Aviation

General course

Marking key for the Externally set task

Sample 2016

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# Aviation

## Externally set task – marking key

The Boeing 787 Dreamliner is a long-range, mid-size wide-body, twin-engine jet airliner, developed by Boeing Commercial Airplanes. Its variants seat 210 to 330 passengers. Boeing states that it is the company's most fuel-efficient airliner and the world's first major airliner to use composite materials as the primary material in the construction of its airframe. The 787 has been designed to be 20% more fuel efficient than the 767 it is to replace. The Dreamliner's distinguishing features include mostly electrical flight systems, a four-panel windshield, noise-reducing chevrons on its engine nacelles, and a smoother nose contour. It shares a common type rating with the larger 777 twinjet, allowing pilots qualified for the 777 to operate both models, due to their related design features.

The first 787 was unveiled in a roll-out ceremony on July 8, 2007. By October 2013, the 787 program had logged 982 orders from 58 customers. Average price of a 787: USD$ 250 million.

Source: http://en.wikipedia.org/wiki/Boeing\_787\_Dreamliner

1. Give **three (3)** reasons why an airline executive would want to buy a Boeing Dreamliner to add to an airline fleet

|  |  |
| --- | --- |
| **Description (any three of the following)** | **Marks** |
| Superior fuel efficiency | 1 |
| Chevrons on engine nacelles | 1 |
| Composite materials used in construction | 1 |
| Common type rating with 777 | 1 |
| **Total** | **3** |

1. For each reason stated above, provide an explanation that would justify the decision.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Superior fuel efficiency means cheaper to fly and longer range (1) avoiding hubs (1) | 1–2 |
| Chevrons on engine nacelles reduce noise (1) therefore less intrusive in built up areas (1) | 1–2 |
| Composite materials are lighter/stronger (1) therefore can pressurise to lower altitude (1) | 1–2 |
| Common type rating with 777 means less time (1) and hence less money training crew (1) | 1–2 |
| **Total** | **6** |

1. With the aid of a diagram, describe the process of orographic lifting to form a cloud. **(3 marks)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Annotated diagram to show the following:   * clouds forming as moist air is forced to rise over a mountain range * indication that the air cools as it rises at the dry adiabatic lapse rate * if the parcel of air reaches the dew point while ascending, then clouds will form. | 1 per annotation  (maximum 3\_ |
| **Total** | **3** |

1. Complete the table of cloud types below. **(5 marks)**

One mark for each fully completed row.

|  |  |  |  |
| --- | --- | --- | --- |
| **Cloud type** | **Abbreviation** | **Level**  **H, M, L** | **Description** |
| **Cirrus** | Ci | High | Fine wispy ‘Mare’s Tails’ |
| **Altocumulus** | Ac | Medium | Mid level fluffy or lumpy clouds |
| **Stratus** | St | Low | Flat, layer of cloud in stable air |
| **Cumulus** | Cu | Low | Fluffy lumpy “cauliflower” cloud |
| **Cumulonimbus** | Cb | Low | Thunderstorm cloud, rain-bearing |

5(a) What is the principle of operation of the magnetic compass? (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The Earth has a magnetic field aligned approximately North/South. The magnetic compass is basically a bar magnet suspended to rotate freely so it always points towards Magnetic North | 2 |
| **Total** | **2** |

(b) What is magnetic variation? (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Magnetic variation is the angle between True North and Magnetic North. | 2 |
| **Total** | **2** |

(c) What is magnetic deviation? (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Magnetic deviation is the deviation of the magnetic compass away from Magnetic North due to the magnetic field associated with the aircraft itself, its engine and electrical equipment. | 2 |
| **Total** | **4** |

6. What are **two (2)** advantages of a turbocharged engine over a normally aspirated engine? **(4 marks)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any two (2) of:   * more specific power over a naturally aspirated (NA) engine. It means an engine can produce more power for its size * reuse of excess exhaust heat (it gets channeled into the turbocharger to increase boost to the engine) means the engine runs more efficiently than NA, or supercharged, engines * because a small engine can be made to produce the power of a huge NA engine, fuel economy is often better on a per kW basis. | 4  (2 per advantage) |
| **Total** | **4** |

1. Explain how the torque reaction of the propeller causes an aircraft to yaw during the take-off run.

**(5 marks)**

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Defines ‘yaw’ as the tendency of the aircraft to rotate about its centre of gravity.  The tendency for the body to rotate results as a reaction to propeller’s opposite rotation (torque reaction).  Rotation places additional downward force on one wheel (1)  Downward force on one wheel effectively acts as a brake on that wheel (1)  The nose of the aircraft tends to change direction, or ‘yaw’ (1) | 1  1  1  1  1 |
| **Total** | **5** |

1. Threat and error management (TEM) is now an integral part of aircraft operations. What are **three (3)** important human TEM factors that can affect aviation safety? Explain the effect of each factor.

**(6 marks)**

|  |  |
| --- | --- |
| **Description (any three of the following)** | **Marks** |
| **Stress**  Pressure on pilot to meet schedule demands. Can lead to poor decision making.  **Training**  Insufficient training in operational procedures or new aircraft type.  **Fatigue**  Clear link to poor decision making.  **Communication skills**  Intra-cockpit and ATC communication imperative.  **Assertiveness/judgement**  Pilot/co-pilot relationship has to be balanced to ensure both contribute.  **Cockpit culture**  Related to above. Any crew member can influence the pilot decision. | 1 per identification  (maximum 3)  1 per explanation  (maximum 3) |
| **Total** | **6** |

1. Define dihedral. **(10 marks)**

With the aid of a diagram, explain the purpose of dihedral in the design of an aircraft and how it affects stability.

|  |  |
| --- | --- |
| **Description (any three of the following)** | **Marks** |
| Dihedral means that the wing tips are higher than wing roots | 1–2 |
| Dihedral contributes to the lateral stability of an aircraft. | 1–2 |
| Following a lateral disturbance, an AC will begin to side-slip in the direction of the dipped wing. | 1–2 |
| Due to dihedral, the AoA of the dipped wing with the sideways airflow is greater than that of the raised wing. | 1–2 |
| This results in the dipped wing generating more lift than the raised wing and causes the wings to resume a level orientation. | 1–2 |
| **Total** | **10** |