RYANAIR TECHNICAL QUESTIONS

B737-800/8200

How many seats are on a 737-800? 189 seats, 8200: 197 seats

What type of engines are on a 737-800? The 737-800 has a high-bypass turbofan engine called the CFM56-7B. (27,300 pounds of thrust)
8200: CFM-LEAP-1B

28000

How many flight attendants are there on a 737-800? There are 4 flight attendants, 1 for every 50 passengers.

texto

Pressurisation of the cabin in cruise on a 737-800? Normally around 6000-8000ft, (between 11-12 psi).

8000 FT 9.1 PSI MAX

What is the optimum cruising altitude on a 737-800? The optimum cruising altitude is not a fixed figure and depends on many factors for example weight, atmospheric conditions (density, temperature, wind), the optimum altitude is the altitude for the best possible fuel efficiency in cruise (fuel miles, distance covered against a specific amount of fuel), found on the FMC or performance sheets.

What are winglets and what advantages do they give on a 737-800? (8" tall, also a source of advertisement)
• Winglets lower drag and improve aerodynamic efficiency, thus reducing fuel burn, winglets can improve cruise mileage up to 6%.
• Winglets on the 737-800 have demonstrated drag reduction in the 5-7% range, which increases range and fuel efficiency.
• Winglets were proven to be environmental friendly, winglets help lower NOx emissions by 5%. (nitrogen oxide)
• Winglets offer better climb performance which also lowers thrust settings, thus extending engine life and reducing maintenance costs, on the take-off, winglets allow up to 3% incremental de-rate and also allow a steeper climb improving take-off/climb performance especially from obstacle limited, high, hot, weight limited and noise restricted airports, in the cruise thrust levels are reduced by up to 4%.
• Winglets increase the lift generated at the wingtip and reduce the lift induced drag caused by wingtip vortices. (recovery of the wingtip vortices).

What is the fuel capacity of a 737-800? 20,000 kgs, 26000 litres

What is the range of a 737-800? 3000nm, 8200: 3700nm

What is the FMA? Where is it location? Explain the modes?
• The FMA is a flight mode annunciator which indicates what system is controlling the aircraft and what mode is operational.

• The FMA is located on the top of the captain and first officers PFD (primary flight display)
• The FMA is divided into 3 columns and 2 rows, the left column relates to the A/T (auto-throttle), while the centre and right-hand column display roll and pitch modes. The upper row indicates modes are that operational (green), and the lower row indicates modes that are armed (white).

Icing protection and systems on a 737-800?

• Windshield heat – electrically heated, prevents ice building up, also offers protection from bird strikes and hail as the windshield becomes pliable, whereas a cold window is brittle. (speed restriction of 250kts below 10,000ft)

• Wing Anti-ice – the wing anti-ice system provides protection for the three inboard leading- edge slats by using bleed air.

• Engine Anti-Ice – the engine anti-ice heats the engine cowl to prevent ice build-up, which could break off and enter the engine. The 737-800 have an elliptical cone shaped spinner which also prevents ice build-up and deflects ice away, the engine anti-icing uses bleed air, uses 5th and 9th stage compressor.

• Ice detection – an advisory only ice detection system detects airplane icing in flight. The system consists of a probe on the forward left fuselage, when the system detects ice build- up, the ICING light illuminates.

• Probe and sensor heat – Pitot probes, total air temperature probes and the alpha vanes are electrically heated, the static ports are not heated.

Can the 737-800 fly in icing conditions? The 737-800 can be dispatched into light and moderate conditions if the PIC and the dispatcher thinks it's safe, but not into severe.

Emergency exits available to pilots? #2 window on each side, there is also an escape rope.

Max Mach number on a 737-800? Mach 0.82

What is the cruise speed of a 737-800? MNO 0.78 – 0.80

What is VNE and what limits it? Never exceed speed, Transport category planes uses VMO and MMO, 737-800 VMO is 340 IAS it's limited by structural limit.

Max ceiling of a 737-800? 41,000ft Absolute ceiling.

MTOW of a 737-800? 78000kg / 172,475 lbs

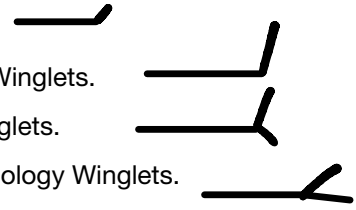
How many exits on a 737-800? 8 exits.

Which direction does the fan blades rotate on a 737-800? Both engines rotate clockwise.

What is the ratio? The ratio is how much air goes around the engine to how much goes into the core.

B737 winglets?

- 737-200 Mini-Winglets.
- 737 Classic/NG Blended Winglets.
- 737 NG Split Scimitar Winglets.
- 737 MAX Advanced Technology Winglets.



What is cost index?

-It's the ratio of the aircraft operating cost to fuel cost
-You get the number from the flight plan and write it into the FMC
-It give the speeds for climbs, cruise, descent and it gives optimum altitude
-High cost index —> fly fast to stay less in air
-B737NG —> 0 - 500 CI

What is optimum altitude?

-Altitude which results in the minimum total trip cost (time/fuel) —> does not depend on fuel burn only
-Calculated by FMC, doesn't count the wind
-It increases during the flight as weight decreases

It is defined as being the pressure altitude which provides the greatest specific range or fuel mileage at a given weight and speed.

Does the 737-800 have a critical engine? There is no critical engine on a jet engine, in strong crosswind the upwind engine may act as a critical engine, this is because there is hardly any p factor and the engines are symmetrical plus torque effects on the airframe are not as apparent as in a propeller aircraft.

COMPRESSORS ARE LOCATED W A CONVERGENT DUCT ↓ ANNULUS

How does the CFM56-7B engine on the 737-800 work? The air races through the fan that acts like a huge propeller accelerating the air which is separated, so only 20% of the air goes into the engine and 80% of the air is bypassed creating huge thrust. (due to its enormous volume, the air only needs to be accelerate through the bypass duct in order to create thrust) This is the bypass ratio and is about 5:1, 20% of the air that enters the engine goes first to the low-pressure compressor that compresses the air so the pressure and temperature rises, then it enters the high-pressure compressor that rotates faster causing the pressure and temperature (450 degrees Celsius) to rise even further. (this is in a convergent duct causing the velocity to rise, venturi effect), It then enters a diffuser to lower its velocity, then the air is mixed with fuel and then ignited in the combustor (1700 degrees Celsius) increasing the energy level (more pressure = more energy when heated). The hot air then spins the high-pressure turbines that are connected via shaft to the high-pressure compressors, known as the high spool. Then the air passes through the larger low-pressure turbine that powers the low-pressure compressor, the last turbine powers the fan, finally the combusted air races down through the exhaust nozzle at the back to be accelerated one more time producing 20% of thrust, the remaining 80% being created by accelerated bypass air.
In basic English: A turbine fan is therefore a flow cycle engine, air is compressed then heated by burning fuel, after which it passes through the turbines which drive the compressors and the fan.

Differences between the 737-800 and the MAX?
• New CFM-LEAP-1B Engines which are bigger than the CFM56-7B engines (diameter is bigger by 8 inches), this gives a 9:1 bypass ratio versus 5:1, the maximum thrust is 29,300lbs versus the older engine's 27,300lbs.
• This version is quieter thanks to its new engines, it is also 12% more fuel efficient and 7% reduction in operating costs.
• Fly-by-wire spoiler system – improves stopping distances and reduces weights.
• Reshaped tail cone – reduces drag giving 1% less in fuel burn.
• The cockpit of the 737 MAX is a lot more refined and uncluttered, it has the latest avionics and four large 15-inch LCD screens.
• New electronic bleed air system – increased optimisation of the cabin pressure and ice protection systems, giving better fuel burn. (the electric controller allows the aircraft to tune in the amount of air that is needed rather than the all or nothing system.

MCAS ↓ AUTOMATIC TRIM THAT WANTS TO GIVE TO PILOTS THE FEELING OF FLYING A 800

• The thrust line has changed because the engines had to be moved forward and up to accommodate the larger fan diameter. Any handling differences as a result of this have been tuned out by Boeing in the flight control system to make the types feel the same to flight crew. (necessary to keep certification under the same type certificate) (nose gear strut lengthened by 8 inches to give more engine ground clearance)
• The standard wingtips of the MAX are ADVANCED TECHNOLOGY (currently optional on the 737- 800), the lower split-scimitar winglet aerofoil generates a vertical lift component that is vectored away from the fuselage and also slightly forward increasing the efficiency of the wing. (reducing fuel costs)
• Also, the 737 MAX has 197 seats compared to the 737-800 which only has 189, 10 emergency exits was added, toilets moved back, galley spaces lowered and the seats are slimmer.

Electrical system of a 737-800?
• Primary electrical power is provided by two engine integrated drive generators (IDGS) which are rated at 90 KVA (kilo-volt amps) and supply three-phase, 115-volt, 400 cycle (Hz) alternating current.
• The battery is a 36 ampere-hour, 24-volt, nickel-cadmium battery and should provide around 30 minutes standby power if all other generators fail.
• Auxiliary Battery – This is a reserve battery on the 737NG which is normally isolated unless the main battery is powering the standby system, the auxiliary battery combined with the main battery can provide 60 minutes of standby power.

What is the sweep angle of a 737-800, why this value and not another? The sweep angle of a 737- 800 is 25 degrees.

-Sweep angle is a value calculated on normal operating speed range of the aircraft.

-The 737 has much less sweep than its predecessors (25° compared to 35° on the 727) because speed was not considered important for a short range jet.

-A320 has angle of 25° also —> because they fly approx at the same speed

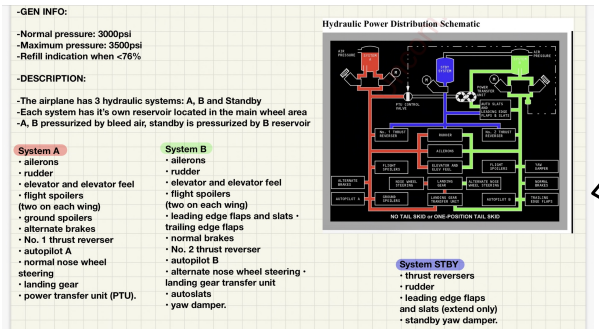
Do you know how many sectors we fly per day? 2-4 depending on length of journey.

Rejected take-off procedure on MCC?

- If a failure occurs before 80kts, we will stop for any malfunction.
- If a failure occurs after 80kts and before V1, we will only stop for a severe malfunction.
- If a failure occurs at and after v1, we will continue the date off and deal with the problem in the air.
- In the event of a failure before 80kts, either pilot can call "stop", after 80kts only the captain can call STOP or GO.
- For "stop", the captain will stop the aircraft by simultaneously applying maximum brake pressure, retard the thrust levers & disconnect the A/T, manually select speed brakes UP and apply maximum reverse thrust, when the aircraft has stopped, he will set the parking brake and call the cabin crew to their stations.
- The first officer will monitor the captain's RTO actions and call any omissions, call ATC to say that we are stopping. When the aircraft has stopped, select flaps to 40 degrees, select "MAN" on the pressurisation panel and open the outflow valve.

Hydraulic pressure for 737-800?

- Normal hydraulic pressure is 3000 psi
- Minimum hydraulic pressure is 2800 psi
- Maximum hydraulic pressure is 3500 psi
- Normal brake accumulator pre-charge is 1000psi



How are control surfaces operated on a 737-800? Primary flight controls linked mechanically to hydraulic power control units which command the primary flight control surfaces: ailerons, elevators and rudder, the flight controls are powered by system A and system B.

How many hydraulic systems does the 737-800 have? What do they operate?

Either A or B hydraulic system can power all flight controls with no decrease in airplane controllability. Both A and B hydraulic systems have an engine-driven pump and an AC electric motor-driven pump. (The system A engine-driven pump is powered by No.1 engine, and the system B engine-driven pump is powered by No.2 engine.)

The standby hydraulic system is provided as a backup if system A and/or B pressure is lost, the standby system uses a single electric motor-driven pump.

The power transfer unit can be used to supply the additional volume of hydraulic fluid needed to operate the auto-slats and leading-edge flaps and slats at a normal rate when system B engine- driven hydraulic pump volume is lost. (same for the landing gear transfer unit pump if system A engine-driven hydraulic pump volume is lost.)

2 x WING

4 x WING —> ONLY THE 3 INBOARD HAVE ANTI-ICE

What leading edge devices are on a 737-800? 4 Krueger flaps inboard of the engines, and 8 slats outside of the engines (the flaps and slats are high lift devices that increase wing lift and decrease stall speed during take-off, low speed manoeuvring and landing.)

What trailing edge devices are on a 737-800? The trailing edge devices consist of double slotted flaps inboard and outboard of each engine.

What do you know about 737-800?
Boeing 737 is a mid-size, short to medium range flights. The first 737-100 flew in 1967 and entered into service in 1968. In the 1980s Boeing launched the versions: -300 -400 -500, and in the 1990s launched the Next GeneraEon Boeing 737-700. Boeing 737-800 is also called Next GeneraEon, because is an evolution of the Boeing 737 Classic. It has new wings, with optional winglets, full efis cockpit and new interiors. The wing was redesigned with a new airfoil, greater chord, increased wing span and area of 25% that increases of the 30% the fuel capacity. The range is increased of 900 NM, now permitting transcontinental service. High MTOW, and a redesigned vertical stabilizer, and winglets were available on most models. The flight deck was upgraded with modern avionics, and passenger cabin improvements similar to those on the Boeing 777.

- ADD SOME INFO ABOUT HOW MANY OF THEM ARE OP AND WHO FLIES THEM

How is the landing gear operated in a 737 NG?
The B737 has two main gear and a nose gear. Each main gear is a two-wheel landing gear unit. The nose gear is a steerable two-wheel unit. Hydraulic power for retraction, extension, and nose wheel steering is normally supplied by hydraulic system A. A manual landing gear extensions system and an alternate source of hydraulic power for nose wheel steering is also provided. The normal brake system is powered by hydraulic system B. The alternate brake system is powered by hydraulic system A. Antiskid protection is provided on both brake systems, but auto brake system is available only with the normal brake system. The landing gear are controlled by the landing gear level.

What is wingspan on Boeing 737-800?
The wingspan is 35,79 meters. ≅ 36M

How much voltage does the engine produces? And how much hertz?
115V and 400 HZ.

What is the Hertz when the engine doesn't rotate fast?
SEII 400HZ.

What is the G limit of the 737-800:
With flaps up: +2.5G / -1.0G
With flaps : +2.0G / 0.0G

ELEVATORS MOVED MANUALLY, STABILIZER ELECTRICALLY (TRIM)

What kind of elevator system the 737 has?
The elevators in the 737 are hydraulically powered. The elevators need only one hydraulic system (A or B) to work. In the event of failure of both hydraulic system, ~~elevators~~ can be moved electrically. Elevator feel is created by a computer that with the input of the airspeed and the stabilizer position enable the computer to simulate the aerodynamic force. Also a Mach trim provides speed stability above Mach .615. The elevators are adjusted nose up in a programmed manner with respect to the stabilizer position. Engagement and disengagement is automatic.

Does the engine on the 737 rotate in the same direction?
Yes.

What navigation systems are on a 737-800? Compass, ADF, IRS, DME, VOR, GPS, INS/IRS

Electrical system of a 737-800?
• Primary electrical power is provided by two engine integrated drive generators (IDGS) which are rated at 90 KVA (kilo-volt amps) and supply three-phase, 115 volt, 400 cycle (Hz) alternating current.
• The battery is a 36 ampere-hour, 24-volt, nickel-cadmium battery and should provide around 30 minutes standby power if all other generators fail.

PRINCIPLES OF FLIGHT

SOMEWHERE IN THE A/C (USUALLY THE WING)

What is Mcrit?
Mcrit is the aircraft's speed at which the airflow over a wing becomes sonic. Characteristics: - Mach buffet because of the shock waves on the wing
- Increase of drag requiring a pull force
- Mach tuck
- A possible loss of control
-Mcrit does not equal Mach 1.0. Aircraft's Mach number

What is Mach Tuck?
Mach tuck is the nose down pitching moment that an aircraft experiences as it passes its critical Mach Number. Mach tuck is a form of longitudinal instability that occurs because of the center of pressure's rearward movement behind the center of gravity, which induces the aircraft to pitch down.

What is Mach Trimmer?
Mach trimmers is a system that artificially corrects for mach tuck above the aircraft's Mcrit by sensing the aircraft speed and signaling a proportional upward movement of the elevator or variable-incidence stabilizer

in order to maintain aircraft's pitch attitude throughout its speed range up to its maximum demonstrated diving speed (Vmdf).

Why does some aircraft have winglets?
Winglets are aerodynamically efficient surfaces located at the wing Eps. They are designated to reduce induced drag dispensing the airflow from the upper and lower surfaces of the wing on different points, thus preventing the intermixing of these airflows that otherwise would create induced drag vortices.
By making the wing more efficient, winglets reduce approach speeds as well, improving landing performance (i.e. due to lower touchdown speeds)

How would you load an aircraft to gain maximum range?
An AFT CG position will allow an aircraft to gain its maximum range. It could be done using the a8 cargo hold. In this case the stabilizer can be streamlined to the airfoils, producing no relevant drag. In addition, with an AFT CG position, it is increased aircraft's overall lift capabilities.

What is coffin corner?
Coffin corner occurs at an aircraft's absolute ceiling, where the speeds at which Mach number buffet and pre stall buffet occurs are coincident. Therefore, a margin is imposed between an aircraft's operating and absolute ceiling.
Stall speed =(circa) Max operating speed
Increase in speed —> overspeed
Decrease in speed —> stall

Describe the wing of a jet?
The wing of the jet is thin, minimal-chamber, swept wing.

- AERODYNAMIC WASHOUT: - CAMBER AND SHAPE CHANGE, CHORD ANGLE DOESN'T CHANGE
- GEOMETRIC WASHOUT: - CHORD LINE ANGLE CHANGES, CAMBER DOES NOT

What advantages/disadvantages are there with swept wings?
The advantages are:
High Mach cruise speed because the wing delays the airflow over the wing from going supersonic and allows the aircraft to maximize the jet engine's potential for higher Mach cruise speed. Also a swept wing is designated with a minimal chamber and thickness, thereby reducing profile drag, which further increases the wing's ability for higher speeds. Stability in turbulence, because the swept wing's produces less li8 and therefore is less responsive to up draughts.
The disadvantages are:
Poor lift qualities, because the design of the wing has the effect of reducing the lift capabilities of the wing. Higher stall speed, consequence of the poor lift qualities. Speed instability, second consequence of poor lift qualities at lower speeds. Speed is unstable below minimum drag speed , where power is required with reducing speed. Wing-tip stalling, because of the high local CL. This could be solved by a greater chamber on the tip section, or with the twisting (washout) which creates a lower angle of incidence at the wing tip.

Why does a wing stall?

An aircraft stalls when the laminar airflow over the wing's upper surface, which produces li8, breaks away from the surface when the critical angle of a[ack is exceeded, and becomes turbulent, causing a loss in li8. In a swept wing it stalls first at the Ep.

SWEPT WING

Where does a wing stall?

Wing stall at the tip first, the centre of pressure will move inward and forward thus creating a pitch up tendency.

Why do we have winglets on Boeing 737-800 and how much percentage do they improve your performance?

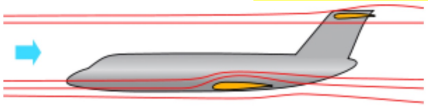
Because winglets reduce induced drag, increasing the range, increasing performances between 4 to 6 % percent.

If you get in a spin, what is best? A fwd/mid/aft CG?

Forward CG, because the further forward the center of gravity less readily the airplane will spin, and the more readily it will recover from the spin

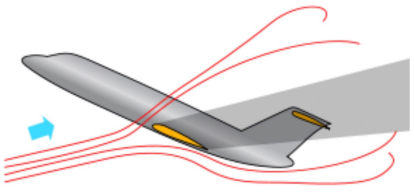
Advantage of a T-tail and disadvantages?

Advantages: a t-tail increases the elevator efficiency by giving a larger effective span. High elevator effectiveness is required for high li8 wings o8en mounted above the fuselage, thus the tail has to be out of the down wash. Disadvantages: in all t-tailed aircraft there is the possibility of deep stall, where the elevator/ stabilizer becomes stalled and the nose becomes impossible to push over, thus causing the plane to remain in a stalled condition, certain aircraft overcome this by fins or strakes on the fuselage.



-It's a requirement for fuselage mounted engines
-Makes the stabilizer free from turbolent flow from fuselage and wing—> more efficiency

→ DEEP STALL



What is the angle called between the body and the wing?

