Module 8

Aerodynamics

Exam Number:-1.

1. If the wing tips stall before the root on a swept wing aircraft, the aircraft will

a) roll

b) pitch nose up

c) pitch nose down

2) Angle of attack .

a) increases with an increased angle of incidence (angle of attack)

b) decreases with an increase in angle of incidence (angle of attack)

c) does not change with a change in angle of incidence (angle of attack)

3. On a straight wing aircraft, stall commences at the

a) root on a high thickness ratio wing

b) tip on a high thickness ratio wing

c) tip on a low thickness ratio wing

4. On a high wing aircraft in a turn

a) the up-going wing loses lift causing a de-stabilising effect

b) the down-going wing gains lift causing a stabilising effect

c) the down-going wing loses lift causing a de-stabilising effect

5. For the same angle of attack, the lift on a delta wing

a) is greater than the lift on a high aspect ratio wing

b) is lower than the lift on a high aspect ratio wing

c) is the same as the lift on a high aspect ratio wing

6. The ISA?

a) is taken from the equator

b) is taken from 45 degrees latitude

c) assumes a standard day

7. As altitude increases, pressure

a) decreases at constant rate

b) increases exponentially

c) decreases exponentially

8. The thrust-drag couple overcomes the lift-weight couple. What direction of force is required to be produced by the tail of the aircraft to maintain straight and level flight

a) upwards

b) downwards

c) sideways

9. When the pressure is half of that at sea level, what is the altitude?

a) 12,000 ft

b) 8,000 ft

c) 18,000 ft

10. During a turn, the stalling angle
a) increases
b) decreases
c) remains the same

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ans[1] = "b";
ans[2] = "a";
ans[3] = "a";
ans[4] = "b";
ans[5] = "b";
ans[6] = "b";
ans[7] = "c";
ans[8] = "a";
ans[9] = "c";
ans[10] = "c";
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explain[1]="Picture a side view of a swept wing aircraft. The wing tips are behind the wing root. Think, therefore, of the lift on the wing tip holding the tail up. Lose the lift on the tips and what will happen?";
explain[2]="This question is much easier than it looks at first read. All wing types (straight, swept, delta etc.) increase lift with an increase in angle of attack (up to the stall angle).";
explain[3]="Thickness ratio is a red herring. But you must learn the stall points for different types of wing platforms - they differ greatly.";
explain[4]="The down-going wing has an increased lift due to an increas in angle of attack (due to the up flow of air). This opposes the roll which is a stabilizing effect.";
explain[5]="A long slender wing (i.e. high Aspect Ratio) has a higher lift than a short stubby wing (low Aspect Ratio). A delta wing is about as low Aspect Ratio as you can get (about 1:1 for concord for example).";
explain[6]="The properties of a standard day are related to sea level at latitude 45 degrees with absolutely dry air.";
explain[7]="Pressure decreases - sure! But the rate of decrease reduces with altitude. At 18000 ft, half the pressure is lost already, and there is still another 40,000ft or so to go";
explain[8]="On most aircraft, the thrust-drag couple produces a nose up pitch moment (think of how low the thrust line is on a Boeing). It is balanced by the Centre of Lift being behind the CG. So to correct a nose up moment, what force do you need at the tail?";
explain[9]="Just one of those facts you have to learn - but it is quoted in just about every text book on the CAA reading list.";
explain[10]="Do not get cofused between stalling angle and stalling speed. In a turn the vertical component of lift is less, so to compensate the pilot must increase speed, but the stalling angle is a fixed quantity for any aerofoil, regardless of any other factor.";

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Number:-2.

