made up of several gases. Which one of these gases makes up the greatest percentage in the atmosphere? __________.

8. If "sub" means below, trans" means between, and "super" means above or beyond, develop three words from these prefixes for the range of speeds below, between, and beyond the speed of sound: __________, __________, __________.

9. If a control surface, such as a vertical or horizontal stabilizer, does not move or provide lift, can it still be considered an airfoil? __________.

10. If you mount a ski rack on top of an automobile, it creates aerodynamic __________ and this can affect gas mileage.

11. Forces in motion are said to be __________.

12. If the air is dead calm at an airport, can airplanes still fly? __________ (Y/N)

13. When an airplane moves down the runway, for takeoff, a flow of air is created in the opposite direction to the direction of the takeoff. This is known as the __________.

14. There is a line between the leading and trailing edges of a wing. What is it called? __________

15. In the myth about Icarus and Daedalus, it gives an account of a man and his son flying from an island across the Aegean Sea. There is an error in the myth that has to do with their flight. Which of the following answers best describes that error.
   a. As Daedalus flew higher, the wax on his wings melted.
   b. As Icarus flew higher, the temperature of the air should have been cooler.
   c. Sea bird feathers don't provide lift.
   d. Warm bee's wax won't stick to human arms.

16. A very significant date in history was November 21, 1783. What happened on that date?
   a. Joseph and Etienne Montgolfier first flew in a hot air balloon.
   b. The first hydrogen balloon flew over Paris, France.
   c. Marco Polo first flew the English Channel in a Montgolfier balloon.
   d. None of the above are correct.

17. In 1299 AD, Marco Polo observed __________ sailors being used as observers aboard what kind of a flying device? __________

18. A bird is a living __________ machine.

19. A large bubble of warm air is used to lift what kind of flying machine? __________. Who is given credit for inventing this flying machine? __________.
20. When you learn the *Important Terms* in the new *Introduction To Aerospace*, you are learning a new _____________.

21. The action of a bird’s wing that moves the air downward and backward can be compared to a _____________ on an airplane.

22. A bird has two “control surfaces” for maneuvering. They are the _____________ and the _____________.

23. Sir Isaac Newton’s three laws of motion can be used to explain how a bird flies. When the wings move downward, this propels a bird forward as well as providing lift. This is an example of Newton’s _____________ Law.

24. The curvature, or camber, on the upper surface of a bird’s wing, is an example of what kind of “lift.” (Bernoulli or Newton) _____________.

25. As a fluid, like air, is accelerated, the _____________ drops. This is an example of _____________ Law.

26. As the air flows over the top of a wing, it is accelerated. What happens to the pressure? _____________.

27. As air passes under a wing, a certain amount of lift is generated. This is an example of _____________ Law.

28. The _____________ is an imaginary line, in an airfoil, that connects the leading and trailing edges.

29. A curvature on the top of a wing, is called the _____________.

30. Name the two natural forces acting upon an airplane in flight: _____________ and _____________.

31. Name the two artificial forces acting upon an airplane in flight: _____________ and _____________.

32. A person weighing 160 pounds is flying a high performance fighter. In one combat maneuver, that person weighs 1280 pounds. How many “Gs” is that? _____________.

33. Bicycle helmets now have a distinct “tear drop,” or streamlined shape. This is an effort to reduce what natural force? _____________.

34. When an airplane is ready for takeoff, the pilot applies power. This power provides an artificial force called _____________ and it overcomes a natural force known as _____________. As the plane gathers speed, a mechanical device, called an airfoil, or _____________, causes a fluid, commonly known as _____________, to accelerate over and around the airfoil. This causes a _____________ in pressure on the upper curvature, known as the _____________. When the pressure on the top is _____________ and on the bottom is _____________, the airfoil will rise away from gravity. This creates an artificial force called _____________. The oncoming air, known as the _____________ _____________ also impacts the underside of the airfoil. This is an example of _____________ Law. State that law in its entirety: _____________.

35. The control surfaces on the trailing edge of a paper airplane’s wing are called _____________.

36. There are four ways of increasing lift in an airfoil. They are:
   a. _____________
   b. _____________
   c. _____________
   d. _____________
37. When a wing is angled upward, this is called “increasing the ______ of _______? 
   At a certain point, the airflow over the top of the wing will separate. This causes the 
   boundary layer of air to break away from the upper camber of the wing. When this 
   happens, a loss of lift occurs. This is called a___________.

38. What is that point at which a wing will stall? ___________________________________________________________________

39. The word “bubble” means turbulent, tumbling air. This occurs over the top of a wing 
   during a _________.

40. That axis which passes through an airplane from nose to tail? ____________

41. That axis which passes through an airplane from top to bottom? ____________

42. That axis which passes through an airplane from wingtip to wingtip? ____________

43. Movement around the axis in question #43 is called? ____________

44. Movement around the axis in question #44 is called? ____________

45. Movement around the axis in question #45 is called? ____________

46. The point where all three axes come together is called the ____________.

47. What control surface, on an airplane, makes it roll about the vertical axis?
   a. The rudder
   b. The ailerons
   c. The elevator
   d. None of the above are correct.

48. The elevator causes the nose to ___________ up and down.

49. The ailerons cause the aircraft to ___________ about its longitudinal axis.

50. The ___________ causes the aircraft to yaw about its vertical axis.

51. If an elevator and stabilizer are combined to make one control surface that acts by 
   changing angle of attack, it is called a ___________.

52. When one aileron moves down, the other ___________.

53. A propeller is actually a wing lifting ___________.

54. In close to the hub of a propeller, the ___________ of ___________ is greater than at the 
   tip.

55. The tip of a propeller achieves most of its “lift” because of greater ___________.

56. The “wing” of a propeller is called the ___________.

Chapter 2—To Fly By The Lifting Power of Rising Air

57. Fluid motion due to regions of unequal heating is called? ____________

58. The ratio between the span of a wing and its chord is called? ____________.

59. The mathematical relationship between the distance a glider will travel forward to 
   the loss of altitude is known as the ____________.

60. A column of air that moves vertically is known as ____________.

61. What is the great force that drives the motion of our atmosphere? ____________.

62. If the average worldwide temperature at 59 degrees Fahrenheit, what would be 
   average temperature for a city 5000 above sea level.

63. To find the Celsius equivalent of a Fahrenheit temperature, use the formula C=5/9(F- 
   32). Based on this formula, what is the average Celsius equivalent temperature, 
   worldwide, if the average Fahrenheit temperature at sea level is 59 degrees. Ans. 
   ____________.
64. If a glider's wing has a span of 80 feet and a chord of 4 feet, what is the aspect ratio? 

65. If the Air Force Academy TG-4A glider has an aspect ratio of 11.85 to 1, what is the chord of its wing? 

66. The dive brakes, or spoilers, on the TG-4A create a _________ of _________ when deployed in flight.

67. Adding a penny to a foam glider adds weight ahead of the _________ of _________.

Chapter 3—Balloons—They Create Their Own Thermals

68. The heat source for filling an envelope with hot air is known as the _________.

69. A lightweight, low carbon fuel used in hot air balloon burners? _________

70. The main body of a hot air balloon? _________

71. A balloon operates on the principle of _________.

72. A typical hot air balloon will derive about _______ of lift per 1,000 cubic feet. If a balloon has a volume of 68,500 cubic feet, how much weight can be lifted? _______

73. Based on the weight of an average human being 170 pounds, four tanks of propane at 290 pounds, an envelope weighing 160 pounds, a basket and burner assembly at 150 pounds, how many passengers and miscellaneous pieces of equipment will the balloon in question #76 carry? _________.

74. A _________ inside of the envelope of a hot air balloon allows the pilot to release hot air for the purpose of descent.

75. Although a hot air balloon has no horizontal control, pilots can achieve some directional changes by seeking out changes in _________ _________ at various altitudes.
MODULE 2

AIRCRAFT SYSTEMS & AIRPORTS

Chapter 1 – Airplane Systems
Learning Outcomes
Upon completion of this chapter, the cadet should know:
- How a reciprocating aircraft engine operates.
- Be able to recognize parts of the engine when viewed externally.
- How a jet engine operates.
- The basic cockpit-mounted power plant controls.
- The basic flight instruments.

Chapter 2 – Airports
Learning Outcomes
Upon completion of this chapter, the cadet should know:
- The basic layout of a general aviation airport.
- The taxiway and runway signs and markings.
- The role of the Federal Aviation Administration in controlling air traffic.
- The flight profile.
- The phonetic alphabet.

