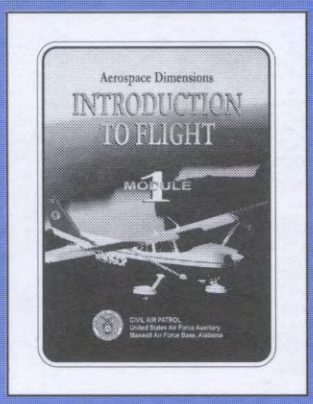

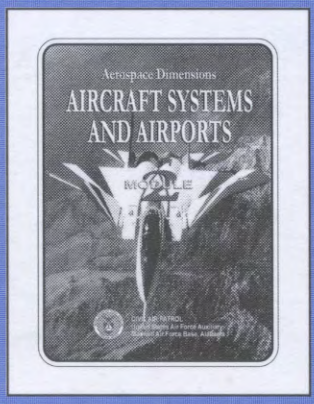

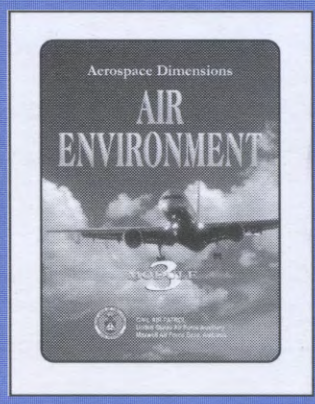

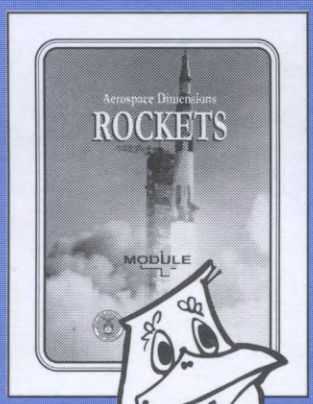

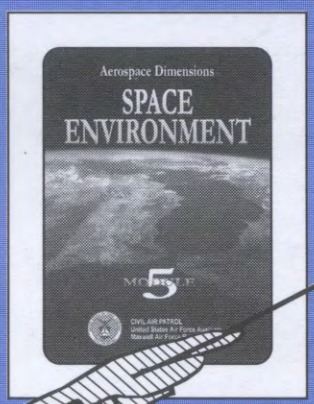

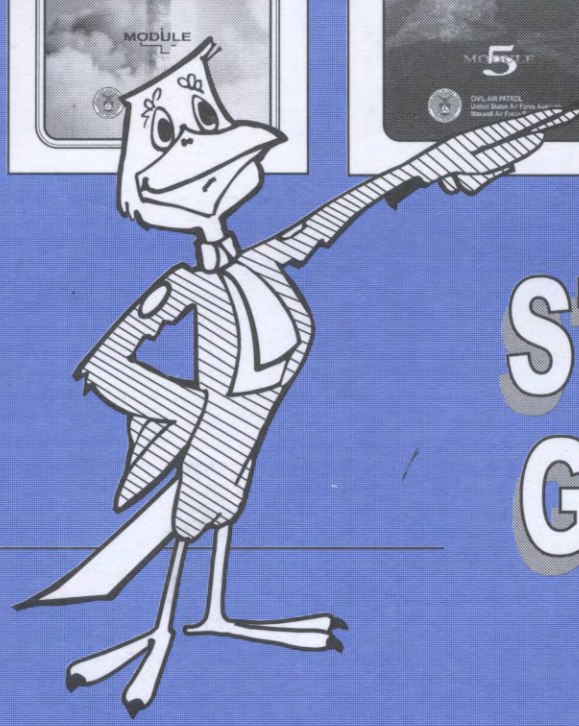

STUDY GUIDE

UNITED STATES AIR FORCE AUXILIARY
CIVIL AIR PATROL

STUDENT STUDY GUIDE

FOR

AEROSPACE DIMENSIONS

2000

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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. ie. 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

Priority	Assignment
1	History – read chap 5
2	Math – complete homework

OR

Priority	Assignment
H	Write English paper
M	Read Science chap 9

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.

Mon	Tues	Wed	Thur	Fri	Sat	Sun

Time Schedule

Week of _____

Hour	Mon	Tues	Wed	Thur	Fri	Sat	Sun
AM							
7-8							
8-9							
9-10							
10-11							
11-12							
12-1							
1-2							
2-3							
3-4							
4-5							
5-6							
6-7							
7-8							
8-9							
9-10							
10-11							

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:

   Total pages ÷ Number of days x 4 (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 ÷ 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 x 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.