1. If gauge pressure on a standard day at sea level is 25 PSI, the absolute pressure is
a) 10.3 PSI
b) 43.8 PSI
c) 39.7 PSI

2. The C of G moves in flight. The most likely cause of this is
a) movement of passengers
b) movement of the centre of pressure
c) consumption of fuel and oils

3. The C of P is the point where
a) all the forces on an aircraft act
b) the three axis of rotation meet
c) the lift can be said to act

4. The three axis of an aircraft act through the
a) C of G
b) C of P
c) stagnation point

5. Pressure decreases
a) proportionally with a decreases in temperature
b) inversely proportional to temperature
c) Pressure and temperature are not related

6. As air gets colder, the service ceiling of an aircraft
a) reduces
b) increases
c) remains the same

7. What is sea level pressure?
a) 1013.2 mb
b) 1012.3 mb
c) 1032.2 mb

8. When the weight of an aircraft increases, the minimum drag speed
a) decreases
b) increases
c) remains the same

9. An aircraft will have
a) less gliding distance if it has more payload
b) more gliding distance if it has more payload
c) the same gliding distance if it has more payload

10. When an aircraft experiences induced drag

a) air flows under the wing spanwise towards the tip and on top of the wing spanwise towards the root
b) air flows under the wing spanwise towards the root and on top of the wing spanwise towards the tip
c) Neither a) or b) since induced drag does not caused by spanwise flow

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ans[1] = "c";
ans[2] = "c";
ans[3] = "c";
ans[4] = "a";
ans[5] = "b";
ans[6] = "b";
ans[7] = "a";
ans[8] = "b";
ans[9] = "c";
ans[10] = "a";

explain[1]="Absolute pressure = gauge pressure plus atmospheric pressure. Atmospheric pressure at seal level = 14.7 PSI.";
explain[2]="Unless the fuel tank is right on the aircraft Cof G, the consumption of fuel will always cause a shift in Cof G.";
explain[3]="Just a definition";
explain[4]="Another definition!";
explain[5]="As temperature decreases, pressure increases - therefore they are inversely proportional.";
explain[6]="As air gets colder it gets denser. Lift increases (remember the lift equation has density) and the engines produce more thrust - so it can climb higher.";
explain[7]="Learn the ISA sea level quantities, in all units.";
explain[8]="Sketch the drag - speed curve, with induced, profile and total drag. As aircraft weight increases, it must produce more lift to support it. More lift = more induced drag. Now sketch the induced drag curve higher, and see where the intersection with profile drag moves to.";
explain[9]="This may surprise you. A glider converts potential energy (ie height) into kinetic energy (ie speed) and thus lift. More weight = more speed = more lift. The glide angles of a heavy glider is exactly the same as a light glider. (But the increased speed means it covers the distance faster).";
explain[10]="The high pressure under the wing flows around the tip to the low pressure on top of the wing. The resulting vortex is what causes induced drag. Since air is viscous it drags the air underneath the wing towards the tip, and pushes the air on top of the wing towards the root.";

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Exam Number:-3.

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1. At stall, the wingtip stagnation point
a) moves toward the lower surface of the wing
b) moves toward the upper surface of the wing
c) doesn't move

2. How does IAS at the point of stall vary with height?
a) It is practically constant
b) It increases
c) It decreases

3. The rigging angle of incidence of an elevator is
a) the angle between the mean chord line and the horizontal in the rigging position
b) the angle between the bottom surface of the elevator and the horizontal in the rigging position
c) the angle between the bottom surface of the elevator and the longitudinal datum

4. What is the lapse rate with regard to temperature?
a) 1.98oC per 1000 ft
b) 1.98oF per 1000 ft
c) 4oC per 1000 ft

5. What happens to load factor as you decrease turn radius?
a) It increases
b) It decreases
c) It remains constant

6. If you steepen the angle of a banked turn without increasing airspeed or angle of attack, what will the aircraft do?
a) It will remain at the same height
b) It will sideslip with attendant loss of height
c) It will stall

7. An aircraft wing tends to stall first at
a) the tip due to a higher ratio thickness/chord
b) the tip due to a lower ratio thickness/chord
c) the root due to a higher ratio thickness/chord

8. Dihedral wings combat instability in
a) pitch
b) yaw
c) sideslip

9. To stop aircraft decreasing in height during a sideslip, the pilot can
a) advance the throttle
b) pull back on the control column
c) adjust the rudder position

10. What control surface movements will make an aircraft fitted with ruddervators yaw to the left?

a) Left ruddervator lowered, right ruddervator raised
b) Right ruddervator lowered, left ruddervator raised
c) Both ruddervators raised