Dihedral.

-Wing dihedral has a disadvantage of increased fuel consumption

-This is because the vertical component of lift (which is what gets the aircraft off the ground and keeps it flying) is reduced due to the upward inclination of the wings (creates an horizontal component of lift as well, which is of no benefit)

-However, this increase in fuel consumption is usually negligible at small dihedral angles

Why some aircrafts doesn't need a dihedral?

Because the CG is located beneath the wing.

- ALREADY HAVE LATERAL STABILITY

Explain manouvering speed

This is the highest speed at which full flight controls deflection can be made without exceeding the limit load factor. Up to this speed, if the load factor is exceeded the aircraft will stall before sustaining any structural damage. Otherwise at speeds above Va high load factors could lead to a structural damage. Va varies with aircraft's weight.

What do spoilers do?

Spoilers consist of opening panels that extend from the upper surface of the wing and have the effect of spoiling/disturbing the airflow over the wing, creating drag that reduces li8. They can be used for roll control (spoilers are raised on one wing and not on the other, which creates an imbalance of li8 values that produce a rolling moment), as air speed brakes (they air raised symmetrically on both wings to a flight detent position which cause a large increase in drag that slows down the speed of the aircraft) and as ground li8 dumpers (they are raised symmetrically thus causing a large increase in drag decreasing li8 over the wing and causing the aircraft to sink on the ground).

What is Dutch roll?

Dutch roll is an oscillatory instability associated with swept-wing jet aircraft, a combination of yawing and rolling motions. It occurs when a yaw is induced either by a natural disturbance or by a commanded or an uncommanded yaw input on a swept wing aircraft. This cause the outer wing to run faster thus creating more li8 because of the increased angle of a[ack. At the same time, the inner wing will travel slower and become more swept relative to the airflow, reducing its li8. Therefore a marked bank occurs to the point where the outer upward moving wing exceeds its critical angle of a[ack, stalls and loses all li8. The wing will drop causing a yaw to the dropped wing and thus leading to the sequence being repeated in the opposite direction.

- HIGH LATERAL STABILITY
- LOW DIRECTIONAL STABILITY

What is a yaw damper?

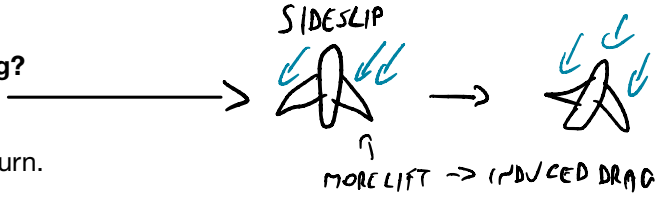
A yaw damper is a gyro system that is sensitive to changes in yaw, and it feeds a signal into the rudder, which applies opposite rudder to the yaw before the roll occurs thus preventing dutch roll.and eventually a roll.

Dihedral wings
Dihedral is the upward inclination of a wing from the root to the tip. The sideslip conditions produce greater angle of attack on the forward-yawed wing and smaller angle of a[ack on the rearward-yawed wing. As greater angle of attack produces more lift (in the usual case, when the wing is not near stalling), the forward wing will have more lift and the rearward wing will have less lift. This difference in lift between the wings is a rolling moment, and since it is caused by sideslip, it is dihedral effect (or more correctly, it is a contribution to the total dihedral effect of the aircraft).

Why does Dutch roll happen? In a jet aircraft with swept wings, when the aircraft yaws, the wing moving somewhat "forward" becomes subject to extra lift, raising that wing, and the consequence is extra drag, this then pulls that wing back, and the aircrafts opposite wing then moves forward...

How would you recover from Dutch roll without a yaw damper? The aircraft is more prone to Dutch roll at a higher altitude, as altitude (and therefore TAS) increases, the directional stability reduces at a greater rate than lateral stability, the correction would be to fly low and slow, the denser the air, the more damping there is, which means the yaw oscillations will die out quicker.

What is the sweep angle of a 737-800, why this value and not another? The sweep angle of a 737- 800 is 25 degrees.

What are the advantages of a swept wing?


• More lateral stability. (turbulence/friction)
• Higher speed.
• Lower drag at higher speed – lower fuel burn.
• Increase in MCRIT****
• Delays airflow from going supersonic over the wing. (stops shockwaves which creates huge amount of drag)
***** by reducing the chordwise flow and increasing the spa wise flow

What are the disadvantages of a swept wing?
• Poor lift qualities
• Higher stall speeds (consequence of the poor lift qualities)
• Speed instability at slow speeds
• Tendency to stall at the wingtip first.

What is added to a swept wing to increase its lift capabilities?
• Slats, slots, flaps (trailing and leading edge, Fowler and Krueger)

Difference between leading edge slats and flaps? (both used in low-speed situations)

• Slats produce a slot somewhat aft of the leading edge in order to allow high-speed air from below the wing to pass through and maintain laminar flow to a somewhat higher AoA.

• Flaps are devices on the leading edge (Krueger) which increase camber and the depth of the wing to reduce stalling speed and increase lift. (used in the root of the wings) They are similar to slats but they are deployed differently and are hinged, used to produce same amount of lift at a lower airspeed.

• Main idea is to encourage the wing roots to stall before the tips as slats delay the stall better.

High drag devices on a wing? Trailing edge flaps (in a higher drag/lower lift position), spoilers (used inflight as speed-brakes, on ground as lift dumpers.), landing gear, thrust reversers.

What is drag? Drag is the aerodynamic force that opposes an aircraft's motion through the air.

Where does a straight wing stall? At the wing root, which is good because the aircraft will keep aileron authority, also causes a pitch down effect which is good.

• WITH THE HELP OF WASHOUT (RECTANGULAR WINGS)

Can we keep sweeping a wing back? If the angle of sweep is increased, the stall speed is also increased.

Drag on a swept wing?
• Induced drag is reduced as a swept wing has poor lift capabilities, especially at lower speed.
• Wave drag is reduced due to the MCRIT being increased.
• Profile drag is reduced as profile drag increases directly with speed, but the wing of a swept wing has a slower local air velocity (makes the wing feel like it's going slower)

→ ALSO BECAUSE IT'S THIN, WITH LOW CAMBER

What is a spoiler? Spoilers are panels mounted on the upper surface of the wing, when extended, both increase drag and decrease lift by disrupting airflow over the wing. Spoilers can serve as; ground spoilers, roll spoilers, speed brakes.

The amount of spanwise flow compounds as you approach the wingtip, decreasing the wingtip's effective airspeed and thickening the boundary layer. *This can cause the wingtip to stall before the wing root - meaning you lose aileron control at the onset of the stall.* That could make for a wild ride.

To counter this, engineer's place flow fences on the wing to stop the spanwise flow from building up

Where does a swept wing stall? At the wing tip due to the span-wise flow over the wing, which is bad because the loss of lift at the wing tips causes an undesirable nose up effect, also losing aileron effectiveness. Vortex generators can help to maintain control of the ailerons whilst the rest of the wing is stalled, the solution to wing tip stall is washout/wing-twist. (increase camber at the wingtip, delaying the stall)

Vortex Generators? There are 3 fences on the underside of each wings leading edge slats, the angle of the plate causes the air to swirl and create a vortex behind it, this effect allows the airflow to remain attached. They let you use the ailerons when the rest of the wing is stalled, encourage laminar flow and discourage stalls.

Critical angle of attack? The critical angle of attack is the angle which produces the maximum lift coefficient (stall angle of attack) airflow begins to separate from the upper surface.

Dihedral vs Anhedral? Dihedral wings are inclined upwards and increase the stability of the aircraft in the roll axis, (in a roll the aircraft wants to return back to level flight) also engines are located on the bottom of the wing, dihedral offers a convenient way of making more room, greater clearance between wingtips too). Anhedral is commonly found in fighter aircraft, it provides more manoeuvrability. (high wing aircraft use Anhedral as its too stable anyway, low wing aircraft use dihedral to make it more stable)

What is centre of gravity? The centre of gravity is the point through which the total weight of a body will act.

Forward Center of Gravity increases stall speed due to greater downward force required by the stabilizer, whereas an aft Center of Gravity reduces stall speed due to less downward force required by the stabilizer

What is wing load and how can we control it? Wind loading is the total mass of an aircraft divided by the area of its wing. High wing loading will need greater take-off and landing distances (because they will have a higher stall speed) but will be more stable in turbulence and will have less manoeuvrability. The more loading of a wing, the more lift it must produce. (low mass, large wings = low wing loading). (can increase it by increasing the area of the wing using flaps, slats etc.)

Low wing vs High wing?
• High wing aircraft offer better visibility, very good ground clearance, high wing aircraft have better roll stability due to their centre of gravity located under the centre of pressure, if an airplane sideslips to the right, the resultant airflow will act on the wings from the right side. This increases the lift it produces; the result is the aircraft returning to level flight. (can add manoeuvrability with Anhedral wings too) The high wing aircraft can encounter less ground effect on take-off. (generally, has a smaller landing distance as well, also its better for cargo as no spar gets in the way) (pendulum effect) (does not require fuel pumps)

• Low wing aircraft has advantage in water landings as the wings can keep the fuselage above the water, it can be used to step out onto the wings for over-wing exits, the main gear can be lower. Maintenance is more straight forward and refuelling is easily accessible, and also it doesn't block any of the cabin. Also, a low wing aircraft is more stable on the ground.

What is MCRIT? (critical Mach number) The lowest Mach number at which the airflow over any part of the aircraft reaches the speed of sound.

What determines the MCRIT? The critical Mach number is dependant on the thickness of the wing (a thin wing will have a higher MCRIT), the camber of a wing (a higher cambered wing will reach sonic speed earlier, as the air accelerates faster over the wing), weight of the aircraft (heavy aircraft would require more lift, which means greater acceleration over the wing, which means lower MCRIT, vice versa for light aircraft)

How does a swept wing increase the MCRIT? In a swept wing, the air flows at an angle (instead of perpendicular on a straight wing), this increases the effective chord of the wing, but the wings thickness remains unchanged, so this reduces the thickness/chord ratio of the wing which results in a higher MCRIT and delays shockwave formation, in a swept wing, the airflow is divided into two parts, the span-wise flow and the chordwise flow meaning the chordwise flow will be slower, so we can increase the aircraft speed without hitting supersonic speeds over the wing (increasing MCRIT)

How would you design a high-speed wing?
• Swept Wing (increases MCRIT)
• Minimal camber (increases MCRIT)
• Thin wing (increases MCRIT)

What is Mach Tuck? When airflow over the wings reaches the LSS, shock waves form, air flowing through these shockwaves experience a sudden increase in static pressure, this sudden pressure increase causes sudden deceleration which tends to cause the airflow to separate from the wing just behind the shockwave, the overall effect is a loss of lift and an increase in drag. (shock stall)

• AS SPEED INCREASES THROUGH TRANS REC., CP MOVES AFT ⟶ PITCHING DOWN MOMENT

The shock waves form first at the wing roots where the chord provides the biggest acceleration, meaning that the shock stall affects the wing root before the wing tip, so the loss of lift due to shock stall at the wing roots causes the centre of pressure to move rearwards, this causes the aircraft to pitch down – Mach tuck.

What is a Mach Trimmer? The Mach trimmer is a system that resists the nose down tendency of Mach tuck.

How does a Mach Trimmer work? Mach Trim is accomplished automatically above Mach .615 by sensing the aircraft's speed and in turn moving the stabilizer to maintain the aircrafts pitch attitude. (tuck under makes the aircraft nose down, the Mach trimmer pulls it up to level flight)
Also, there is another way, we can move the centre of gravity of the aircraft by moving the fuel into the rear tanks which would also trims nose up.

Coffin Corner? (aerodynamic ceiling) (occurs at absolute ceiling) Coffin Corner is the area of the speed envelope where the low-speed buffet and the high-speed buffet come close together. (stall speed and max Mach speed)

→ CRITICAL ↓ REDUCES, VS ↑ INCREASE

• As altitude increases, air density, and thus lift decreases, therefore the stall speed increases, this defines the lower speed limit at which an aircraft can operate. (low speed buffet)

• As altitude increases, temperature decreases, so the speed of sound decreases, so the critical Mach number also decreases. (high speed buffet)

• The aircraft can not fly faster due to high speed buffet, and can not fly slower due to low speed buffet, making it difficult to control during turbulence or descending. (stall or MCRIT)

• With an increase in weight, stalling speed also increases so the margin for the coffin corner is less.

How does a wing work and how is lift created?
• An aerofoil generates lift by exerting a downward force on the air as it flows past. (newtons)

• As the velocity changes around an object, the pressure changes as well, the pressure on the upper surface where the flow is moving faster is lower than the pressure on the lower surface where it is moving slower.

• The airflow follows the curvature of the aerofoil (downwards), the upper surface is moving faster, so causes the aerofoil exerting a downward force generating lift.

Lift is created due to air pressure differences between the lower and the upper surfaces of the wing, which are caused due to the curvature of the wing that generates a Venturi tube effect (high pressure air below the wing moving towards low pressure air above the wing).
The greater the curvature of the wing, the greater its lift capability.

What is pitch angle (attitude)?

- It is the angle between the aircraft's longitudinal axis and the horizon

What is flight path angle?

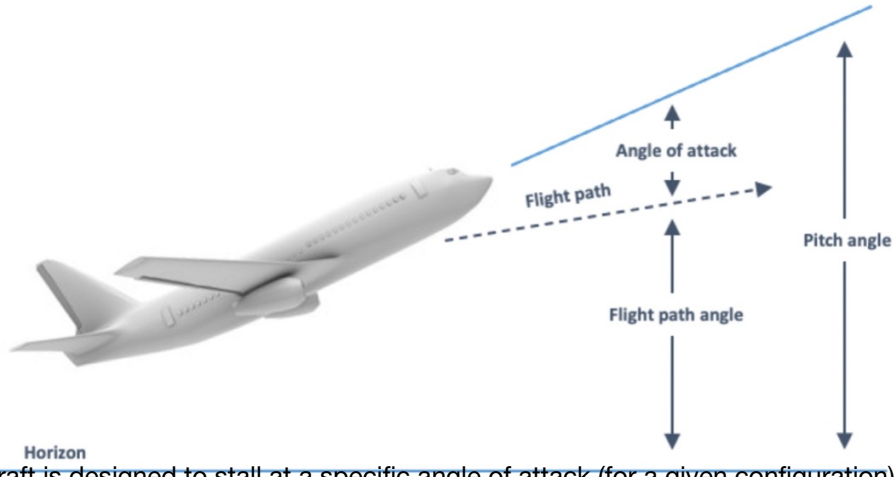
- It is the angle between the aircraft's flight path and the horizon

What is the angle of attack?

- It is the angle between the relative airflow and a reference line on an aircraft or wing
- For most jet aircrafts the reference line is the aircraft's longitudinal axis
- The reason is because most jet aircrafts have leading edge devices which would degrade the accuracy of angle of attack measurement when changing configuration, if the reference line was the chord line of the wing

Note:

- Angle of Attack = Pitch Angle – Flight Path Angle
- During level flight (i.e. Flight Path Angle = 0) Angle of Attack = Pitch Angle (attitude)



-Each aircraft is designed to stall at a specific angle of attack (for a given configuration) and can stall at any airspeed, attitude or altitude if this critical angle of attack is exceeded

-However, at high altitudes and high M, critical angle of attack reduces and stall speed increases. This is due to wing reaching its lift capability limits at high M

-Also, in case of airframe icing, the critical angle of attack may be reduced → STICK SHAKER MAY NOT ACTUATE DUE TO REDUCES CRITICAL A THAT HAS ALREADY BEEN EXCEEDED

-Wing configuration has an impact on critical angle of attack as well. Extension of leading edge slats and flaps increases the critical angle of attack, whereas extension of trailing edge flaps reduces the critical angle of attack

Why is critical angle of attack reduced when extending trailing edge flaps?

-A wing will stall when it reaches the critical angle of attack, which is the angle at which the wing has reached its maximum lift capability (Clmax)
-When we extend trailing edge flaps, Clmax increases and, for a given angle of attack, Lift produced by the wings increases as well
-However, the wings are not able to sustain this higher lift up to the same angle of attack that they can when the flaps are up
-This means that although Clmax increases, it is achieved at a lower angle of attack (critical angle) than it is achieved with flaps up and therefore, critical angle of attack decreases

How does stall speed change in a banked turn?

Stall speed varies directly with the square root of load factor
Load factor = Lift / Weight or 1 / cos bank angle

What are the secondary flight controls?

Flaps
Slats
Spoilers
Stabilizer

How does load factor affect the aileron effectiveness?

The higher the load factor (G load) the lower the aileron effectiveness
This means that at high bank angles and G loads, more force in control column would be required in order to roll wings level

During a nose high upset recovery, why is it important to reduce pitch attitude first before rolling wings level?

Bank angle helps the nose to fall and reduce pitch attitude,this is because when wings are not level, the vertical component of lift, which acts directly opposite to weight force, is reduced.

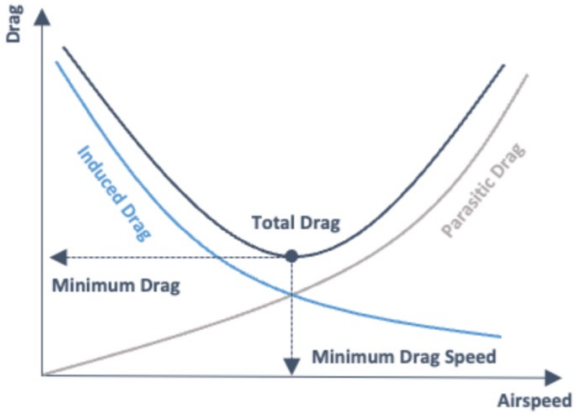
During a nose low upset recovery, why is it important to level wings before increasing pitch attitude?

How does parasite drag and induced drag vary with speed during level flight?

-Parasite drag increases with increasing speed
-Induced drag increases with increasing angle of attack, which leads to an increased coefficient of lift (Cl). As Cl increases, speed needs to be reduced in order to maintain the same amount of lift

When would you have minimum drag?

- When parasite drag equals induced drag
- This is also the point at which maximum lift/drag ratio occurs during level flight



Note: Maximum lift/drag ratio occurs at a specific angle of attack for each aircraft. This angle of attack results in the maximum range during a glide descent (e.g. all engines failed) irrespective of aircraft's weight

What happens if you fly at speeds below the minimum drag speed? (Backside of the drag curve)

- Speed is unstable. This means that if airspeed suddenly decreases (e.g. due to turbulence) it will continue to decrease if thrust is not increased
- On top of that, as airspeed decreases below minimum drag speed, total drag increases as well (see graph above)
- This makes speed recovery harder and higher thrust settings than normal are needed to regain speed

What is aspect ratio?

- It is the ratio of wing span to the average chord line of the wing
- Since S = wing span x average chord line of the wing, aspect ratio is also: wing span^2/S

How does aspect ratio affect induced and parasite drag?

- The higher the aspect ratio the lower the induced drag
- The higher the aspect ratio the higher the parasite drag

Does the center of gravity remain constant throughout the flight?

No, it changes as a result of:
-Fuel burn
-Passenger movement

Stability, controllability, manoeuvrability?

-High stability= high controllability, low manoeuvrability
-Low stability= low controllability, high manoeuvrability

What is adverse yaw? Adverse yaw is the natural and undesirable tendency for an aircraft to yaw in the opposite direction of a roll, caused by the down going aileron creating more drag than the up going aileron, the solution to this is differential or frise type ailerons.

Forces on a plane? Lift, weight, drag and thrust.

ELECTRICS

What is electricity?
Electricity is the movement of electrons that produces a power.

DC
Direct current electrical power flows in only one direction around a circuit and has no appreciable variation in its amplitude.

AC
Alternate current continuously reverses its direction of flow in an electric circuit. The complete reversal of current is known as a cycle and occurs very rapidly.

Advantages of AC over DC
1. AC generators are simpler and more robust in construction than the dc machines.
2. The power-to-weight ratio of AC machines is much better than DC's.
3. The supply voltage can be converted to a higher or lower value with great efficiency using transformers.
4. Any required DC voltage can be obtained simply and efficiently by using transformer-rectifier units.
5. Three-phase ac motors can be operated from a constant frequency source (alternator).
6. AC generators do not suffer from communication problems associated with DC machines and consequently are more reliable, especially at high altitudes.
7. High-voltage AC systems require less cable weight than comparable power low-voltage dc systems.