Chapter 3 – Airport to Airport – Aeronautical Charts
Learning Outcomes
Upon completion of this chapter, the cadet should know:
- The basic layout of the sectional chart.
- The sectional chart legend.
- How to read latitude and longitude.
- How to find features, such as railroads, pipelines, obstructions and highways.
- How to read all of the information given about an airport.

Chapter 1 – Airplane Systems

1. The ratio of fuel to air in which, upon combustion, all of the fuel is burned, is known as the ________________ ____________.
2. An ____________________________ engine converts chemical energy into mechanical energy.
3. The four stroke operating cycle of a reciprocating engine are: (a)__________, (b)__________, (c)__________, and (d)__________.
4. In a jet engine, air is mixed with fuel and ignited in ________________ stage.
5. In a jet engine, fuel is often sprayed into the exhaust stage. This gives additional thrust and is called an ________________.
6. When a mixture contains more fuel than is needed for normal combustion, it is called a ________ mixture.
7. When a mixture contains less fuel than needed for normal combustion, it is called a ______ mixture.

8. When the fuel tanks are mounted above the engine, as you would find in high wing (Cessna type) airplanes, what force keeps the fuel moving toward the power plant? ______

9. What is the source of electrical power for the spark plugs? ______

10. A recurring series of events is called a ______.

11. As an airplane climbs higher, the air becomes thinner. This means that there is less air than at altitudes closer to the Earth. What control, located in the cockpit, does the pilot use to decrease the amount of fuel that is allowed to enter the intake phase? ______

12. Most aircraft carburetors are located on the ______ of the engine.

13. A carburetor has a restriction called the ______. When air enters the restriction, it speeds up and the ______ drops. This is an example of ______ Principle.

14. Referring to the illustration of the Pratt & Whitney turbofan jet engine, as the air enters the front end, it immediately starts being compressed. From this stage, the air enters the ______ chamber where ______ occurs. The exhaust gases from this stage then pass through a ______ which in turn rotates a shaft and powers the ______ located up front.

15. A jet engine, like a standard reciprocating engine, has four stages. They are: ______, ______, ______, and ______.

16. The two primary functions of the oil system in an airplane engine is ______ and ______.

17. Inside the cockpit, there are two gages that monitor the operation of the oil system. They are the ______ and ______.

18. The engine instrument that monitors engine speed is known as the ______.

19. There are three main flight instruments that operate from the pitot/static system. They are ______, ______, ______.

20. The three flight instruments that operate on the principle of a spinning gyroscope are: ______, ______, and ______.

21. The standard pressure at sea level is 29.92 inches of mercury. What is the equivalent of this in millibars? ______

22. As we go higher in the atmosphere, the pressure ______.

23. The pressure drops approximately ______ inch per 1000 feet of altitude.

24. One flight instrument, other than the altimeter, monitors the rate of change in altitude. This is known as the ______.

25. Another flight instrument records the difference between static air and air being rammed into the system. This is the ______.

26. Some airspeed indicators show their numbers in knots. A "knot" is actually short for the "naut," or nautical mile. What is the length of a nautical mile in feet? ______

27. What is the length of a statute mile in feet? ______

28. If the distance between point A and point B is 25 statute miles, will the nautical equivalent number be (a) ______ longer or (b) ______ shorter?

29. The spinning "wheel" inside a gyro is called the ______.
30. What aircraft instrument was once known as the "artificial horizon?" 
31. What flight instrument is actually and artificial compass? 
32. What flight instrument can be monitored to give precise rate of turn information? 

33. If an aircraft is moving toward the inside of a turn, it is said to be _____________. 
If it is moving toward the outside of the turn it is ___________________. 

Chapter 2 - Airports 

34. If an airport has a control tower, it is said to be a ____________ airport. 
35. The letters "FAA" stand for _______________ 

36. What is an airport's "parking lot?" ____________
37. Some airports have a problem with excessive noise and the governing authorities will set policies that deal with this problem. This is called _____________. 

38. A passageway between the parking area and the runway system is called a _____________.

39. There are basically two sets of rules that govern flight. They are known as VFR and IFR. Which set will you follow in early flight training? ________
40. Once an airplane becomes airborne from an airport, it is subject to traffic rules. The first "leg" of the traffic pattern begins at takeoff and it is known as the _______ leg. 
41. When an airplane is approaching an airport for the purpose of landing, it is required to enter a standard traffic pattern. The first part of this pattern is known as "entry." From the entry leg, a pilot will turn _______________. This part of the pattern is followed until the pilot turns onto the _______ leg. The next leg points directly toward the runway and this is known as ___________________. 
42. There are two numbers, one at each end of the runway. These numbers are abbreviated _____________.
43. If you were watching a movie and a control tower operator in that movie said to a pilot, ",..... you are cleared to land on runway 44," you would know this is wrong. Why? _______________.

44. If runway 9 is actually three runways in parallel, their numbers would be ________, and ___________.
45. In the photograph of Jefferson County Airport, Broomfield, Colorado, you will see runway 29R in the center of the picture. After examining the runway markings you should be able to see that this is a ________________ runway. (precision, non-precision)
46. In the same photograph, there is a runway that crosses runway 29R and it is exactly 90° to Runway 29R. What numbers would this runway have at each end? 
47. If a runway sign is yellow with black lettering and gives information about such things as areas that cannot be seen by the control tower, noise abatement procedures and applicable radio frequencies, it is said to be an _______________ sign.
48. If a sign provides direction to special locations like military or fixed base operations, it is said to be a _______________ sign.
49. What color are threshold lights when viewed from the landing end? _____________.
50. What color are the border lights at most non-precision runways? _______________.
51. If you are a pilot on final approach to land, and you notice the VASI lights are both red, this is an indication that you are ____________________________.

52. The beacon is a light that guides pilots to airports at night. If you see two white flashes, followed by a green flash, you know this is a ____________________ airport.

53. If a beacon has one white flash, followed by a yellow flash, it is a _______ airport.

54. What indicator uses the power of the wind to give direction? ________________.

55. The phonetic alphabet for the letter "U" is ____________.

Chapter 3 - Airport to Airport - Aeronautical Charts

56. A system of lines that run parallel to the equator? ________________

57. All longitude lines converge at either the _______ or the _______.

58. A chart that is scaled 1:500,000 inches, or approximately 8 mile? ________________

59. Every degree, on a sectional chart, has _______ minutes.

60. If an airport symbol is blue, it means that the real airport has a ____________________________.

61. In the example of Cherokee, Oklahoma, airport, there is a block of information just above the symbol. It reads "CHEROKEE (OK6Ω)," followed on the next line by "1177 L 38 122.9 ©." Answer this and following questions using the CHEROKEE example. The question is: The Cherokee airport symbol is magenta in color - this means the airport has ____________________________.

62. Cherokee’s airport symbol has a star at the top of it. This means that the actual airport has ____________________________.

63. The number "1177" in the airport information is the _______ _________.

64. The number 1177 is followed by "L 38." This means: ____________________________.

65. What is the location identifier for Cherokee’s airport? ________________

66. What is the frequency for the Cherokee airport UNICOM? ________________

67. What is the height above sea level of the town of Cherokee, Oklahoma?

68. There is a large dotted, light blue symbol to the east of the town of Cherokee, Oklahoma. What is this symbol? ____________________________________________?

69. The towns of Jet and Cherokee, Oklahoma, are connected by two "roads." One is a ____________________________ and the other is a ____________________________.
MODULE 3

AIR ENVIRONMENT

Chapter 1 - Air Circulation
Learning Outcomes
After completing this chapter, you should be able to:
- Describe how the sun heats the Earth.
- Describe the Earth’s rotation and revolution, and its effort on the Earth’s seasons.
- Explain the various theories of circulation.
- Describe Coriolis Force.
- Define the jet stream.

Chapter 2 - Weather Elements
Learning Outcomes
After completing this chapter, you should be able to:
- Define wind.
- Describe the Beaufort Scale.
- Define heat.
- Explain what temperature is and how it can be expressed.
- Describe what wind chill is and what it does.
- Describe how a microburst can affect a plane.

Chapter 3 - Moisture and Clouds
Learning Outcomes
After completing this chapter, you should be able to:
- Describe the condensation process.
- Describe how saturation occurs.
- Define dew point.
- Define what precipitation is and give some examples.
- Define fog.
- Define turbulence.

Chapter 4 - Weather Systems and Changes
Learning Outcomes
After completing this chapter, you should be able to:
- Define an air mass and identify air mass characteristics.
- Define a front and describe the types of fronts.
- Describe hurricanes, thunderstorms and tornadoes.
- Identify the stages of a thunderstorm.
- Outline safety precautions for thunderstorms and tornadoes.