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ans[1] = "a";
ans[2] = "a";
ans[3] = "a";
ans[4] = "a";
ans[5] = "b";
ans[6] = "b";
ans[7] = "c";
ans[8] = "c";
ans[9] = "a";
ans[10] = "a";

explain[1]="At stall the angle of attack is high (all along the wing) is positioned towards the lower surface of the wing..";
explain[2]="The true airspeed at which an aircraft stalls increases with height due to a drop in density. However the Indicated Airspeed decreases with height due to the same drop in density. Therefore there is practically no change in stall speed with height..";
explain[3]="The angle of incidence of any surface is measured from the mean chord line.";
explain[4]="The lapse rate is approximately 2 degrees Centigrate per 1000 feet.";
explain[5]="Since the load factor increases in a turn, if you decrease the turn rate the load factor decreases.";
explain[6]="Increasing the angle of a banked turn without increasing the airspeed or angle of attack, the aircraft will sideslip and lose height.";
explain[7]="The boundary layer separates at a lower angle of attack with a higher thickness/chord atio. Therefore it will stall first at the root..";
explain[8]="As the aircraft sideslips, there is a greater angle of attack on the lower wing which increases lift, straightens the aircraft and stops the sideslip.";
explain[9]="During a turn, extra speed is required to stop the aircraft sideslipping and decreasing in height.";
explain[10]="To make the aircraft yaw to the left, the left ruddervator is lowered, the right ruddervator is raised.";

Exam Number:-4.

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1. When a leading edge slat opens, there is a gap between the slat and the wing. This is
a) to allow it to retract back into the wing
b) to allow air through to re-energize the boundary layer on top of the wing
c) to keep the area of the wing the same

2. Which of the following is true?
a) Lift acts at right angles to the wing chord line and weight acts vertically down
b) Lift acts at right angles to the relative airflow and weight acts vertically down
c) Lift acts at right angles to the relative air flow and weight acts at right angles to the aircraft centre line

3. If the wing tips stall before the root on a swept wing aircraft, the aircraft will
a) roll
b) pitch nose up

c) pitch nose down

4. Lift on a delta wing aircraft
a) increases with an increased angle of incidence (angle of attack)
b) decreases with an increase in angle of incidence (angle of attack)
c) does not change with a change in angle of incidence (angle of attack)

5. On a straight wing aircraft, stall commences at the
a) root on a high thickness ratio wing
b) tip on a high thickness ratio wing
c) tip on a low thickness ratio wing

6. On a high wing aircraft in a turn
a) the up-going wing loses lift causing a de-stabilizing effect
b) the down-going wing gains lift causing a stabilizing effect
c) the down-going wing loses lift causing a de-stabilizing effect

7. For the same angle of attack, the lift on a delta wing
a) is greater than the lift on a high aspect ratio wing
b) is lower than the lift on a high aspect ratio wing
c) is the same as the lift on a high aspect ratio wing

8. The ISA
a) is taken from the equator
b) is taken from 45 degrees latitude
c) assumes a standard day

9. As altitude increases, pressure
a) decreases at constant rate
b) increases exponentially
c) decreases exponentially

10. The thrust-drag couple overcomes the lift-weight couple. What direction of force is required to be produced by the tail of the aircraft to maintain straight and level flight?
a) Upwards
b) Downwards
c) Sideways
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ans[1] = "b";
ans[2] = "b";
ans[3] = "b";
ans[4] = "a";
ans[5] = "a";
ans[6] = "b";
ans[7] = "b";
ans[8] = "b";
ans[9] = "c";
ans[10] = "a";


