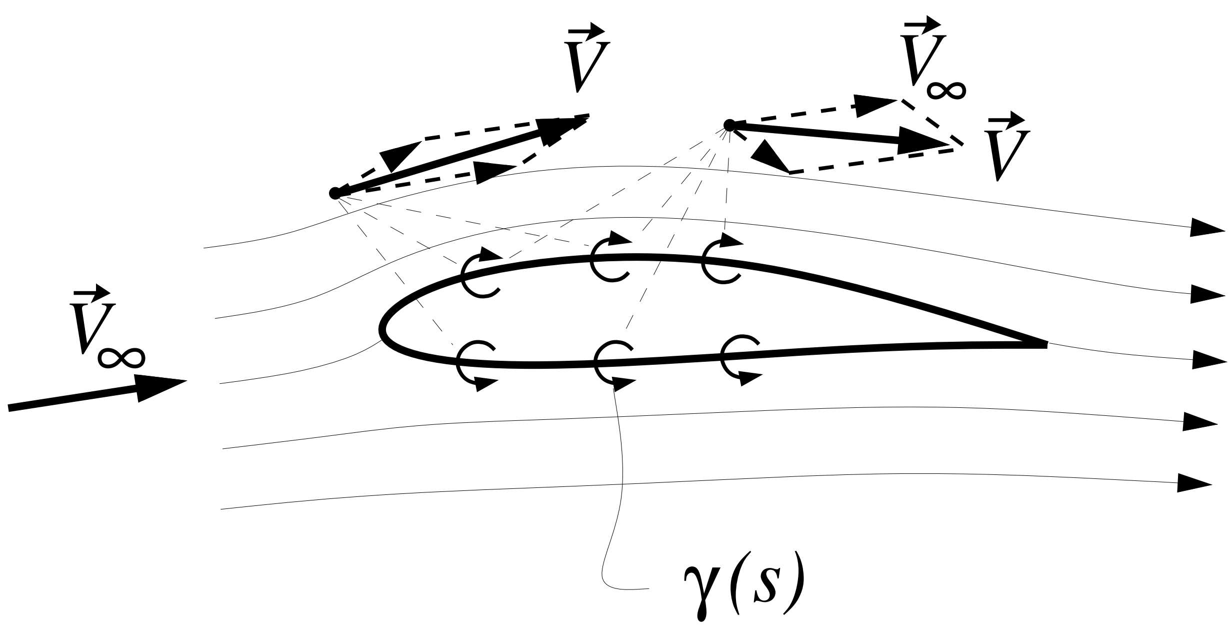
The velocity field $\vec{\mathbf{V}}$ about the airfoil is represented as a superposition of a freestream and a vortex sheet.

I feel the following about this concept.

1. **Very uncertain**
2. **Somewhat uncertain**
3. **Somewhat comfortable**
4. **Very comfortable**



The circulation of $\vec{\mathbf{V}}_1(\mathbf{x}, \mathbf{y})$ about the circuit of perimeter $\mathbf{s}_{\rm tot}$ is $\mathbf{\Gamma_1}$.

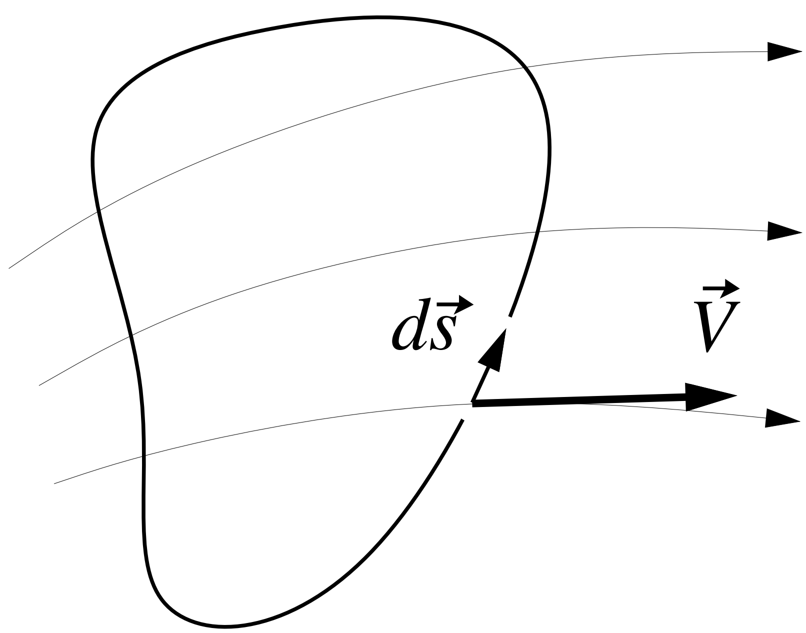
A constant $\mathbf{\Delta}\vec{\mathbf{V}}$ is now added to make $\vec{\mathbf{V}}_2 = \vec{\mathbf{V}}_1 + \mathbf{\Delta}\vec{\mathbf{V}}$.