Alternator
1. Produces AC power at specified frequency by electromagnetic induction
2. Coil rotate with respective magnetic field // magnetic field with respect to the coil
3. ROTOR rotating magnetic flux (induce electricity in) ARMATURE coils are stationary

Electrical system of a 737-800?
• Primary electrical power is provided by two engine integrated drive generators (IDGS) which are rated at 90 KVA (kilo-volt amps) and supply three-phase, 115-volt, 400 cycle (Hz) alternating current.
• The battery is a 36 ampere-hour, 24-volt, nickel-cadmium battery and should provide around 30 minutes standby power if all other generators fail.
• Auxiliary Battery – This is a reserve battery on the 737NG which is normally isolated unless the main battery is powering the standby system, the auxiliary battery combined with the main battery can provide 60 minutes of standby power.

Difference between AC and DC? (alternating current is the best way to transmit electricity over large distances) (AC is produced using an alternator)

• DC cannot travel very far until it begins to lose energy, but AC can travel and prove more power.

• DC electrons flows in one direction in the circuit, AC electrons reverses its direction while flowing in a circuit.

• Frequency of DC is 0 Hz, the frequency of AC is 50Hz or 60Hz depending on the country.

• DC can be stored, for example in batteries, AC can not be stored. (but can be changed to AC using an inverter)

What is Hertz? Hertz (Hz) is a unit derived from time which measures frequency, frequency is how often something happens... a frequency of 1 Hz means that something happens every 1 second. (e.g. a piano has 262 Hz, meaning there is 262 vibrations per second.

Explain volts and amps? Which one will electrocute you?
• A potential difference, also called Voltage, across an electrical component is needed to make a current flow through it. (cells or batteries often provide the potential difference needed) (it is the push that causes charges to move in a wire)

• Current is a measure of how much electrical charge flows through a circuit, the more charge that flows, the bigger the current. Current is measured in amps. (amperes)

• The amps are how much, and the volts are how much force behind it, it's the amps that kill you... (for example if you are cut by a pressure washer, technically it's the water that cuts you but it's the force behind the water that actually cuts you... same thing applies, volts is the pressure, while amps is the water.)

Plug socket in the wall? The electric supply in Ireland and UK is 230volts, 50Hz

POWERPLANT

How does the jet engine works?
All jet engines, which are also called gas turbine, work on the same principle. The engine sucks the air in the front with a fan. Than a compressor raises the pressure of the air. The compressor is made up of fans with many blades a[ached to a shaft. The blades compress the air, than the air is sprayed with fuel and an electric spark lights the mixture. The burning gases expand and blast out through the nozzle, at the back of the engine. As the jets of the gas shoot backward, the engine and the aircraft are thrust forward.
ONLY FOR START, THEN IT AUTO-IGNITES
CFM56-7B high bypass ratio – Primary flow passes through the combustor and secondary flow passes only through the fan. 80%

Why do we have turbo chargers? And how do they work?
A turbocharger is a centrifugal compressor powered by a high speed turbine that is driven by an engine's exhaust gases. Its benefit lies with the compressor increasing the mass of air entering the engine (forced induction), resulting in greater performance.

What is a Supercharger? What is the difference between Turbo and Supercharger?
A supercharger increases the air delivered to the engine cylinder above its normal aspirated capacity by compressing the intake air, which in turn requires more fuel to be delivered to the carburettor to maintain the correct mixture ratio, which in turn produces a greater power output. The difference between turbo and supercharger is that superchargers are not powered by exhaust gases but are connected directly or indirectly to an engine. A superchargers uses mechanical energy from the engine to drive the supercharger. In comparison a turbochargers does not place a direct mechanical load on an engine, it is more efficient because it converts the waste heat of the exhaust gas into horsepower used to drive the compressor.

- IT ONLY HAS THE COMPRESSOR
- MORE RESPONSIVE : · TURBO IS SLOW BCS IT NEEDS TIME FOR THE EXHAUST GASES ——> TURBO LAG
  · SUPER IS FAST BCS OF DIRECT LINK

Explain carburettor icing?
Ice formation can occur in the engine induction system and in the carburettor of piston engines, particularly in the venturi and around the throttle valve, where acceleration of the air can produce a temperature fall. This combined with the heat absorbed as the fuel evaporates, can cause serious icing, even where there is no visible moisture present. It is more likely to occur with low power settings when the part ally closed butterfly creates its own venturi cooling effect. Carburettor icing should be expected in a piston engine when the outside temperature is between -10°C and +30°C with a high humidity and or visible moisture present in the air.

① **Thermal efficiency**
Efficiency at which fuel energy is converted into kinetic energy • DA CARBURO AI PISTONI CHE SI MUOVONO

Total efficiency
Chemical power transformed into propulsive power • DAL CARBURO ALLO SPOSTAMENTO

(2) **What is propulsive efficiency?**
Propulsive efficiency is the efficiency, in percent, with which the energy contained in a vehicle's propellant is converted into useful energy, to replace losses due to air drag, gravity and acceleration.
Efficiency at which kinetic energy is converted into propulsive force, depends on the amount of energy wasted by the engine

• DAI PISTONI ALLO SPOSTAMENTO VERO E PROPRIO

What is Fadec?
Fadec is full authority digital engine control and is a system that automatically controls engine functions. Fadec is a system consisting of digital computer, called ECU (engine control unit) and its related accessories that control all aspects of aircraft engine performance. Fadec works by receiving multiple input variables of the current flight condition. The inputs are received by ECU and analized up to 70 times per second. The fadec basic purpose is to provide optimum engine efficiency for a given flight condition.
It also has automatic protection functions.

Explain high bypass engine?
The bypass engine involves a division of the airflow. All the air entering into the engine is given to an initial low compression, and a percentage is then ducted to bypass the engine core. The remainder of the air is delivered to the combustion chamber. The bypass air is then either mixed with the hot airflow from the engine core in the jet pipe exhaust or a8er it has been discharged to atmosphere to generate a resulting forward thrust force. The high bypass ratio is 5:1.

What is a critical engine?
The engine that most adversely affects directional control of the aircraft
The critical engine is the engine that determines the critical control speed of the aircraft. Normally is the number 1 engine in clockwise rotating propeller engines for 2 reasons:

- Slipstream effect: the slipstream from the number 2 engine will produce a sideways force that aggravates the yawing moment, resulting in a more critical situation. Therefore, a greater control force is required, resulting in a need for a higher critical speed to make the rudder more effective during a number 1 engine failure.
- Asymmetric blade effect: on the fin Propeller blades produce more thrust in the downward rotaEon than in the upward, therefore the point through which the thrust acts will be displaced toward the down-going blade.

Does a jet aircraft have a critical engine? Why?
There is no critical engine for gas turbine engines if the engines are positioned symmetrically with opposing revolution direction. However, aerodynamically, crosswind effect can result as a critical engine effect: a crosswind coming from the same side of the failed engine.

How does the CFM56-7B engine on the 737-800 work? The air races through the fan that acts like a huge propeller accelerating the air which is separated, so only 20% of the air goes into the engine and 80% of the air is bypassed creating huge thrust. (due to its enormous volume, the air only needs to be accelerate through the bypass duct in order to create thrust) This is the bypass ratio and is about 5:1, 20% of the air that enters the engine goes first to the low-pressure compressor that compresses the air so the pressure and temperature rises, then it enters the high-pressure compressor that rotates faster causing the pressure and temperature (450 degrees Celsius) to rise even further. (this is in a convergent duct causing the velocity to rise, venturi effect), It then enters a diffuser to lower its velocity, then the air is mixed with fuel and then ignited in the combustor (1700 degrees Celsius) increasing the energy level (more pressure = more energy when heated). The hot air then spins the high-pressure turbines that are connected via shaft to the high-pressure compressors, known as the high spool. Then the air passes through the larger low-pressure turbine that powers the low-pressure compressor, the last turbine powers the fan, finally the combusted air

races down through the exhaust nozzle at the back to be accelerated one more time producing 20% of thrust, the remaining 80% being created by accelerated bypass air.
In basic English: A turbine fan is therefore a flow cycle engine, air is compressed then heated by burning fuel, after which it passes through the turbines which drive the compressors and the fan.

What happens to the cold air? It is redirected around the core of the engine and expelled out the back.

Where does N1 come from? Where is the fan? (N1 is the fan speed, N2 is the engine core speed) N1 comes from the front fan speed, its related to thrust more than the engine core as it creates more thrust due to the high bypass.

- N1: LOW PRESSURE COMPRESSORS SECTION + LP TURBINE
- N2: HP COMP. + HP TURBINE
- EPR: $\frac{\text{TURBINE DISCHARGE P}}{\text{COMPRESSOR INLET P}}$

How is thrust generated? Thrust is generated by the propulsion of air around the engine from the high bypass and the remainder of the air that is combusted in the combustion chamber, that is exhausted out the back through the exhaust.

What is FADEC? (full authority digital electronic control) FADEC electronically monitors and adjusts the engine for proper and smooth operation instead of the pilot manually adjusting the mixture and throttle controls, it gives advantages such as; better fuel efficiency, automatic engine protection, care-free engine handling, there is multiple channel computers which provide redundancy if it fails, reduces the number of parameters to be monitored by flight crews and it also helps to start the engines.

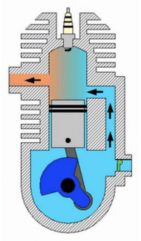
Why are jet engines more efficient at high altitude? They work better at high altitude because the air is cooler, cool air expands more when heated than warm air, it is the expansion of the air that drives the combustion engines. Also the air is less dense at altitude therefore the aircraft flies much faster at high altitude than low altitude at the same thrust.

. CFM VS ARMC

What is compressor stall? A compressor stall occurs when there is an imbalance between the airflow supply and the airflow demand, in other words, a pressure ratio that is incompatible with the engine RPM,

when this occurs, smooth airflow is interrupted and turbulence and pressure fluctuations are created within the turbine. Compressor stalls can be caused by foreign object damage, such as bird-strikes, worn, dirty or contaminated compressor components, in-flight icing, extreme flight maneuvers and improper engine handling.

Difference between 2-stroke and 4-stroke engine?

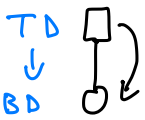


• A 2-stroke engine completes 1 rotation of the crankshaft after completing one cycle, power is produced once during 2 strokes of the piston, design is simpler, the air-fuel mixture enters through the inlet port and travels to combustion chamber through the crankcase, the 2 stroke engines are lighter, louder and more powerful. (2 stroke engines are designed for high RPM, so it is less durable)

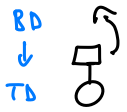
• A 4-stroke engine completes 2 rotations of the crankshaft after completing once cycle, power is produced once during 4 strokes of the piston, the design is more complicated, the mixture only goes to the combustion chamber, the 4 stroke engines are heavier, make less noise but less powerful, 4 stroke engines are more fuel efficient because fuel is consumed once every 4 strokes meaning less pollution as well, the 4-stroke engine is more durable too.

Four separate strokes?

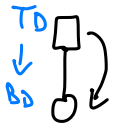
• Intake – also known as induction or suction, the stroke of the piston begins at the top dead centre and ends at the bottom dead centre, in this stroke the intake valve must be in the open position while the piston pulls an air-fuel mixture into the cylinder by producing vacuum pressure into the cylinder through its downward motion. (the piston is moving down as air is being sucked in by the downward motion of the piston)



• Compression – The stroke begins at the bottom dead centre, and ends at the top dead centre, in this stroke the piston compresses the air-fuel mixture in preparation for ignition during the power stroke. (both the intake and exhaust valves are closed during this stage)



• Combustion – also known as power or ignition, this is the start of the second revolution of the four-stroke cycle, at this point has completed a full 360-degree revolution. While the piston is at the top dead centre, the compressed air-fuel mixture is ignited by a spark plug (gasoline engine), or by heat generated by high compression (diesel engine), forcefully returning the piston to bottom dead centre, this stroke produces mechanical work from the engine to turn the crankshaft.



• Exhaust – also known as outlet, during the exhaust stroke, the piston once again returns from bottom dead centre to top dead centre while the exhaust valve is open, this action expels the spent air-fuel mixture through the exhaust valve.

• In a two-stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust functions occurring at the same time.
-Valve Lead: process of opening the inlet valve before TDC —> maximise amount of entering mixture
-Valve Overleap: both valves are open at the end of exhaust stroke —> exhaust gases flowing out help to drive more mixture in
-Ignition Timing: ignition starts before TDC, otherwise the piston would have already travelled down a bit before combustion —> maximises combustion

What is a turbocharger? A turbocharger is a turbine driven forced induction device that increases an engines efficiency and power output by forcing extra air into the combustion chamber

Compressor Stall?

It's a partial breakdown of airflow through the engine that occurs when there is an imbalance between the air flow supply and the airflow demand.
Causes: fod; improper engine handling; icing etc…
Results: loss of thrust, reverse airflow, possible flame on inlet and/or exhaust

Compressor Surge?

Consequence of compressor stall.
The progressive deterioration of the situation will eventually cause a complete breakdown of airflow through the engine called a surge. In severe cases this could cause an instantaneous reversal of the gases in the engine, with air being expelled through the engine intake with a loud bang.

Hot start:

Temperature limitations are exceeded during start, possibly damaging the engine's hot section. If the condition continues unchecked, a fire may result.

Hot starts may be caused by:

-improper pilot action (introducing fuel before reaching the proper motoring rpm)

-failure of the fuel controller or fuel nozzles

-tailwind component (the wind inhibits exhaust flow at the back of the engine)

-weak battery causing the electric starter to peter out after light-off.

Action: typically is to cut fuel off immediately and leave the starter engaged.(this allows the gases to exit the engine and to cool it)

Hung start:

A hung start occurs when the engine starts but doesn't accelerate to idle speed.

Hung start may be caused by:

-problem wherein the HMU/ECU falls off the acceleration schedule or fails to bring the secondary fuel nozzles online

Action: cut the fuel off and motor the engine.

What is MAP?

Manifold pressure is **a measure of the absolute pressure of the fuel/air mixture within the intake manifold of the aircraft engine**. The intake manifold is a pipe that transports the air/fuel mixture into the cylinder as the piston moves from the top to the bottom of the cylinder during the intake stroke.

How does a jet engine work?

-Air is drown trough an intake and enters the compressor (20%, the other is bypassed)
-As air cannot go from LP to HP —> Convergent **annulus** to control the direction of the flow
-Before entering the combustion chamber —> **diffuser** to slow the flow
-In the combustion chamber air expands and exits ,part of energy is absorbed by turbines to drive compressors
- Aft section of the engine is a convergent duct (**jet nozzle**) to increase speed even more

How does a turbocharger work? (feeding more air, allows the engine to burn more fuel meaning more power)

• It all starts at the turbine, which is driven by exhaust gases exiting the engine, as exhaust exits through the exhaust manifold, it passes over the turbine and spins it, the more exhaust gases that pass through, the faster the turbine spins.

• A shaft connects the turbine and the compressor, so when the turbine starts spinning as the engine is started, the compressor starts spinning too.

• The compressor is in charge of drawing air from the outside of the aircraft, compressing it and then putting it on the engine.

• Turbochargers are good at increasing the air pressure in the engines intake manifold (manifold pressure), how do turbochargers prevent too much air from entering the engine? (risk of damage/destroying the engine)

• Waste gates open and close to regulate the amount of air that passes over the turbine and prevent the turbine from spinning too fast

Advantages of a turbocharger?
• Better at high altitudes
• Better power to weight ratio
• Can deliver sea level power at altitude
• Compared to the supercharger, it is more efficient, uses less fuel and have less weight

How does a supercharger work? The supercharger works on the same principle as a turbocharger, the only difference being is that it is mechanically driven by a direct connection to the engine (crankshaft) whereas a turbocharger is driven by a turbo using exhaust gases.

Advantages of a supercharger?
• Relatively cheaper than turbochargers
• They run at cooler temperatures
• Superchargers don't have any lag; the power is immediate.

Mixture
Mixture is the air/fuel ratio. Sets the amount of fuel added to the intake airflow. At higher altitudes, the air pressure (and therefore the oxygen level) declines so the fuel volume must also be reduced to give the correct air/fuel mixture. This process is known as "leaning".

AIRFRAME

What is fly-by-wire? Flight control systems that use computers to process the flight control inputs made by the pilot or autopilot and send corresponding signals to the flight control surface actuators. (replaces mechanical inputs, and pilot does not directly control the surfaces)
Benefits:
-weight saving: eliminates all mechanical components (pulleys,cranks,cables,etc…)
-self protection functions: limits pilots controls to assure safety

How does Anti-Skid work? The anti-skid system compares the speed of the aircraft with the rotational speed of each main wheel, if the speed of any wheel is too slow, the brakes are released to allow the wheel to speed up and prevent skidding. The system is fully automatic.

- T/O OR LANDING ALLOWED OR NOT ?!

MASS AND BALANCE

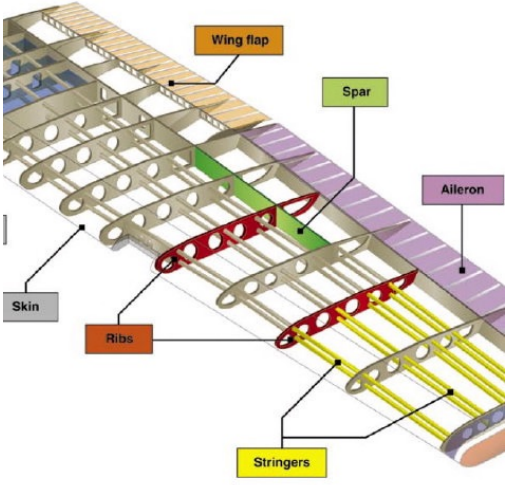
Explain mass and balance and the relation of centre of gravity
The mass of an aircraft and the location of its centre of gravity is vital information required before commencement of any flight. Knowing the actual aircraft empty weight and position of its centre of gravity, the passenger and freight load and the planned fuel load, the maximum weight of the aircraft and its centre of gravity can be calculated for any phase of the flight. The aircraft mass and its centre of gravity must remain at all times within the limits specified in the AFM for the relevant stage of flight.

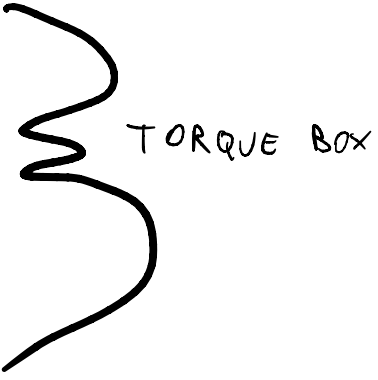
AIRFRAME

Types of wings?

-Cantilever wing: NO external struts or bracing —> wing is supported by itself

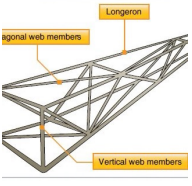
-Non Cantilever: YES external struts



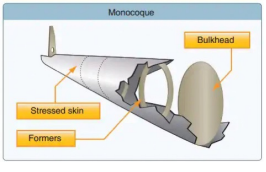


Types of Fuselages?

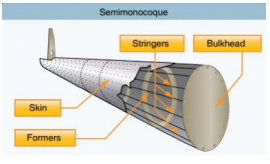
-Truss: skeleton —> longerons with diagonal bracing



-Monocoque: skin takes alone all the loads



-Semimonocoque: has also stringers ——> USED BY PRESSURIZED A/C



What is PTU?

-It's the power transfer unit that allows the hydraulic pressure of one hydraulic system to drive a pump to pressurize a second hydraulic system without any transfer of hydraulic fluid.

-Used in case of failure of one hydraulic system, no during normal operations.

What is RAT?

-It's the ram air turbine

-Made of windmilling blades that are used to drive an hydraulic pump.

-Used for flight controls ONLY

Flight controls?

-B737:
-normal operation: yoke—> cables—> pcu—> flight controls
-emergency: yoke—> cables—> flight controls

-A320:
-normal operation: sidestick—> wires—> computer—> pcu—> flight controls
-emergency: the same, hydraulic power is supplied by RAT

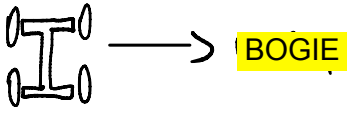
-APU: in case of 2 eng failure apu can supply power to the electrical hydraulic pumps, and you can try to restart the engine (apu on only below a certain altitude)

Landin gear

-2 types: -tricycle
-tail wheel

-types of struts:

Cantilever
Fork
Half fork
Dual wheels



Braking technique?

-Steel brake (p2008,etc..): multiple small and light brake application

-Carbon brake (b737,etc…): one firm application

Are fuel tanks pressurized?

