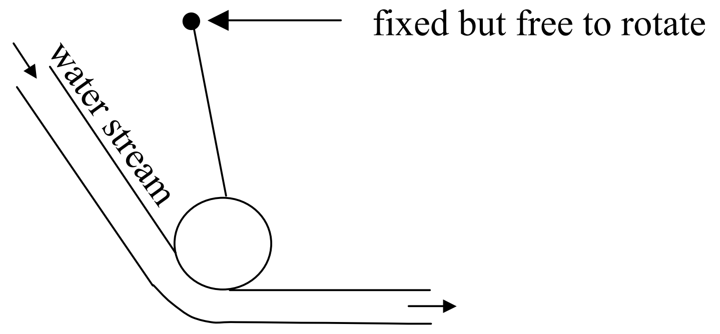
darmofal:

1

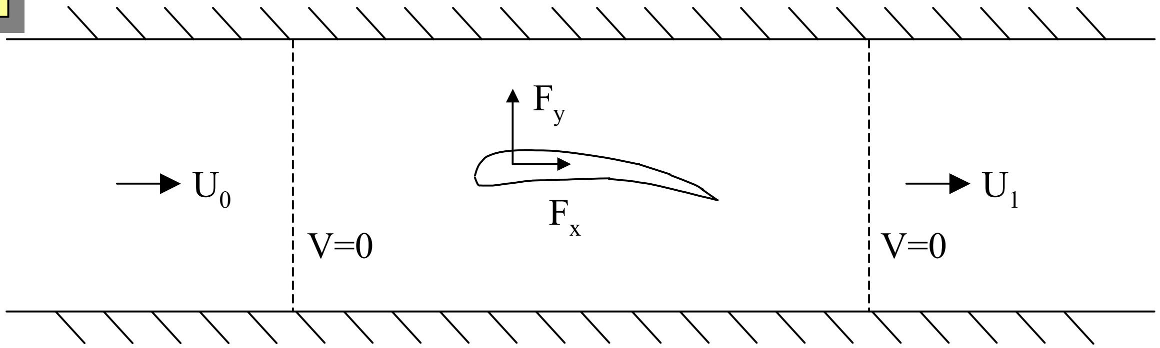


Given the water behaves as shown above, which direction will the cylinder rotate?

1) Clockwise
2) Counter-clockwise
3) Not enough information

darmofal:

1



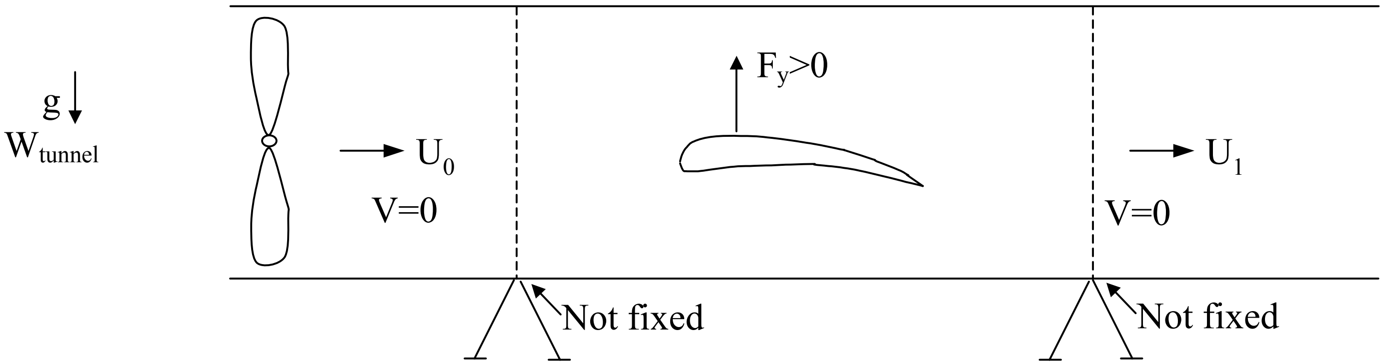
An airfoil which has $F_y>0$ when flying at speed U_0 in the atmosphere is placed in a wind tunnel with a straight wall test section. The velocity a few chords upstream & downstream have V=0.

1) $F_y>0$
2) $F_y<0$
3) $F_y=0$

darmofal:

2

$F_y > W_{tunnel}$
(airfoil fixed to a force balance, not the tunnel)



An airfoil is placed in a wind tunnel and experiences a lifting force $F_y > 0$. Given a very light tunnel such that $W_{tunnel} < F_y$: True or False: will the tunnel "lift off"

