Technical Questions

How many seats are on a 737-800? 189 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)

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

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

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 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)

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

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 5^{th} and 9^{th} 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? M_{NO} 0.78 – 0.80

What is V_{NE} and what limits it? Never exceed speed, Transport category planes uses V_{MO} and M_{MO}, 737-800 V_{MO} is 480-490 KIAS, it's limited by structural limit.

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

MTOW of a 737-800? 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.
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.

What is p factor? Also known as the asymmetric blade effect, normally occurring in propeller aircraft, the shift in location of the centre of thrust will exert a yawing moment on the aircraft, causing it to yaw to one side. (propellers ascending will have a decreased relative wind velocity and therefore decreased thrust)

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.

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.

Why did we order the max? When are they arriving? Primarily due to better fuel economy whilst also increasing number of seats, the engines and winglets prove to be more efficient in fuel costs plus the cockpit is a lot less cluttered. They are to start arriving at the start of 2019.

How many passengers did we carry last month? 9.3 million customers.

What controls are activated by the yaw damper? The rudder is activated to prevent Dutch roll.

What is Dutch roll? A Dutch roll is a combined roll/yaw oscillation that occurs when the dihedral effects of an aircraft are more powerful than the directional stability.

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.
- 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 boomerang winglets (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, a new emergency exit 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 a yaw damper? A yaw damper is used to dampen/reduce the rolling and yawing oscillations known as the Dutch roll, it consists of yaw rate sensors and a processor that provides a signal to an actuator connected to the rudder.

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 M_{CRIT}
- Delays airflow from going supersonic over the wing. (stops shockwaves which creates huge amount of drag)

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.

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 M_{CRIT} 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)

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.

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.

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)

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.

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 M_{CRIT}? (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 M_{CRIT}? The critical Mach number is dependant on the thickness of the wing (a thin wing will have a higher M_{CRIT}), 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 M_{CRIT}, vice versa for light aircraft)

How does a swept wing increase the M_{CRIT}? 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 M_{CRIT} 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 M_{CRIT})

How would you design a high-speed wing?

- Swept Wing (increases M_{CRIT})
- Minimal camber (increases M_{CRIT}**)**
- Thin wing (increases M_{CRIT}**)**

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)

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)

- 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 M_{CRIT}) • With an increase in weight, stalling speed also increases so the margin for the coffin corner is less.

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.

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.

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.

What is V_1? (decision speed) The speed beyond which the take-off should no longer be aborted. (V1 reduces with contaminated runway)

What is V_R? (rotation speed) The speed at which the pilot begins to apply control inputs to make the aircraft nose pitch up. (ensures that V_2 at screen height)

What is V_2? (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) (V_2 needs to be higher than V_{MCA}) (V_2 cannot be less than V_S x1.20 and V_{MCA} x 1.10) (V_2 depends on runway length

What is V_{NE}? (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

What is V_{REF}? (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 V_{MCG} and the relationship to V_1? (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, V_1 is not allowed to be lower than V_{MCG}, must be equal or lower. (rudder is more powerful the faster.), if an engine failure is detected after V_1, the take off must be continued, this implies that the aircraft must be controllable on the ground, therefore V_1 is always greater than V_{MCG} (other engine remaining on full power)

What is V_{MCA}? (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.

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)

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

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.

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)

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)

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.

How far can you track a VOR? Maximum theoretical range is calculated using: (heights in ft, AMSL)

1.23 X (√Transmitter) + (√Receiver)

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 the most important thing on instrument flight? Your scan

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 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)

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 **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.

System A	**System B**	**Standby**
A/P "A"	A/P "B"	
Ailerons	Ailerons	
Rudder	Rudder	Rudder
	Yaw damper	Standby yaw damper (as installed)
Elev & Elev feel	Elev & Elev feel	
Inboard flight spoiler	Outboard flight spoiler	
Ground spoilers		
	L/E flaps & slats	L/E flaps & slats (for extension only)

	T/E flaps	
PTU for autoslats	Autoslats	
No1 thrust reverser	No2 thrust reverser	Nos 1 & 2 thrust reversers (slow)
Nose wheel steering	Alt nose wheel steering	
Alternate brakes (man only)	Normal (auto & man) brakes	
Landing gear	Landing gear transfer unit (retraction only)	