explain[1]="The gap between the wing and the slat is to allow air from the lower surface through to the upper surface to re-nergise it at high angles of attack.";
explain[2]="Lift acts at right angles to the relative airflow and weight acts vertically down.";
explain[3]="If the tips of a swept wing aircraft stall, the lift still acting at the roots, will pull the aircraft up..";
explain[4]="Lift (on any type of wing) increases with an increased angle of attack.";
explain[5]="Stall commences on a straight wing at the root (on any thickness ratio wing).";
explain[6]="The down going wing gains lift due to the uplflow, which stops the aircraft banking.  This is the basic mechanism of dynamic stability.";
explain[7]="For the same angle of attack, the lift on a delta wing is lower than the lift on a delta wing.";
explain[8]="The ISA is taken from 45 degrees latitude as an average of the World's atmospheric data.";
explain[9]="As altitude increases, pressure decreases exponentially.  Since pressure is given by density x gravity x height, both density and height decreases (that is, height above the point you are measuring) so the decrease in pressure is exponential";
explain[10]="Since the thrust-drag couple is usually a nose-up couple (on low engined aircraft) then if the thrust-drag couple overcomes the lift weight couple, the aircraft will pitch nose-up.  The tail of the aircraft would have to produce an upward force to counteract this..";

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Exam Number:-5.

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1. When the pressure is half of that at sea level, what is the altitude?
a) 12,000 ft
b) 8,000 ft
c) 18,000 ft

2. During a turn, the stalling angle
a) increases
b) decreases
c) remains the same

3. The vertical fin of a single engined aircraft is
a) parallel with both the longitudinal axis and vertical axis
b) parallel with the longitudinal axis but not the vertical axis
c) parallel with the vertical axis but not the longitudinal axis

4. Aircraft flying in the transonic range most often utilize
a) sweptback wings
b) advanced supercritical airfoils
c) high wings

5. Which type of flap changes the area of the wing?
a) Fowler
b) Split
c) Slotted

6. Forward swept wings tend to stall at the root first so the aircraft retains lateral control, so why are they never used on passenger aircraft?
a) Because the wing tips wash in at high wing loads
b) Because the wing tips wash out at high wing loads
c) Because at high loads their angle of incidence increases and the loads imposed on the wing can increase until they destroy it

7. What happens to air flowing at the speed of sound when it enters a converging duct?
a) Velocity decreases, pressure and density increase
b) Velocity increases, pressure and density decreases
c) Velocity, pressure and density increase

8. As the angle of attack of an airfoil increases the centre of pressure
a) moves forward
b) moves aft
c) remains stationary

9. An aircraft, which is longitudinally stable, will tend to return to level flight after a movement about which axis?
a) Pitch
b) Roll

c) Yaw

10. Vapour trails from the wingtips of an aircraft in flight are caused by
a) low pressure above the wing and high pressure below the wing causing vortices
b) high pressure above the wing and low pressure below the wing causing vortices
c) low pressure above the wing and high pressure below the wing causing a temperature rise

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ans[1] = "c";
ans[2] = "c";
ans[3] = "a";
ans[4] = "a";
ans[5] = "a";
ans[6] = "c";
ans[7] = "c";
ans[8] = "a";
ans[9] = "a";
ans[10] = "a";


explain[1]="At 18000 feet the pressure is half of that at sea level.";
explain[2]="During a turn the stalling angle does not change.  The stalling angle never changes providing the wing section shape (CL) does not change.  Do not get confused with stalling SPEED which increases as turn rate increases.";
explain[3]="The vertical fin is parallel with the longitudinal axis (when viewed from above) and parallel with the vertical axis (when viewed from the front).";
explain[4]="Aircraft which fly in the transonic range most often use swept back wings.";
explain[5]="The fowler flap changes the area of the wing because it slides backwards as well as downwards.";
explain[6]="Forward swept wings are known as 'structurally divergent'.  This means when they flex upwards, they present more of their underside to the airflow which causes them to flex up even more - untill they break off.";
explain[7]="Air at the speed of sound will increase in velocity and due to the compressibility effect, will increase in pressure and density also.";
explain[8]="As the angle of attack of the aerofoil increases, the centre of pressure moves forward.";
explain[9]="Longitudinal stability is around the pitch axis.";
explain[10]="Vapour trails are caused by wing tip vortices which are caused by low pressure above the wing and high pressure below the wing.";
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Exam Number:-6.

