2003 HIGHER SCHOOL CERTIFICATE EXAMINATION

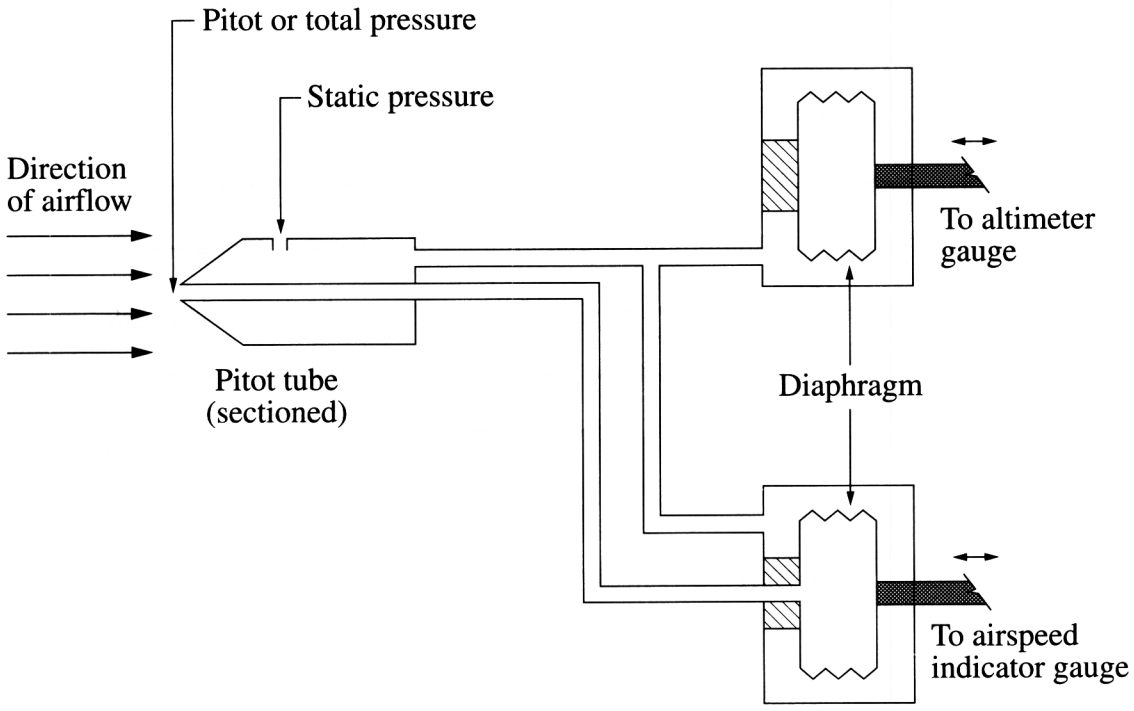
Engineering Studies

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**

Airspeed is determined by the amount of pressure acting on the diaphragm compared to the amount of pressure in the diaphragm. It compares the static pressure to the total pressure and this gives an indication of the speed that the aircraft is travelling.

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**

Iron and steel are ferrous metals. Aluminium alloys contain impurities which are the alloying elements. The elements give certain properties to the aluminium and one of these properties is corrosion resistance

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

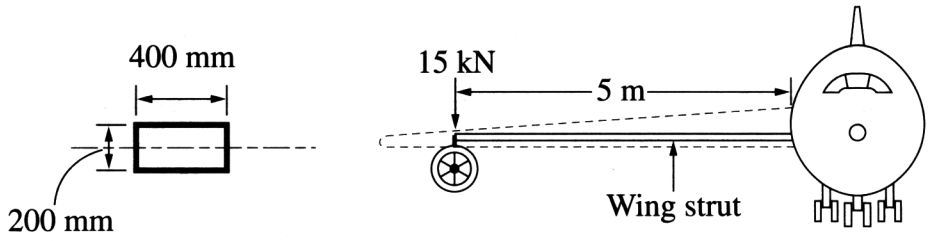
One advantage is that the composite materials are lighter in weight than aluminium alloys but the disadvantage is that the composite materials can cost up to or above 4 times the alloy.

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 strut experiences bending moments as the engine places stresses on the strut. In flight the strut experiences a variety of pulling stress and bending stresses due to the engine and the air resistance while in flight

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

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

15000 N
↓ 5m

$M = F \times d$
$= 15000 \times 5$
$= 75000$

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

$$\sigma = \frac{75000 \times 0.2}{267 \times 10^6}$$

$$= 5.62 \times 10^{-5}$$

Bending stress = 5.62×10^{-5} N

Question 15 continues on page 24

Marks

Question 15 (continued)

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

The angle of attack becomes too great or too small and the areas of pressure under the wing are effected. The speed of the air over the wing decreases significantly and causes the regions of pressure to be effected causing the air to not flow smoothly over the wing causing the plane to stall

End of Question 15