Yes, they are in order to prevent vapour locking: pumps are designed to pump liquid fuel,not vapour that wouldn't be able to be sucked

Is fuel hated?

It's heated just before just before passing the filters of the LP fuel pumps to prevent fuel to form wax like particles and ice crystals.
JETA1 freezing T°: -47°C

Fuel system B737?

Each fuel tank uses two AC powered fuel pumps which are cooled and lubricated by fuel passing through the pump. Center tank pumps produce higher pressure than main tank pumps. This ensures that center tank fuel is used before main tank fuel.

When main tank fuel pump pressure is low, each engine can draw fuel from its corresponding main tank through a suction feed line that bypasses the pumps.

Detonation vs Pre-Ignition?

Detonation:
During detonation, the fuel/air charge explodes rather than burning smoothly. Occurs near or after top dead center.
May be caused by:
-low octane fuel
-weak mixtures give high temp mixture and combustion,thus can create detonation
-carb hot air: increases t in the engine and thus risk of detonation. Do not use carb heat above at power settings greater than 80%, use only for short time.
Recognized by:
-low egt; high cht
-rough engine sound
Mixture explodes in un uncontrolled manner.

Pre-ignition:
Ignition of mixture when the piston is still in compression phase.
May be caused by:
- hot carbon deposits
Recognized by:
-high egt; high cht
-rough engine sound

Take Off config warning, what is it and what systems does it comprehend?
It's a system that alerts pilots that something in the configuration is wrong for take off, and that taking off could be dangerous.
It comprehends:

-Position of High Lift Devices such as flaps and slats

-Elevator trim position o trimable horizontal stabiliser position as appropriate

-Position of autobrake

-Position of ground spoilers or speedbrakes

-Engagement of parking brakes

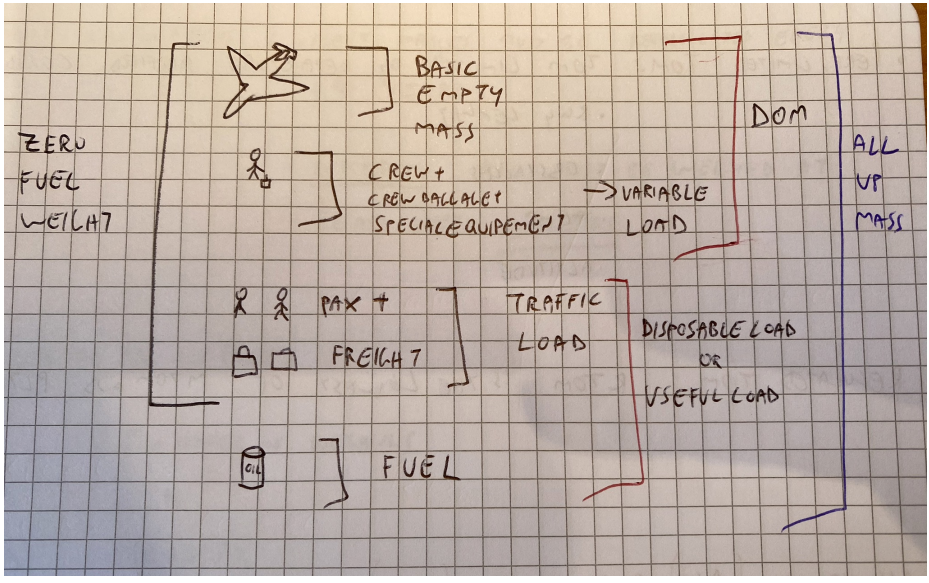
What can cause vibration in the engine?
An imbalance is the more likely one,such as the fan section blade separating.

Jet engines operate at a very high RPM, something like 14,000 RPM! So even the smallest imperfection in the engine blades can cause a vibration to occur.

What's an IDG

Is the main source of A.C. (alternating current) electrical power on the aircraft; it is a combination of a constant speed drive and an electrical generator driven by the engine through the accessory gearbox.

All the Weights?



Mass of people?

- 30 seats or more: -adults 84kg
  -children (2-12 years) 35kg

-Flight crew: - 85kg including hand baggage
-Cabin crew: - 75kg including hand baggage

What is load sheet?

A document which records the weight and CG settings for a commercial flight.
2 copies: - the original —> left on ground
- the copy —> given to the captain

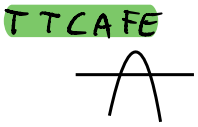
Regulated T/O weight?

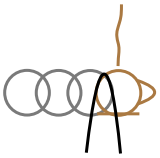
-Max weight subject to airport and performance requirements
-RTOW<MTOW

What is a load sheet and why does the captain fill it?
It is filled to control that loads and mass doesn't exceed structural and performance limits of the aircraft.

What is centre of gravity? The centre of gravity is the point through which the total weight of a body will act.

How do you calculate fuel for the flight?





- Taxi Fuel
- Trip Fuel (SID and STAR)
- Contingency (5% of trip fuel)
- Alternate fuel
- Final reserve fuel (30 minutes holding at 1500ft) (45-minute reciprocating engines)
- Extra

METEO

What is a jet stream?
A jetstream is a strong and narrow current in the upper tropopause or stratosphere characterized by strong vertical and/or lateral windshear (CAT). The wind speed must be (up to 300) for a wind to be classified as a jetstream. Jetstreams are Epically . They are Epical in the polar front (about 60° of laEtude) and in the intertropical front. The core of the jet is Epically in the lower part towards the subtropical air. The greater CAT is Epically found towards the polar air in the upper part of the jetstream.

How are thunderstorms formed?
Thunderstorms are normally associated with cumulonimbus clouds. These clouds are formed with 4 conditions:
-High moisture content in the air

-A trigging lifting action to cause a parcel of air rising (convection, turbulence, frontal, orographic)

-Adiabatic cooling of the air

-High instability (once the air starts to rise it will continue rising), ELR must be greater than SALR

During the development of the CB updrafts move air aloft, allowing condensation to take place throughout the ascent of the convective currents. During the mature stage, water drops start to fall through the cloud, but stronger upwards current will increase the cloud: updrafts (5-60008/min) in this stage are stronger than downdrafts (30008/min). This is the most hazardous phase of thunderstorms, where we can find hail, torrential rain, severe turbolence, severe icing, windshear, microbursts and lightning. Decaying stage is the final stage of the thunderstorm. In this phase there is an end of continuous rain and the start of sporadic showers. At higher levels it may take on the anvil shape as upper winds spread out under the tropopause. An anvil must be avoided because of the presence of strong downward vertical currents beneath it. A thunderstorm can produce several hazards for aircrafts: severe windshear, turbulence, icing, hail, reduced visibility, lightning strikes and radio comms and navs interference. CBs must be avoided by a minimum of 10NM and, in severe conditions, by at least 20NM.

- > 2 h FOR ALL STAGES
- MOVING AT THE 10000 FT WIND
- LIGHTNING MORE LIKELY BETWEEN -10° AND +10°C

What is radiation fog?
Radiation fog occurs inland, especially in valleys and low-lying areas.
This requires the following conditions:

-Cloudless night, this allows the earth's surface to lose heat by radiation, and causes water vapour to condense out in liquid form.

-Moist air, with a high relative humidity, which only requires a slight cooling to reach its dewpoint temperature.

-Light winds, between 2 and 8 kts.

What is advection fog?
The term advection means heat transfer by the horizontal movement of the air. Fog formed in this manner is called advection fog and can occur day or night, land or sea, if the following conditions exits:
-Warm, moist air mass flowing across a colder surface, which is cooled from below.

-Light to moderate winds, that encourages the mixing of the lower levels to give a layer of fog.

-Sea fog, very cold air passes over a warmer sea that causes evaporating moisture to condense out into whispers of vapor.

What is a warm front?
A warm front is the boundary produced between two air masses, where the warmer, less dense air mass rises up and replace at alEtude the colder air mass at the surface. In a warm front, the frontal air at alEtude is actually well ahead of its depicted position on a weather chart. On the weather charts warm front is represented by half circles along the front line. As the warm front approaches: lowering of the cloud base. Clouds change from cirrus to cirrostratus to altostratus with possible change into nimbostratus with rainfall.

Poor visibility, due to the increase in low-level clouds and rain. Atmospheric pressure fall. As the warm front passes: rise in temperature, due to the arrival of the warm sector air mass. Low level cloud base or fog. Wind veers direction in the northern hemisphere and backs in the southern. Atmospheric pressure stop falling and rises.

DIMENSIONS ???

What is a cold front?
A cold front is a boundary between two air masses, where the colder, denser air mass undercuts and replaces the warmer preceding air mass from the surface upward. On weather charts cold front is represented by barbs along the front line. As the cold front approaches: cumulus and cumulonimbus is experienced, so we can find heavy rain, thunderstorm, turbulence and wind shear. Poor visibility due to the increase in heavy clouds through a large vertical band and heavy rain. The atmospheric pressure will fall. As the cold front passes: drop in air temperature, due to the arrival of the cold sector. Clear skies, good visibility, wind veers in direction in the northern hemisphere and backs in the southern hemisphere. Atmospheric pressure will stop falling and start rising.

Describe ICE
Icing conditions exist below 10°C with visible moisture (clouds, fog with visibility of one statute mile (1600m) or less, rain, snow, sleet, ice crystals, and so on) is present in the air or ice, snow, slush or standing water is present on the ramps, taxiways or runways. There are several types of ice, but the most common are: clear ice, rime ice or hoar frost. Clear ice is a very serious form of icing, heavy and difficult to remove. It forms when supercooled droplets impact with an air frame. The water flow over the frame releasing latent heat before freezing. It's normally found in CBs and nimbostratus, where you can find large droplets (moderate or severe). Rime ice is formed by smaller droplets which tends to freeze instantly. It is a granular coating which is normally easy to remove. Can occur in any cloud with small water droplets or freezing fog (light to moderate). Hoar frost occurs when air is cooled to the temperature at which saturation occurs and the airframe is below 0°C. It is formed by sublimation: water vapour turns directly to ice without passing through the liquid state. It can occur on ground or a8er takeoff.
Problems related with ice are:

- Adverse aerodynamic performance effects reducing stalling angle and maximum li8 capability, and thus increasing stall speed and drag.

- Control surfaces may be freezed.
- Increase in aircraft weight.
- Reduced engine power (jet intake or carburettor can restrict the air flow into the engine).
- Vent blockage effects (pitot and static ports).
- Degraded navigation and radio communication effects if ice builds up in aerials.

What is a Jetstream? Jetstream's are strong, generally westerly winds concentrated in a relatively narrow and shallow steam in the upper troposphere of the earth.
A jet stream is formed as a result of temperature gradients. (thermal gradients)

Where is a Jetstream found and how high?

• Subtropical Jetstream – (west-east) Usually found around 30 degrees of latitude, normally found between 33,000ft to 52,000ft.
• Polar front Jetstream – (west-east) Usually found around 60 degrees of latitude, normally found between 30,000ft to 39,000ft. (this is the strongest, especially when it is over land in the winter)
• Usually Jetstream's are 1500nm long, 200nm wide, and 12000ft deep.

How strong does the wind have to be to be considered a jet stream? To be classified as a jet stream, the minimum is 60kts.

Why westerly? Jetstream's are westerly due to the Coriolis effect (caused by the earths rotation, deflects wind to the right in the northern hemisphere, and to the left in the southern hemisphere)

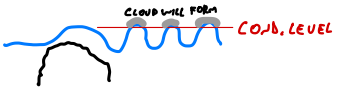
What is clear air turbulence? Clear air turbulence is defined as sudden severe turbulence occurring in cloudless regions that causes violent buffeting of the aircraft. Any CAT is strongest on the cold side of the jet stream where the wind shear is greatest, CAT can be encountered 7000ft below to about 3000ft above the tropopause.

What is the height of a tropopause and why is it higher at the poles? The height of the tropopause is on average 36,000ft (ISA), approximately 20,000ft over the poles and at approximately 60,000ft above the

equator. (lowest at the poles, since colder air is denser and takes up less space, its also thicker in the equator due to the earths spin, the centrifugal force is greatest at the equator and minimum over the poles, due to this the earth tends to shift air towards the equator.)

What are lenticular clouds? Are they good or bad? Why? Where are they found?

• Lenticular clouds are stationary lens-shaped clouds that form in the troposphere, normally in perpendicular alignment to the wind direction.
• As air travels along the surface of the earth, obstructions are encountered such as mountains and hills, these disrupt the flow of air into “eddies” or areas of turbulence.
• Lenticular clouds are formed when air moves over mountains, cooling sufficiently for condensation to take place, they are continually reformed over the same location by new air rising up over a mountain, condensing and producing the clouds. Airflow is disrupted by obstructions causing turbulence or eddies, sinking air warms and dries, whereas the rising air cools and condenses, lenticular clouds form in the moist layers of rising air.
• Even though they look pretty, lenticular clouds are a sign of turbulence and should be avoided, they indicate the presence of standing mountain waves and CAT (clear air turbulence, they are normally found on the downwind side of hills/mountains.



• WIND V > 15KT ⊥ TO MOUNTAIN RIDGE; STABLE AIR ;

Cold front characteristics? A cold front form’s when a colder, denser air mass replaces a warm air mass. (slides under) The characteristics of a cold front is good visibility except in precipitation, moderate-heavy precipitation (showers, rain, snow, hail), colder temperature, clouds formed are mainly cumuliform, (unstable, cumulus, cumulonimbus, altocumulus, stratocumulus, cirrus), in cold fronts the windspeed is a lot higher than a warm front (gusty), wind veers on passing. (pressure increases on passage).

Warm front characteristics? A warm front form’s when a warmer, moist air mass replaces a cold air mass. (sliders over) The characteristics of a warm front is bad visibility, light-moderate precipitation (rain, drizzle), warmer temperature, clouds formed are mainly stratiform (stable, stratus, nimbostratus, altostratus, cirrostratus, cirrus), normally low cloud base and fog, wind veers on passing. (pressure drops)

What is the dew point? Dew point is the temperature below which water droplets begin to condense and clouds form. (a relative humidity of 100% indicates the dew point is equal to the temperature and that the air is maximally saturated with water)

$(T° - DP°) \times 400 = \text{CLOUD BASE}$

What is the difference between SAT (OAT) and TAT?

• TAT is SAT corrected for temperature rise due to aircraft's speed

-Practically speaking, it is the temperature that the aircraft's outer surface feels

Note: TAT can't be lower than SAT

What is the tropopause?

-It is the boundary between troposphere and stratosphere

-Over the tropopause, temperature stops decreasing with height and there is typically no weather significant to aviation

Note: Although temperature stops decreasing, pressure and density continue to decrease with increasing height

What is the difference between stable and unstable air?

-Stable air is cooler than surrounding air and stops rising due to being more dense and heavier than the surrounding air

-Unstable air is warmer than surrounding air and continues to rise due to being less dense and lighter than surrounding air

When will unstable air stop rising?

-When it reaches an altitude at which surrounding air has the same temperature

-That's why over tropopause there is no significant weather to aviation, as temperature stops decreasing with height

How should you avoid thunderstorms?

-By at least 20 NM laterally and 5000 ft vertically

-You should deviate from the upwind side, as this will give you the least chance of encountering turbulence, ice crystals and hail

Background info:
If needed to deviate from the downwind side, a good rule of thumb is to avoid the thunderstorm by at least as many NM as the wind speed at your altitude

What are the three stages of a thunderstorm?

1)Developing stage (or towering cumulus stage)
Characterized by updrafts due to warm unstable air rising

2)Mature stage
Characterized by both updrafts and downdrafts due to air continuing to rise and heavy precipitation starting to fall

3)Dissipating stage
Characterized by downdrafts as air stops rising due to falling precipitation which in turn stops the development of new water droplets inside the cloud

What is temperature inversion?

-It is temperature increasing with altitude

-Inversions close to the ground can be associated with low clouds and fog as the air is prevented from rising

Why wind speeds increase with increasing altitude?

-As altitude increases, temperature difference between different columns of air generally increases

-These larger temperature differences create larger pressure differences which in turn create stronger winds

-Also as altitude increases air density decreases —> air is thinner thus bringing less resistance to the winds

What is Coriolis force?

-Coriolis force is the result of the direction the Earth rotates and also its speed of rotation varying with latitude

What is a cloud ceiling?

-It is the lowest cloud base that covers more than half of the skv (reported as broken or overcast)

-It refers to cloud base height above airfield level (AAL)

What are the jet streams?

-They are high altitude (near the tropopause) strong winds with westerly direction (i.e blowing from West to East) and wind speed of at least 60 kts

-Jet streams are created when warm tropical air masses meet cold polar air masses

-This large difference in temperature creates a low and a high pressure area

-This is because as cold air is more dense than warm air, air pressure decreases more quickly inside the cold air mass than it does inside the warm air mass

-The result is that at a given level near the tropopause, the pressure at the side of the cold air mass is lower than at the side of the warm air mass

-This difference in air pressure together with Coriolis force create the westerly jet streams

-They are associated with CAT (clear air turbulence)

-The only easterly jet stream is the tropical (equatorial)

Can you detect CAT?

-Weather radars detect turbulence associated with precipitation

-As CAT is associated with clear air and not precipitation you cannot detect it

-You can however anticipate CAT under certain weather conditions (e.g. flying through a jet stream)
Note: CAT is usually strongest at the cold side of the jet stream

When is the aircraft susceptible to icing?

When i) OAT (on the ground) or TAT (in flight) are less than or equal to 10 °C and ii) there is any kind of visible moisture

What is the difference between METAR and ATIS?

-METAR is a weather report in a text format whereas ATIS is a weather report in an audio format (i.e. you listen it through a specified VHF frequency)
-ATIS contains more information than METAR, such as runway in use, type of approach, taxiway closures etc.

Should you use METAR wind or ATIS wind to calculate takeoff performance?
-ATIS wind must be used for all performance calculations
-The reason is because ATIS wind and runway heading are in degrees Magnetic whereas METAR wind is in degrees True

What happens if OAT is 2 degrees and dewpoint is 2 degrees? What conditions can we expect? When the dew point meets the temperature, normally we can expect fog and clouds, in general the closer the dew point is to the temperature, the lower the cloud ceiling will be.

If you're in the middle of a field with a light breeze, where is the centre of pressure? Buy ballots law states that if you stand with your back to the wind, the lower pressure is on your right-hand side in the southern hemisphere.

What is Radiation Fog? Radiation fog forms on clear, calm/light wind, humid nights (especially with a high-pressure system) ... typically extends less than 20ft off the ground, the land surface loses heat to the atmosphere by radiation and cools, moist air in contact with the cooling surface also cools and when the temperature falls below the dew point, fog forms. If there is a light wind of around 5kts, then this will mix the air in contact with the surface and the layer of fog will be thicker. With stronger winds, the fog may lift to form layers of stratus. (disperses with high winds, and increase in temperature)

What is Advection Fog? Advection fog occurs when a warm, moist, air mass flows across a colder surface, the air mass is cooled below by the colder surface and if the temperature of the air mass is reduced to its dew point, then fog forms.

What is Frontal Fog? Frontal fog is a type of evaporation fog, this type of fog forms when warm raindrops evaporate into cooler drier layer of air near the ground, once enough rain has evaporated (liquid changes to gas) into the layer of cool surface, the humidity of this air reaches 100% and fog forms.

What is a thunderstorm? Thunderstorms are associated with cumulonimbus clouds, formed when three conditions are met: There must be a deep layer of unstable air, the air must be warm and moist, a trigger mechanism must cause the moist warm air to rise. (lifting action) (warm air rises because it expands, it becomes less dense than the air around it and hence air pressure exerts an upward force, warm air is less pressure, cold air is denser and more pressure)

• Building phase – Updrafts move the warm air aloft, allowing condensation (vapour to liquid) to take place throughout the ascent. (warm air rises, and cools... once it cools to its dewpoint, water droplets are produced), it continues to rise and starts getting bigger and bigger. (cumulus cloud)

• Mature phase – In the mature stage of a thunderstorm, the warmed air continues to rise until it reaches an area of warmer air and can rise no further (tropopause), the air is instead forced to spread out giving an 'anvil' shape resulting in a CB, the water droplets form into large and heavier droplets and freeze to become ice particles, as these fall they melt to become rain. (if the updrafts are strong enough the droplets are held aloft long enough to become so large that they do not melt completely but fall as hail), while updrafts are

still present, the falling rain drags the surrounding air with it creating downdrafts as well, this is then the mature stage of the storm and creates CB's. Downdrafts can reach 3000ft per minute, and updrafts can reach 5000ft per minute. The mature stage is the most hazardous stage, the dangers include: rain, hail, severe turbulence, severe icing, wind shear and microbursts and lightning.

