Questions based on the Aerodynamics series

1) **Which of the following types of parachute would be suitable as an aerodynamics decelerator to reduce an aircraft's landing role?**

a) Conical(solid fabric) b) hemispherical (solid fabric) c) conical (ribbon)

Hint: See ESDU 09012

Answer: c) conical (ribbon) . ESDU 09012. Only designs with high levels of geometric porosity can deliver the stability requirements of this application.

2) **A re-design for a munition requires its cross-sectional area to be changed from circular to square for packaging requirements whilst maintaining volume i.e. the cross-sectional area is to be maintained. What would be the likely effect on its body's contribution to lift- curve slope?**

Hint: See ESDU 04007

a) increase b) remain the same c) decrease

Answer: a) increase (by 19%) . Covered in Table 3.1 of ESDU 04007

3) **Estimate the skin friction drag coefficient of a thin, flat plate of a wing of span 12m with a mean geometric chord 1.5m by assuming it can be modelled as a thin flat plate at zero angle of attack in a flow with a Mach number of 0.1 at sea level. Assume a turbulent boundary layer.**

a) 0.026 b) 0.086 c) 0.126

Hint: See ESDU 73017

Answer c) 0.126. From ESDU 73017 with M = 0.1 at sea level Unit Reynolds number = 2.3 million. Reynolds number based on a length of 1.5m = 2.3 (1.5) = 3.45 million, so from ESDU 68020 the mean skin friction coefficient is 0.0035. Total surface area is 12×1.5×2 = 36m^2. Skin friction drag coefficient = 36×0.0035 = 0.126.

4) **What blunting ratio for a radome formed by a spherically-blunted tangent ogive would deliver the minimum pressure drag? The forebody including the radome is of overall fineness ratio 1 and the Mach number is 0.9.**

a) 0 b) 0.42 c) 0.82

Hint: See ESDU 80021

Answer: b) 0.82. From ESDU 80021 Figure 2a, Blunting ratio b = 0.82.

5) **Estimate the lift-curve slope (per radian) of an unswept wing of aspect ratio 8 and taper ratio 0.5 in low speed flow.**

a) 6.72 b) 5.72 c) 4.72

Hint: See ESDU 70011

Answer c) 4.72 per rad from ESDU 70011 (by hand/interactive graphs/programs) 1/A(d CL/d alpha) = 0.59, so d CL/d alpha = 8 (0.59) = 4.72 per rad.

6) **What is the drag area (D/q) of the undercarriage of an aircraft of mass 30,000Kg. Hint: use a method suitable for a feasibility study.**

a) 1.86 b) 18.6 c) 186

Hint: See ESDU 79015

Answer a) 1.86. From formula given in Section 3 of ESDU 79015

7) **In the design of a fighter-type aircraft a wing is proposed with quarter-chord sweepback of 50 degrees and an aspect ratio of 4. Will it exhibit pitch-up or pitch-down behaviour at high angle of attack?**

a)Pitch-up b) pitch-down c) marginal

Hint: See ESDU 01005

Answer a) Pitch-up. See Sketch 5.1 of ESDU 01005.

8) **What has is the most established device used device to suppress noise and other unsteady flow effects in aircraft cavities such as bomb bays?**

a) Rod-in-cross flow b) spoiler c) vortex generators

Hint: ESDU 08012

Answer b) Spoiler. This is discussed in great detail in ESDU 08012.

9) **What potentially critical problem might occur when using a very high propulsive jet pressure ratio such as might happen during the boost phase of a missile or rocket operation at high altitude.**

a) low propulsive efficiency b)motor flame out c) Plume-induced separation.

Hint: See ESDU 99010

Answer c) Plume- induced separation. ESDU 99010 discusses under expanded jets in Section 3. Plume-induced separation over the afterbody can result in loss of effectiveness of aerodynamic controls.

10) **When a spoiler is deployed on the upper surface of a wing, what typicall happens to the pressure distribution on the lower surface?**

a) decrease b) increases c) remains the same

Hint: See ESDU 90030

Answer a) decreases. See Sketch 2.2 of ESDU 90030.