Chapter 1 - Air Circulation
1. The sun heats the _______ and is the fundamental cause of our _________.
2. The sun heats parts of the earth _______ than others.
3. This _______ or _______ heating causes _________ and _______ differences.
   This creates _______ or the _______ of air.
4. The sun heats the earth through a method known as _________.
5. Heat from the sun is _______ and _______ depending on the _______ or the _______.
6. About _____ % of the sun’s radiation is absorbed by the Earth’s surface. The other ______ % is _______ and _______ in the atmosphere and space.
7. Warm air _______. This is an ingredient for producing _______.
8. Warm air molecules are spaced _______ than cool air molecules.
9. The Earth _______ around the sun. The Earth’s revolution takes ___ days, ___ hours and ___ minutes.
10. The Earth rotates on its axis at an angle of ___ degrees. The rotational tilt causes the length of the ___ to vary and the rotation plus the revolution cause the _______ _______ to occur.
11. The Northern Hemisphere is tilted directly toward the sun on _____This is called the _______ _______.
12. On December 22, the Northern Hemisphere is tilted directly ___ from the sun.
   This is called the _______ _______.
13. The _______ _______ occurs on March 21, and the _______ _______ occurs on September 22. On both occasions, the sun’s direct rays strike the equator.
14. The Earth rotates on its axis in a _______ direction in the Northern Hemisphere. This rotation causes an object moving freely in the Northern Hemisphere to be deflected to the right of its intended path. This deflection is called _______ _______.
15. Between 30° north and south latitude and the equator, the movement of air toward the equator is called _______.
16. Converging trade winds can cause an area of calm winds. This area of calm is called the _______.
17. _______ _______ in the Northern Hemisphere are responsible for many of the weather movements across the US and Canada.
18. Winds at about 60° latitude result from the air over the poles cooling, sinking and spreading out. This area of winds is called the _______.
19. The _______ is wind that usually crosses the US at 30,000-35,000 feet and generally moves in a west to east direction.

Chapter 2 - Weather Elements

20. _______ is a body of air in motion.
21. _______ _______ is defined as the direction from which the wind is blowing.
22. A knot equals ___ mph.
23. A scale for estimating winds on either land or sea is called the _______ _______.
24. To determine _______ _______ you use temperature and wind speed to explain how cold it feels.
25. Airplanes takeoff _____ the wind because the wind gives the plane more lift.
26. A strong tailwind will _______ a plane’s air speed.
27. A _________ is defined as a downdraft or downburst of wind.
28. _______ is the total energy of all molecules within a substance.
29. _________ is a measure of molecular motion expressed on a man-made scale.
30. Fahrenheit’s freezing point is ____° and its boiling point is ____°.
31. Celsius’ freezing point is ____° and its boiling point is ____°.
32. Kelvin’s freezing point is ____° and its boiling point is ____°.
33. Warmer temperatures require _______ runways for takeoff.
34. Extreme heat can cause heat _______ , _______ , and _______. Always drink plenty of _______ when it is extremely hot.
35. In extreme cold, _______ and _______ may occur.
36. The weight or push on the Earth’s surface is called _______ _______.
37. Scientists and meteorologists mainly use a _______ barometer.
38. A _______ _______ is found in weather stations and gives a permanent record of pressure readings.

Chapter 3 - Moisture and Clouds

39. _______ is the most important element in the development of weather.
40. Moisture, in its gaseous state, is called _______ _______.
41. When a parcel of air is holding all of the water it can, _______ _______ is reached.
42. The temperature at which the air becomes saturated is called the _______ _______.
43. Converting water vapor to a liquid is called _______ _______.
44. Clouds and fog are products of _______ _______.
45. _______ _______ is the amount of humidity in the air compared to its total water vapor capacity at a given temperature. It is expressed in a _______ _______.
46. _______ is composed of tiny droplets of liquid water in contact with the surface. It is actually a cloud that is touching the ground.
47. Clouds are made up of minute droplets of _______ or _______ _______ of _______ or both.
48. There are three basic cloud forms: _______ , _______ and _______.
49. _______ is a fair weather cloud indicating good weather.
50. _______ has a very uniform appearance with very little vertical development.
51. _______ clouds are white, thin, wispy clouds, usually in patches, filaments, hooks or bands and are mainly composed of ice crystals.
52. _______ is heavier and darker than stratus and produces rain that can last for hours.
53. _______ is the cloud that produces thunderstorms with thunder and lightning.
54. The cumulonimbus _______ occurs at the base of the cloud and looks like bulges or pouches.
55. _______ is the unrest or disturbance of the air and refers to its instability.
56. Many types of _______ clouds are associated with turbulence.
57. _______ is the general term given to the various types of condensed water vapor that fall to the Earth’s surface, such as rain or snow.
58. Rain that freezes on contact with the ground or highway is called _______ _______.

19
Chapter 4 - Weather Systems and Changes

59. An ____ _____ is a huge body of air, usually 1,000 miles or more across that has the same temperature and moisture characteristics.

60. An air mass’ place of origin is called its ____ ____ ____. The ideal source region must be very ____ and the ____ ____ ____ must be consistent throughout. ____ ____ and ____ ____ locations are the best source regions.

61. Air masses are classified by their ____ ____ ____ and the ____ of the surface in their ____ ____ ____.

62. Air masses are identified by a two-letter code consisting of a ____ ____ letter and a ____ ____ letter.

63. An air mass’ temperature or latitude is placed into four categories: ____ ____ (P), ____ ____ (A), ____ ____ ____ (T) and ____ ____ ____ ____ ____ (E).

64. The lowercase letter of an air mass is either an ____ (____) or ____ (____).

65. A boundary between two air masses is called a ____ ____.

66. A ____ ____ occurs when warm air moves into an area of colder air and they collide.

67. A ____ ____ occurs when the air moving into the area is colder than the already present warmer air.

68. When air masses bump against each other, but not strong enough to force movement, it is called a ____ ____ ____ ____.

69. When three differing air masses are involved with each other, it is called an ____ ____ ____ ____.

70. ____ ____ ____ ____ come from cumulonimbus clouds and always possess thunder and lightning.

71. Thunderstorms have three stages: ____ ____ ____ and ____ ____ ____.

72. The ____ ____ ____ stage of a thunderstorm is dominated by updrafts.

73. ____ ____ ____ is the most dangerous part of a thunderstorm.

74. A tornado’s ____ ____ ____ are the main reason for the tremendous destruction associated with tornadoes.

75. The ____ ____ ____ ____ ____ ____ explains the categories of wind speed and expected damage for tornadoes.

76. If a tornado is coming and time permits, get to a ____ ____ or underground.

77. If a tornado is coming and you are in open country, move at ____ ____ ____ angles away from it.

78. To be classified as a hurricane, the winds must go above ____ miles per hour.

79. Hurricanes are classified into ____ ____ categories. These categories are presented on the ____ ____ ____ ____ ____ ____.

80. The center of a hurricane is called an ____ ____.
MODULE 4
ROCKETS

Chapter 1 - History of Rockets

Learning Outcomes
After completing this chapter, you should be able to:
- Identify historical facts about the Greeks, Chinese and British, and their roles in the development of rockets.
- Describe America’s early contributions to the development of rockets.
- List the early artificial and manned rocket launches and their missions.

Chapter 2 - Rocket Principles

Learning Outcomes
After completing this chapter, you should be able to:
- Define acceleration.
- Define inertia.
- Define thrust.
- Describe Newton’s Laws of Motion.

Chapter 3 - Rocket Systems and Controls

Learning Outcomes
After completing this chapter, you should be able to:
- Identify the four major systems of a rocket.
- Describe the purpose of each of the four major systems of a rocket.
- Define payload.

Chapter 1 - History of Rockets

1. A Greek named _________ developed the first rocket engine. It was propelled by _________.
2. The _________ were the first people to develop gunpowder.
3. In the 1200s, the Chinese and Mongols used rockets as _______ of _______ _____.
4. In England, _________ _______ increased the range of rockets.
5. In France, _________ _______ achieved more accuracy by launching rockets through tubes.
6. In the 17th century, _________ _______ laid the scientific foundations for modern rocketry when he developed his laws of ________.
7. In the 18th century, _________ _______ designed rockets for military use.
8. _________ _______ conducted many practical rocket experiments and became known as the Father of Modern Rocketry.
9. Goddard’s first successful flight was fueled by _______ _______ and _________.
10. The V-2 rocket was built under the directorship of _________ _______ _______.