What is $\vec{\mathbf{V}}_2$'s circulation $\mathbf{\Gamma_2}$ about the same circuit?

1. $\mathbf{\Gamma_2 = \Gamma_1} - |\mathbf{\Delta}\vec{\mathbf{V}}|\, \mathbf{s}_{\rm tot}$

2.* $\mathbf{\Gamma_2 = \Gamma_1}$

3. $\mathbf{\Gamma_2 = \Gamma_1} + |\mathbf{\Delta}\vec{\mathbf{V}}|\, \mathbf{s}_{\rm tot}$



An airfoil in steady motion at speed V_1 has circulation Γ_1.

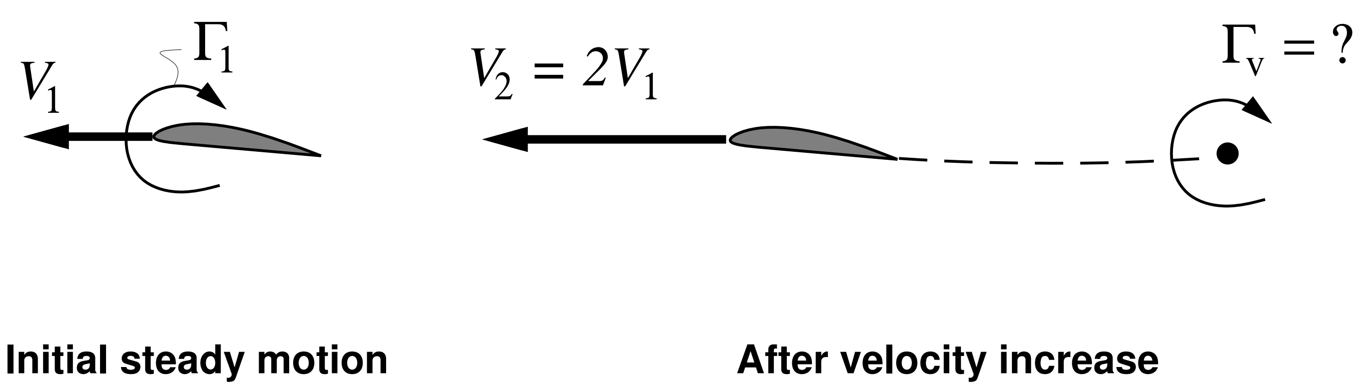
The speed is suddenly increased to $V_2 = 2V_1$.

What is the circulation Γ_v of the shed vortex?

1. $\Gamma_v = -\Gamma_1/2$

2.* $\Gamma_v = -\Gamma_1$

3. $\Gamma_v = -2\Gamma_1$



A vortex sheet is γ placed on the x axis in a freestream V_∞. The average x-velocity $(\vec{\mathbf{V}}_{\mathbf{u}} + \vec{\mathbf{V}}_\ell) \cdot \hat{\imath} \,/\, \mathbf{2}$ on the sheet itself, will

1. **Increase**
2. **Decrease**

3.* Not change

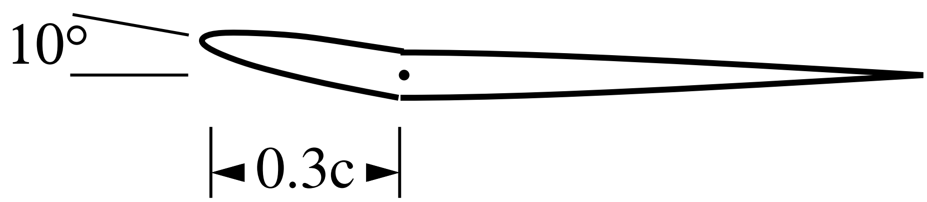
Which type of control surface deflection will cause the largest change in the magnitude of the zero-lift angle?

