2003 HIGHER SCHOOL CERTIFICATE EXAMINATION

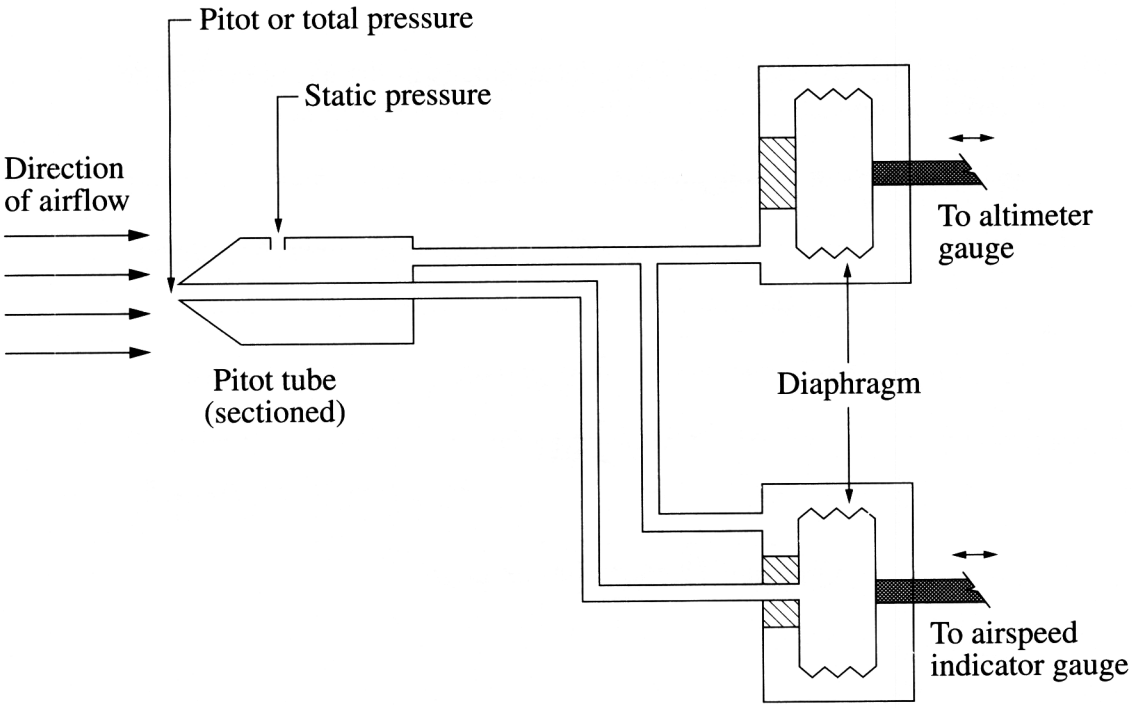
Engineering Studies

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**

As the aircraft travels faster, the dynamic pressure will increase. The dynamic pressure feeds into a diaphram that is able to expand if the dynamic pressure is greater than static pressure. If the diaphram contracts or expands, it moves a linkage that is geared to move the airspeed needle in the gauge.

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 alloys are more active than steels, and therefore repel electrons that cause ~~causing~~ corrosion, as it has an active anode present

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

*Advantage - Composite materials are often much lighter than aluminium alloys

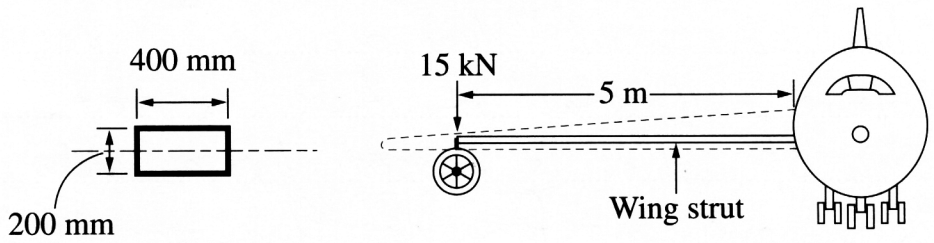
*Disadvantage - Some composites such as carbon fibre are very strong, but can fracture/fail without warning.

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 the plane is stationary, the wing strut experiences a downward force from the wing due to its weight, but during flight, the wing will experience upward pressure and therefore create an upward force on the wing strut, not to mention a force pushing the wing backwards due to air resistance.

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

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

$M = 15000 \times 5000$
$= 75000000$

$\sigma = \frac{My}{I}$

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

$y = 100\,\text{mm}$

$\sigma = \frac{75000000 \times 100}{267 \times 10^6}$

$= 28.1$

Bending stress = 28.1 MPa

Question 15 continues on page 24

Marks

Question 15 (continued)

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

As Bernoulli's Principal states, a high velocity fluid will have an associated low pressure, and vice-versa

*A plane will stall if there is not enough lift, which is caused by a slow velocity, and therefore no lifting pressure. (Fig 1)

*A plane will stall if if it is lifting too much (too big of an incline), and the air travelling over the wing creates turbulence and therefore no associated pressure. (Fig 2)

End of Question 15

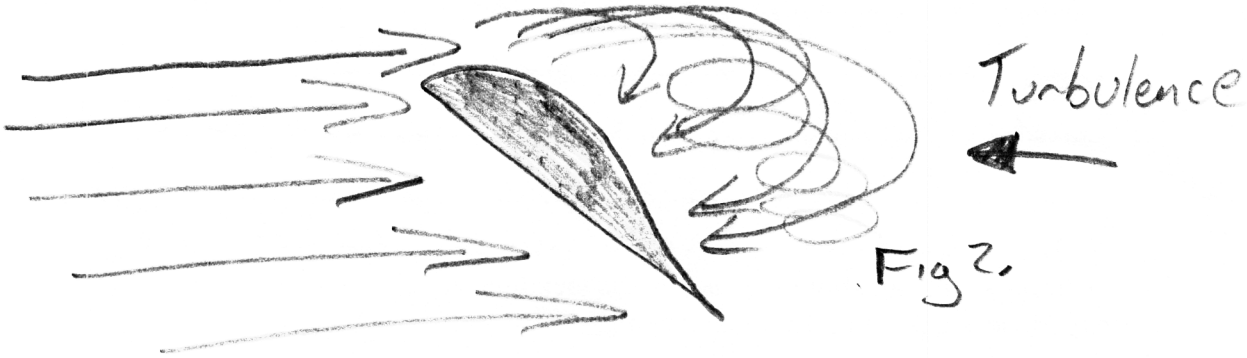


Fig 2.

Fig 1.