

# **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 I--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 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  $C = \frac{5}{9}(F - 32)$ . 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.