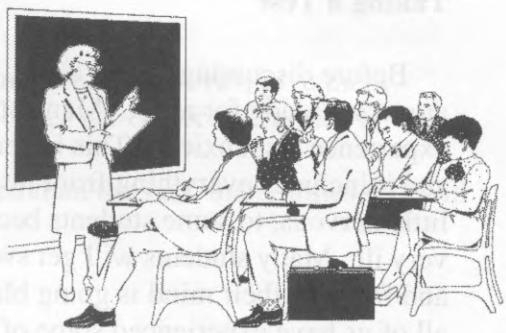
Be prepared by reading your assignment ahead of time.

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 you 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 it 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 Daedulus, 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 Daedulus 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 and 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 under 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 "burble" 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 airports "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 (OK6∅)," 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 _____ _____ 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 _____ _____.

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 _____ _____ _____.

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 _____.

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 _____ series explored the environment of Mars.
17. Satellites as a system are made up of four parts: _____, _____ _____, _____-_____ and a _____.
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 linkup 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

Answers	Reference Page
Why Aerospace Education	
1. general education, knowledge skills attitudes, impact	vi
2. July 1, 1946	vi
3. United States	vi
Chapter 1 – Flight	
4. Aircraft	1
5. Airplane	1
6. Aeronautics and space	1
7. Nitrogen	1
8. Subsonic, transonic, supersonic	1
9. Yes	1
10. Drag	1
11. Dynamic	1
12. Yes	4
13. Relative wind	1
14. Chord	1
15. a & b	2
16. d	3
17. Chinese	2
18. Flying	4
19. Balloon, Montgolfier brothers	3
20. Language	1
21. Propeller	4
22. Tail feathers and wing feathers	4
23. Third	6
24. Bernoulli	5
25. Pressure Bernoulli's	5
26. It decreases or drops	5
27. Newton's	6
28. Chord	7
29. Camber	7
30. Gravity and drag	8
31. Thrust and lift	8
32. 8	8
33. drag	8

Answers	Reference Page
34. thrust, drag, wing, air, drop, camber, decreased, increased, lift, relative wind, Newton's, for every action, there is an equal and opposite reaction.	7,8
35. elevons	18
36. a. increase speed b. increase camber c. increase area d. increase angle of attack	9
37. angle of attack, stall	9
38. critical angle of attack	9
39. stall	9
40. longitudinal	11
41. vertical	11
42. lateral	11
43. roll	11
44. yaw	11
45. pitch	11
46. center of gravity	11
47. d	11
48. pitch	12
49. roll	12
50. rudder	12
51. stabilator	12
52. moves upward	12
53. forward	14
54. angle of incidence (or attack)	14
55. speed	14
56. blade	14

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

57. convection	23
58. aspect	23
59. glide ratio	23
60. thermal	24
61. Sun	24
62. 41.5	24
63. 15°C	24
64. 20 to 1	25
65. 4.3 feet	25
66. loss, lift	26
67. center, gravity	26

Answers	Reference Page

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 ft^3 , it will lift 1164.5 lbs (17lbs/1000ft^3) 68,500 ft^3, it will lift 1370.0 lbs (20lbs/1000ft^3) 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	34
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

Answers	Reference Page
22. decreases	16
23. 1	16
24. vertical speed indicator	17
25. airspeed indicator	17
26. 6076	18
27. 5280	18
28. b	18
29. rotor	18
30. attitude indicator	18
31. heading indicator	19
32. turn coordinator	19
33. slipping, skidding	19
Chapter 2 – Airports	
34. controlled	22
35. Federal Aviation Administration	21
36. Ramp	21
37. Noise abatement	21
38. Taxiway	22
39. VFR	23
40. Departure	23
41. downwind, base, final approach	23
42. magnetic headings	24
43. the highest runway number is 36	24
44. 9 right, 9 center, and 9 left	24
45. precision	25
46. 2/20	25
47. information	26
48. destination	26
49. green	27
50. white	27
51. below the glide path	28
52. military	29
53. water	29
54. windsock	22
55. uniform	30
Chapter 3 – Airport to Airport – Aeronautical Charts	
56. latitude	33
57. north pole, south pole	33
58. sectional	33