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1. Vortex generators on the wing are most effective at
a) high speed
b) low speed
c) high angles of attack

2. The chord line of a wing is a line that runs from
a) the centre of the leading edge of the wing to the trailing edge
b) half way between the upper and lower surface of the wing
c) one wing tip to the other wing tip

3. The angle of incidence of a wing is an angle formed by lines
a) parallel to the chord line and longitudinal axis
b) parallel to the chord line and the lateral axis
c) parallel to the chord line and the vertical axis

4. The centre of pressure of an aerofoil is located
a) 30 - 40% of the chord line back from the leading edge
b) 30 - 40% of the chord line forward of the leading edge
c) 50% of the chord line back from the leading edge

5. Compressibility effect is
a) drag associated with the form of an aircraft
b) drag associated with the friction of the air over the surface of the aircraft
c) the increase in total drag of an airfoil in transonic flight due to the formation of shock waves

6. Lateral control of an aircraft at high angle of attack can be maximised by using
a) fences
b) vortex generators
c) wing slots

7. Stall strips are always
a) made of metal
b) on the leading edge of a wing
c) fitted forward of the ailerons

8. Stall strips
a) cause the wing root to stall
b) cause the wing tip to stall
c) cause the wings to stall symmetrically

9. Due to the interference of the airflow on a high wing aircraft between the fuselage and the wings, the lateral stability of the aircraft in a gusty wind situation will cause
a) the upper wing to increase its lift
b) the upper wing to decrease its lift
c) the lower wing to decrease its lift

10. Slats

a) reduce the stall speed

b) reduce the tendency of the aircraft to Yaw

c) decrease the aerofoil drag at high speeds

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ans[1] = "c";
ans[2] = "a";
ans[3] = "a";
ans[4] = "a";
ans[5] = "c";
ans[6] = "b";
ans[7] = "b";
ans[8] = "a";
ans[9] = "b";
ans[10] = "a";

explain[1]="Vortex generators on the wing are designed to re-energise the boundary layer at high angles of attack and help prevent separation of the airflow";
explain[2]="The chord line is a STRAIGHT line which goes from the leading edge of the wing to the trailing edge of the wing.";
explain[3]="The angle of incidence is the angle between the chord line and the longitudinal axis.";
explain[4]="The centre of pressure is positioned roughly 30 - 40 % of the chord line BACK from the leading edge.";
explain[5]="Compressibility effect is associated with an increase in drag during the transonic flight stage.";
explain[6]="At high angles of attack, the airflow over the ailerons can be separated from the surface. Vortex generators, positioned just forward of the ailerons, are designed to re-energise the boundary layer and help to prevent this separation. This makes the ailerons more effective at high angles of attack.";
explain[7]="Stall strips are fitted at the leading edge of the wing to ensure that the root of the wing stalls before the tips.";
explain[8]="Stall strips are fitted at the leading edge of the wing to ensure that the root of the wing stalls before the tips.";
explain[9]="In a gust, the aircraft may be forced to roll and sideslip away from the gust. In such a slideslip, the fuselage shields the upper wing from some of the airflow. This reduces the lift on the upper wing which drops and opposes the gust.";
explain[10]="Slats are designed to increase the lift at low speed, and hence decrease the stall speed.";

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Exam Number:-7.

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1. What is the temperature lapse rate for aircraft flying below 36,000 feet altitude?

a) 1°C per 1000 feet
b) 3°C per 1000 feet
c) 2°C per 1000 feet

2. For a pressure of 25lbs/in² at sea level, what is the absolute pressure?
a) 39.7 lbs/in²
b) 49.7 lbs/in²
c) 10.3 lbs/in

3. An aircraft banks into a turn. No change is made to the airspeed or angle of attack. What will happen?
a) The aircraft enters a side slip and begins to lose altitude
b) The aircraft turns with no loss of height
c) The aircraft yaws and slows down

4. The relationship between induced drag and airspeed is
a) directly proportional to the square of the speed
b) inversely proportional to the square of the speed
c) directly proportional to speed

5. What is the definition of Angle of Incidence?
a) The angle the underside of the mainplane or tailplane makes with the horizontal
b) The angle the underside of the mainplane or tailplane makes with the longitudinal datum line
c) The angle the chord of the mainplane or tailplane makes with the horizontal