21
11. On October 4, 1957, the _______ _______ launched the first artificial satellite. It was called _______ _______.
12. The United States’ first artificial satellite was called _______ _______.
13. A Russian, _______ _________, was the first man to orbit Earth.
14. _______ _________ was the first American in space.
15. _______ _________ was the first American to orbit the Earth.
16. On July 20, 1969, Apollo 11 astronaut _______ _________ became the first man to walk on the Moon.
17. The United States’ first space station was called _________.
18. The space transportation system used for transporting to space and returning to Earth is called the _______ _________.
19. A _______ _________ is the rocket system that lifts the spacecraft.
20. When John Glenn orbited the Earth he was launched by the powerful _______ rocket.
21. The _______ ___ was the launch vehicle for the Apollo 11 mission.

Chapter 2 - Rocket Principles

22. _______ _______ is the rate of change in velocity with respect to time.
23. Newton’s _______ Law of Motion states that a body at rest remains at rest and a body in motion tends to stay in motion at a constant velocity unless acted on by an outside force.
24. _______ _______ is the tendency of an object at rest to stay at rest and an object in motion to stay in motion.
25. _______ _______ is defined as the amount of push used to get the rocket traveling upwards.
26. Newton’s Second Law of Motion states that the rate of change in the _______ _______ of a body is _______ _______ to the force acting upon the body and is in the direction of the force.
27. Newton’s _______ Law of Motion states that to every action, there is an equal and opposite reaction.
28. Newton’s Second Law of Motion can be explained by a mathematical formula. The formula has three parts - ___ = ___ ___.

Chapter 3 - Rocket Systems and Controls

29. Modern rockets consist of four major systems: _______ , _______ , _______ and _______ _______.
30. The _______ _______ provides the shape of the rocket.
31. The airframe of a rocket must be lightweight, yet structurally _______.
32. The _______ _______ is defined as whatever the rocket is carrying.
33. The astronauts and their data are also part of the _______ _______.
34. The _______ _______ is the brain of a rocket.
35. The _______ _______ system is responsible for getting the rocket to its destination.
36. A computer is programmed to guide the rocket on a desired _______.
37. The _______ _______ system steers the rocket and keeps it stable.
38. The ________ system consists of everything directly associated with propelling the rocket.
39. There are two rocket propellants, ________ or ________.
40. In a solid propellant, the fuel is usually a mixture of ________ compounds and ________. The oxidizer is made up of ________ compounds.
41. Liquid propellants are carried in compartments separate from the ________, one for the ________ and one for the ________.
42. The liquid propellant is usually ________ or ________ ________; the oxidizer is usually ________ ________.
43. The ________ propellant is what is commonly used today.
44. The ________ system takes information from the guidance system, and keeps the rocket in the proper position and makes any needed corrections.
45. The ________ system is small compared to the rest of the rocket. It is a self-contained electronic unit with a computer.
46. The ________ is the skin of the rocket and serves as the wall of the propellant tanks.
MODULE 5

SPACE ENVIRONMENT

Chapter 1 - Space
Learning Outcomes
After completing this chapter, you should be able to:
- Describe microgravity.
- Identify characteristics of space.
- Describe what makes up the universe.
- Define constellation.
- Define galaxy.
- Describe nebulae.
- Define interplanetary and interstellar space.

Chapter 2 - Solar System
Learning Outcomes
After completing this chapter, you should be able to:
- Describe our solar system.
- State basic facts about the planets in our solar system.
- Define a comet.
- Explain the differences between an asteroid, meteoroid and a meteor.
- Recall the differences between solar flares, solar prominences and sunspots.

Chapter 1 - Space

1. __________ is a region beyond the Earth's atmosphere where there is very little molecular activity.
2. Many people generally agree that space occurs at about _____ miles outward from Earth.
3. The __________ includes everything, stars, planets, galaxies, animals, plants and humans.
4. Space is characterized by a lack of __________.
5. Small or low gravity is called __________.
6. Our sun, which is the center of our solar system, is but a tiny spot in our __________.
   In fact, there are _____ ________ _____ in our galaxy, and our galaxy is just one of ________ of galaxies.
7. A __________ is an enormous collection of stars, and these stars are arranged in a particular shape. The three main shapes are __________, __________ and __________.
8. __________ is oval shaped. __________ has arms spiraling outward from a center. __________ has no particular shape.
9. Our galaxy is called the __________. It is ________ shaped.
10. Galaxies contain giant clouds of gas and dust called __________.
11. ________ are bodies of hot gases.
12. The ________ is a part of the atmosphere divided by its electrical activity.
13. The ________ is the primary cause of the Van Allen belts.
14. Most stars are composed of ________ and ________ in their gaseous state.
15. About half of all stars come in pairs with the stars sharing the same gravitational center. These are called ________ stars.
16. A ________ is a grouping of stars that look like imaginary figures.
17. The Big Dipper is an example of a ________.

Chapter 2 - Solar System

18. Our ________ is the sun and the bodies that orbit around it.
19. Without heat and light, the Earth would be a ________, _______ planet.
20. The central star of our solar system is the ________.
21. The Earth is ________ miles from the sun.
22. The sun is composed of about ______% hydrogen, ______% helium and minor amounts of several other elements. The temperature of the sun ranges from ______°C in its coolest regions to over ______°C at its center.
23. ________ are darker, cooler areas of the sun.
24. ________ are short-lived high-energy discharges.
25. ________ are larger and longer lasting high-energy discharges.
26. The Earth’s Moon has a diameter of about ________ miles, which is about ______ of the Earth’s diameter. The distance from the Earth to the Moon varies from approximately ________ miles at its farthest point to ________ miles at its nearest point.
27. The Moon rotates on its axis in the same amount of time it takes to orbit the Earth, ________ days. Therefore, the same side of the Moon, the ________ side, always faces the Earth.
28. When the Moon is on the side of the Earth nearer the sun, the Moon is ________. When it is on the opposite side of the Earth, the Moon is ________.
29. Primarily, the Moon has two types of terrain, ________ and ________.
30. Temperatures on the Moon range from about ______° in the day, to below ______° at night.
31. ________ is the closest planet to the sun, and it revolves around the sun every ________ days. Its daytime temperature reaches ______°F, while its nighttime temperatures reach ______°F.
32. ________ is the closest planet to Earth. It revolves around the sun in ________ days. It is the ________ planet in the solar system with temperatures in excess of ______°.
33. ________ is the only known planet to rotate in a ________ manner.
34. The atmosphere of Venus is 96% ________ and 4% ________.
35. The Earth’s atmosphere contains 78% ________ and 21% ________.
36. The surface of our planet is covered with over 67% ________.
37. The Earth revolves around the sun in ________ days.
38. Mars is known as the ________ planet and even with the naked eye we can see this ________ color. This color is due to the ________ and ________ covering the surface of Mars.
39. The surface of Mars is covered with deserts, high mountains, deep craters and huge ________. One of Mars' ________ is the highest known mountain in our solar system.

40. The atmosphere of Mars consists of 95% ________ ________. Daytime temperatures on Mars reach _______°F, while nighttime temperatures can dip to _______°F.

41. In July 1997, the space probe called the ________ ________ landed on Mars. The next day the rover, ________, ________, began its exploration of the planet. The rover was _______ feet long and _______ foot tall.

42. Next to Earth, ________ has the most favorable conditions for life of any of the other planets in our solar system.

43. ________ is the largest planet in our solar system. It is ______ times larger than Earth.

44. Jupiter is a gas giant, with ________ ________ accounting for about 90% of the atmosphere, followed by ________, ________, and ________.

45. A distinguishing feature of Jupiter is ________ ________ Spot. This spot is a giant storm that is _______ miles long and _______ miles wide. Also, Jupiter is known for its ______ moons.

46. The rings are the most recognizable feature of ________. The rings are made of _______ chunks of _______ ranging from tiny _______ to large ________.

47. The main rings are made up of hundreds of narrow ________.

48. The entire ring system is about _______ thick and extends about _______ miles from the planet.

49. Saturn has an _______ _______ core surrounded by metallic ________, with an outer layer of _______ and ________.

50. It takes Saturn ______ years to revolve around the sun.

51. The winds of Saturn have been known to reach ______ mph.

52. Saturn is _______ miles from the sun.

53. ________, one of the moons of Saturn, is the only moon in the solar system to have its own ________.

54. ________ is about 1.7 billion miles from the sun. It has a rocky core surrounded by ________, ________, and ________, in both _______ and _______ form.