• Decaying phase – In the decaying phase, the thunderstorm is dominated by a downdraft, if conditions don't support cellular development this stage occurs rather quickly. Since warm moist air can no longer rise, cloud droplets can no longer form, the storm dies out with light rain as the cloud disappears from top to bottom.

- HEAVY PRECIPITATION

Microburst
A microburst is a severe downdraught emanating from the base of a cumulonimbus cloud during a thunderstorm. They are highly concentrated, only about 4 km across, and are found in the middle of a thunderstorm under a mature CB cloud. Microburst can reach up to 3000 ft/min and have a wind speed of approximately 100kt.

• LLWAS: LOW LEVEL WINDSHEAR ALERT SYSTEM

• DRY AND WET MICROBURST

Standard ISA conditions? 15 degrees Celsius, 1013.25 hPa, -2 degrees Celcius every 1000ft lapse rate.

• TROPOPAUSE: – 36000 FT
- -56,5°C°

One millibar in feet? 27ft

INSTRUMENT

What is an airspeed indicator? And how does it work?
The airspeed indicator measures dynamic pressure as the difference between the total pitot pressure measured in the instrument's capsule and the static pressure measured in the case. The dynamic pressure represents the IAS on the instrument.

What is an altimeter? And how does it work?
An altimeter is designated to measure static pressure, which it relates to an indicated alEtude. As the aircraft ascends, the static pressure in the instrument case will decrease, which allows the enclosed capsule to expand, and this in turn moves the needle to the correct alEtude. For a descent, the opposite function applies. The altimeter is calibrated to ISA.

• DIGITISER: SENDS INFO TO TRANSPONDER

What are the NDB/ADF errors?
The errors are: Interference from other NDB stations, static (thunderstorms), night effect, coastal refraction, mountain effect, aircraft quadrantal error and synchronistic transmission. A NDB must maintain its accuracy to within +-5 degrees.

What happens with the airspeed indicator if the pitot probe is blocked during climb?
It shows an increase on the airspeed indicator.

What happens with the airspeed indicator if the pitot probe is blocked in a descent?
It shows an ~~increase~~ on the airspeed indicator.
DECREASE

What happens if pitot tube is blocked? ASI errors, PUDSOD, a blocked pitot tube will affect the airspeed indicators in reverse. (increase of airspeed in climb, decrease of airspeed in descent) This is caused by the pressure in the pitot system remaining constant when the atmospheric pressure is changing. (capsule inside expands when there is less pressure, when there is more pressure it compresses)

What happens if static port is blocked? PUDSOD (will affect all three, ASI, VSI, ALTIMETER) The altimeter will be stuck on the altitude at the time of the blockage as the pressure inside isn't changing, The VSI will also read no change in pressure so it will not change. (it will go back to 0 slowly and stay there), If we descend with a blocked static port, the ASI will over-read, and if we climb the ASI will under-read.

What is the difference between IAS and TAS?
TAS is the speed of an aircraft relative to the air mass in which it flies. At sea level and at ISA conditions TAS and IAS will be the same. At increasing alEtudes, the IAS reduces as the air density is reduced, however TAS will remain the same, therefore TAS is IAS adjusted for changes in air density and alEtudes.

What is LSS at sea level with +15 degree Celsius?
The LSS is 660 kts – ~~39.94 x RACINE(Absolute temp) Absolute temp = temp + 273~~
38.95 · √T°KELVIN

“Pointing to MCP on a 738 cockpit poster” What is this?
In the MCP (Mode Control Panel) mode selector switches are pushed to select desired command modes for the AFDS and A/T. The switch illuminates to indicate mode selection and that the mode can be deselected by pushing the switch again. While a mode is active, deselection can be automatically inhibited and is indicated by the switch being extinguished. All AFDS modes can be disengaged either by selecting another command mode or by disengaging the A/P and turning the F/Ds off.

Where do we monitor what the AFDS is doing?
We monitor Autopilot Flight Director System actions in the FMA.

“Pointing to FMA” What is this?
The FMA (Flight Mode Annunciator) annunciates the engagement or armed autopilot and auto-throttle functions controlled by the MCP. They are showed in green if acEve, or in white if armed. It is divided in 3 secEons, from left to right: A/T engagement mode, roll engaged mode and pith engaged mode. In the lower part of roll and pitch engaged mode there is the roll and pitch armed mode.

Why don't we do this on the MCP?
The MCP is used to set the AFDS commands, but we must check the correct selection and the correct engagement thus checking the FMA.

What's an INS? What's the differences with a GPS?
An INS is an onboard self-contained inertial navigation system that can provide continuous information on an aircraft’s position without any external assistance. An IRS is a modern INS that usually has a greater integration into the flight management system (FMS) and provides the aircraft’s actual magnetic position and heading information with reference to the FMS required position and heading. The general principle of all inertial navigation system (INS) is that the system measures the aircraft’s inertial movement from an initial position as a great circle track direction and distance to continuously determine its up-to-date position.
The components of the IRS are ACCELEROMETERS, GYROSCOPES and POSITION COMPUTER. The aircraft moves in 3 dimensions but the navigation equipment is only interested in acceleration in the horizontal plane, therefore the key to the whole INS arrangement is the ACCELEROMETERS.
An INS is a better system than the Global Positioning System for providing navigation mainly because the downgrading imposed on the normal GPS and because the IRS is the only truly onboard self-contained system, therefore is not prone to external influences (natural effects or transmitter errors such as those which affect the GPS).

GPS affected by: Standard positionning system is degraded but accurate within 100m 99.9% of the time.

- IVS CAN BE INTEGRATED WITH NAV AIDS TO INCREASE ACCURACY
- RLG OF IRS REMOVE PRECESSION, AND ALL OTHER MECHANICAL GYRO'S PROBLEMS
- INS : 2 ACC ; 3 GYRO
- IRS: 3 ACC ; 3 RLG
- IRS : INTEGRATED WITH GPS
- INS: TH IS PROVIDED, BUT NO MH ; IRS PROVIDES MH

What is an FMS and FMC? (flight management system) The FMS is an on-board multi-purpose navigation, performance and aircraft operations, the FMC is a computer system that uses a large database to allow routes to be programmed and fed into the system. (navigation by GPS and IRS).

- FMS = FMC + CDU
  - FMC → NAV + PERF DATABASE (UPDATED EVERY 28 DAYS)
  - CDU → CONTROL DISPLAY UNIT

What is the FMA? Where is it location? Explain the modes?
• The FMA is a flight mode annunciator which indicates what system is controlling the aircraft and what mode is operational.
• The FMA is located on the top of the captain and first officers PFD (primary flight display)
• The FMA is divided into 3 columns and 2 rows, the left column relates to the A/T (auto-throttle), while the centre and right-hand column display roll and pitch modes. The upper row indicates modes are that operational (green), and the lower row indicates modes that are armed (white).

What is an INS/IRS? An INS (inertia navigation system) is an onboard self-contained navigation system that can provide information on an aircrafts position, an IRS (inertia reference system) is a modern INS that has a greater integration into the flight management system (FMS), and provides the aircrafts actual magnetic position and heading information. The directional acceleration information from the accelerometers and gyroscopes is calculated by the position computer that determines the aircrafts latitude and longitude position. (provided a correct initial position has been input) The general principle of the INS, is that the system measures the aircraft's inertia movement from an initial position. (dead reckoning) (there are 2 systems on the 737-800 for redundancy)

Advantages of an INS/IRS?
• Enables an aircraft to fly great circle tracks and to navigate accurately across areas where no ground base navigation aids are available.
• It is a completely self-contained system and therefore is free from external navigation aids and atmospheric errors.
• It is a very accurate system.

What navigation systems are on a 737-800? Compass, ADF, IRS, DME, VOR, GPS, INS/IRS

What is the Cost Index?

It's the "Aircraft operating cost" / "Fuel cost" —> this index will be inserted in the fms and it will give the best speed and consumption profiles for that condition in order to spend less.

What is Datalink?

Datalink is digital air/ground communications between aircraft and ground systems (NO voice communication).

-ACARS: used for datalink communication between aircraft and operator.

-CPDLC: used for datalink communication between controller and pilot (non urgent messages). Increases safety by reducing comprehension errors, and leaves voice frequency free for important communications.

-ATSU: is the computer used to make datalink communications (Airbus only).

GPWS?

It's a system that alerts the pilots of the risk of flying into high terrain and/or unsafe aircraft condition or configuration. EGPWS gives terrain look ahead function and terrain clearance floor.

Inputs:

-CAS

-Radio Altitude

-Press Altitude

-V/S

-Glide Deviation

-Flaps and Gear position

-4D FMS position (EGPWS only)

-Terrain Database (EGPWS only)

TCAS?
It's the traffic collision avoidance system. Uses nearby aircraft transponder signal to alert the pilots of the danger of mid air collision.

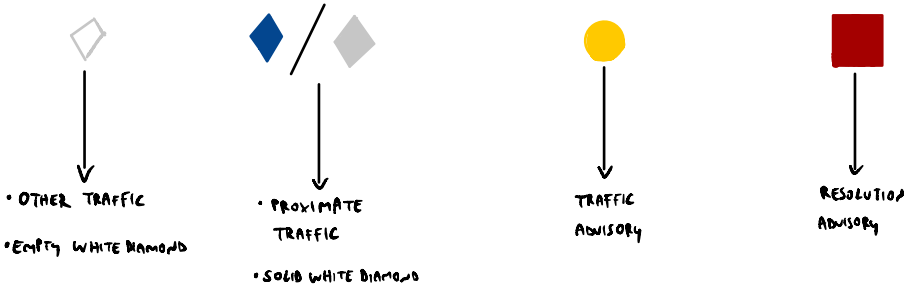
TCAS modes:

1)Proximate Traffic: a/c is within 6NM range and it's at +- 1200FT (not a danger still)

2)TA (traffic advisory): when traffic is between 45 and 35 sec —> "traffic,traffic"
NO manoeuvre should be made at this stage, just monitor.

3)RA (resolution advisory): when traffic is between 35 and 15 sec —> "climb!"

-Timing can depend on the altitude



-Actions in case of a RA:

• Autopilot……..Off

• Both Flight Directors……..Off

• Vertical Speed…….. Adjust or Maintain

• Respect Stall, GPWS or Windshear Warnings.

• ATC……..Notify: -"TCAS RA"
-"CLEAR OF CONFLICT, RETURNING TO…"
-"RESUMED"

*NOTE: TCAS RA HAS PRIORITY OVER ATC INSTRUCTIONS
↓
IN CASE OF ATC INSTRUCTION DURING RA : "UNABLE TCAS RA"

Autopilot autoland?

-Fail operational autoland: after a failure of 1 autopilot, landing can be completed because it ha 3 of them and can exclude the faulty one (or 2 channel atuopilot but with a system that can identify and disconnect the faulty autopilot).

-Fail passive autoland: if 1 autopilot fails, it's not possible to identify which one. A/P off, manual landing.

Tell me about ELT's? (emergency locator transmitters) ELT's are small, battery-powered devices that broadcast a distinct sound on a dedicated emergency frequency, older units broadcast on 121.5 MHz, while newer units broadcast on 406 MHz, a group of dedicated officials listen for signals, which are captured by satellites and then sent to a command centre (ELT must first begin transmitting), Accelerometers in the units are designed to activate the emergency signal once a certain force threshold is reached.

PERFORMANCE

- GRAPHS
- FACTORIZATIONS

https://pilotinterviewhandbook.com/performance/

Name the V speeds in order they come?
VMCG V1 VMCA VR V2
V1= Vmcg (minimum), Vr or Vmbe (maximum) VR = 1.05 VMCA(minimum) ~~Vmbe, (maximum)~~ V2 = 1.20 VS or 1.10 VMCA

What is screen height?
Screen height relates to the minimum height achieved over the runway before the end of the clearway should an engine failure occur on takeoff. For a jet aircraft screen height is 35ft in dry conditions, 15ft in wet conditions. The screen height also marks the end of the take off distance.
It's the minimum height that an aircraft must achieve before the end of the TODA in the event of an engine failure during takeoff.

- 15 FT IN WET ⟶ DUE TO DECREASED V1, IT WOULD TAKE LONGER TO ACC. TO VR IN CASE OF EN. FAIL ⟶ WOULD BE GREATER TODR ⟶ BUT WE REDUCE SCREEN HEIGHT

What is V1?
V1 is the decision speed in the event of an engine failure during the takeoff roll, at which it is possible to continue the takeoff and achieve the screen height or to stop the aircraft within the emergency distance available (ASDA). The minimum V1 speed is restricted by the VMCG speed, and the maximum V1 is the VMBE (maximum brake energy speed).

What is V2?
V2 speed is the takeoff safety speed achieved by the screen height in the event of an engine failure that maintains adequate directional control and climb performance properties.

- FLOWN IN CASE OF ENGINE FAILURE
- IN NORMAL OPERATIONS: $V_2 + 10/20$

VMCA VS V2 : - V2 GIVES ALSO CLIMB GRADIENT REQUIREMENTS
- VMCA GIVES CONTROLLABILITY ONLY

What is VMCA?

VMCA is the minimum control speed in the air for a multiengine aircraft in the takeoff and climb-out configuration, at and above which it is possible to maintain directional control of the aircraft around the normal/vertical axis by use of the rudder within defined limits after the failure of an off-center engine.

CAN BE INCREASED WITH DE-RATED POWER (NOT THE ASSUMED T°)
↓
CAN INCREASE MTOW

What is VMCG?

VMCG is the minimum control speed on the ground for a multiengine aircraft at a constant power setting and configuration at and above which it is possible to maintain directional control of the aircraft around the vertical axis by use of the rudder to maintain runway heading after failure of an off-center engine.

- ALLOWS 30FT DEVIATION FROM CENTERLINE
- CALCULATED IN OKTS XWIND ⟶ IF XWIND: - UPWIND ENGINE IS WORSE ⟶ DURING T/O YOU NEED TO RUDDER OPPOSITE TO WIND + E. FAIL. UPWIND ⟶ EVEN MORE RUDDER REQUIRED ⟶ "CRITICAL ENGINE"

Defintions of TORA, clearway, TODA, stopway, ASDA.

-TORA is the usable length of the runway available that is suitable for the ground run of an aircraft taking off. In most cases this corresponds to the physical length of the runway.

-CLEARWAY is the length of an obstacle-free area at the end of the runway in the direction of take off, with a minimum direction of 75m either side, over which an aircraft may make a portion of its initial climb to the screen height.

-TODA is the length of the usable runway available plus the length of the clearway available. TODA is not to exceed 1,5xTORA.

-STOPWAY is the length of an unoreoared surface at the end of the runway in the direction of the takeoff that is capable of supporting an aircraft if the aircraft has to be stopped during the takeoff run, and doesn't require to be 75m either side of the centerline as the clearway, but just as wide as the runway. ASDA is the length of the takeoff run available, usually the phisically length of the runway, plus the length of any stopway if available.

Runway conditions

Damp: moisture is on runway, but is not reflective

Wet: water < 3mm, for at least 25% of runway

Contaminated: -slush
-snow
-water>3mm

Water Patches: stagnant water patches on the runway

Flooded: excessive stagnant water on the runway

How does a wet runway affect your takeoff?

A wet runway increases the takeoff distance, and change the V1 to V1wet that is V1 – 10 or, if lower than Vmcg, the Vcmg.

- V_1 WET = V_1 - 10KT
  ⏟
  IF $< V_{MCG}$ ⟶ V_1 WET = V_{MCG}

1) LONGER T/O DISTANCES
2) LOWER V1
3) SCREEN HEIGHT 15FT

Advantages of flying at high altitude?

-As altitude increases, air density decreases

-This means that at high altitudes there is less air resistance (drag) on the aircraft, thus allowing it to fly at higher TAS resulting in better fuel efficiency

-As a rule of thumb, TAS = IAS + FL/2

-On top of that, jet engines operate more efficiently at higher thrust settings and with less density and colder air

-This means that at high thrust settings, an increase in thrust results in lower increase in fuel burn than the same increase at low thrust settings (lower specific fuel consumption)

What is Long Range Cruise speed?

It is the speed that gives you:

-1% less distance to fly than the Maximum Range Cruise speed

-Approximately 3.5% higher cruise speed than the Maximum Range Cruise speed, resulting in less flight time, thus being more efficient

For jet aircrafts, which would result in higher fuel burn; Maximum Range Cruise speed or Maximum Endurance speed?

-Maximum Endurance speed for jet aircrafts is the minimum drag speed (VMD) and thus results in the minimum fuel consumption

-Maximum Range Cruise speed would result in higher fuel consumption due to increased drag (compared to VMD)

Note: For jet aircrafts, maximum endurance speed is approximately 75% of maximum range speed

Background info:

-For propeller aircrafts VMD is the maximum range speed

-For propeller aircrafts VMP is the maximum endurance speed

What is ETOPS?

-ETOPS stands for Extended Twin Operations (or Extended Operations in the US)

-ETOPS approved twin-engine aircrafts are able to fly at distances more than 60 minutes away from a suitable airport

-ETOPS approved aircrafts with more than two engines are able to fly at distances more than 180 minutes away from a suitable airport

-Distance away from a suitable airport is determined based on one-engine-inoperative cruise speed in still air conditions (zero wind)

What is climb gradient?

- Climb Gradient= Climb rate / TAS

• Actual climb gradient formula is: 6000 / 6080 x Climb rate / TAS

• Example: Climb gradient 2.5% with TAS 140 kt means minimum rate of climb required is 350 ft / min

What is the missed approach minimum climb gradient required?

-2.5% (takes into account one-engine-out climb performance in case of a go-around)

What is the SID minimum climb gradient required?

• 3.3% (does not take into account one-engine-out climb performance in case of an engine failure on takeoff)

Note: In case of Engine Failure After Take Off, aircraft is permitted to leave the SID, as it is a safety issue, however should inform ATC as soon as possible
(aviate - navigate - communicate)

1

What is coffin corner?

AERODYNAMIC CEILING

Coffin corner occurs at an aircraft's ~~absolute ceiling~~, where the speeds at which Mach number buffet and pre stall buffet occurs are coincident. Therefore, a margin is imposed between an aircraft's operating and absolute ceiling.

↓

1.3g → MANOUVRE CEILING

Effects of high altitudes operations?

1

High altitude operations are taken to be those above FL250. Above this altitudes there is a reduction in the range of airspeed over which an aircraft remains controllable, in the event of depressurization the time of useful consciousness reduces dramatically and flying at high alEtudes occupants are exposed to cosmic radiation.

2

3

AT MCT

2

Absolute ceiling

→ $V_x = V_y$ → THRUST = DRAG → ROC = 0 FT/MIN → NO MORE EXCESS POWER

It's an aircraft's maximum attainable altitude/flight level at which the rate of climb is zero, or the Mach number buffet and prestall buffet occur coincidentally, therefore an aircraft is unable to climb above its absolute ceiling. It is determined during flight certification trials.

3

Maximum service ceiling

→ INFLUENCED BY T°; CG; WEIGHT

It's an aircraft imposed en route maximum operating altitude/flight level which provides a safety margin (1.5g) below its absolute ceiling and it can sustain a climb gradient of at least 500 ft/min (jet).