6. What is Boundary Layer?
a) Separated layer of air forming a boundary at the leading edge
b) Turbulent air moving from the leading edge to trailing edge
c) Sluggish low energy air that sticks to the wing surface and gradually gets faster until it joins the free stream flow of air

7. The normal axis of an aircraft passes through
a) the centre of gravity
b) a point at the center of the wings
c) at the centre of pressure

8. On a high winged aircraft, what effect will the fuselage have on the up-going wing?
a) The up-going wing will have a decrease in angle of attack and therefore a decrease in lift
b) The down-going will have a decrease in angle of attack and therefore a decrease in lift
c) The up-going wing will have an increase in angle of attack and therefore a decrease in lift

9. What is the collective term for the fin and rudder and other surfaces aft of the centre of gravity that helps directional stability?
a) Effective keel surface
b) Empennage

c) Fuselage surfaces

10. Temperature above 36,000 feet will
a) decrease exponentially
b) remain constant
c) increase exponentially
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ans[1] = "c";
ans[2] = "a";
ans[3] = "a";
ans[4] = "b";
ans[5] = "c";
ans[6] = "c";
ans[7] = "a";
ans[8] = "a";
ans[9] = "a";
ans[10] = "b";

explain[1]="Temperature lapse rate up to 36,000 feet (the tropopause) is approximately 2 degress centigrade per 1000 feet. Above the tropopause it is constant.";
explain[2]="Absolute pressure = gauge pressure + atmospheric pressure. Atmospheric pressure = 14.7 psi.";
explain[3]="When an aircraft banks and turns, some of the lift vector is used to turn the aircraft, therefore the aircraft will lose altitude.";
explain[4]="Induced drag decreases proportionally with the square of the speed.";
explain[5]="Angle of incidence is the 'wing setting angle'. That is the angle of the chord of the mainplane or tailplane with the horizontal - or aircraft centre line when in the rigging position.";
explain[6]="The boundary layer is the layer of air immediately in contact with the aircraft skin which is slowed down by the skin friction.";
explain[7]="All the axis of the aircraft (normal, longitudinal and lateral) pass through the centre of gravity.";
explain[8]="The up-going wing of an aircraft in a turn or bank has a down-flow of air due to its movement. It therefore has a decrease in angle of attack and a decrease in lift. This is the basic mechanism of dynamic stability.";
explain[9]="All the side surfaces aft of the centre of gravity which aid the directional stability are collectively called the EFFECTIVE KEEL SURFACE.";
explain[10]="Temperature lapse rate up to 36,000 feet (the tropopause) is approximately 2 degress centigrade per 1000 feet. Above the tropopause it is constant.";

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Exam Number:-8.
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1. A decrease in incidence toward the wing tip may be provided to

a) prevent adverse yaw in a turn
b) prevent spanwise flow in maneuvers
c) retain lateral control effectiveness at high angles of attack

2. The angle of attack which gives the best L/D ratio

a) decreases with a decrease in density
b) in unaffected by density changes
c) increases with a decrease in density

3. For a given aerofoil production lift, where
P = pressure and V = velocity:

a) P1 is greater than P2, and V1 is greater than V2
b) P1 is less than P2 and V1 is greater than V2
c) P1 is greater than P2, and V1 is less than V2

4. Low wing loading

a) increases stalling speed, landing speed and landing run
b) increases lift, stalling speed and maneuverability
c) decreases stalling speed, landing speed and landing run

5. Due to the change in downwash on an untapered wing (i.e. one of constant chord length) it will

a) not provide any damping effect when rolling
b) tend to stall first at the root
c) not suffer adverse yaw effects when turning

6. True stalling speed of an aircraft increases with altitude
a) because reduced temperature causes compressibility effect
b) because air density is reduced
c) because humidity is increased and this increases drag

7. As a general rule, if the aerodynamic angle of incidence (angle of attack) of an aerofoil is slightly increased, the centre of pressure will

a) never move
b) move forward towards the leading edge
c) move towards the tip

8. The "wing setting angle" is commonly known as
a) angle of incidence
b) angle of attack
c) angle of dihedral

9. On a very humid day, an aircraft taking off would require
a) a shorter take off run
b) a longer take off run
c) humidity does not affect the take off run