55. Uranus revolves around the sun in ______ years. Daylight lasts for ______ years followed by ______ years of night.

56. Uranus also has 11 very narrow and black _______ around it.

57. Neptune is about _______ miles from the sun and takes _______ Earth years to complete an orbit.

58. Neptune's atmosphere consists of ________, ________, and ________.

59. The ________ gives Neptune a bluish color.

60. ________ is the most windy planet in the solar system. It has recorded winds of _______ mph.

61. ________ is the smallest planet in our solar system. It is a dark and _______ planet. Its surface is made up of ________ ________.

62. Asteroids, comets and meteoroids are collectively thought of as _______ orbiting in space.
63. _______ are chunks of rock that range in size from particles of dust to some that are a few hundred miles across.

64. Most __________ travel in an orbit between Mars and Jupiter. This area is known as the _____________.

65. A _______ is described as a giant dirty _______. It is composed of _______ gases, _______ and _______.

66. _______ are tiny particles of dust and sand that are usually leftover from a comet.

67. If a meteoroid enters the Earth’s atmosphere it is called a _______.

68. Meteors that actually hit the Earth are called _____________.

27
MODULE 6

SPACECRAFT

Chapter 1 - Unmanned Spacecraft

Learning Outcomes
After completing this chapter, you should be able to:
- Define a satellite.
- Describe an orbit.
- Define apogee and perigee.
- Identify Sputnik.
- Define a space probe.
- Describe the related parts that make up a satellite system.

Chapter 2 - Manned Spacecraft

Learning Outcomes
After completing this chapter, you should be able to:
- List the manned space flight projects and their missions.
- Identify the American and Russian joint manned spacecraft mission.
- Describe the accomplishments of Alan Shepard and Neil Armstrong.
- State specific facts about the Hubble Space Telescope.

Chapter 3 – Living and Working in Space

Learning Outcomes
After completing this chapter, you should be able to:
- Describe Space Station Alpha.
- Explain the differences between Mir and Skylab.
- Define Spacelab.
- Recall the significance of Salyut 1.
- Describe the living and working conditions in space.
- Describe the different space suits.

Chapter 1 – Unmanned Spacecraft

1. In 1957, the Russians launched __________, the first artificial satellite.
2. The term __________ is used for either a natural or an artificial object in space.
3. Communication satellites began in 1958 when taped messages were broadcast from orbit on the ______ satellite. In 1962, _______ became the first commercial satellite.
4. Intelsat stands for __________.
   It is made up of 109 nations worldwide that control ______ satellites.
5. TDRSS stands for _______ and _______. It provides full-time coverage for the ________.
6. The Deep Space Network provides continuous communications for planetary spacecraft probing into ________ ________.
7. The first navigational satellite, ________, was developed to provide Polaris missile submarines with the ability to fix accurate positions.
8. GPS is the NAVSTAR ________, ________ ________ that offers a precise ________.
9. The Natural Resources Satellites locate ________ and monitor other conditions on the Earth’s surface. This is the task of the ________ series of satellites.
10. In 1960, Tiros 1 became the first ________ satellite.
11. GOES stands for ________, ________ ________. GOES provides pictures of the Earth’s ________, pictures of ________ and provides information which helps with ________.
12. The ________ satellite series discovered the Van Allen radiation belts.
13. Satellites or spacecraft that either fly by, orbit or land on a celestial body, other than Earth, are called ________ ________.
14. The ________ ________ took pictures of the Moon in preparation of the Apollo landings. The ________ ________ series flew by Venus and Mercury and gave us pictures of Venus’ clouds and Mercury’s cratered surface.
15. In the 1970s, the ________ probes gave us pictures of Jupiter and Saturn. Then in the late 1970s, ________ ________ and ________ also encountered Jupiter and Saturn.
16. In 1975, the ________ ________ explored the environment of Mars.
17. Satellites as a system are made up of four parts: ________, ________, ________, and ________.
18. Customers define the overall ________ and ________ ________ for satellites.
19. ________, ________, ________ ________, and ________ ________ are potentially dangerous for satellites.
20. ________ ________, and ________ ________ can also harm satellites. Some 20,000 tons of ________ ________ make it into the Earth’s atmosphere every year.
21. Manmade ________ or ________ is also a threat.
22. The first aspect that ties the sub-systems together is the satellite’s ________ _________. The first step of the design of the sub-system is the ________ ________.
23. The ________ ________ of a satellite is like a building.
24. The ________ ________ system provides the boost to get the satellite into orbit.
25. To make minor corrections in direction, the ________ ________ system is used.
26. The main source of electricity while the satellite is in orbit is the ________ ________.
27. Temperature data is part of the ________ ________ sub-system.
28. The ________ and ________ ________ function of a satellite is a communication system.
29. The sub-system that gets the satellite into orbit is the ________ ________.
30. An ________ ________ is the movement or path a satellite takes around a celestial body.
31. ________’s First Law states that the orbit of each planet is an ellipse, with the sun at the focus.
32. The highest point of an orbit is called the ________, and the lowest point is called its ________ ________.

Chapter 2 – Manned Spacecraft
33. America’s first manned space flight program was called __________.  
34. __________ was the first American in space.  
35. __________ was the first American to orbit the Earth. His orbit lasted for __ hours and __ minutes and orbited the Earth __ times.  
36. Project Mercury answered the basic questions about __________ in __________.  
37. __________ was the first two-man capsule, and it also achieved the first __________ in __________.  
38. __________ landed on the Moon on July 20, 1969, and __________ was the first man to walk on the Moon. After we landed on the Moon, only one of the next six flights __________ didn’t land on the Moon.  
39. __________’s mission was to put a laboratory into space. Scientists were interested in continuing their studies of the effects of __________ space flights.  
40. The first crew manned Skylab for __ days. The final crew spent __ days in space.  
41. The __________ was the link-up in space of an American and a Soviet manned spacecraft.  
42. In 1981, the Space Transportation System, commonly called the __________, was launched. It provides a system for __________ into space and a __________ to Earth. The major advantage of this system is that it can be used __________ and __________.  
43. The Space Shuttle consists of three main parts: the __________, the __________, and the __________. The part that looks like an airplane is called the __________.  
44. In April 1990, the shuttle Discovery deployed the __________. It operates at over __ miles above the Earth and is free of any atmospheric __________.  
45. It 1993, the shuttle carried the European developed __________ into orbit.  

Chapter 3 – Living and Working in Space  
46. Russian launched the first space station, __________, in April 1971.  
47. __________ stayed in space for six months then burned up when it reentered the Earth’s atmosphere.  
48. The next model of Russian space station was called __________. It was launched in February 1986.  
49. The US’ first space station was __________. It was launched in 1973. Three different crews lived abroad, with the last crew staying the longest, __ days.  
50. The European Space Agency also built a space station called __________.  
51. Zero gravity or __________ exists inside the space stations.  
52. The air inside the space stations is a mixture of __________ and __________. This mixture works better than breathing __________.  
53. For sleeping, the astronauts place sleeping bags __________ along the walls.  
54. The general term used for going outside the Space Shuttle is __________ __________ __________ (____).
55. Russian _______ _________ accomplished the first space walk in March 1965. Less than three months later, _______ _________ was the first American to walk in space.

56. In 1973, _______ _______ set the record for the longest EVA with seven hours and one minute.

57. It was during Gemini 7 that space suits were _______ _______ inside the spacecraft for the first time.

58. In 1984, astronauts used the _______ _________ _______ (_____) for the first time, allowing them to move around in space without being tied to the spacecraft.

59. In November 1998, the first of several launches to construct _______ _________ _______ _______ took place. This is a joint venture between _______, ________, ________ and ________.

