2003 HIGHER SCHOOL CERTIFICATE EXAMINATION

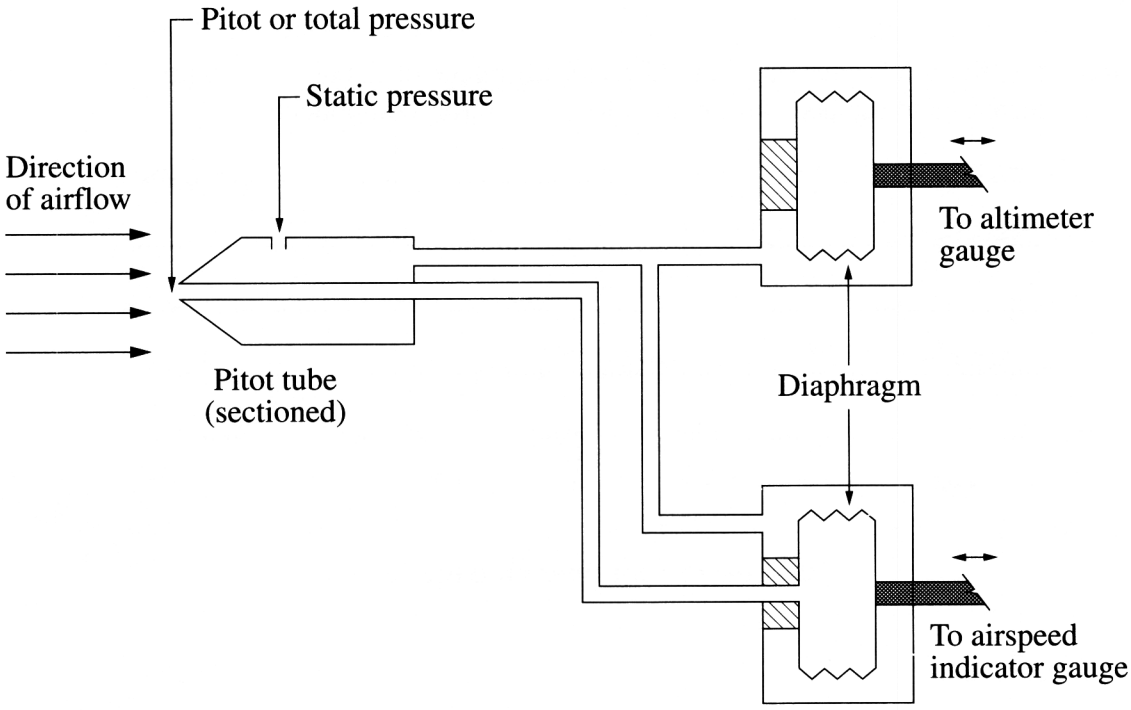
Engineering Studies

Section II (continued)

Marks

Question 15 — Aeronautical Engineering (15 marks)

In common aircraft instruments a pitot tube is connected to both the altimeter and airspeed indicator.



(a) Explain how the airspeed indicator determines airspeed from the pressures sensed by the pitot tube. **3**

The air speed indicator measures the static pressure and the dynamic pressure created by the airflow. The higher the dynamic pressure the more it will force the diaphragm to expand making it push on the black rod which would be conected to a meter to measure it
When the static pressure is equal to the dynamic pressure the diaphragm will not change position and wont apply a force

Question 15 continues on page 22

Marks

Question 15 (continued)

(b) (i) Aluminium and its alloys are generally more active than irons and steels in the galvanic series. Explain why aluminium alloys are more corrosion-resistant than steels. **2**

- Aluminium quickly reacts when exposed to oxygen and forms Aluminium oxide on its surface and this surface is now sealed.
- When iron and steels corrode they too form an oxide layer but it is not a protective coating like the Aluminium and this allows the iron and steel to continue rusting

(ii) Identify ONE advantage and ONE disadvantage of the use of composite materials to replace aluminium alloys in aircraft components. **2**

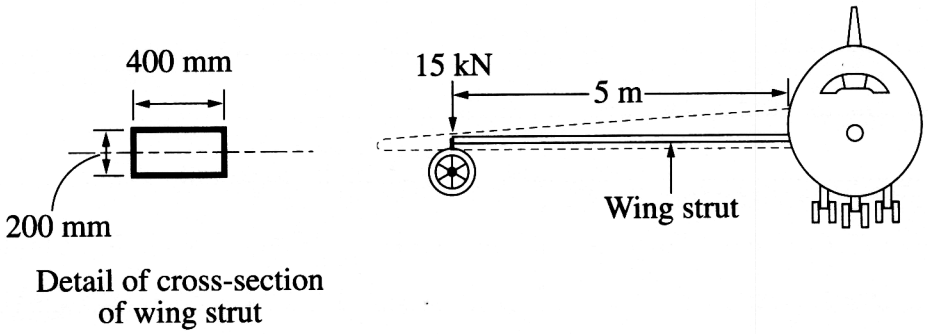
- Advantage, Compisite materials have a greater strength to weight ratio than Aluminium allows.
- Disadvantage. Composites do not age harden like some allows of Aluminium which gives them greaterstrength later in their life when they need it more.

Question 15 continues on page 23

Marks

Question 15 (continued)

(c) In the diagram of an aircraft, the wing has been shown as hidden outline to reveal the wing strut, which has uniform section along its length.



Detail of cross-section of wing strut

(i) Compare the nature of the stresses experienced by the surfaces of the wing strut when the aircraft is stationary on the ground and when the aircraft is in flight. **3**

- When stationary the 200mm vertical walls would be taking much of the wings weight 15 kN so it would be 7.5 kN per wall
- When in flight the lift created by the wing lets the verticle walls rest but the drag force created by the movement through air places a force against the horizontal 400 mm edges of the strut

(ii) Determine the maximum value of the bending stress when the strut experiences a force of 15 kN at its end. **3**

Use $I = 267 \times 10^6\ \text{mm}^4$.

$\sigma = \frac{My}{I_{xx}}$ $= \frac{15000 \times 5 \times 0.1}{267 \times 10^6}$ =

$M = 15000 \times 5\text{m}$

$y = \frac{20\text{mm}}{2} = 0.1\text{m}$

Bending stress = 2.809×10^{-5} Pa (To 3 decimal places)

Question 15 continues on page 24

Marks

Question 15 (continued)

(d) Outline TWO conditions that may cause an aircraft to stall during flight. **2**

- An aeroplane may be trying to take-off with too larger angle of attack, thus not creating enough lift causing a stall.
- There might be a tail wind on the aeroplane which ~~can~~ is big enough to councel out the plance velocity through the air, thus again creating not enough lift causing a stall.

End of Question 15