2003 HIGHER SCHOOL CERTIFICATE EXAMINATION

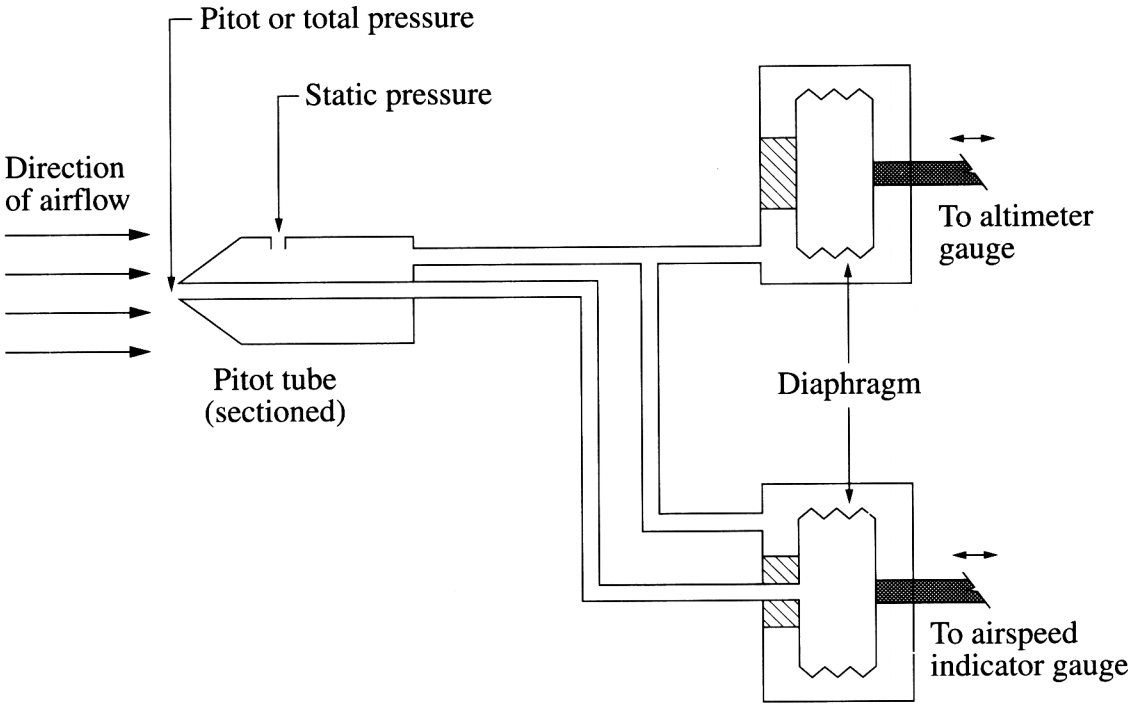
Engineering Studies

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 plane travels, air is effectively flowing into the tube. The preasure of the air is constantly changing however it is proportional to speed. As the plane moves faster more air is present and hence more preasure in the tube. The diaphragms sence this change and it is indicated on the airspeed indicator.

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 passive substances. As they corrode, they form an oxide layer that reduces the corrosion rate. Metals however have a corrosion product of rust which constantly feeds into new exposed metal.

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

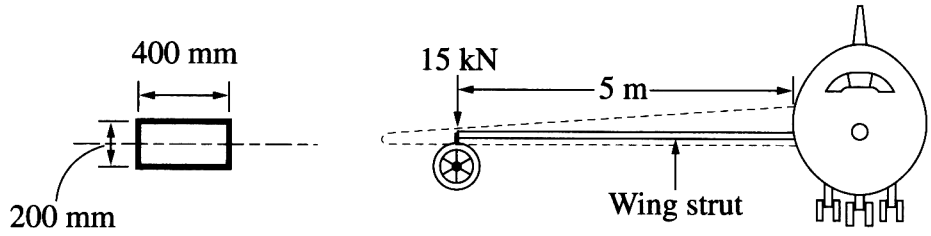
Composite materials such as carbon fibre (carbon fibres in epoxy resin matrix) have excelent strength to weight ratio. Such composites combine the best features of two or more materials. The disadvantage though is that numerous forming methods must be done before use.

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 on ground, the temp is normal, pressure is low. In flight however the temp is constaly varying, adding cyclical stress to the wing and the pressure is enourmous. The weight of the wing also provides a bending stress to the wing.

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

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

$\sigma = \frac{My}{I}$ where $y = 2500\text{mm}$, $M = 15 \times 10^3$

$= \frac{15000 \times 2500}{267 \times 10^6}$

$= 0.1404...$

Bending stress = 140.45 Pa

Question 15 continues on page 24

Marks

Question 15 (continued)

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

(1) If the angle of attact is too steep, the airflow ofer the planes rear will produce eddys or 'whirlying winds'. this causes the plane to stall. ~~turbulance~~. (2) If the planes velocity is too low, the airflow will again cause a stall as it will not correctly ~~be~~ flow around the aircraft.

End of Question 15