60. The _______ will replace the Space Shuttle in the 21st century.
APPENDIX 1

ANSWERS

Module 1 – Introduction To Flight

<table>
<thead>
<tr>
<th>Answers</th>
<th>Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why Aerospace Education</td>
<td></td>
</tr>
<tr>
<td>1. general education, knowledge</td>
<td>vi</td>
</tr>
<tr>
<td>2. July 1, 1946</td>
<td>vi</td>
</tr>
<tr>
<td>3. United States</td>
<td>vi</td>
</tr>
</tbody>
</table>

Chapter 1 – Flight

<table>
<thead>
<tr>
<th>Questions</th>
<th>Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Aircraft</td>
<td>1</td>
</tr>
<tr>
<td>5. Airplane</td>
<td>1</td>
</tr>
<tr>
<td>6. Aeronautics and space</td>
<td>1</td>
</tr>
<tr>
<td>7. Nitrogen</td>
<td>1</td>
</tr>
<tr>
<td>8. Subsonic, transonic, supersonic</td>
<td>1</td>
</tr>
<tr>
<td>9. Yes</td>
<td>1</td>
</tr>
<tr>
<td>10. Drag</td>
<td>1</td>
</tr>
<tr>
<td>11. Dynamic</td>
<td>1</td>
</tr>
<tr>
<td>12. Yes</td>
<td>4</td>
</tr>
<tr>
<td>13. Relative wind</td>
<td>1</td>
</tr>
<tr>
<td>14. Chord</td>
<td>1</td>
</tr>
<tr>
<td>15. a &amp; b</td>
<td>2</td>
</tr>
<tr>
<td>16. d</td>
<td>3</td>
</tr>
<tr>
<td>17. Chinese</td>
<td>2</td>
</tr>
<tr>
<td>18. Flying</td>
<td>4</td>
</tr>
<tr>
<td>19. Balloon, Montgolfier brothers</td>
<td>3</td>
</tr>
<tr>
<td>20. Language</td>
<td>1</td>
</tr>
<tr>
<td>21. Propeller</td>
<td>4</td>
</tr>
<tr>
<td>22. Tail feathers and wing feathers</td>
<td>4</td>
</tr>
<tr>
<td>23. Third</td>
<td>6</td>
</tr>
<tr>
<td>24. Bernoulli</td>
<td>5</td>
</tr>
<tr>
<td>25. Pressure Bernoulli’s</td>
<td>5</td>
</tr>
<tr>
<td>26. It decreases or drops</td>
<td>5</td>
</tr>
<tr>
<td>27. Newton’s</td>
<td>6</td>
</tr>
<tr>
<td>28. Chord</td>
<td>7</td>
</tr>
<tr>
<td>29. Camber</td>
<td>7</td>
</tr>
<tr>
<td>30. Gravity and drag</td>
<td>8</td>
</tr>
<tr>
<td>31. Thrust and lift</td>
<td>8</td>
</tr>
<tr>
<td>32. 8</td>
<td>8</td>
</tr>
<tr>
<td>33. drag</td>
<td>8</td>
</tr>
<tr>
<td>Question</td>
<td>Reference Page</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>34. thrust, drag, wing, air, drop, camber, decreased, increased, lift,</td>
<td>7.8</td>
</tr>
<tr>
<td>relative wind, Newton's, for every action, there is an equal and</td>
<td></td>
</tr>
<tr>
<td>opposite reaction.</td>
<td></td>
</tr>
<tr>
<td>35. elevons</td>
<td>18</td>
</tr>
<tr>
<td>36. a. increase speed</td>
<td>9</td>
</tr>
<tr>
<td>b. increase camber</td>
<td></td>
</tr>
<tr>
<td>c. increase area</td>
<td>9</td>
</tr>
<tr>
<td>d. increase angle of attack</td>
<td></td>
</tr>
<tr>
<td>37. angle of attack, stall</td>
<td>9</td>
</tr>
<tr>
<td>38. critical angle of attack</td>
<td>9</td>
</tr>
<tr>
<td>39. stall</td>
<td>9</td>
</tr>
<tr>
<td>40. longitudinal</td>
<td>11</td>
</tr>
<tr>
<td>41. vertical</td>
<td>11</td>
</tr>
<tr>
<td>42. lateral</td>
<td>11</td>
</tr>
<tr>
<td>43. roll</td>
<td>11</td>
</tr>
<tr>
<td>44. yaw</td>
<td>11</td>
</tr>
<tr>
<td>45. pitch</td>
<td>11</td>
</tr>
<tr>
<td>46. center of gravity</td>
<td>11</td>
</tr>
<tr>
<td>47. d</td>
<td>11</td>
</tr>
<tr>
<td>48. pitch</td>
<td>12</td>
</tr>
<tr>
<td>49. roll</td>
<td>12</td>
</tr>
<tr>
<td>50. rudder</td>
<td>12</td>
</tr>
<tr>
<td>51. stabilator</td>
<td>12</td>
</tr>
<tr>
<td>52. moves upward</td>
<td>12</td>
</tr>
<tr>
<td>53. forward</td>
<td>14</td>
</tr>
<tr>
<td>54. angle of incidence (or attack)</td>
<td>14</td>
</tr>
<tr>
<td>55. speed</td>
<td>14</td>
</tr>
<tr>
<td>56. blade</td>
<td>14</td>
</tr>
</tbody>
</table>

**Chapter 2 – To Fly By the Lifting Power of Rising Air**

<table>
<thead>
<tr>
<th>Question</th>
<th>Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>57. convection</td>
<td>23</td>
</tr>
<tr>
<td>58. aspect</td>
<td>23</td>
</tr>
<tr>
<td>59. glide ratio</td>
<td>23</td>
</tr>
<tr>
<td>60. thermal</td>
<td>23</td>
</tr>
<tr>
<td>61. Sun</td>
<td>24</td>
</tr>
<tr>
<td>62. 41.5</td>
<td>24</td>
</tr>
<tr>
<td>63. 15°C</td>
<td>24</td>
</tr>
<tr>
<td>64. 20 to 1</td>
<td>25</td>
</tr>
<tr>
<td>65. 4.3 feet</td>
<td>25</td>
</tr>
<tr>
<td>66. loss, lift</td>
<td>26</td>
</tr>
<tr>
<td>67. center, gravity</td>
<td>26</td>
</tr>
</tbody>
</table>
Chapter 3 – Balloons – They Create Their Own Thermals

68. burner .............................. 33
69. propane ................................ 33
70. envelope ................................ 33
71. buoyancy .............................. 33
72. 17-20, 1164.5 – 1370.0 ................. 34
73. Balloon with envelope, propane, burner = 600 lbs
   At 68,500 ft³, it will lift 1164.5 lbs (17lbs/1000ft³)
   68,500 ft³, it will lift 1370.0 lbs (20lbs/1000ft³)
17 565lbs will be the payload
20 700lbs will be the payload
4 humans weigh 680
3 humans weigh 510
2 humans weigh 340
   based on the low 17 lbs lift, the balloon can carry 3 humans and 55 lbs of equipment
   based on the high 20 lbs lift, the balloon can carry 4 with 20 lbs of equipment
74. parachute .............................. 35
75. wind direction .......................... 34

MODULE 2 – AIRCRAFT SYSTEMS & AIRPORTS
Chapter 1 – Airplane Systems

1. stoichiometric ratio ................. 1
2. internal combustion .................. 3
3. a) intake  b) compression  c) power  d) exhaust .................. 1
4. intake ................................... 5
5. afterburner ............................. 5
6. rich ...................................... 6
7. lean ...................................... 6
8. gravity ................................... 6
9. magneto ................................ 10
10. cycle .................................... 1
11. mixture ................................. 6
12. bottom ................................... 8
13. Venturi, pressure, Bernoulli’s ........ 8
14. combustion, ignition ............... 13
15. intake, compression, power, and exhaust .... 13
16. lubricate, cool ....................... 14
17. oil temperature and oil pressure ... 14
18. tachometer ............................ 14
19 airspeed, altimeter, vertical speed indicator .... 15
20. attitude indicator, turn coordinator and heading indicator .... 18
21. 1013.2 mb ............................. 16
<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>decreases</td>
<td>16</td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>24</td>
<td>vertical speed indicator</td>
<td>17</td>
</tr>
<tr>
<td>25</td>
<td>airspeed indicator</td>
<td>17</td>
</tr>
<tr>
<td>26</td>
<td>6076</td>
<td>18</td>
</tr>
<tr>
<td>27</td>
<td>5280</td>
<td>18</td>
</tr>
<tr>
<td>28</td>
<td>b</td>
<td>18</td>
</tr>
<tr>
<td>29</td>
<td>rotor</td>
<td>18</td>
</tr>
<tr>
<td>30</td>
<td>attitude indicator</td>
<td>18</td>
</tr>
<tr>
<td>31</td>
<td>heading indicator</td>
<td>19</td>
</tr>
<tr>
<td>32</td>
<td>turn coordinator</td>
<td>19</td>
</tr>
<tr>
<td>33</td>
<td>slipping, skidding</td>
<td>19</td>
</tr>
</tbody>
</table>