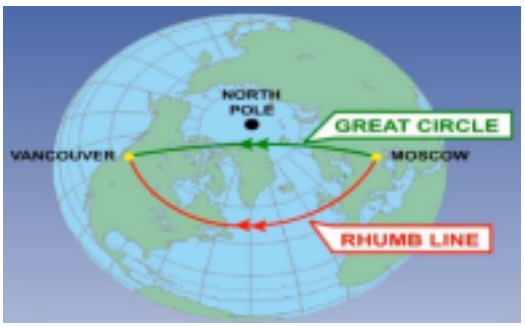
Both A and B hydraulic systems have an engine-driven pump and an AC electric motor-driven pump. (The system A engine-driven pump is powered by No.1 engine, and the system B engine-driven pump is powered by No.2 engine.)

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.)

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 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.

Crosswind calculation technique? Clock method – 60 degrees = all the crosswind, 30 degrees = half the crosswind, windspeed X SIN (wind 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 the black arrow on approach chart? Highest obstacle (or go-around)

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)

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.

Take-off segments

- **1st segment –** The 1st segment starts at the screen height (35ft) at the end of the TOD, speed remains at V_2 and ends when the landing gear is retracted.
- **2nd segment –** The 2nd segment starts when the landing gear is retracted, speed also remains at V_2 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).

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.

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.

Why do we fly at high altitudes? As altitude increases, air density decreases. At higher altitudes there is less drag due to being less dense, which means we can use less thrust, saving in fuel. Also, aircraft can travel faster at high altitudes because of less drag. (thinner air imposes less drag)

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.

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

How do you calculate fuel for the flight?

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

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

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, 150m RVR at touchdown (lighting)
- **CAT III –** DH 50ft, RVR 200m (automatic landing system, heads up display)

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

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.

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.

Piper PA34 Seneca

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? ¼ to ½ 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.

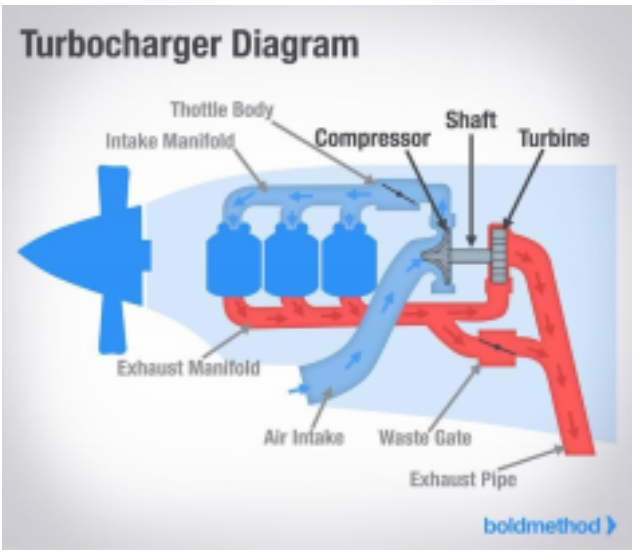
What is a turbocharger? A turbocharger is a turbine driven forced induction device that increases an engines efficiency and power output by forcing extra air into the combustion chamber

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.

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 (V_Y)

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 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.

Effect of CofG in a spin? Which is best? The recovery of a spin becomes progressively more difficult as its centre of gravity moves aft, a forward centre of gravity results in greater flight stability and reduced danger of stalling (reduced stalling speed), an aft centre of gravity reduces the drag (less tail down force to maintain level flight) meaning that you can burn less fuel and better manoeuvrability and lower take-off and landing distances.
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)

- $\mathbf{V_{S0}}$ – 61kts
- $\mathbf{V_{S1}}$ – 63kts
- $\mathbf{V_{MCA}}$ – 66kts
- $\mathbf{V_{X}}$ – 76kts
- $\mathbf{V_{R}}$ – 77kts
- $\mathbf{V_{2}}$ – 85kts
- $\mathbf{V_{Y}}$ – 89kts
- $\mathbf{V_{LO}}$ – 129kts down/ 100kts up
- $\mathbf{V_{A}}$ – 121kts
- $\mathbf{V_{NO}}$ – 163kts
- $\mathbf{V_{NE}}$ – 195kts

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.

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)

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.

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

One millibar in feet? 27ft
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