**1. Forces are vectors because \_\_\_\_\_\_\_\_\_\_. (4.A.3)**

a. they involve gravity

b. they have length and width

c. they have magnitude and direction

d. they can point in two directions

**2. Which best describes Newton’s Third Law of Motion? (4.A.1)**

a. Any object will remain at rest until an force acts on it.

b. For every action there is an equal and opposite reaction.

c. Any object will remain in motion until an force acts on it.

d. Any force applied to an object moves the object in the same direction of the force.

**3. Lift on a wing is most properly defined as the \_\_\_\_\_\_\_\_\_\_\_\_. (4.A.2)**

a. differential pressure acting perpendicular to the chord of the wing

b. increased pressure resulting from air flow over the upper camber of an airfoil, which acts perpendicular to the mean camber

c. force acting perpendicular to the relative wind

d. the force that opposes drag

**4. True or False. The reaction of downwash causes an downward reaction according to Newton’s Third Law of Motion. (4.B.1)**

**5. Which of the following is true for an airplane in steady flight? Select all that apply. (4.A.3)**

a. The sum of all upward components of forces equals the sum of all downward components of forces

b. The sum of all forward components of forces is greater than the sum of all backward components of forces

c. The sum of all upward components of forces equals the sum of all forward components of forces

d. The sum of all upward components of forces is greater than the sum of all downward components of forces

e. The sum of all forward components of forces equals the sum of all backward components of forces

**6. Which of the following is true relative to a changing angle of attack? (4.B.1 and 4.B.3)**

a. A decrease in angle of attack will increase the pressure below the wing and increase drag

b. An increase in angle of attack will decrease the pressure above the wing and increase lift

c. An increase in angle of attack will increase the pressure above the wing and increase drag

d. An decrease in angle of attack will increase lift

**7. The Longer Path theory (or Equal Transit Time theory) says that the molecules of air flowing over the top of a wing must travel faster than the molecules of air flowing beneath the wing in order to meet at the trailing (back) edge. What is the problem with this theory? (4.B.1)**

a. It assumes that molecules of air arriving at the front of the wing are divided equally above and below the wing.

b. It assumes that molecules move at the same speed regardless of how fast air flows above and below the wing.

c. It assumes that molecules of air arriving at the front of the wing at the same time must also arrive at the back edge of the wing at the same time.

d. It assumes that more air travels above the wing than below the wing.

**8. The \_\_\_\_\_\_\_\_\_\_ of an airplane can act as an airfoil by helping to produce stability and lift. (4.B.2)**

a. propeller

b. fuselage

c. vertical stabilizer

d. All of the above

**9. Increasing an airplane’s wing area will \_\_\_\_\_\_\_\_\_\_. Select all that apply. (4.B.2 and 4.E.1)**

a. reduce pressure below the wing

b. increase drag

c. increase lift

d. increase the camber

**10. If the velocity of an airplane is doubled, the lift will \_\_\_\_\_\_\_\_\_. (4.B.3)**

a. increase by a factor of 2

b. increase by a factor of 4

c. decrease by a factor of 4

d. decrease by a factor of 2

**11. An aircraft always stalls at the same \_\_\_\_\_\_\_\_\_\_ regardless of airspeed, weight, or any other factor. (4.B.4)**

a. velocity

b. angle of attack

c. altitude

d. acceleration

**12. What safety measures do airplane designers take in regard to stalls? Select all that apply. (4.B.4)**

a. Ensure the airplane is as controllable as possible during a stall.

b. Ensure a stall is delayed as long as possible.

c. Ensure the pilot is warned of a possible stall.

d. All of the above

**13. Considering an aircraft’s weight and balance, \_\_\_\_\_\_\_ is the term used to describe the line or reference plane from which all measurements of “arm” are taken. (4.C.1)**

a. moment

b. station

c. datum

d. center of gravity (CG)

**14. The center of gravity of an airplane can be determined by which method? (4.C.1)**

a. Dividing total moments by total weight

b. Multiplying total moments by total weight

c. Multiplying total arms by total moments

d. Dividing total arms by total weight

**15. What can happen when the center of gravity (CG) of an airplane is forward of its acceptable CG range? (4.C.1)**

a. Rudder effectiveness is limited creating insufficient nose-up force for landing.

b. Rudder effectiveness is limited creating insufficient nose-down force for landing.

c. Elevator effectiveness is limited creating insufficient nose-down force for landing.

d. Elevator effectiveness becomes limited creating insufficient nose-up force for landing.