**Chapter 2 – Airports**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>controlled</td>
<td>22</td>
</tr>
<tr>
<td>35</td>
<td>Federal Aviation Administration</td>
<td>21</td>
</tr>
<tr>
<td>36</td>
<td>Ramp</td>
<td>21</td>
</tr>
<tr>
<td>37</td>
<td>Noise abatement</td>
<td>21</td>
</tr>
<tr>
<td>38</td>
<td>Taxiway</td>
<td>22</td>
</tr>
<tr>
<td>39</td>
<td>VFR</td>
<td>23</td>
</tr>
<tr>
<td>40</td>
<td>Departure</td>
<td>23</td>
</tr>
<tr>
<td>41</td>
<td>downwind, base, final approach</td>
<td>23</td>
</tr>
<tr>
<td>42</td>
<td>magnetic headings</td>
<td>24</td>
</tr>
<tr>
<td>43</td>
<td>the highest runway number is 36</td>
<td>24</td>
</tr>
<tr>
<td>44</td>
<td>9 right, 9 center, and 9 left</td>
<td>24</td>
</tr>
<tr>
<td>45</td>
<td>precision</td>
<td>25</td>
</tr>
<tr>
<td>46</td>
<td>2/20</td>
<td>25</td>
</tr>
<tr>
<td>47</td>
<td>information</td>
<td>26</td>
</tr>
<tr>
<td>48</td>
<td>destination</td>
<td>26</td>
</tr>
<tr>
<td>49</td>
<td>green</td>
<td>27</td>
</tr>
<tr>
<td>50</td>
<td>white</td>
<td>27</td>
</tr>
<tr>
<td>51</td>
<td>below the glide path</td>
<td>28</td>
</tr>
<tr>
<td>52</td>
<td>military</td>
<td>29</td>
</tr>
<tr>
<td>53</td>
<td>water</td>
<td>29</td>
</tr>
<tr>
<td>54</td>
<td>windsock</td>
<td>22</td>
</tr>
<tr>
<td>55</td>
<td>uniform</td>
<td>30</td>
</tr>
</tbody>
</table>

**Chapter 3 – Airport to Airport – Aeronautical Charts**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>56</td>
<td>latitude</td>
<td>33</td>
</tr>
<tr>
<td>57</td>
<td>north pole, south pole</td>
<td>33</td>
</tr>
<tr>
<td>58</td>
<td>sectional</td>
<td>33</td>
</tr>
</tbody>
</table>
Answers

59. 60
60. control tower
61. no control tower
62. a rotating beacon in operation sunset to sunrise
63. field elevation
64. lighted runway 3800 feet long
65. OK60
66. 122.9 Mghz
67. 1177 feet
68. wild life refuge
69. railroad, highway (US 64)

Reference Page
34
36
36
38
39
39
40
40
40
36

MODULE 3 AIR ENVIRONMENT

Chapter 1 Air Circulation

1. Earth weather
2. more
3. uneven unequal temperature pressure circulation movement
4. radiation
5. absorbed differently surface substance
6. 50 50 reflected absorbed
7. rises clouds
8. farther apart
9. revolves 365 days 5 hours 48 mins
10. 23.5 day seasonal changes
11. June 21 summer solstice
12. away winter solstice
13. spring (vernal) equinox fall (autumnal) equinox
14. counterclockwise Coriolis Force
15. trade winds
16. doldrums
17. Prevailing Westerlies
18. polar easterlies
19. jet stream

Chapter 2 - Weather Elements

20. wind
21. wind direction
22. 1.1
23. Beaufort Scale
24. wind chill
25. into
26. increase

Reference Page
9
9
9
10
10
11
11
### Answers

<table>
<thead>
<tr>
<th>Question</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>27. microburst</td>
<td>11</td>
</tr>
<tr>
<td>28. heat</td>
<td>12</td>
</tr>
<tr>
<td>29. temperature</td>
<td>12</td>
</tr>
<tr>
<td>30. 32</td>
<td>212</td>
</tr>
<tr>
<td>31. 0</td>
<td>100</td>
</tr>
<tr>
<td>32. 273</td>
<td>373</td>
</tr>
<tr>
<td>33. longer</td>
<td>13</td>
</tr>
<tr>
<td>34. cramps, fainting, heat exhaustion heatstroke water</td>
<td>13</td>
</tr>
<tr>
<td>35. hypothermia frostbite</td>
<td>13</td>
</tr>
<tr>
<td>36. atmospheric pressure</td>
<td>13</td>
</tr>
<tr>
<td>37. mercury</td>
<td>13</td>
</tr>
<tr>
<td>38. aneroid barometer</td>
<td>13</td>
</tr>
</tbody>
</table>

### Chapter 3 – Moisture and Clouds

<table>
<thead>
<tr>
<th>Question</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>39. moisture</td>
<td>19</td>
</tr>
<tr>
<td>40. water vapor</td>
<td>19</td>
</tr>
<tr>
<td>41. saturation</td>
<td>19</td>
</tr>
<tr>
<td>42. dew point</td>
<td>19</td>
</tr>
<tr>
<td>43. condensation</td>
<td>19</td>
</tr>
<tr>
<td>44. condensation</td>
<td>19</td>
</tr>
<tr>
<td>45. relative humidity percentage</td>
<td>19</td>
</tr>
<tr>
<td>46. fog</td>
<td>19</td>
</tr>
<tr>
<td>47. water tiny crystals of ice</td>
<td>20</td>
</tr>
<tr>
<td>48. cumulus, status cirrus</td>
<td>20</td>
</tr>
<tr>
<td>49. cumulus</td>
<td>20</td>
</tr>
<tr>
<td>50. stratus</td>
<td>20</td>
</tr>
<tr>
<td>51. cirrus</td>
<td>20</td>
</tr>
<tr>
<td>52. nimbostratus</td>
<td>20</td>
</tr>
<tr>
<td>53. cumulonimbus</td>
<td>20</td>
</tr>
<tr>
<td>54. mammatus</td>
<td>21</td>
</tr>
<tr>
<td>55. turbulence</td>
<td>21</td>
</tr>
<tr>
<td>56. cumulus</td>
<td>21</td>
</tr>
<tr>
<td>57. precipitation</td>
<td>21</td>
</tr>
<tr>
<td>58. freezing rain</td>
<td>21</td>
</tr>
</tbody>
</table>

### Chapter 4 – Weather Systems and Changes

<table>
<thead>
<tr>
<th>Question</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>59. air mass</td>
<td>27</td>
</tr>
<tr>
<td>60. source region large physical features tropical and polar</td>
<td>27</td>
</tr>
<tr>
<td>61. source region nature source region</td>
<td>27</td>
</tr>
<tr>
<td>62. capital lowercase</td>
<td>27</td>
</tr>
<tr>
<td>63. polar arctic tropical equatorial</td>
<td>27</td>
</tr>
<tr>
<td>64. m (maritime) c (continental)</td>
<td>27</td>
</tr>
<tr>
<td>65. front</td>
<td>28</td>
</tr>
</tbody>
</table>
Answers
66. warm front
67. cold front
68. stationary front
69. occluded front
70. thunderstorms
71. building mature dissipating
72. building
73. lightning
74. winds
75. Fujita Wind Damage Scale
76. Basement
77. Right
78. 74
79. 5 Saffir-Simpson Hurricane Damage Potential Scale
80. eye

MODULE 4 - ROCKETS

Chapter 1 - History of Rockets
1. Hero
2. Chinese
3. arrows flying fire
4. Roger Bacon
5. Jean Froissart
6. Sir Isaac Newton
7. Colonel William Congreve
8. Dr. Robert Goddard
9. liquid oxygen and gasoline
10. Wernher von Braun
11. Soviet Union Sputnik I
12. Explorer I
13. Yuri Gagarin
14. Alan Shepard
15. John Glenn
16. Neil Armstrong
17. Skylab
18. Space Shuttle
19. launch vehicle
20. Atlas
21. Saturn V

Chapter 2 - Rocket Principles
22. Acceleration
Answers
23. First
24. Inertia
25. Thrust
26. momentum proportional
27. Third
28. f = ma

Chapter 3 - Rocket Systems and Controls
29. airframe guidance control propulsion
30. airframe
31. strong
32. payload
33. payload
34. guidance
35. guidance
36. trajectory
37. control
38. propulsion
39. liquid solid
40. hydrogen carbon oxygen
41. combustion chamber, fuel oxidizer
42. kerosene liquid hydrogen liquid oxygen
43. liquid
44. control
45. guidance
46. airframe

MODULE 5 – SPACE ENVIRONMENT

Chapter 1 – Space
1. space
2. 250
3. universe
4. oxygen
5. microgravity
6. galaxy
7. galaxy elliptical, spiral and irregular
8. elliptical spiral irregular
9. Milky Way spiral
10. Nebulae
11. Stars
12. Ionosphere
13. Sun
**Answers**