10. An aircraft is flying at 350 MPH, into a head wind of 75 MPH, what will its ground speed be?

a) 175 mph

b) 275 mph
c) 200 mph
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ans[1] = "c";
ans[2] = "b";
ans[3] = "c";
ans[4] = "c";
ans[5] = "b";
ans[6] = "b";
ans[7] = "b";
ans[8] = "a";
ans[9] = "b";
ans[10] = "b";

explain[1]="A decrease in incidence towards the wingtip (known as washout) causes the wing root to stall before the wing tip. So, even after the wing roots have stalled, the wing tips are still flying and full aileron control is provided.";
explain[2]="Since the lift formula both contain density, L/D is unaffected with a change in density.";
explain[3]="Bernoulli's principle applies.";
explain[4]="Wing loading is aircraft weight divided by wing area, therefore an aircraft with a low wing loading will require less landing speed, less landing run and have a decreased stalling speed.";
explain[5]="The change in downwash is referring to downwash which causes the root of the wing to stall before the tip.";
explain[6]="Since lift provided by the wing reduces with density, the stalling speed increases with altitude due to the decrease in altitude with density.";
explain[7]="As the angle of attack increases the centre of pressure moves towards the leading edge.";
explain[8]="The wing setting angle is commonly known as the 'angle of incidence'.";
explain[9]="Since water vapour wighs less than dry air, and it displaces dry air, the density on a humid day is less, and an aircraft requires a longer take-off run.";
explain[10]="Ground speed = IAS minus headwind.";

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Exam Number:-9.

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1. When does the angle of incidence change?

a) When the aircraft attitude changes
b) When the aircraft is ascending or descending
c) It never changes

2. As the angle of attack decreases, what happens to the centre of pressure?

a) It moves forward
b) It moves rearwards
c) Centre of pressure is not affected by angle of attack decrease

3. A decrease in pressure over the upper surface of a wing or aerofoil is responsible for

a) approximately 2/3 (two thirds) of the lift obtained
b) approximately 1/3 (one third) of the lift obtained
c) approximately 1/2 (one half) of the lift obtained

4. Which of the four forces act on an aircraft?

a) Lift, gravity, thrust and drag
b) Weight, gravity, thrust and drag
c) Lift, weight, gravity and drag

5. Which of the following types of drag increases as the aircraft gains altitude?

a) Parasite drag
b) Induced drag
c) Interference drag

6. Correcting for a disturbance which has caused a rolling motion about the longitudinal axis would re-establish which of the following?

a) Lateral stability
b) Directional stability
c) Longitudinal stability

7. The layer of air over the surface of an aerofoil which is slower moving, in relation to the rest of the airflow, is known as
a) camber layer
b) boundary layer
c) none of the above

8. What is a controlling factor of turbulence and skin friction?
a) Aspect ratio
b) Fineness ratio

c) Counter sunk rivets used on skin exterior

9. Changes in aircraft weight

a) will not affect total drag since it is dependant only upon speed

b) cause corresponding changes in total drag due to the associated lift change

c) will only affect total drag if the lift is kept constant

10. The aircraft stalling speed will

a) increase with an increase in weight

b) be unaffected by aircraft weight changes since it is dependant upon the angle of attack

