

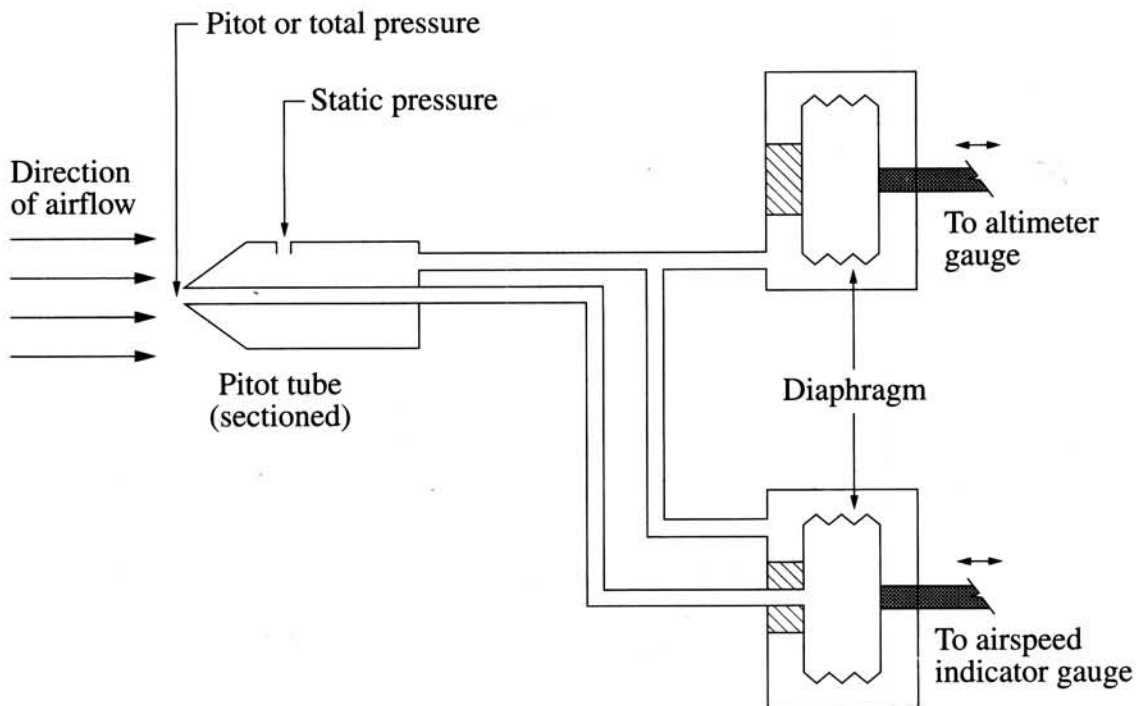
Engineering Studies

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 airspeed indicator takes the pressure of both static & dynamic and compares both of them to give the indicated airspeed. The change in pressure forces the indicator gauge to the needle using it to show the indicated speed.

Question 15 continues on page 22

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 is a much more cathodic material than steels. This enables the alloy to corrode slower. If it is an alloy, it is mixed with a more anodic material making the anodic material corrode first.

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

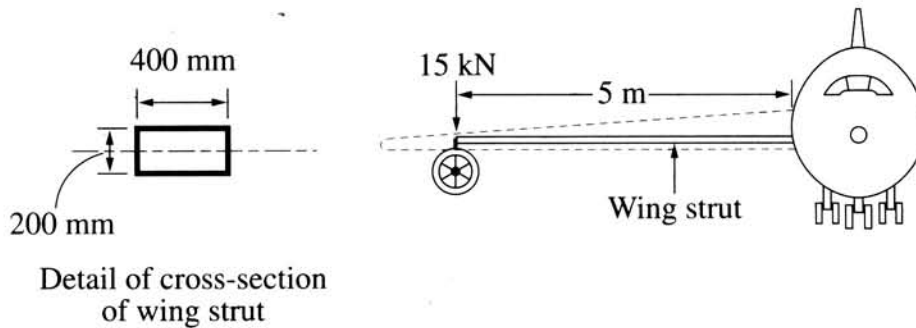
★ one advantage is strength, for example carbon fibre is much stronger than aluminium & lighter for weight.

★ the disadvantage to this is that carbon fibre is very brittle and extremely expensive & making it impractical for overall design.

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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.



- (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

** The wing strut on the ground experiences only minor horizontal forces but the full force of gravity.
 * The wing strut in flight experiences many different horizontal forces because of wind and still the full force of gravity.*

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

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

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

$$\begin{aligned} \sigma &= F/A \\ &= \frac{15000}{8 \times 10^{-4}} \\ &= 1875000 \text{ N} \\ &= 1.875 \times 10^7 \text{ N} \end{aligned}$$

$$\begin{aligned} A &= 400 \times 200 \\ &= 80000 \text{ mm}^2 \\ &= 8 \times 10^{-4} \text{ m}^2 \end{aligned}$$

Bending stress = $1.875 \times 10^7 \text{ N}$.

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Question 15 (continued)

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

2

★ An aircraft will stall if there is no pressure within its engine, for example when an aircraft tries to raise its nose too high causing the pressure within the jets.

★ An aircraft will stall if the plane tries to bank too quickly at a slow speed. End of Question 15 not enough air getting to the motor because of lack of speed. the engine will stall if there is no air pressure at all!!