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>hydrogen and helium</td>
</tr>
<tr>
<td>15.</td>
<td>binary</td>
</tr>
<tr>
<td>16.</td>
<td>constellation</td>
</tr>
<tr>
<td>17.</td>
<td>constellation</td>
</tr>
<tr>
<td>18.</td>
<td>solar system</td>
</tr>
<tr>
<td>19.</td>
<td>lifeless, ice-covered</td>
</tr>
<tr>
<td>20.</td>
<td>sun</td>
</tr>
<tr>
<td>21.</td>
<td>93 million</td>
</tr>
<tr>
<td>22.</td>
<td>90, 9 4200 15 million</td>
</tr>
<tr>
<td>23.</td>
<td>sunspots</td>
</tr>
<tr>
<td>24.</td>
<td>solar flares</td>
</tr>
<tr>
<td>25.</td>
<td>solar prominences</td>
</tr>
<tr>
<td>26.</td>
<td>2155 ¼ 252,000 221,000</td>
</tr>
<tr>
<td>27.</td>
<td>27</td>
</tr>
<tr>
<td>28.</td>
<td>new full</td>
</tr>
<tr>
<td>29.</td>
<td>highlands lowlands</td>
</tr>
<tr>
<td>30.</td>
<td>250 -250</td>
</tr>
<tr>
<td>31.</td>
<td>Mercury 88 800 -300</td>
</tr>
<tr>
<td>32.</td>
<td>Venus 225 hottest 850</td>
</tr>
<tr>
<td>33.</td>
<td>Venus clockwise</td>
</tr>
<tr>
<td>34.</td>
<td>carbon dioxide nitrogen</td>
</tr>
<tr>
<td>35.</td>
<td>nitrogen oxygen</td>
</tr>
<tr>
<td>36.</td>
<td>water</td>
</tr>
<tr>
<td>37.</td>
<td>365</td>
</tr>
<tr>
<td>38.</td>
<td>red red rock dust</td>
</tr>
<tr>
<td>39.</td>
<td>volcanoes volcanoes</td>
</tr>
<tr>
<td>40.</td>
<td>carbon dioxide 65 -130</td>
</tr>
<tr>
<td>41.</td>
<td>Mars Pathfinder Sojourner Truth two one</td>
</tr>
<tr>
<td>42.</td>
<td>Mars</td>
</tr>
<tr>
<td>43.</td>
<td>Jupiter 11</td>
</tr>
<tr>
<td>44.</td>
<td>hydrogen helium methane ammonia</td>
</tr>
<tr>
<td>45.</td>
<td>The Giant Red 30,000 10,000 16</td>
</tr>
<tr>
<td>46.</td>
<td>Saturn icy rock particles boulders</td>
</tr>
<tr>
<td>47.</td>
<td>Ringlets</td>
</tr>
<tr>
<td>48.</td>
<td>one mile 250,000</td>
</tr>
<tr>
<td>49.</td>
<td>icy rock hydrogen hydrogen helium</td>
</tr>
<tr>
<td>50.</td>
<td>29</td>
</tr>
<tr>
<td>51.</td>
<td>1100</td>
</tr>
<tr>
<td>52.</td>
<td>900 million</td>
</tr>
<tr>
<td>53.</td>
<td>Titan atmosphere</td>
</tr>
<tr>
<td>54.</td>
<td>Uranus water, ammonia and methane ice and liquid</td>
</tr>
<tr>
<td>55.</td>
<td>84</td>
</tr>
</tbody>
</table>

---

**Reference Page**

<table>
<thead>
<tr>
<th>Question</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.</td>
<td>5</td>
</tr>
<tr>
<td>15.</td>
<td>5</td>
</tr>
<tr>
<td>16.</td>
<td>5</td>
</tr>
<tr>
<td>17.</td>
<td>5</td>
</tr>
<tr>
<td>18.</td>
<td>14</td>
</tr>
<tr>
<td>19.</td>
<td>14</td>
</tr>
<tr>
<td>20.</td>
<td>14</td>
</tr>
<tr>
<td>21.</td>
<td>14</td>
</tr>
<tr>
<td>22.</td>
<td>14</td>
</tr>
<tr>
<td>23.</td>
<td>15</td>
</tr>
<tr>
<td>24.</td>
<td>15</td>
</tr>
<tr>
<td>25.</td>
<td>15</td>
</tr>
<tr>
<td>26.</td>
<td>15</td>
</tr>
<tr>
<td>27.</td>
<td>15</td>
</tr>
<tr>
<td>28.</td>
<td>16</td>
</tr>
<tr>
<td>29.</td>
<td>17</td>
</tr>
<tr>
<td>30.</td>
<td>17</td>
</tr>
<tr>
<td>31.</td>
<td>17</td>
</tr>
<tr>
<td>32.</td>
<td>18</td>
</tr>
<tr>
<td>33.</td>
<td>18</td>
</tr>
<tr>
<td>34.</td>
<td>18</td>
</tr>
<tr>
<td>35.</td>
<td>18</td>
</tr>
<tr>
<td>36.</td>
<td>18</td>
</tr>
<tr>
<td>37.</td>
<td>19</td>
</tr>
<tr>
<td>38.</td>
<td>19</td>
</tr>
<tr>
<td>39.</td>
<td>19</td>
</tr>
<tr>
<td>40.</td>
<td>19</td>
</tr>
<tr>
<td>41.</td>
<td>19</td>
</tr>
<tr>
<td>42.</td>
<td>19</td>
</tr>
<tr>
<td>43.</td>
<td>20</td>
</tr>
<tr>
<td>44.</td>
<td>20</td>
</tr>
<tr>
<td>45.</td>
<td>20</td>
</tr>
<tr>
<td>46.</td>
<td>20</td>
</tr>
<tr>
<td>47.</td>
<td>20</td>
</tr>
<tr>
<td>48.</td>
<td>20</td>
</tr>
<tr>
<td>49.</td>
<td>21</td>
</tr>
<tr>
<td>50.</td>
<td>21</td>
</tr>
<tr>
<td>51.</td>
<td>21</td>
</tr>
<tr>
<td>52.</td>
<td>21</td>
</tr>
<tr>
<td>53.</td>
<td>21</td>
</tr>
<tr>
<td>54.</td>
<td>21</td>
</tr>
<tr>
<td>55.</td>
<td>21</td>
</tr>
</tbody>
</table>
Answers
56. rings
57. 3 billion 165
58. hydrogen, helium and methane
59. methane
60. Neptune, 1340
61. Pluto frozen
62. Debris
63. Asteroids
64. asteroids, asteroid belt
65. comet, snowball
66. meteoroids
67. meteor
68. meteorites

MODULE 6 – SPACECRAFT

Chapter 1 – Unmanned Spacecraft

1. Sputnik
2. Satellite
3. Score Telestar I
4. International Telecommunications Satellite Organization 16
5. Tracking and Data Relay Satellite System space shuttle
6. deep space
7. Transit
8. Global Positioning System positioning service
9. natural resources LANDSAT
10. weather
11. Geostationary Operational Environmental Satellites clouds weather forecasting
12. Explorer
13. space probes
14. Rangers Mariners
15. Pioneer Voyager 1 and 2
16. Viking
17. people, space environment, sub-systems and launch
18. purpose and requirements
19. radiation, charged particles and solar flares
20. micrometeorites space debris natural materials
21. debris or junk
22. mission payload requirements
23. structure
24. propulsion
25. attitude control
26. sun
Answers
27. thermal control
28. command and control
29. launch
30. orbit
31. Kepler
32. Apogee

Chapter 2 – Manned Spacecraft

33. Project Mercury
34. Alan Shepard
35. John Glenn
36. survival in space
37. Project Gemini walk in space
38. Apollo 11 Neil Armstrong
39. Project Skylab long-duration
40. 28 84
41. Apollo-Soyuz Test Project
42. Space Shuttle transportation return back again and again
43. orbiter, solid rocket boosters external tank orbiter
44. Hubble Space Telescope
45. Spacelab

Chapter 3 – Living and Working in Space

46. Salyut 1
47. Salyut 1
48. Mir
49. Skylab 84
50. Spacelab
51. Weightlessness
52. oxygen and nitrogen
53. vertically
54. Extravehicular Activity (EVA)
55. Aleksei Leonov Ed White
56. Skylab 4
57. taken off
58. Manned Maneuvering Unit (MMU)
59. Space Station Alpha US, Europe, Canada, Japan and Russia
60. X-33