1. Fill in the blank. Leonardo da Vinci’s flying machine, the ornithopter, was an invention that \_\_\_\_\_\_\_\_\_\_\_. (2.A)

1. resembled a parachute
2. launched from and landed on water
3. had rotating blades, powered by humans
4. flapped its wings like a bird

2. Which of the following best explains why wind tunnels are used in testing the design of aircraft? (2.D)

1. To test scale models of airfoils and aircraft
2. To study why an airplane crashes or malfunctions
3. To correct any human errors made during manufacturing
4. To conduct a test flight of an aircraft without effects of weather

3. Which of the following represents a contribution Greek myths made to civilization today? (2.A)

1. Early flight techniques
2. Inspiration for human flight
3. Earliest designs of airplanes
4. Scientific concepts related to flight

4. Which concept(s) best illustrates the mechanics of flying a hot air balloon? Select all that apply. (2.B)

1. density
2. gravity
3. weight
4. buoyancy

5. What does the camber of an airfoil refer to? (2.D)

1. The straight line that connects the leading edge to the trailing edge of the wing
2. The distance between the top and bottom of the wing
3. The symmetry of the wing
4. The curve of the wing

6. Birds generate \_\_\_\_\_\_\_ by flapping their wings. (2.C)

1. Air pressure
2. lift and thrust
3. drag and pull
4. height and weight

7. What is the purpose of the burner of a hot air balloon? (2.B)

1. It warms the air just outside the balloon causing it to rise.
2. It warms passengers at high altitudes.
3. It heats the air inside the balloon causing it to rise.
4. It lowers the weight of the basket by warming the balloon.

8. When the four forces of flight are balanced, the flying object is said to have \_\_\_\_\_\_\_\_. (2.C)

1. lift
2. equilibrium
3. thrust
4. velocity

9. What part of a bird most resembles the propeller on an aircraft? (2.C)

1. Wings
2. Head
3. Tail
4. Beak

10. Hot air balloons rise because warm air in the balloon \_\_\_\_\_\_\_, lifting the balloon. (2.B)

1. starts to cool
2. becomes less dense
3. becomes heavier
4. evaporates

11. For modern day gliders, what does Bernoulli’s Principle demonstrate? (2.C)

1. The speed of the air is faster as it hits the top of the wing causing an increase in pressure and creating lift. This permits flight of the glider.
2. Air slows down as it hits the top of the wing, which increases pressure and creates drag. This permits the flight of the glider.
3. Air moves faster over the top of the wing than air moving below the wing. This creates an area of low pressure on top of the wing, which lifts the glider up.
4. An airplane’s wing is an obstacle to the oncoming air. As the air meets the wing, its path widens.

12. Why is air density important when using hot air balloons? (2.B)

1. It is a measure of how much air there is surrounding the balloon to help support it.
2. It is a measure of how much drag there is surrounding the balloon to help stabilize it.
3. Density of cold air is less than hot air. The cold air presses against the balloon on the outside, pushing it up.
4. As air inside the balloon gets warmer, the density of the air in the balloon decreases, causing it to rise.

13. Which type of aircraft performs best with a symmetrical airfoil? (2.D)

1. Airliner
2. Space shuttle
3. Fighter jet
4. Aerobatic aircraft

14. Which statement accurately portrays the Wright Brothers? (2.D)

1. They discovered the principles of flight mostly from their experience in flying gliders.
2. They approached problems systematically and methodically, controlling all other variables.
3. They intentionally avoided learnings from early pioneers in hope for new perspectives.
4. They created the world’s first powered, controlled heavier-than-air glider.

15. Movement of a wing through the air creates \_\_\_\_\_\_\_ on the top of the wing as compared to the bottom of the wing, allowing for lift. (2.C)

1. lower pressure
2. more thrust
3. less drag
4. higher pressure

16. Why did the Wright brothers include a rudder in their airplane design? (2.D)

1. To increase the weight of the glider.
2. To allow the glider to warp its wings.
3. To reduce the thrust of the engines on the glider.
4. To prevent the glider from spinning out of control.

17. In early aviation research, which was the most important contribution of Sir George Cayley? (2.C)

1. Created the first self-propelled airplane
2. Used kites to explain the thrust of an airplane
3. Described the underlying principles and forces of flight
4. Discovered the most suitable materials from which to construct an airplane

18. Fill in the blank. Both the Wright brothers and Leonardo da Vinci based their theories of flight from observations of \_\_\_\_\_\_\_. (2.D)

1. parachutes
2. falling leaves
3. other engineers
4. animals in flight

19. Which is an aircraft whose flight does not depend principally on an engine? (2.C)

1. Glider
2. Airliner
3. The Wright Flyer
4. Gyrocopter

20. A pilot descends a hot air balloon by allowing air to escape through \_\_\_\_\_\_\_\_\_. (2.B)

1. the basket
2. the parachute valve
3. the gores
4. the propane valve

21. In 2-3 sentences, explain how the Wright brothers used the engineering practices to successfully achieve flight when other engineers failed. (2.D)

The Wright brothers started by defining their problem. By understanding that controlling their aircraft was the hardest challenge, they knew what question to focus their energies on. They then studied designs of other flyers to understand why they were not successful. From these studies, they came up with new wing and airfoil models. They built these airfoil models and tested them in a wind tunnel. With each iteration, they improved their design. In the end, they tested and refined over two hundred different designs.

22. In 2-3 sentences, explain what the Wright brothers learned from building a wind tunnel. (2.D)

The Wright brothers built a wind tunnel to study why their airfoil designs did not achieve the same theoretical lift predicted by Otto Lilienthal and others. Using balances and instruments incorporated into their wind tunnel, they were able to measure the lift and drag of more than 200 airfoil designs.

23. In 2-3 sentences, explain how hot air balloons create lift. (2.B)

Hot air balloons experience lift due to Archimedes’ Principle because hot air is less dense and thus more buoyant than cooler air. Archimedes’ Principle states that the buoyant force on an object is equal to the weight of displaced fluid. By using a burner to fill a hot air balloon with a substance with low density, a large amount of heavy fluid is displaced by the volume of the balloon, resulting in a large buoyant force that provides lift.

24. In 2-3 sentences, explain how gliders produce lift even though they do not have engines. (2.C)

A glider produces thrust by converting potential energy into kinetic energy. A glider starts its flight from a high altitude. As the glider falls, its gravitational potential energy is converted into kinetic energy that increases the glider’s speed. The fast flow of air over a glider’s wings produces a region of low pressure, that provides lift to the glider.

25. In 2-3 sentences, explain how ancient Greek stories contributed to modern aviation. (2.A)

The myth of Icarus and Daedalus inspired humans to build flying machines. Throughout time, humans have watched birds fly and have attempted to emulate their use of wings in flight. Because the story has been retold in literature, arts, and science for thousands of years, it has inspired many engineers to work toward this goal.