c) only change if the MTMA were changed

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ans[1] = "c";
ans[2] = "b";
ans[3] = "a";
ans[4] = "a";
ans[5] = "b";
ans[6] = "a";
ans[7] = "b";
ans[8] = "c";
ans[9] = "b";
ans[10] = "a";
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explain[1]="The angle of incidence is the angle at which the wing is 'set' into the fuselage. It never changes.";
explain[2]="The centre of pressure moves FORWARDS with an INCREASE in angle of attack. Therefore it moves REARWARDS with a DECREASE in angle of attack.";
explain[3]="Look at a diagram of the lift distributions on the top and bottom surfaces of a wing. 2/3rds of the lift is provided by the top surface.";
explain[4]="The four forces on an aircaft are lift, weight (gravity), thrust and drag.";
explain[5]="As density decreases with altitude, the lift must be compensated by increasing speed. Induced drag increases with the square of the speed, therefore induced drag increases with altitude.";
explain[6]="The aircraft's response to rolling is lateral stability.";
explain[7]="The boundary is the layer of air in immediate contact with the skin of the aircraft which is slowed down by skin friction.";
explain[8]="Countersunk rivets reduce skin friction and turbulence.";
explain[9]="A change in aircraft weight will require a change in lift. Increasing aircraft lift increases aircraft drag (lift dependant drag). Total drag is induced drag plus parasite drag.";
explain[10]="With an increase in aircraft weight, the aircraft must fly with a greater angle of attack. Therefore it will stall at a higher speed.";
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Exam Number:-10.

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1. In a bank and turn

a) extra lift is not required
b) extra lift is not required if thrust is increased
c) extra lift is required

2. To maintain straight and level flight on the aeroplane shown, with a decrease in tail-plane download the mainplane lift would have to

a) remain constant
b) decrease
c) increase

3. To achieve the maximum distance in a glide, the recommended air speed is

a) as close to the stall as practical
b) as high as possible with VNE
c) the speed where the L/D ratio is maximum

4. If the C of G is aft of the Centre of Pressure

a) changes in lift produce a pitching moment which acts to increase the change in lift
b) when the aircraft sideslips, the C of G causes the nose to turn into the sideslip thus applying a restoring moment
c) when the aircraft yaws the aerodynamic forces acting forward of the Centre of Pressure

5. Porpoising is an oscillatory motion in the

a) pitch plane
b) roll plane
c) yaw plane

6. Directional stability is maintained

a) by the mainplanes, and controlled by the ailerons
b) by the tailplane, and controlled by the elevators
c) by the keel surface and fin, and controlled by the rudder

7. Due to the interference effects of the fuselage, when a high wing aeroplane sideslips

a) the accompanying rolling due to keel surface area is destabilizing
b) the accompanying lift changes on the wings produces a stabilizing effect
c) the accompanying rolling due to the fin is destabilizing

8. The power required in a horizontal turn
a) is greater than that for level flight at the same airspeed

b) must be the same as that for level flight at the same airspeed
c) is less than that for level flight at the same airspeed

9. A wing mounted stall sensing device is located
a) usually on the under surface
b) always at the wing tip
c) always on the top surface

10. For an aircraft in a glide
a) thrust, drag, lift and weight act on the aircraft
b) weight, lift and drag act on the aircraft
c) weight and drag only act on the aircraft

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ans[1] = "c";
ans[2] = "b";
ans[3] = "c";
ans[4] = "a";
ans[5] = "a";
ans[6] = "c";
ans[7] = "b";
ans[8] = "a";
ans[9] = "a";
ans[10] = "b";

explain[1]="In a bank and turn, extra lift is required and this is usually provided by increasing the thrust.";
explain[2]="Total lift is mainplane lift minus tailplane download. If the tailplane download decreases, the total lift increases. Therefore to maintain straight and level flight the mainplane lift would have to decrease.";
explain[3]="The most efficient angle of attack is when the L/D ratio is a maximum. This is usually around 4 degrees.";
explain[4]="If the C of G is aft of the centre of pressure, an increase in lift will pitch the aircraft nose-up, which will increase the lift even further etc. etc.";
explain[5]="Porpoising is an oscillatory motion in the pitch plane.";
explain[6]="Directional stability is maintained by the keel surface and the fin and controlled by the rudder.";
explain[7]="When a high wing aircraft sideslips, the upper wing is shielded from some of the airflow by the fuselage. The upper wing's lift reduces, it drops and the aircraft opposes the sideslip.";
explain[8]="Since some of the lift vector is used to turn the aircraft, there will be a tendancy to reduce height. To maintain height, power must be increased to compensate.";
explain[9]="A wing mounted stall sensing device is mounted just underneath the wing leading edge.";
explain[10]="For an aircraft in a glide, weight lift and drag act. The weight produces the forward motion.";

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