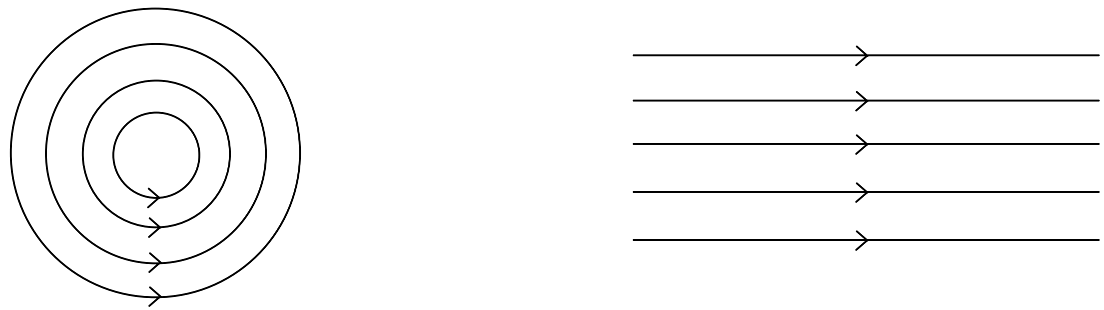
1) True

2) False

darmofal:

5

e following streamlines for a steady, two dimensional flow:



(a) (b)

Which of these flows is irrotational:

(1) Only (a)

(2) Only (b)

(3) Both (a) & (b)

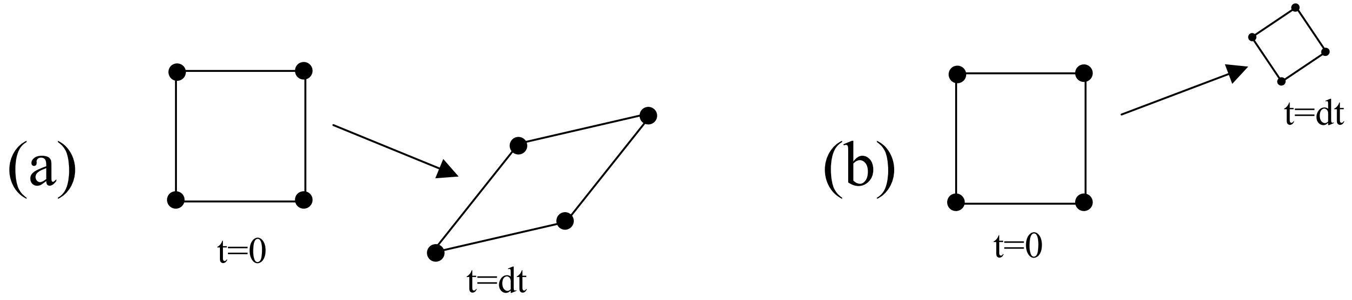
(4) Neither

(5) Not enough information

darmofal:

1

the motion of two fluid elements:



Which of these fluid element motions could be from an incompressible flow:

(1) Only (a)

(2) Only (b)

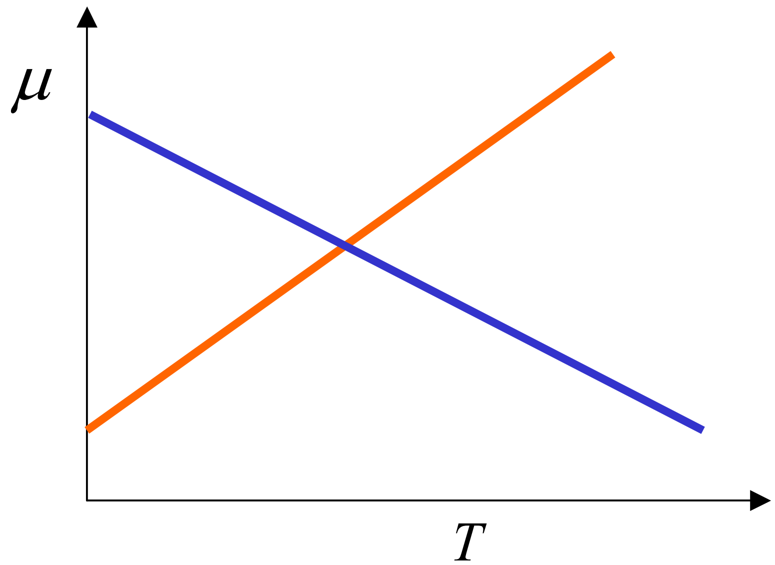
(3) Both (a) & (b)

(4) Neither

(5) Not enough information

darmofal:

2



Which trend do you think is most realistic for air:

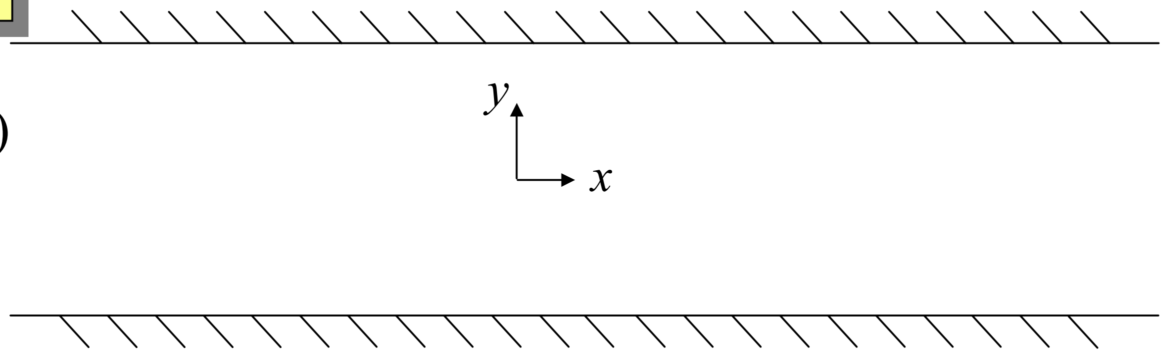
1) The **blue** line (dynamic viscosity decreases with temperature)

