1. (10%) For an airfoil, what is the aerodynamic center? What is the center of pressure? Please sketch an airfoil to explain your answers.

2. (10%) Almost all modern high-speed aircraft have swept-back wings, why? Please sketch a swept wing and explain why in detail.

3. (10%) For low speed flow about an airfoil, (a) What is the principal reason for a blunt leading edge? (b) What is the principal reason for a sharp trailing edge?

4. (10%) How do a general aviation aircraft to measure its altitude and velocity? Please provide the device's name and describe the theorem which is based on.

5. (10%) For airplane navigation, CAA plans to replace the current ground assisting navigation equipment (e.g. DME/VOR) with the global navigation satellite system (e.g. GPS) within next ten years. Please describe in detail the benefits of using global navigation satellite system over using the current ground navigation aids.

6. (10%) What are the four major forces acting on an airplane in level flight? Please sketch to describe the directions of the forces.

7. (10%) Based on Newton's second law, derive the equations of motion in the directions parallel and perpendicular to the flight path, respectively, for an airplane in climbing flight with a climbing angle θ.

8. (10%) Consider an airplane of speed V in a level turn of radius R and with a roll angle ϕ. Define the lift load factor $n = L/W$. Show that the turn radius can be expressed as:

$$R = \frac{V^2}{g\sqrt{n^2 - 1}} \qquad \text{(Note: } W = mg\text{)}$$

9. (10%) What is the V-n diagram for an aircraft? What is its significance?

10. (10%) In aircraft design, what are the major concerns in selecting appropriate structural materials?