- 500 FT/MIN JET
- 100 FT/MIN PROP
- 50 FT/MIN PISTON

Crosswind formula

Crosswind speed = wind speed * sin (α) Headwind speed (or tailwind) = wind speed * cos (α)

X Wind calculations

	20°	30°	45°	60°	70°
Vt	0.3 Vw	0.5 Vw	0.7 Vw	0.86 Vw	Vw (0.93)

Crosswind calculation technique? Clock method – 60 degrees = all the crosswind, 30 degrees = half the crosswind, windspeed X SIN (wind angle)

- RULE OF THUMB: RWY 03, WIND 090/20

↓

03 - 090 = 0.2

↓

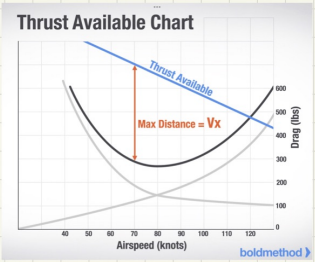
0.2 + 0.2 = 0.4

↓

0.4 X 20KT = 8KT

-VX:

Occurs where we have max difference between Thrust Available and Total Drag= max excess Thrust

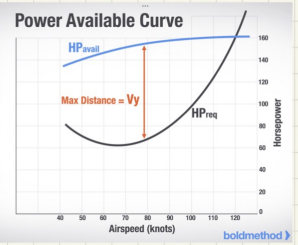


Propeller can generate the most thrust at slow speed because of higher alpha

-VY:

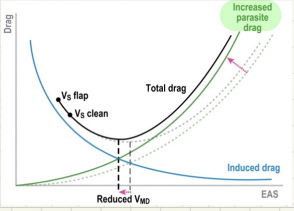
Occurs where we have max difference between Power Required and Power Available= max excess Power

Power Required= Thrust Required X Airspeed (horsepower= power X 0.003)
P=Lavoro/Tempo= Forza X Spostamento / Tempo= Forza X Velocità



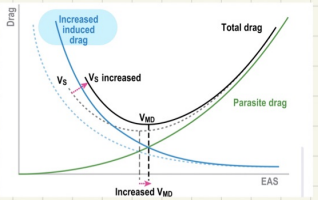
-VX & VY WITH FLAPS:

Parasite drag increases, Vmd decreases, Vx&Vy decrease



-WITH WEIGHT:

Induced drag increases, Vmd increases, Vx&Vy increase



-WITH ALTITUDE:

Vx and Vy expressed in tas increase because the curves move forward

Vx increases faster than Vy, and if we express them as IAS, for Vy the Ias is decreasing because the increase due to altitude is not as big as the change in altitude that makes difference between ias and Tas.
So with altitude:
-Vx constant
-Vy decreases
Until they get the same speed

Why are jet engines more efficient at high altitude? They work better at high altitude because the air is cooler, cool air expands more when heated than warm air, it is the expansion of the air that drives the combustion engines. Also the air is less dense at altitude therefore the aircraft flies much faster at high altitude than low altitude at the same thrust, AND LESS DENSE AIR = COMPRESSOR ROTATES MORE EASILY

What is V1? (decision speed) The speed beyond which the take-off should no longer be aborted. (V1 reduces with contaminated runway)

What is VR? (rotation speed) The speed at which the pilot begins to apply control inputs to make the aircraft nose pitch up. (ensures that V2 at screen height)

- $V_R < V_{LIFT\ OFF}$

What is V2? (take-off safety speed) The speed at which the aircraft may safely be climbed with one engine in-operative, the minimum speed to be maintained up to the acceleration altitude, in the event of an engine failure after V1, flight at V2 ensures that the minimum required climb gradient is achieved and that the aircraft is controllable, the minimum speed that must be reached at a height of 35ft (screen height) (V2 needs to be higher than VMCA) (V2 cannot be less than VS x1.20 and VMCA x 1.10) (V2 depends on runway length

→ FOR PROP A/C

What is VNE? (Never exceed speed – true airspeed) The speed if exceeded result in structural damage to the aircraft, represented by a red line. (flutter) It is limited by stress limits on the surfaces

- TRANSPORT A/C : USE VMO/MMO

What is VREF? (landing reference speed) The speed required as the runway threshold is crossed at a height of 50ft in landing configuration, 1.3 times the stalling speed.

Where is the screen height? The 35ft screen height is at the end of TODA (take-off distance available) (wet runway, screen height reduces to 15ft.)

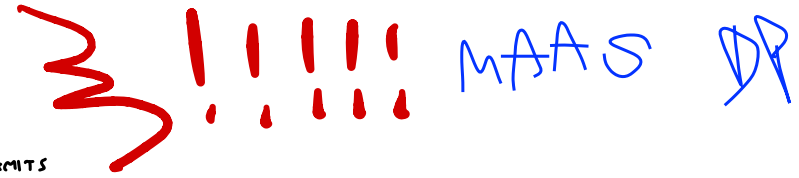
What is VMCG and the relationship to V1? (minimum control speed on ground) The minimum speed, whilst on the ground that directional control can be maintained, using only aerodynamic controls, with one

engine inoperative, V1 is not allowed to be lower than VMCG, must be equal or lower. (rudder is more powerful the faster.), if an engine failure is detected after V1, the take off must be continued, this implies that the aircraft must be controllable on the ground, therefore V1 is always greater than VMCG (other engine remaining on full power)

What is VMCA? (minimum control speed in air) The minimum speed, whilst in the air that directional control can be maintained with one engine inoperative, take off power, maximum bank of 5 degrees to the good engine. (gear retracted)

What limits altitude? The higher you get, the lower the density of the air becomes, meaning lower lift. Also, the higher you get, the lower the thrust your engines deliver. Maximum Mach number also limits altitude, Coffin Corner.

- MANOUVRE CEILING
- ABSOLUTE CEILING
- AERODYNAMIC CEILING
- SERVICE CEILING
- DIFFERENTIAL PRESS. LIMITS



Could an aircraft take-off at MTOW and reach FL410 (ceiling)? No, if weight and altitude increases, stalling speed increases, increasing weight requires more lift to keep the aircraft in the air. (lift is proportional to speed)

- ↗W = ↗L = ↘VS = MAX ALT ↙

Why do we fly at Mach number? The ASI works by picking up the increased pressure as the airplane travels through the air and displays that information as airspeed.
But the atmosphere is not at a constant density, the higher one goes up the less dense air is, so the basic ASI compensate for the significant differences in density at higher altitudes. The speed of sound is the new reference point from which to measure our speed. ⟶ CROSSOVER ALTITUDES FL260
Mach number = TAS / LSS
LSS = 38.94 X Square root of temperature (in kelvin, degrees celcius + 273, LSS decreases with altitude, TAS increases with altitude, Mach number increases with altitude)

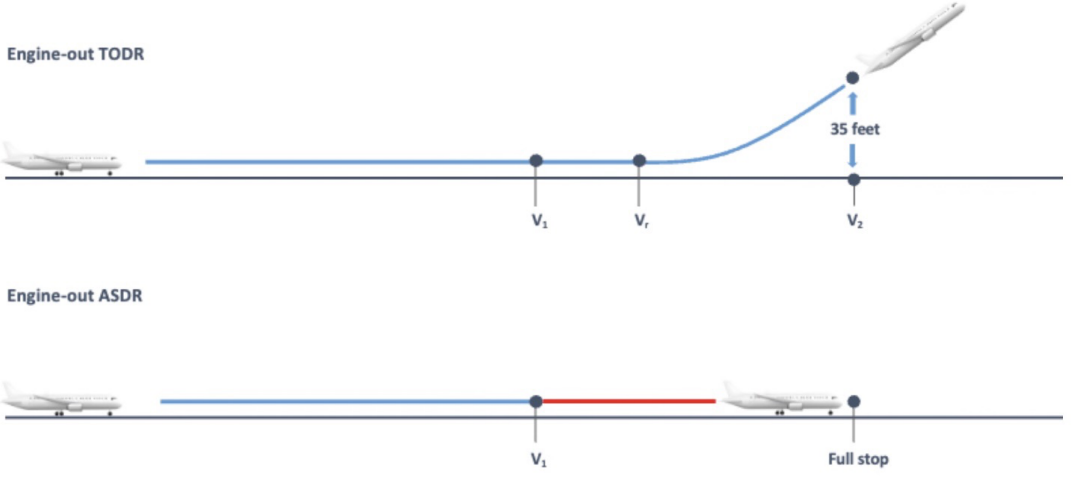
- LSS = $38.94 \cdot \sqrt{T°\text{KELVIN}\ (C° + 273)}$
- AFTR CROSSOVER ALT → MN MORE RESTRICTIVE

What is a stopway/clearway?
• A stopway is an area beyond the runway which can be used for deceleration in the event of a rejected take-off, capable of supporting the aeroplane without causing structural damage. (used in ASDA)

• A clearway is an area beyond the paved runway, free of obstructions and under the control of the airport authorities. (not less than 152m wide) (used in TODA)

What is balanced V_1?

- The V_1 that results in TODR equal to ASDR is called balanced V_1
- If an engine failed just prior to V_1 the point at which the aircraft would come to a complete stop in the STOP case would be the same with the point at which the aircraft would reach the screen height in the GO case
- Balanced V_1 gives the minimum field length required for a given weight, called balanced field length. Any lower V_1 would increase TODR as it would take longer for the aircraft to accelerate to V_2 with one-engine-inoperative and any higher V_1 would increase ASDR due to higher energy absorption by the brakes
- In essence, balanced V_1 improves field length limited takeoff performance



Note:

- Field length can be limited by either ASDR, TODR or 115% of all-engine TODR
- If an engine failed exactly at V1, you may not be able to reject the takeoff within ASDR
- This is because of minimum recognition time required between the engine failure and initiation of RTO (i.e. engine failure at V1 means that the first action to reject takeoff would be taken after V1)

What is unbalanced V_1?

- Any V_1 that results in TODR different than ASDR is called unbalanced V_1
- Unbalanced V_1 allows for higher takeoff weights by taking advantage of any runway and clearway or stopway available in excess of balanced field length
- A lower than balanced V_1 allows for higher brake energy limited weights due to lower energy absorption by the brakes, whereas a higher than balanced V_1 allows for higher obstacle and climb limited weights due to faster acceleration to V_2
- In essence, unbalanced V_1 is the optimum V_1 if you are not field length limited

What is the reason for the 80KTS call?

1) Incapacitation check

2) Airspeed indicator crosscheck —> only moment where we can actually check ASI

3) Transition from low to high speed rejected takeoff —> now we have less reasons for a rejected T/O

How do take off speeds vary with flap setting?

The higher the flap settings the lower the takeoff speeds.
This is because higher flap settings increase S (wing surface area) and Cl (coefficient of lift) of the wing, which results in lower takeoff speeds required in order to generate the same amount of lift

How would you configure for a field length limited takeoff?

-Balanced V1
-High flap setting

How would you configure for a climb/obstacle limited climb?

-Lower flaps setting

Assumed T°?

Increases fuel burn since you produce less thrust but you increase time fro T/O and climb —> increase in fuel burn

Energies that can control a pilot?

-Kinetic, potential , chemical

Up until what point can you execute a go-around?

-Up until selecting reverse thrust
-Once reverse thrust has been selected, you are committed to land

A go-around executed below minimums is called a rejected landing if initiated prior to touchdown or a balked landing if initiated after touchdown

How do you convert wind speed in m/s into kts?

As a rule of thumb, knots are approximately double the m/s (e.g. 5 m/s is 10 kts)

What is TODA/TORA/ASDA?
• TODA (Take Off Distance Available) – TODA is the length of the runway plus any clearway if available, if no clearway TODA = TORA

• TORA (Take Off Run Available) – TORA is the length of the runway declared available and suitable for the ground run of an aircraft taking off.

• ASDA (Accelerate Stop Distance Available) – ASDA is the length of the TORA plus the stopway if provided (used for the calculation of V1)

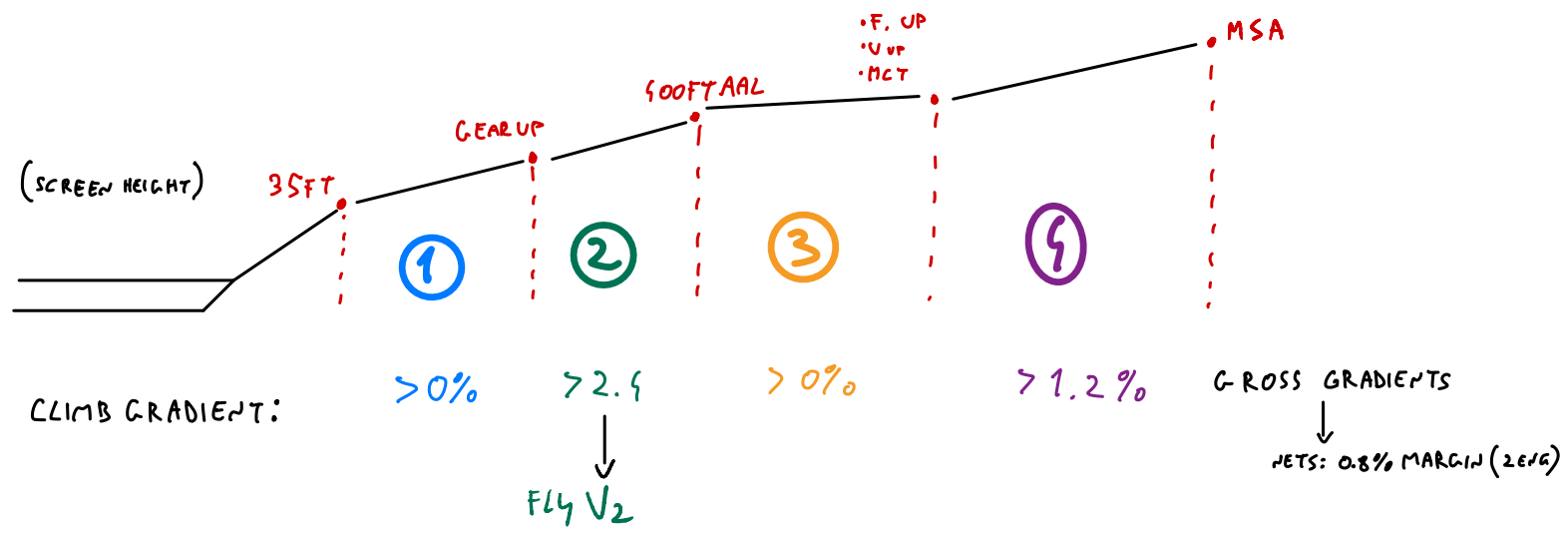
Why do we not use maximum take-off thrust? We don't use maximum take-off thrust as the required thrust for take-off normally is less than what the engines are capable of producing, main advantages – cost saving through increased engine life, fuel savings. (it may be possible to increase the maximum take-off weight for a specific runway using a reduce thrust profile)

Take-off segments

• 1st segment – The 1st segment starts at the screen height (35ft) at the end of the TOD, speed remains at V2 and ends when the landing gear is retracted.

• 2nd segment – The 2nd segment starts when the landing gear is retracted, speed also remains at V2 and ends at 400ft AAL. (or higher if obstacles)
• 3rd segment – The 3rd segment is a level accelerating segment where flaps are retracted, the speed is accelerating, ends when the speed has accelerated to the clean speed, power then reduced to maximum continuous thrust.

• 4th segment – The 4th segment starts when the aircraft is clean configuration, and set to maximum continuous thrust. The 4th segment ends when the aircraft is at 1500ft AAL (or higher if obstacles). MSA



Why do we have take-off segments? During the take-off segments, the configuration of the aircraft changes and so does the performance, therefore diving the flight path in segments, helps us to study the different climb gradients the aircraft will fly to ensure it clears obstacles in case of an engine failure.

Why do we have climb gradients? Climb gradient is simple how steeply the aircraft can climb, for example, a climb gradient of 6% means for every 6ft of altitude, the aircraft travels 100ft along the ground. Certain gradients are to be met by aircraft with an engine failure during take-off and an engine failure during the go-around.

Net Vs Gross flight paths? Net is what we do the calculations on (reduced performance), gross is what we fly.

- 0.8% 2ENG

How to calculate aquaplaning speed? (P = tyre pressure in psi) (moving wheel loses contact with surface)

- Take-off – Hydroplaning speed (kts) = 9 X Square Root of P
- Landing – Hydroplaning speed (kts) = 7.7 X Square Root of P

T/O: $V = 9 \cdot \sqrt{P(psi)}$ ⟶ ROTATING

LDG: $V = 7.7 \cdot \sqrt{P(psi)}$ ⟶ NOT ROTATING

NAV

Range of vor?

1.25 √Receiver Ht (in feet) + √Transmi[er Ht (in feet)

$1.23\sqrt{H_1} + 1.23\sqrt{H_2}$

What is Convergency?

Convergency represents the change of direction experiences along east/west tracks (except rhumb lines) as a result of the way direction is measured due to the effects of converging meridians at the poles. The chance of direction experienced between two points is known as CONVERGENCY, which is clearly dependent on latitude.

convergency = change of longitude X sin mean latitude

What is a Great circle?
A great circle track is a line of shortest distance between two points on a sphere (or a flat surface) with a constantly changing track direction as a result of convergence.

• REPRESENTED ON A CHART IT'S CURVED

How does a VOR work? (VHF omnidirectional range) VOR is a type of navigation system, it is aligned with magnetic north and it emits two signals, a 360-degree sweeping variable signal and an omni- directional reference signal. The signals are compared by the aircrafts receiver, and a phase difference between them is measured, giving a precise radial position of the aircraft and displaying it on the instruments. (it is a line-of-sight instrument and it also has a cone-of-confusion when flying near or over the top of a VOR it will give erroneous readings.

What is a great circle and why do we fly them? A great circle is a line of shortest distance between two points on a sphere with a constantly changing track
direction as a result of convergence. (convergence= sin (mean
latitude) x change in longitude), we fly them because it is a
shorter distance which means it saves time and fuel! (due to the curvature of the globe and also the circumference of the earth is bigger at the equator than towards the poles.)

What is a rhumb line? A rhumb line is a line on the earth's surface cutting all meridians at the same angle.

What is GPS, how does it work? (global positioning system) GPS is a satellite-based navigation system made up of at least 24 satellites, GPS satellites orbit about 20,000km and complete one orbit every 12 hours, ground stations use the signals to track and monitor satellites, and these stations provide the MCS (master control station) with data, the MCS then provides very precise position data to the satellites, the receiver in an aircraft receives time data from the satellites atomic clocks. It compares the time it takes for the signal to go from the satellite to the receiver, and calculates distance based on that very and specific time, GPS uses triangulation, data from at least three satellites, can provide two-dimensional location, four satellites can provide three-dimensional location. (four satellites will always be in line-of-sight range of an aircraft receiver at any position on the earth at any time)

What is an NDB? (non-directional beacon) An NDB is a ground based medium range navigational aid that sends out a signal in all directions for aircraft to home to, the NDB transmits in the 200-1750 kHz medium and low frequency bands and uses a surface-wave propagation path, maximum range over land is 300nm, max range over the sea is 600nm. (ADF needle will point towards the station)

- OMNIDIRECTIONAL SIGNAL
- LF-MF 200 - 1750 kHz
- SURFACE WAVE
- 300nm / 600nm
  - LAND
  - SEA

- ADF : IN THE COCKPIT
- RANGE DEPENDS BY POWER ⟶ $R = 3\sqrt{P(\text{WATTS})}$

What are the errors of an NDB?

- Night Effect – The ionosphere reflects NDB signals back to Earth, causing signal strength fluctuations.
- Terrain Effect – High terrain like mountains and cliffs can reflect radio waves, giving erroneous readings.
- Station Interference – Due to congestion of stations in the LF/MF bands, there is a possibility of interference from stations on or near the same frequency.
- Thunderstorm Error – In areas of high electrical activity, the ADF needle will deflect toward the source of electrical activity, causing erroneous readings.

- COASTAL REFRACTION

AIR LAW/OP

What is the minimum altitude above high ground? In the rules of the air it states: an aircraft shall not fly at a height of less than 1000ft above the highest obstacle within a distance of 5 nautical miles of the aircraft.

- IFR:
  - HIGH TERRAIN: 2000 FT, RADIUS 8 KM
  - NORMAL OPERATIONS: 1000 FT, RADIUS 8 KM

- VFR:
  - ALTITUDE THAT PERMITS SAFE LANDING IN CASE OF EMERGENCY
  - 1000 FT ABV HIGHEST OBSTACLE IN 600M RADIUS OVER CONGESTED AREAS
  - 500 FT ABV GND OR WATER

Wake turbulence distance separation? (aircraft follows another aircraft at same altitude or less than 1500ft below it, or same runway/parallel runways) (radar)

- Heavy – Light = 6nm

- Heavy – medium = 5nm
- Medium – light = 5nm
- Heavy – heavy = 4nm

What is MAA MAX AUTHORIZED ALTITUDE

What is MSA? A radius of 25 NM around an aerodrome giving 1000ft separation from the highest obstacle.

What is MOCA? GIVES 1000 FT - 2000 FT CLRNCE IN AIRWAY 5000 T

What is MEA? • MIN ALT PROVIDING OBSTACLE CLEARENCE + RADIO, NAV SIGNAL COVERAGE 5000

What is MHA? • MIN ALT IN HOLDING : 1000FT OBST. CLR. + COMM, NAV COVERAGE

What is MORA?

1) ROUTE MORA : OBSTACLE CLEARENCE 10NM OFF ROUTE CENTERLINE 5000 a

Etc

2) GRID MORA: 1000 FT CLEARENCE IN A SECTION DEFINED BY LAT AND LONG LINES

What's the difference between DA and MDA?
- DA is a specific altitude in a precision approach at which a missed approach must be initiated if not visual.
- MDA is a specific altitude in a non-precision approach or a circling approach below which descent must not be made without being visual.