1. A

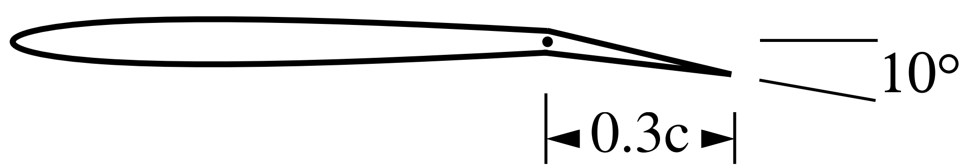
2.* B

3. It will be the same for A and B

A

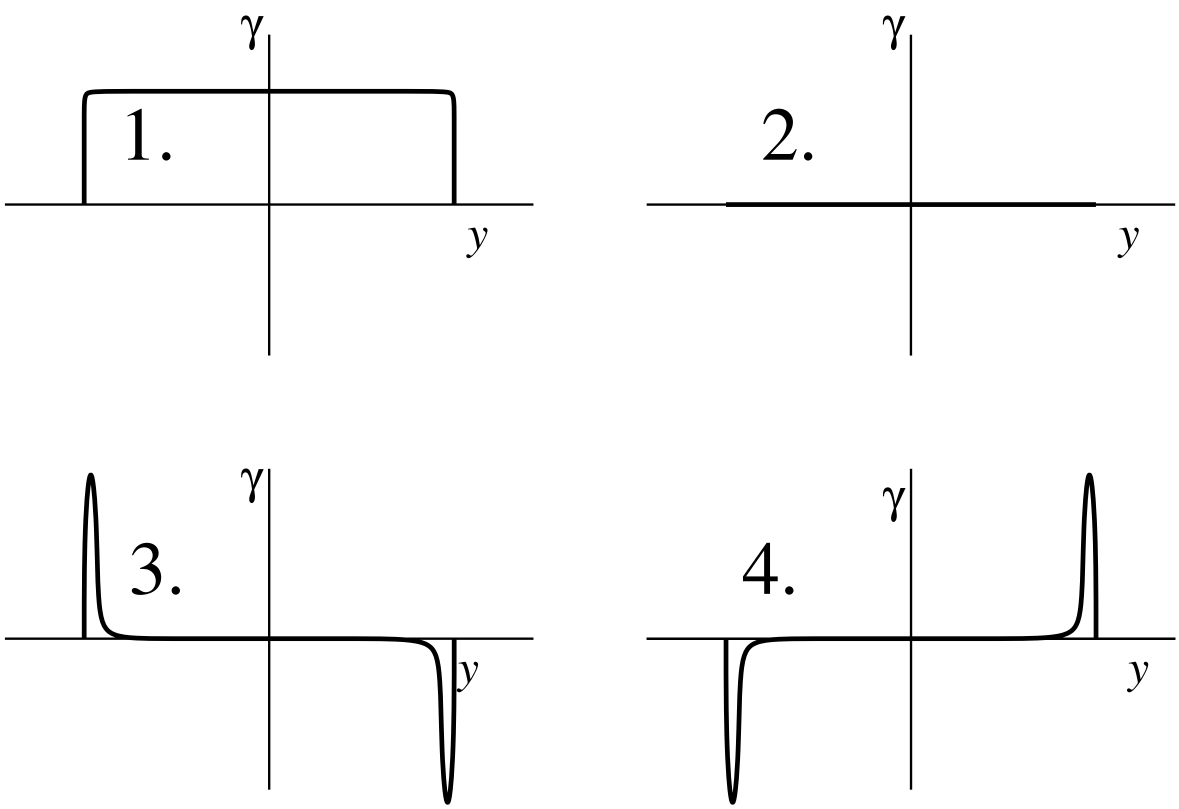


B



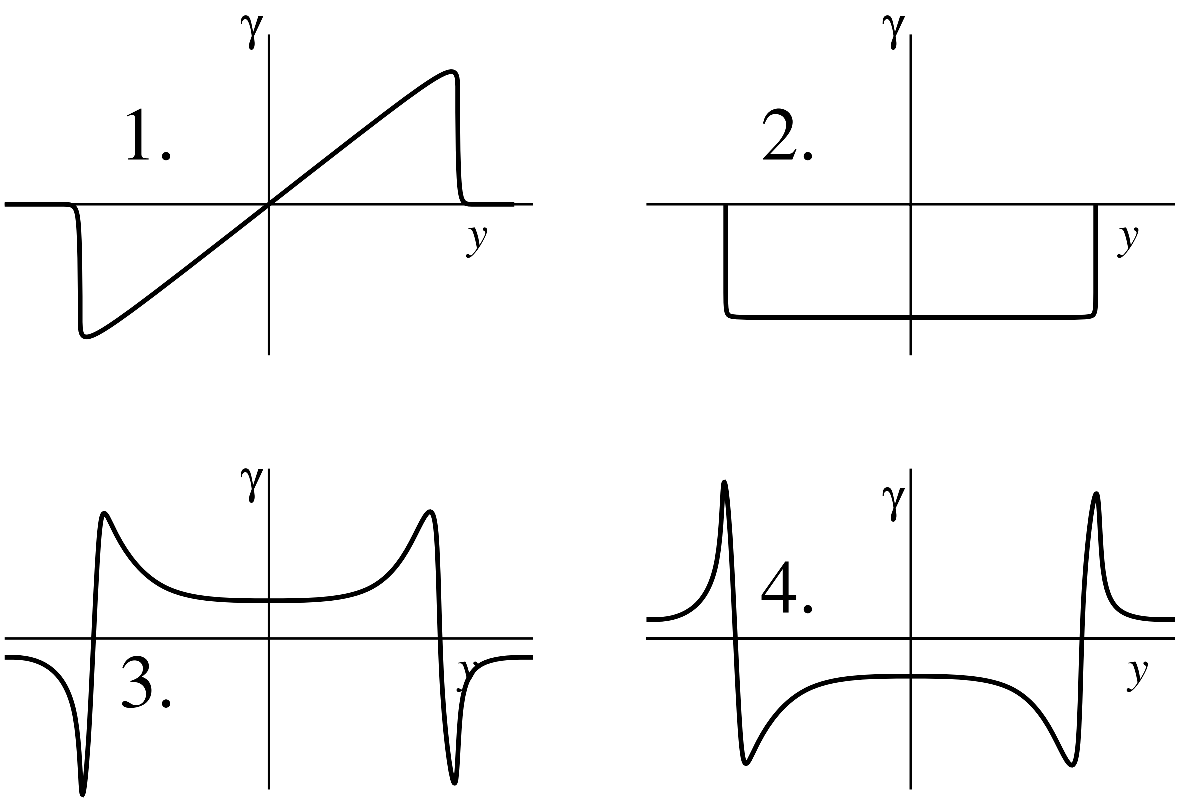
A wing has nearly-uniform circulation $\Gamma(y)$ over the span. What is the associated vortex sheet strength $\gamma(y)$?

