

Name: _____

ID #: _____

**University of Bristol
Department of Aerospace Engineering**

AENG 11301

Aeronautics Test, 24th February 2016

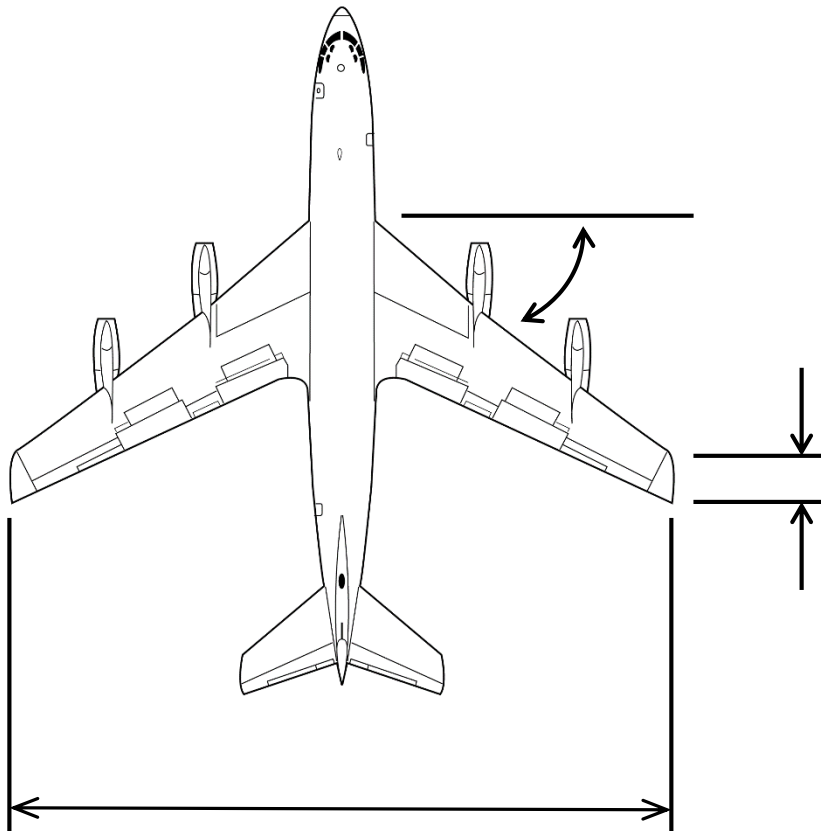
Answer all questions (max mark = 45)