Precision approach CAT
- CAT I – DH 200ft, RVR 550m or 800m visibility single crew (ILS receiver/display required)
- CAT II – DH 100ft, RVR 300m
- CAT III

A - DH< 100FT, RVR 200 m

B - DH > 50 FT, RVR 75M

C - DH 0 , RVR 0

Minimums for the Alternate

• VALID ONLY FOR PLANNING, ONCE AIRBORNE, NORMAL MINIMUMS

Alternate

The planning minima defined in the table below are applicable to destination alternate, isolated destination and 3% ERA.

Type of Approach	Planning Minima
CAT II and CAT III	CAT I RVR
CAT I	Non-precision RVR and the ceiling must be above MDH (See note)
Non-precision	Non-precision RVR and the ceiling must be above MDH (See note) plus 200 ft and 1000 m
Circling	Circling (Vis/RVR/MDH(VM(C))

Note. *Non-precision means the next highest minimum that is available at the aerodrome. So, for CAT I ILS this could be ILS no GP or, for example, a VOR/DME. The same is applicable to non-precision approaches.*

What is RVSM airspace?

A program was initiated by ICAO in 1982 involving worldwide studies to assess the feasibility of a reduction of the Vertical Separation Minima (VSM) above FL290 from 2,000 feet to 1,000 feet.

The principal benefits which the implementation of the reduced VSM were expected to provide were:

- A theoretical doubling of the airspace capacity, between FL290 and FL410; and
- The opportunity for aircraft to operate at closer to the optimum flight levels with the resulting fuel economies.

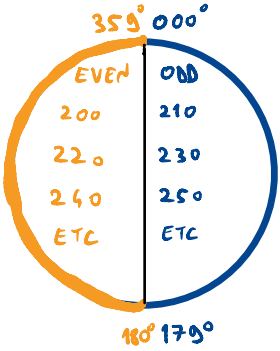
An operator shall ensure that aeroplanes operated in RVSM airspace are equipped with:

1. Two independent altitude measurement system;
2. An altitude alerting system;
3. An automatic altitude control system; and
4. A secondary surveillance radar (SSR) transponder with altitude reporting system that can be connected to the altitude measurement system in use for altitude keeping. (IR-OPS SPA.RVSM.110, EU-OPS 1.872)

Semicircular levels?

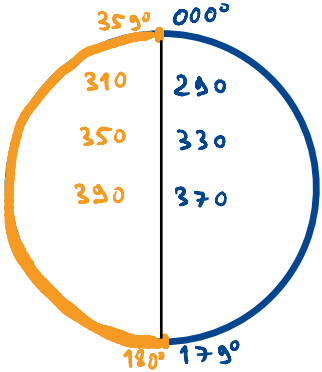
ICAO:

-Below FL290



- VFR
- BELOW FL 245 : ICAO SEMICIRCULAR + 500 FT
- ITALY

-Above FL290



What are the lights on the runway?

1) Runway edge lights: - white lights
- yellow —> in the last 600m, or 1/3 of rwy (caution zone, not always required)

2) Threshold lights: - green —> in the approach direction
- red —> in the opposite direction

3)Runway centreline lights: - white —> threshold - 900m from end
- red&white —> 900m - 300m from end
- red —> the last 300m

4)Touchdown zone lights: - must be provided for cat II and cat III operation runways
- 900m in the touch down zone

Approach lighting?

1)Simple approach lighting system: - non precision app runway
- at least 420m

2)Cat I lighting system: - at least 900m
- at least 1 crossbar

3)Cat II/ Cat III lighting system: - at least 900m
- at least 2 crossbars

-PAPI

Runway markings?

1)Pre-threshold markings:

- temporary displaced 
- tempo or permanently displaced threshold 
- stopway 

2)Aiming point markers: - distance from threshold depends on the LDA 

3)Threshold markings: - number of strips depends on the runway width 

4)Touchdown zone markings: - pair of markings depends on the distance between thresholds or LDA 

VFR weather minimums?

Altitude band	Airspace class	Minimum flight visibility	Minimum distance from clouds
At and above 3050m or 10000ft AMSL	A, B, C, D, E, F, G	8 km	1500 m horizontally 300m or 1000ft vertically
Below 3050m or 10000ft AMSL **and above**, 900m or 3000ft AMSL or, 300m or 1000ft above terrain, whichever is the higher	A, B, C, D, E, F, G	5 km	1500 m horizontally 300m or 1000ft vertically
At or below 900m or 3000ft AMSL or, 300m or 1000ft above terrain, whichever is the higher	A, B, C, D, E	5 km	1500 m horizontally 300m or 1000ft vertically
At or below 900m or 3000ft AMSL or, 300m or 1000ft above terrain, whichever is the higher	F, G	5 km (*)	Clear of cloud and with the surface in sight

Remarks:

- Where flight visibility has been reduced to not less than 1500m, flights may be permitted at speeds that give adequate opportunity to observe other traffic or any obstacles in time to avoid collision (dependent on the country regulations).
- Helicopters may be permitted to operate in less than 1500m flight visibility if they can observe other traffic and any obstacles in time to avoid collision. (depends on your country regulations).
- The VMC minima in class A airspace are included for guidance to pilots and do not imply acceptance of VFR flights in class A airspace automatically.

- A VFR FLIGHT SHALL NOT TAKE-OFF IF:

1) CTR/ATZ: • CEILING < 1500 FT
• VISIBILITY < 5000 M

2) F/G: • CEILING < 600 FT
• VISIBILITY < 1500M

Non precision approaches?

1)Constant angle descent: - app is flown at a constant angle from FAF to 50ft above runway
- when reaching MDA alt is hold until visual reference or until MAP

2)Stepdown descent: - steps of descents and altitude holds
- when reaching MDA altitude is hold until visual reference or MAP

3)Continuous descent final approach: - continuous descent from IAF to 50ft above the runway
- a/c is never flown level, when reaching MDA (MDA + 40ft), if no visual reference —> go around (can't wait until MAP because it's never flown level), no turns before MAP

What are the three types of instrument approaches?

-Precision approaches (e.g. ILS)
-Non Precision approaches (e.g. VOR)
-APV (Approach Procedure with Vertical guidance) approaches (e.g. LNAV/NAV)

-Precision approaches and APV approaches have both lateral and vertical guidance and are flown down to DA
-Non precision approaches have only lateral guidance and are flown down to MDA

What is DA?

-DA stands for Decision Altitude

-It is an altitude on an approach with both lateral and vertical guidance, at which a missed approach must be initiated if the required visual reference to continue the approach has not been established

-The Decision Altitude accounts for altitude loss during go-around

Background info:

-Required visual references to continue the approach vary depending on the approach being flown

-For example, if executing a CAT I approach, a pilot may continue at minimums if visual with any runway lights (e.g. touchdown zone lights, runway threshold lights etc.), whereas if executing a CAT IIIA approach, a pilot may continue only if visual with at least three consecutive lights

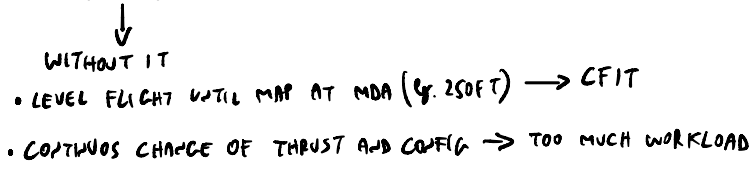
What is MDA?

-MDA stands for Minimum Descent Altitude

-It is an altitude on an approach with only lateral guidance (non-precision approach) below which descent must not be made without the required visual reference

-Altitude loss during go-around should not result in the aircraft descending below MDA

-For this reason, operators add 40-50 ft on the MDA to compensate for altitude loss during go-around and permit continuous descent (CDFA)



What is RVR?

-RVR stands for Runway Visual Range

-It is the horizontal distance a pilot can see down the runway

-RVR is reported only if it falls below 1500 m

-Reported RVR is always greater than or equal to reported visibility

What are the weather minima for CAT I, CAT II and CAT III A approaches?

-CAT I: DH must be at or above 200 ft and RVR at or above 550 m
-CAT II: DH must be at or above 100 ft but less than 200 ft and RVR at or above 300 m (350 m in the US)
-CAT III A: DH must be at or above 50 ft but less than 100 ft and RVR at or above 200 m

Note:
• CAT I minima are not based on radio altitude due to terrain below the aircraft (e.g. you could get the minimums call more than once - before and/or after the actual minimums - depending on the terrain below aircraft's approach path)
• CAT II/IIIA minima are set based on radio altitude whereas CAT I minima are set based on barometric altitude

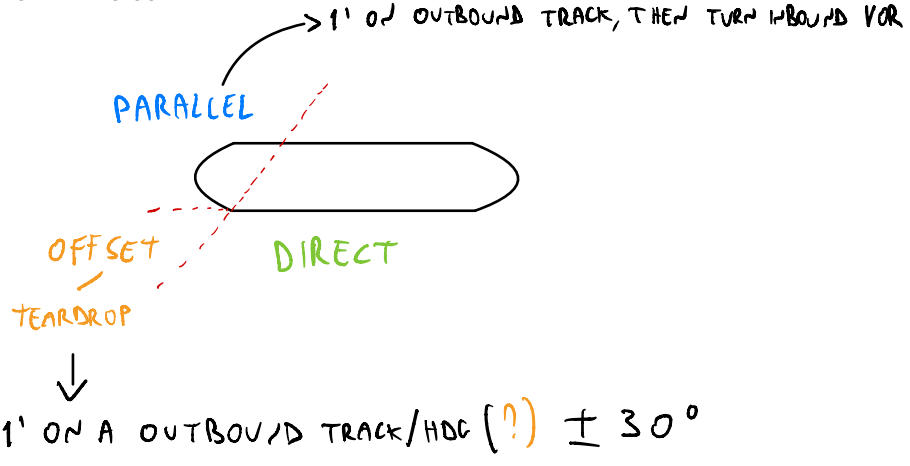
Background info:
-DH is referenced to height above threshold elevation
-Although DH for CAT II operations may not be less than 100 ft, RA minima for CAT II approaches may sometimes be slightly less than 100 ft
-This is because radio altimeter measures height AGL (radio altitude)
-The point that you would reach your A minima for CAT II approaches would be prior to threshold elevation
-If at that point, terrain height below the aircraft is higher than the threshold elevation, then RA minima could be less than 100 ft in order to result in 100 ft above the threshold elevation (DH)

Holding procedures?

-Turns: 25° bank or 3°/sec, whichever requires less bank

-Timing: - at or < FL140 —> 1' outbound
- > FL140 —> 1'30" outbound

-Max Speeds: - at or < FL140 —> 170Kts (A,B); 230Kts (C,D)
- FL140-FL200 —> 240Kts
- FL200-FL340 —> 265Kts
- >FL340 —> M0.83



Airspace classification?

-Speed restriction: -IFR —> A,B,C not restricted
-VFR —> B not restricted

What are the ICAO aircraft weight categories?

They refer to aircraft Maximum certified Takeoff Weight

-Super: equal or greater than 560t (A380)
-Heavy: equal or greater than 136t but less than 560t
-Medium: greater than 7t but less than 136t
-Light: less than or equal to 7t

What is the minimum required horizontal radar separation between aircrafts?

-5 NM but can e reduced to 3 NM if specific radar capabilities permit

What is the minimum required horizontal radar separation between aircrafts established on final approach?

-2.5 NM (within 10 NM from runway threshold)

How long is the touchdown zone?

It is 900 m or half of the runway length (in cases of runway length less than 1800 m), whichever is less

How far from the runway threshold is the touchdown aiming point?

It is located next to the PAPI lights

-For LDA of more than 2400 m the aiming point is at 400 m
-For LDA of less than 2400 m the aiming point is at 300 m

How can you identify runway width by the runway threshold markings?

- 30m wide runway will have 8 stripes on the threshold
- 45m wide runway will have 12 stripes on the threshold
- 60m wide runway will have 16 stripes on the threshold

Note: Each stripe = 3.75 m

Which altitude deviation is considered a level bust?

-Any altitude deviation in excess of 300 ft

Background info:
Main threats associated with a level bust are mid-air collision and CFIT (Controlled Flight Into Terrain)

HUMAN

How does the cabin get pressurised? Bleed air from the engines. (the cabin needs high pressure air because air at 30,000ft is at too low of pressure, bleed air is a very hot high-pressure air)

What regulates cabin pressure? Outflow valves

What is the position of the outflow valve at cruising altitude? Slightly open

Effects of high altitude on the human body? Heartrate and respiratory rate increases as altitude increases, dehydration due to low humidity, dry air.

Symptoms of hypoxia on the human body? (hypoxia is a condition or state in which the supply of oxygen is insufficient for normal life functions)

- Blue Lips
- Confusion
- Rapid breathing, and a fast heart rate
- Shortness of breath
- Sweating
- Inability to communicate

Why jet aircrafts need to be pressurized?

- Jet aircrafts fly at high altitudes in order to be more efficient
- However, due to low pressure at high altitudes, oxygen is not sufficient for the human body to function properly

At what cabin altitudes do jet aircrafts fly?

- Typically between 6000-8000 ft

What is hypoxia and its symptoms?

- It is a condition caused by insufficient oxygen in the atmosphere
- Typical symptoms are euphoria, dizziness, impaired judgement or even death

What is the first action to take in case of cabin decompression?

- Don oxygen mask

At what altitude should aircrafts descend in case of cabin decompression?

- 10000 ft or MSA, whichever is higher

What is the time of useful consciousness at 40000 ft?

- Approximately 15 seconds

Note: The amount of oxygen at 18000 ft is approximately half of the oxygen available at Mean Sea Level!

At what cabin altitude must pilots wear oxygen masks?

- At 10000 ft cabin altitude

At what cabin altitude do passenger masks deploy automatically?

- At 14000 ft cabin altitude

Should passenger oxygen be used in case of smoke in the cabin?

- No. Passenger oxygen is used only in case of cabin decompression
- That is because passenger masks provide a mixture of oxygen and cabin air, which would result in passengers inhaling smoke
- On top of that, oxygen from masks would escape into the cabin atmosphere thus further feeding the source of smoke

Emergency comm
Radio failure
Radio principles
Etc….

PREVIOUS AIRCRAFT

Tell me about the Seneca? The Seneca is a powerful American light aircraft produced by Piper, the Seneca has 6 seats, the Seneca is equipped with hydraulically operated, fully retractable landing gear, and has two turbocharged engines rated at 200 horsepower each, also there is cowl flaps under the engines to regulate cooling. The flaps are manually operated on the Seneca 2, and electrically operated on the Seneca 3, the wings of the Seneca are dihedral, and the engine's propeller are counter rotating, so the left engine rotates clockwise, and the right engine rotates anti- clockwise, this prevents asymmetric thrust during take-off and climb, and also eliminates the critical engine. The Seneca's has variable-pitch propellers, so it is possible to feather the propeller to greatly reduce drag (engine failure), and fine pitch to allow the engine to reach maximum speed and power at low airspeeds, which is vital for take-off and go-arounds, the Seneca also has a great ice protection system, like the leading-edge boots, windshield heat, propeller pads, heated pitot and stall warners.

What is the crosswind limit on the Seneca? 17 knots

Electrical system on a Seneca? Electrical power is supplied by two 65 ampere alternators, one mounted on each engine, A 35 ampere-hour,12 volt battery provides current for starting, for use of electrical equipment when the engines are not running and for a source of stored electrical power to back up the alternator output, also the battery is kept charged by the alternators (located in the nose section), if the electrical system bus voltage exceeds 14-volts, the alternator is taken off the line to avoid damage. Approximately 2000 RPM is required to obtain full alternator output of 65 amperes. (the electrical system is protected by circuit breakers, in the event of malfunctions or a sudden surge of current, a circuit breaker can trip automatically).

Why is the battery on the front left? The battery is on the left because the left engine is started first, it provides DC current is more powerful if it is closer.

Why is the left engine started first? Battery is on the front left, so it is closer to the left engine and direct current is more powerful if less distance to travel, also the door is located on the right side, also the pilot is sitting on the left so he has a better view of the engine.

How do you know the battery is being charged? The ammeter will show positive when charging (alternators need an output of more than 12 volts to keep it charged), a load ammeter at zero is saying that you are using battery power.), on a normal ammeter (centre-zero) it will read a positive when charging, and a negative when it is draining.

Fire Extinguisher on the Seneca and why? Halon (toxic gas)
• Works by interrupting the reaction described as 'Fire Triangle' (fuel, oxygen- heat) which must be sustained for a fire to continue.
• They do not produce residues and therefore do not cause damage.

Ice protection system on a Seneca? Consists of 2 heated stall warner's (inboard activates when 25- 40 degrees flaps, outboard activates when 0-10 degrees flaps), heated pitot tube, electrothermal propeller pads, electric windshield panel, leading edge boots and a wing ice detection light.

How does the leading-edge boots work? 1⁄4 to 1⁄2 inch of ice accumulated, on activated of the switch, the boot solenoid valves are opened and air pressure is released to the boots for 6 seconds, inflating all surface de-icers on the aircraft, when completed the solenoid valves permit automatic overboard exhaustion of pressurized air, suction is then reapplied to the de-icer boots. (when turned off the engine-driven pressure pumps apply a constant suction to the de-icer boots to provide smooth streamlined edges)

Landing Gear of a Seneca? The Seneca is equipped with hydraulically operated, fully retractable, tricycle landing gear, hydraulic pressure for gear operation is furnished by an electrically powered, reversible hydraulic pump. Should the hydraulic system fail, gravity will allow the gear to extend (by pulling the emergency gear extension knob below 85kts), if the gear is neither full up or down, a red warning light will appear, if the throttle is in a low setting while the gear is retracted, a warning horn will sound to alert the pilot that the gear is up. A squat switch located on the left main gear will prevent inadvertent gear retraction on the ground, on take-off when the landing gear oleo strut drops to its full extension, the safety switch closes.

Engine of a Seneca?

• The Seneca is powered by two, six-cylinder turbocharged engines, each rated at 200 horsepower at 2575rpm at sea level, the engines are air cooled and fuel injected.
• There is a turbocharger on each engine operated by exhaust gases.
• Fuel is supplied to the injector pump at a greater rate than the engine requires, “continuous flow” type.

Can you give a stall brief on the Seneca? HASELL check, reduce throttles to 16” MP, passing 100kts props full fine, passing 80kts close both throttles, when stalled, pitch down to un-stall the wings and apply 34” MP, passing 80kts pitch for blue line (VY)

What is the ceiling of the Seneca? 25,000ft.

Propellers

• Seneca consists of a two blade, constant speed, controllable pitch and feathering Hartzell propellers. The propeller mount directly to the crankshaft, pitch is controlled by oil and nitrogen pressure.
• Oil pressure sends a propeller towards high RPM or unfeather position.
• Nitrogen pressure sends a propeller towards low RPM or feather position and also prevents the propeller from over-speeding.
• Governors, one on each engine supply engine oil at various pressures through the propeller shafts to maintain constant RPM settings, a governor controls engine speed by varying the pitch of the propeller.
• Feathering takes approx. 6 seconds, unfeathering is accomplished by moving the propeller control forward and engaging the start until the propeller is wind-milling.
• A feathering lock, operated by centrifugal force, prevents feathering during engine shutdown by making it impossible to feather any time the engine speed falls below 800RPM.

Brakes – consists of two single-disc, double puck brake assemblies, one on each main gear, and a brake system hydraulic reservoir independent of the landing gear hydraulic reservoir. (rear top of the nose baggage compartment)

Flight control system
• Controls actuate the control surfaces through a cable system.
• The horizontal stabiliser is an all movable type with an anti-servo tab mounted on the trailing edge. (anti-servo tabs are longitudinal trim tabs... they move in the same direction as the stabiliser and also decrease the sensitivity of the stabiliser, also acts as a trim tab to relieve control pressure and maintain the stabiliser in the desired position. (helps preventing over control)
• Ailerons are of the Frise-type, (bottom of the up-aileron pivots into the airstream, creating form drag) this design allows the leading edge of the aileron to extend into the airstream to provide increased drag and improved roll control, the differential deflection of the ailerons tends to eliminate adverse yaw. (differential ailerons – one aileron is raised a greater distance than the other aileron that is lowered, the extra upward aileron movement produces more drag)
• The vertical tail is fitted with a rudder which incorporates a combination rudder trim and anti-servo tab.
• The slotted flaps are manually operated and spring loaded to return to the retracted position (0,10,25,40). (electrical on the Seneca 3) (slotted flaps increase wing camber, they make a slot when extended between the wing and flap, by opening a slot, high pressure air from the bottom flows through the slot to the upper surface, this adds energy to the wings boundary layer, delays airflow separation.)
What is the fuel capacity, fuel burn and endurance? The fuel capacity of the Seneca is 123 gallons, the fuel grade is 100LL, approx. 16.5 gallons/hour fuel burn. Endurance is approx. 7 hours.