4.*



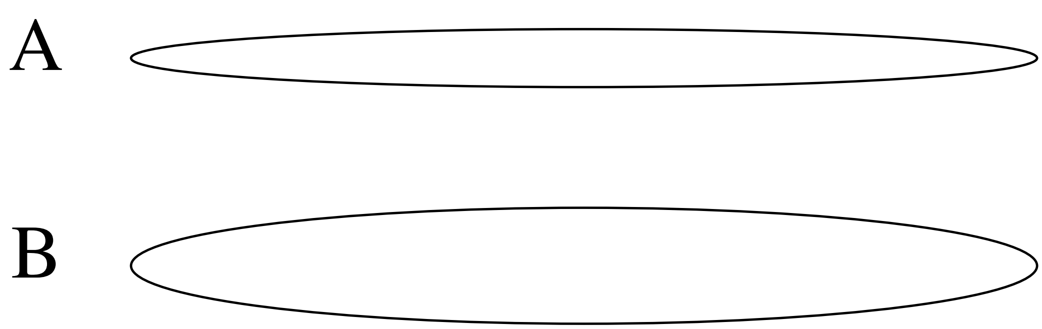
A wing has nearly-uniform circulation $\Gamma(y)$ over the span. What is the associated downwash $w(y)$?

4.*



Two wings are operating at the same velocity and lift. Wing B has doubled chords compared to wing A. How do their D_i's compare?