Time allowed: 45 minutes

1. What is the primary and secondary effects of a positive (down) deflection of the elevator on an aircraft's flight?

4 marks

2. Shade in the gross wing area of the aircraft below and label the dimension lines given:

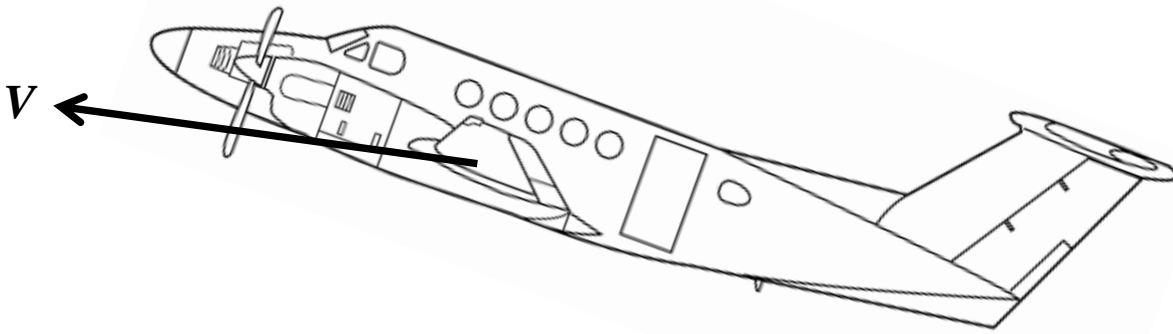


4 marks

3. What are the function of spoilers on a wing and when are they used?

3 marks

4. Draw vectors representing lift and drag on the diagram below:



2 marks

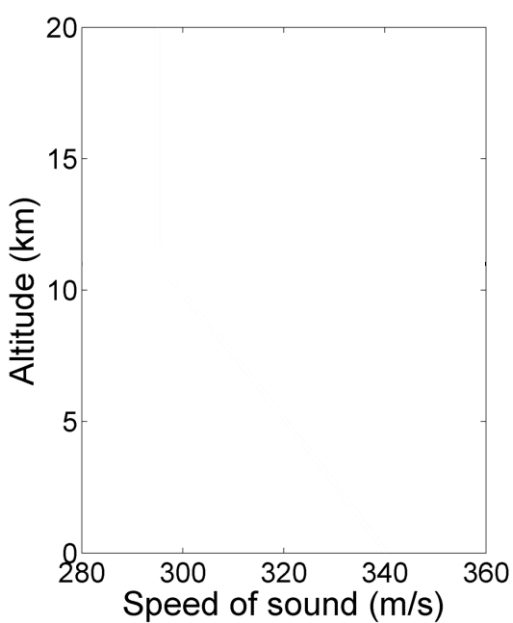
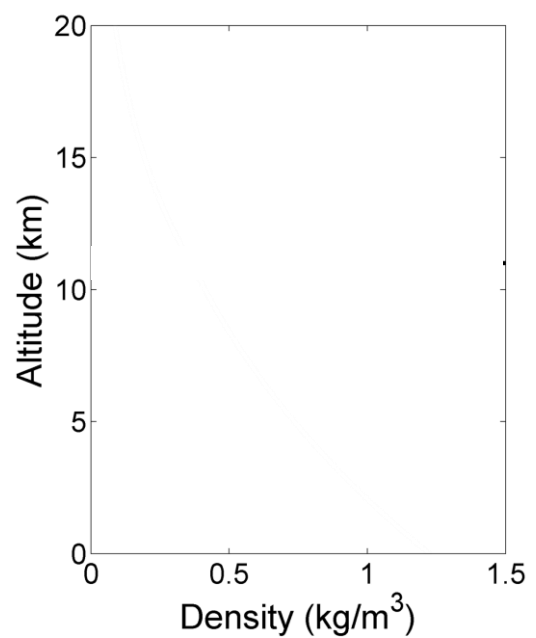
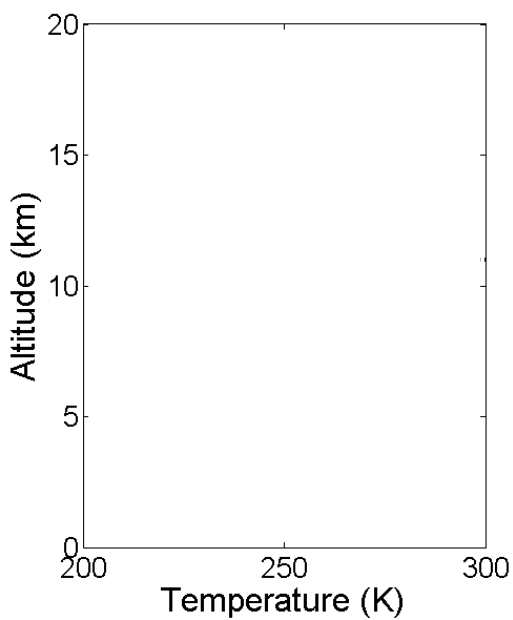
5. What are the two components which make up profile drag?

2 marks

6. What shape of lift distribution over a wing produces the greatest span efficiency and what shape of downwash distribution does this result in?

2 marks

7. Sketch the approximate shapes of the distribution of the labelled variables with altitude as defined in the International Standard Atmosphere.



6 marks

8. The expected aerodynamic characteristics of a proposed new aircraft are:

Lift curve slope, $\frac{dC_L}{d\alpha} = 0.08$ per deg (constant to near stall)

Angle of attack at which lift is zero, -2.5 deg

Profile drag coefficient, $C_{D0} = 0.025$

Efficiency factor, $e = 0.82$

The aircraft's wing has an area of 136 m², a span of 36 m and is of a constant chord

- a) Calculate the angle of incidence (α) that this aircraft will need to fly with to maintain steady level flight at 80 m/s at sea level if its mass (m) is 44,000 kg.

5 marks

- b) Calculate the total drag on the aircraft when flying under the conditions given in (a).
5 marks

- c) The aircraft will cruise at an altitude of 6000 m (air density $\rho = 0.538 \text{ kg/m}^3$) at an air speed of 140 m/s. What is the total drag on the aircraft in cruise if its mass is now 38,000 kg?

4 marks

- d) On landing at sea level the aircraft has burnt much of its fuel and now has a mass of 28,000 kg. If with flaps deployed the aircrafts C_{Lmax} is 2.0 what is the stall speed of the aircraft?

2 marks

- e) Sketch a C_L vs angle of incidence graph to show how deploying flaps will change the aircrafts lift characteristics.

2 marks

- f) If the aircrafts wing were to be modified to have a span of 42 m but keeping the same wing area (S) and assuming C_{D0} is constant, what will be the drag polar equation for the modified aircraft?

2 marks

- g) What effect does increasing the aspect ratio of the wing have on the drag performance of the aircraft and what is the physical reason for this?

2 marks