**16. Torque effect is most pronounced under which conditions? Select all that apply. (4.D.1)**

a. High power setting

b. High airspeed

c. Low angle of attack

d. Low airspeed

e. Low power setting

**17. What is an advantage of a variable-pitch propeller? (4.D.1)**

a. Permits the pilot to select and maintain a desired cruise airspeed

b. Permits the pilot to set the propeller blade angle for the most efficient performance

c. Eliminates engine vibrations

d. Prevents the portion of the propeller blade near the hub from stalling during cruise flight

**18. As airspeed decreases in level flight below that speed for maximum lift/drag ratio, total
 drag of an airplane \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. (4.E.1)**

a. decreases because of lower parasite drag

b. increases because of increased induced drag

c. increases because of increased parasite drag

d. neither increases nor decreases

**19. Which of the following is created by the resistance of air moving across the surface of an airplane? (4.E.1)**

a. Particle drag

b. Induced drag

c. Skin friction drag

d. Total drag

20. If airspeed is doubled while in level flight, parasite drag will become \_\_\_\_\_\_\_\_\_\_. (4.E.1)

a. half as great

b. twice as great

c. four times greater

d. exactly twice the amount of induced drag

**21. Describe two of the three ways a pilot can control lift during flight. (4.B.2)**

 A pilot can control lift by changing the angle of attack by varying the pitch of the
 airplane using the elevator, by changing the airspeed by adjusting the power setting of the engine or by climbing or descending, or by adjusting the camber of
 the wing by extending or retracting lift-enhancing devices like flaps.

**22. Describe how Newton’s Third Law of Motion and Bernoulli’s Principle explain the generation of lift by an airfoil. (4.B.1)**

According to Bernoulli’s Principle, when air moving over the top of a wing surface travels
 faster than air moving over the bottom of the wing surface, pressure above the wing is
 reduced, producing lift. These pressure changes cause the airflow to curve downwards,
 creating downwash behind the airfoil.

 Newton’s Third Law states that for every action there is an equal and opposite reaction, so that a downward force is met with an equal and opposite upward force. When an airfoil bends air traveling across its surface downward, this action results in an equal and opposite upward force called lift.

**23. Is it more desirable for the wing root or wing tip to stall first and why? (4.B.4)**

It is preferable for the wing root to stall first. If the wingtip stalls before the root, the
 disrupted airflow near the wingtip can reduce aileron effectiveness to such an extent that
 that the pilot can lose control over the roll of the aircraft as the aircraft stalls, causing a
 wing to drop, which in extreme cases could lead to entering a spin.

**24. Explain how weight and balance of an airplane can change during flight. (4.C.1)**

An airplane’s weight can change during flight by the burning of fuel or dropping of cargo.
 The balance of an airplane can change by the movement of passengers or the incidental
 shifting or sliding of luggage or cargo during flight.

**25. Explain how ground effect can both help and hinder during takeoff. (4.E.1)**

Ground effect can be a double edged sword on takeoff. On the positive side, it will allow an airplane to
 fly at a slower speed than it could outside of ground effect. This is because induced drag is reduced so
 less thrust is needed to produce lift. This can be used to get the airplane into the air more quickly to
 allow easier and faster acceleration than would be possible on the ground.

On the other hand, if the aircraft lifts off at too low an airspeed because of ground effect, it may not have enough speed to fly outside of ground effect, and could end up settling back onto the runway.