Answers	Reference Page
59. 60	34
60. control tower	36
61. no control tower	36
62. a rotating beacon in operation sunset to sunrise	38
63. field elevation	39
64. lighted runway 3800 feet long	39
65. OK60	40
66. 122.9 Mghz	40
67. 1177 feet	40
68. wild life refuge	40
69. railroad, highway (US 64)	36

MODULE 3 AIR ENVIRONMENT

Chapter 1 Air Circulation

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

Chapter 2 - Weather Elements

20. wind	9
21. wind direction	9
22. 1.1	9
23. Beaufort Scale	10
24. wind chill	10
25. into	11
26. increase	11

Answers	Reference Page
27. microburst	11
28. heat	12
29. temperature	12
30. 32 212	12
31. 0 100	12
32. 273 373	12
33. longer	13
34. cramps, fainting, heat exhaustion heatstroke water	13
35. hypothermia frostbite	13
36. atmospheric pressure	13
37. mercury	13
38. aneroid barometer	13

Chapter 3 – Moisture and Clouds

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

Chapter 4 – Weather Systems and Changes

59. air mass	27
60. source region large physical features tropical and polar	27
61. source region nature source region	27
62. capital lowercase	27
63. polar arctic tropical equatorial	27
64. m (maritime) c (continental)	27
65. front	28

Answers	Reference Page
66. warm front	28
67. cold front	28
68. stationary front	28
69. occluded front	28
70. thunderstorms	29
71. building mature dissipating	29
72. building	29
73. lightning	29
74. winds	30
75. Fujita Wind Damage Scale	31
76. Basement	31
77. Right	31
78. 74	31
79. 5 Saffir-Simpson Hurricane Damage Potential Scale	31
80. eye	32

MODULE 4 - ROCKETS

Chapter 1 - History of Rockets

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

Chapter 2 - Rocket Principles

22. Acceleration	12

Answers	Reference Page
23. First	12
24. Inertia	12
25. Thrust	12
26. momentum proportional	12
27. Third	12
28. f = ma	13

Chapter 3 - Rocket Systems and Controls

29. airframe guidance control propulsion	21
30. airframe	21
31. strong	21
32. payload	21
33. payload	21
34. guidance	21
35. guidance	21
36. trajectory	21
37. control	21
38. propulsion	22
39. liquid solid	22
40. hydrogen carbon oxygen	22
41. combustion chamber, fuel oxidizer	22
42. kerosene liquid hydrogen liquid oxygen	22
43. liquid	22
44. control	21
45. guidance	21
46. airframe	21

MODULE 5 – SPACE ENVIRONMENT

Chapter 1 – Space

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

Answers	Reference Page
14. hydrogen and helium	5
15. binary	5
16. constellation	5
17. constellation	5

Chapter 2 - Solar System

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

Answers	Reference Page
56. rings	21
57. 3 billion 165	22
58. hydrogen, helium and methane	22
59. methane	22
60. Neptune, 1340	22
61. Pluto frozen	22
62. Debris	23
63. Asteroids	23
64. asteroids, asteroid belt	23
65. comet, snowball	23
66. meteoroids	24
67. meteor	24
68. meteorites	24

MODULE 6 – SPACECRAFT

Chapter 1 – Unmanned Spacecraft

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

Answers	Reference Page
27. thermal control	7
28. command and control	7
29. launch	7
30. orbit	7
31. Kepler	8
32. Apogee	8

Chapter 2 – Manned Spacecraft

33. Project Mercury	12
34. Alan Shepard	13
35. John Glenn	13
36. survival in space	13
37. Project Gemini walk in space	13
38. Apollo 11 Neil Armstrong	14
39. Project Skylab long-duration	15
40. 28 84	15
41. Apollo-Soyuz Test Project	15
42. Space Shuttle transportation return back again and again	16
43. orbiter, solid rocket boosters external tank orbiter	16
44. Hubble Space Telescope	17
45. Spacelab	17

Chapter 3 – Living and Working in Space

46. Salyut 1	26
47. Salyut 1	26
48. Mir	26
49. Skylab 84	27
50. Spacelab	27
51. Weightlessness	28
52. oxygen and nitrogen	28
53. vertically	28
54. Extravehicular Activity (EVA)	28
55. Aleksei Leonov Ed White	29
56. Skylab 4	29
57. taken off	30
58. Manned Maneuvering Unit (MMU)	30
59. Space Station Alpha US, Europe, Canada, Japan and Russia	31
60. X-33	32