Engine Failure Technique? Control the aircraft first, dead leg dead engine... Mixtures both to fully rich, props forward to settings, throttles forward to settings, gear up, flaps up... then failed engine throttle closed, failed engine propeller feathered, failed engine mixture idle cut out, cowl flaps dead engine closed, cowl flaps live engine open.

Spin Recovery? Power to idle, ailerons to neutral, use opposite rudder to the spin, and elevator forward.
What is a fuel injection system? A fuel injected works differently as there is no air mixed with the fuel in the metering system. A servo regulator measures airflow entering the engine, and meters fuel accordingly for the proper mixture. At the cylinders, each fuel injector sprays fuel just outside the cylinder head at the intake manifold, this means that your fuel is vaporized and mixed with air before entering the cylinder. In-case the engine driven fuel pump fails, there is a backup electric pump. The advantages are; freedom from vaporisation ice (carb ice), fewer maintenance problems, increased engine efficiency, faster throttle response, easier cold weather starts, better fuel flow and control.

Seneca Speeds (cruise speed is roughly 120kts)

- VS0 – 61kts
- VS1 – 63kts
- VMCA – 66kts
- VX–76kts
- VR – 77kts
- V2 – 85kts
- VY – 89kts
- VLO – 129kts down/ 100kts up
- VA – 121kts
- VNO – 163kts
- VNE – 195kts

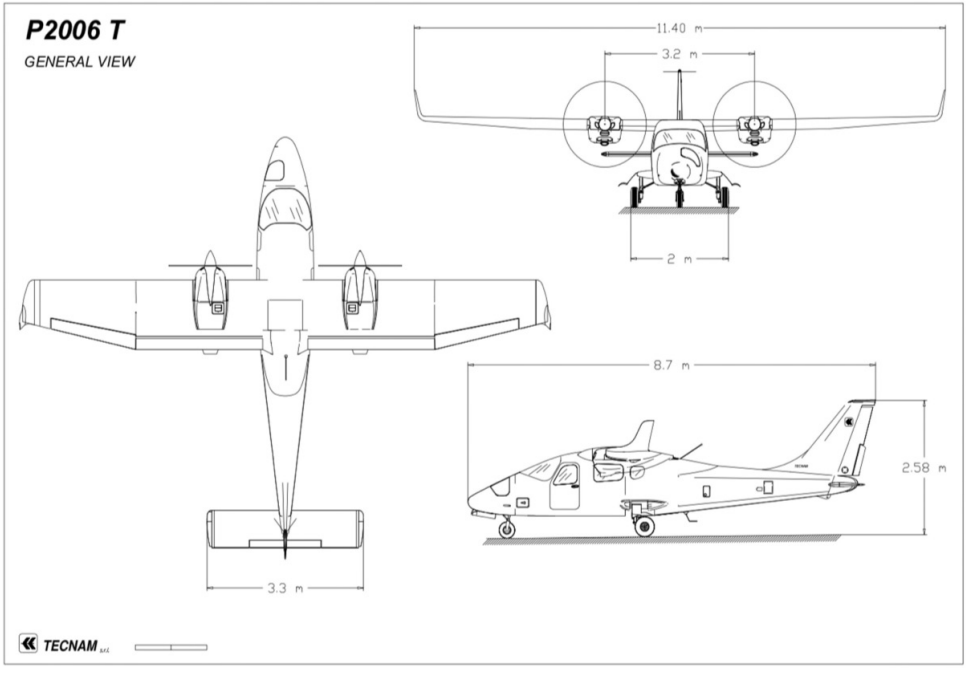
What kind of engine does it have?

What speed is the blue line in that kind of aircraft? What is the critical engine?

How does the landing gear work in that type of aircraft? How many batteries does this aircraft have?

Talk me about the electric system of that aircraft

P2006



SPEED			KIAS		REMARKS
V_{NE}	Never exceed speed		171		Do not exceed this speed in any operation.
V_{NO}	Maximum Structural Cruising Speed		138		Do not exceed this speed except in smooth air, and only with caution.
V_A	Design Manoeuvring speed		122		Do not make full or abrupt control movement above this speed, because under certain conditions the aircraft may be overstressed by full control movement.
V_O	Operating Manoeuvring speed				
V_{LE}	Maximum Landing Gear extended speed		122		Do not exceed this speed with the landing gear extended.
V_{LO}	Maximum Landing Gear operating speed		122		Do not exceed this speed when operating the landing gear.
V_{FE}	Maximum flaps extended speed	***FULL***	93		Do not exceed this speed for indicated flaps setting.
		T.O.	122		
V_{MC}	Aircraft minimum control speed with one engine inoperative		63		Do not reduce speed below this value in event of one engine inoperative condition.

BLUE LINE : 84KTS

Other info:

-“slotted” flaps

Brake system:

-A master cylinder is attached to each pilot/co-pilot pedal

-Hydraulic pressure, applied via the master cylinders, enters the brake via lines connected to an inlet fitting on the wheel brake caliper.

Difference between Boeing and Airbus?
Boeing says pilots should have the ultimate say, meaning that on the Boeing jets, the pilot can override onboard computers and their built-in soft limits.
The pilot is the real one who makes decision on Boeing, the aircraft on Airbus.

Take Off config warning, what is it and what systems does it comprehend?
It's a system that alerts pilots that something in the configuration is wrong for take off, and that taking off could be dangerous.
It comprehends:
-Position of High Lift Devices such as flaps and slats
-Elevator trim position o trimable horizontal stabiliser position as appropriate
-Position of autobrake
-Position of ground spoilers or speedbrakes
-Engagement of parking brakes

What can cause vibration in the engine?
An imbalance is the more likely one,such as the fan section blade separating.

Jet engines operate at a very high RPM, something like 14,000 RPM! So even the smallest imperfection in the engine blades can cause a vibration to occur.

What's an IDG

Is the main source of A.C. (alternating current) electrical power on the aircraft; it is a combination of a constant speed drive and an electrical generator driven by the engine through the accessory gearbox.

-Ryanair history?

Ryanair was founded in **1984** by **Christopher Ryan, Tony Ryan** and **Liam Lonergan**. The company started it's activity on the route **Waterford** and **Gatwick** in **1985** with an embraer bandeirante turboprop with 15 seats.

At first the company didn't start as a **low cost** airline, the model was **started in 1990** by Michel O'Leary, due to decreasing profits, after visiting Southwest Airlines.

In **2000** Ryanair started it's **online site** —> at first it seemed to be useless but it cut all the costs of travel agents and this has increased the company's revenues even more.

In April **2003**, Ryanair acquired its ailing competitor **Buzz** from KLM.

In **2018**, Ryanair expanded its portfolio with Austrian-based Laudamotion, later renamed "**Lauda**".

In **2019**, Ryanair announced (together with the Government of Malta), that it would establish a new airline called **Malta Air**

Before covid, in 2019, approximately **150M** of people travelled with Ryanair.

In **September 2022** Ryanair had **15.9M** of passengers with a load factor of 94%.

Fleet:

-505 aircrafts —> **409** B737 NG + **29** A320 + **67** B737 8200 (will be **210** total, some are still in order)

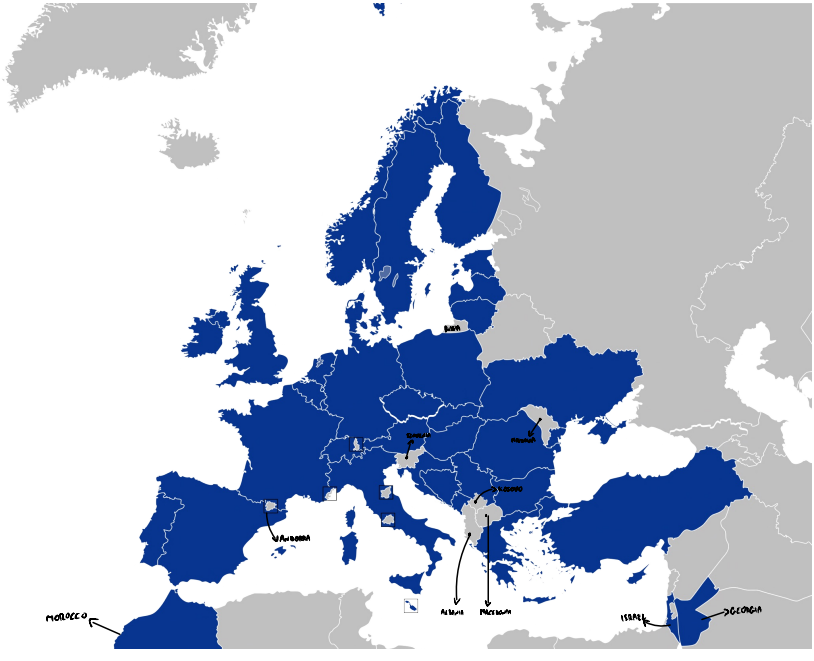
Biggest bases:

1)**Stansted** (44 aircraft)

2)**Dublin**

3)**Bergamo**

Operating countries



—>

Other info:

-more than **2,500 daily flights** from **84 bases**

-**230 destinations** in **40 countries**

- Ryanair has a team of over **17,000** highly skilled aviation **professionals** delivering Europe's No.1 on-time performance, and an industry leading 34-year safety record.

-Ryanair is **Europe's cleanest greenest airline** group and customers switching to fly Ryanair can reduce their CO, emissions by up to 50% compared to the other Big 4 EU major airlines.

Tell us about yourself

Well, as you can see from my resume I've just finished flight school so I still don't have a lot of experience.
My interest for aviation started when i was very young, as my home city (Fano), has a flight school and everyday I had a lot of airplanes flying over my head that started to suscitate lot of interest in them. My parents then started to bring me to the airport and form those days my passion for aviation didn't stop to grow.
At the age of 17 I started flight school in Fano, and i finished my training in July with the aps mcc in Dublin.
Now I'm here because i think I'm the right person for this job because I have an hard working mentality, and i think that i have the knowledge and skills required to be part of Ryanair.

Why do you want to work for us?

I want to work for Ryanair because it's one of the safest airlines in the aviation industry, and i think that this result comes from the application of very efficient SOPs that i had the chance to learn and understand during my aps mcc.
I also appreciate that there are a lot of carrier opportunities and in fact one day i would like to be a flight instructor for the company.
Furthermore it would be a dream coming true to fly the Boeing 737.
(Job stability because company constantly grows)

Where do you see yourself in 5 years?

In 5 years i see my self as a First Officer flying the Ryanair 737-8200 that is starting his flight instructor course for the company.

Notice period?

I'm ready to start as soon as practical as I'm not currently employed.

What are some of the qualities of a good pilot?

-Good knowledge and preparation

-Good situational awareness

-Responsible

-Puts safety first

-Good communication skills

What are your greatest strengths?

-Hard worker: as i started my theoretical ATPL exams I've never stopped working until I achieved my goal.

-Good ability to adapt to change: I don't get scared by changes, but i see them as a chance to have new experiences that can improve my self.

-High discipline: in order to fly in a safe manner you must be disciplined since you need to follow rules and procedures, and i think that every pilot must have this quality (???)

What are your greatest weaknesses?

-The greatest weakness is the lack of experience, but i think that this will be improved as soon as i will start flying professionally.

-Self criticism: when things don't go as good as i wanted i sometimes blame my self, but I'm trying to improve this part of me by avoiding the blame part but instead to focus on what i did wrong and how i can avoid the that result the next time

-Too inquisitive: i like to know the technical know how of the things and may ask too many questions at times.

Why should we hire you?

I think that I'm the right person because i have an hard working mentality, i have the willingness to work hard, learn and grow personally and professionally with Ryanair.

How would you handle a disagreement in the flight deck?

In case of disagreement i would refer to the SOPs since it's useless to have a discussion on who is right, but instead it's important to focus on what is right, and the answer is found in the SOPs.
I the conflict isn't solved i would personally go for the most conservative option.

Do you un have any questions?

1) No, i think all of my questions have been answered trough my research about che company

2)……

Why would you be a good captain?

What are SOPs?

SOPs are standard operating procedures that ensure flight safety that have been made by the company coming from manufacture's directives, common pilot's mistakes, etc..
Every pilot must follow SOPs since deviating from them endangers the flight and all the passengers on board.

How would you react if the captain doesn't follow SOPs?

First of all i would ask him: "captain aren't we supposed to do this thing in this way?"
If he tells "today we in this manner" i would tell him that I'm not happy with this situation and that I want to adhere to sops.
If he descend below minima, i would tell him to go around , then with a different tone of voice, captain go around, and at the end i would call a missed approach to the tower in thus way our landing clearance is canceled and we must go around.

I WOULD UNDERLINE THE FACT THAT HE'S NOT FOLLOWING SOPS, THEN...

TELL HIM THAT I'M NOT HAPPY WITH THAT

HR

• Tell me about yourself.
• Why did you want to become a pilot?
• Tell me about your education?
• Tell me about your previous work experience?
• Why did you choose your flight school?
• What are your hobbies/interests? —> *Cooking, reading, meet friends, football, new interests often, watches*
• How would you spend your time off? —> *Not alone, friends, cooking, reading, good film*

RYANAIR

• Why have you chosen Ryanair?
• What do you know about Ryanair?
• What can you offer Ryanair? *Sociable —> good cockpit environment; Respect the sops —> safety*
• What are your long term career goals? —> *Base captain for Ryanair*
• Where do you see yourself in 5 years time?
• When can you start?
• What are the New Ryanair bases? *Torino, Newcastle, Malaga, Venezia Marco Polo (2021)*
• Do you think Ryanair has a well balanced healthy relationship between a captain and FO?
Yes, because i think that the task n°1 of every crew member is being o good teammate —> if everyone respects it then there will be no issues with the rank/gradient

• Cockpit Gradient between an FO with low hours and an experienced captain will it be good
• What do you think will be the most challenging part of the TR / line training flying?
Learn lot of stuff in a short time
• How do you plan to overcome these challenges?
As i already experienced in the aps mcc i would study with my sim partner
• What do you think a regular day in Ryanair is like?
• What challenges would that present to you?
Tiredness— >overcome with a good sleep and sport to maintain the body fit

LEADERSHIP

• Why would you make a good captain?
• Tell me about a time you had a leadership role/displayed leadership.
• Tell me about a time you made a decision under pressure.
• What are desirable traits in a captain?
Ability to take responsibility, being a good teammate, have good knowledge
• What are undesirable traits in a captain?
Being aggressive, being autocratic, lack of knowledge

• Have you any undesirable traits / Tell me about your weaknesses?
• Tell me about CRM. What are its elements?
Effective management of all the resources in order top achieve a safe flight; even pax are involved
• What qualities do you need to have to be a good training captain?
Good knowledge; good communication; being patient and not aggressive; passion

SITUATIONS

• What would you do if the captain was not following SOP's?
• The company policy is to be 45 minutes early for the briefing. The captain calls you to say he is stuck in traffic and will meet you in the aircraft 10 minutes before departure. What do you do?
I would call the crew coordinator and tell them to expect a delay.

• Cabin crew #1 is aggressive and agitated and not listening to instruction. What do you do? *Talk*
• The captain becomes incapacitated. What do you do?
• You experience an engine fire in the middle of the Mediterranean. What do you do?
Aviate, nav, comm; memory items; qrh; piosee
• You experience engine trouble. What do you do?
• What would you do as a line training captain if a young cadet were to announce 'Going around'?
• When would it then be appropriate to debrief?
• The captain is flying on the approach and you notice a flock of birds. What is your thought process and what do you do?
Ciampino accident
• On a return trip to Tenerife where you are running out of hours, there is a malfunction and you get delayed for 2 hours. There is still a chance to make the return trip. Everyone except #1 are happy to do so. How do you deal with this situation?
Talk all together with the crew and find a solution where everyone is happy.
• You are above the runway at Dublin and just about to go into alternate fuel. ATC tell you they are confident you could land in 10 minutes. What do you do?

IN FLIGHT EMERGENCIES

• Medical emergency
• 78 year old lady with nose full of blood and an extreme headache.
• Fire in cargo compartment.
• Smoke in the cabin.
• Hissing sound from the door.
• Hijacker with a bomb on board wanting to be brought to the Canaries.
• Smashed window in the back with a nervous/panicked #4 on her first day.
• Violent passenger who attacks the passengers and cabin crew.
• An extremely hot floor.

NOTE: Candidates have been told on intercepting the localiser that the problem is solved to see would they still go back or continue with the flight.

737-800 V 737 MAX
• Facts and figures that make the Max more advantageous to 800:
-No. of seats, CO2, Fuel savings, Range, Performance

• Differences between 737-800 and MAX in walkaround.
1) Reshaped tail; 2) Engine; 3) Winglets; 4) Nose gear (8" taller)

• Differences between 737 and A320.
• 737-8200 Engine. How does it work?
• Bypass ratio. *5:1 NG ; 9:1 8200*
• Basic 737 facts.
• Is it worth Ryanair buying the 210 MAX? How will it affect future fares?
• Why will the new B737 game changer be good for the company?
• 737 controls vs Fly by wire.

B737:

-The initial 737-100 made its first flight in April 1967 and entered service in February 1968 with Lufthansa. The lengthened 737-200 entered service in April 1968, and evolved through four generations, offering several variants for 85 to 215 passengers.

-Main design characteristics: -low height—> because it was easier it's usage in primitive airports

-In 1984, the 737 Classic -300/400/500 variants were upgraded with CFM56-3 turbofans and offered 110 to 168 seats.

-In 1997, the 737 Next Generation (NG) -600/700/800/900 variants have updated CFM56-7s, a larger wing (= more fuel = more tange) and an upgraded glass cockpit, and seat 108 to 215 passengers

-In 2017 737 MAX, 737-7/8/9/10 MAX, powered by improved CFM LEAP-1B high bypass turbofans and accommodating 138 to 204 people.

-It's the most popular jet airliner

POF/AGK

• Wing tip vortices.
• Winglets.
• Sweep angle.
• Swept wing V Straight wing.
• Mcrit / Shockwaves.
• High lift devices.
• Spoilers.
• Use of spoilers during roll.
• Advantages/Disadvantages of High tails.
• Critical engine.
• Describe the hydraulics system.
• Anti-Ice/De-icing.
• What kind of de-icing liquids are there? How do you determine which one to use?
-4 types of fluid, we chose them depending on the holdover times, Vr speed, and current weather situation

• On a flap 5 departure, do you set the flaps before taxiing or wait until after de-icing?
-After de-icing because there could be the risk to brake some parts that are frozen

• What happens the airspeed indicator if the pitot tube becomes blocked in a descent?
• Yaw Damper.
• MCAS.
• Trim runaway. What do you do?
1) A/P off ; 2)Trim Cutout switch ; 3) Trim using the manual wheel (manual backup)

MET

• Warm fronts.
• Cold fronts.
• Fog.
• Thunderstorms.
• Weather radar.
• Referring to picture on the wall of a B737 navigation display showing a cell in the top right-hand corner; Are you going to fly through it? Why is it dangerous?
• If you don't have weather radar what are other signs of bad weather and where do you find the information?
1)St Elmos's fire ; 2) Lighting in the distance ; 3) Weather charts
• Wind 180/20kt; Do you use Runway 27 or 09?
• What is the turbulent layer?
• Thermal inversion and associated weather.
• Crosswind component @ runway 27 with 310/7kt.
• Jetstreams and associated weather.

THE AIRCRAFT YOU HAVE FLOWN

• What aircraft have you flown?

• Sell it to me?
-Winglet; door lock; landing gear retractable; 2 engine; endurance/range; fuel consumption; 4 seats; frise ailerons; slotted flaps ; anti - servo tab ; non cantiliver wing

• Describe the performance/handling characteristics.
-Stable —> because of high wing
-Ballooning effect with flaps
-Single engine performance poor

• What is its suitable use (Training/Business travel)? Why is it suitable?
• What kind of fuel is used?

FLIGHT PLANNING

• At what point in the go around does the alternate fuel begin for planning purposes?
-From the MAP
• Describe the components that make up the block fuel.
Ie. Taxi, Trip, Contingency, Alternate, Final reserve, Additional, Extra.

COMMUNICATIONS

• In the case of a loss in communications, what is your decision making process?