1. $(D_i)_A > (D_i)_B$
2.* $(D_i)_A = (D_i)_B$
3. $(D_i)_A < (D_i)_B$

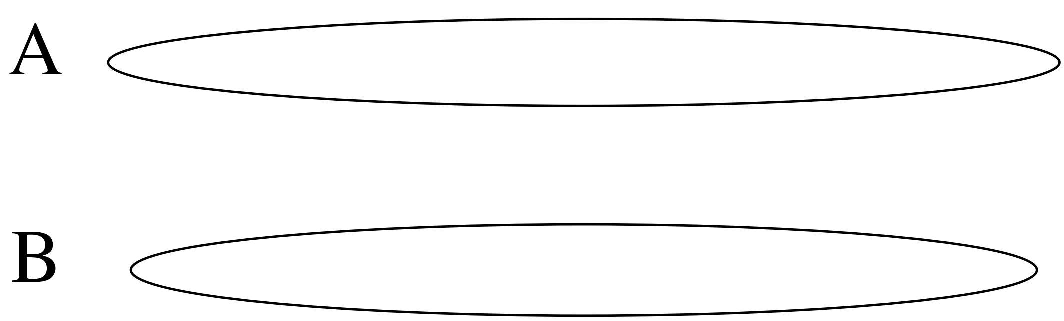


Two wings with the same area are operating at the same velocity and lift. Wing A has a 5% larger span. How do their C_{Di}'s compare?

1.* $(C_{Di})_A \simeq 0.90\,(C_{Di})_B$

2. $(C_{Di})_A \simeq 0.95\,(C_{Di})_B$

3. $(C_{Di})_A \simeq (C_{Di})_B$



To design a wing with an elliptic load distribution at a given V_∞ and b, which variable is NOT in our power to manipulate?

1. $\alpha_{geom}(\mathbf{y})$ **geometric twist**
2. $\alpha_{\mathbf{L=0}}(\mathbf{y})$ **zero-lift angle**
3. * $\alpha_{\mathbf{i}}(\mathbf{y})$ **induced angle**
4. $\mathbf{c}(\mathbf{y})$ **chord**
5. $\mathbf{c}_\ell(\mathbf{y})$ **lift coefficient**
6. **They can all be manipulated**
7. **Not sure**

In our elliptic-loaded wing design example, we increase the constant chord by 10%. What will NOT change in our wing?

1. $\alpha_{\text{geom}}(\mathbf{y})$ **geometric twist**
2.* $\alpha_{\mathbf{i}}(\mathbf{y})$ **induced angle**
3. $\mathbf{c}_{\ell}(\mathbf{y})$ **lift coefficient**
4. **Not sure**

A wing with a non-elliptic loading has $e = 0.900$ ($\delta \simeq 0.10$). The deviation from elliptic loading is halved. What is the new e ?

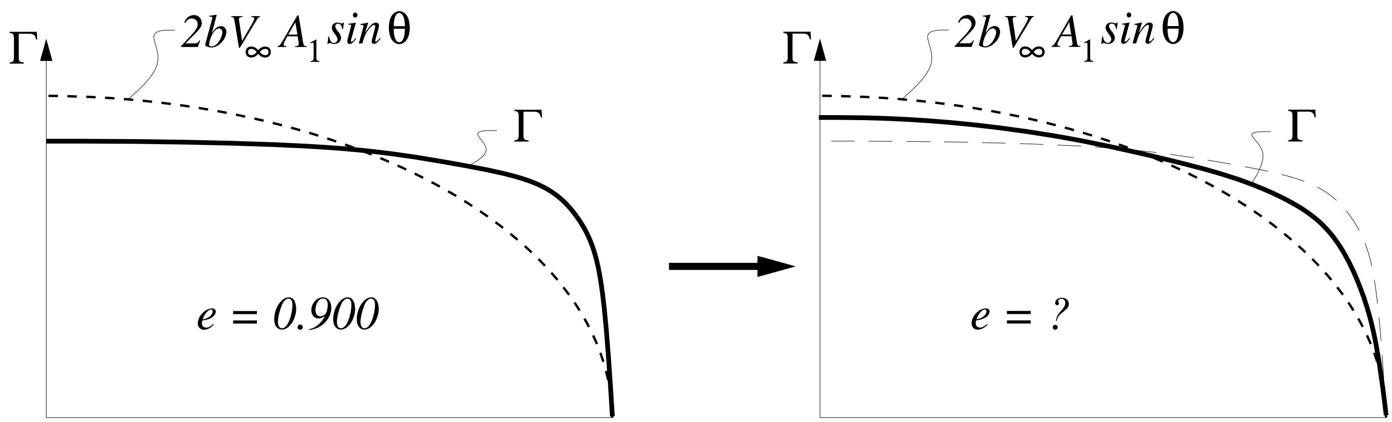
1. 0.900

2. 0.925

3. 0.950

4.* 0.975

5. Not sure



For a particular aircraft, changing the aspect ratio by +10% changes $C_L^{3/2}/C_D$ by +8%, but also changes total weight by +6%. To reduce flight power, the aspect ratio should be

1. **Increased**
2.* **Decreased**
3. **Not sure**