2) The **red** line (dynamic viscosity increases with temperature)

darmofal:

2

$$u = u(y)$$
$$v = 0$$



Consider channel flow as shown above. What is the net viscous force acting on the fluid in the x-direction (per unit depth)?

1) $\left[\tau_{yx}(h) + \tau_{yx}(+h)\right] \times L$

2) $\left[\tau_{yx}(h) - \tau_{yx}(-h)\right] \times L$

3) $\left[-\tau_{yx}(h) + \tau_{yx}(-h)\right] \times L$

4) $\left[-\tau_{yx}(h) - \tau_{yx}(-h)\right] \times L$

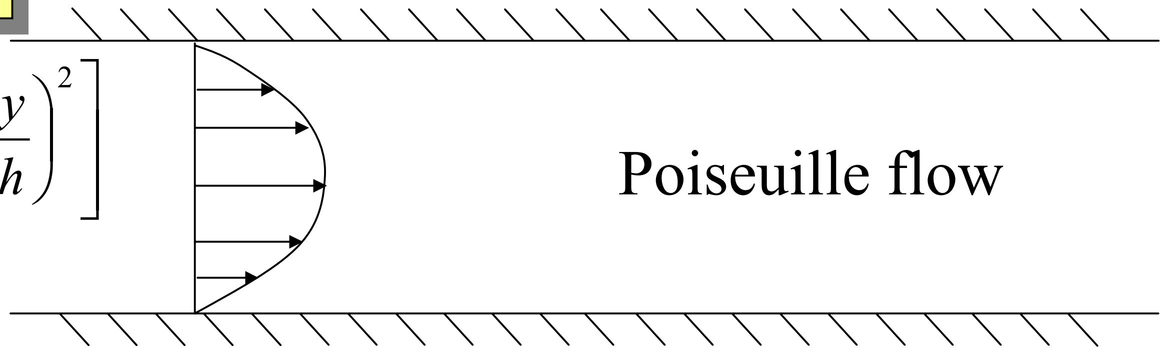
5) None of the above

darmofal:

6

$$u = u_0\left[1 - \left(\frac{y}{h}\right)^2\right]$$

$$v = 0$$



Acceleration of fluid element

(+0) = zero

(+1) = In $\pm x$ direction

Net Pressure Force on a fluid element

(+0) = zero

(+2) = In $\pm x$ direction

Net Viscous Force on a fluid element

(+0) = zero

(+4) = In $\pm x$ direction

Choose one from each column and enter your total (0-7)

OR

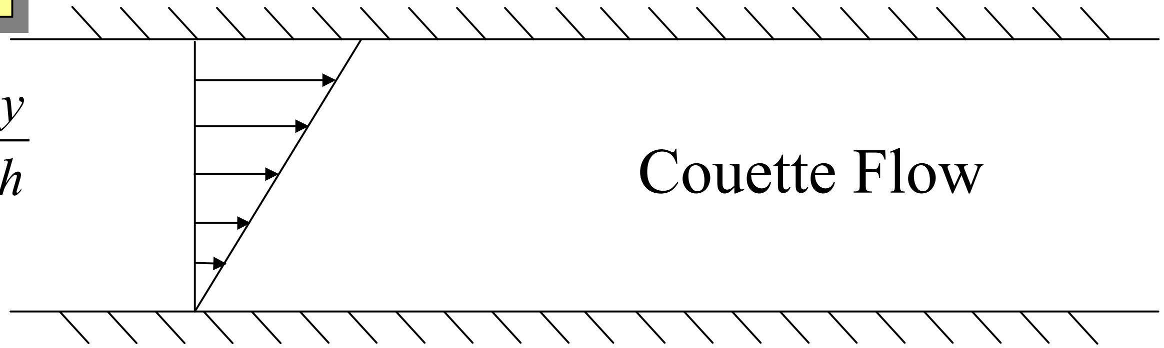
Enter (8) for none of these combinations are correct

darmofal:

0

$$u = u_{wall}\frac{y}{h}$$

$$v = 0$$



Acceleration of fluid element

(+0) = zero

(+1) = In $\pm x$ direction

Net Pressure Force on a fluid element

(+0) = zero

(+2) = In $\pm x$ direction

Net Viscous Force on a fluid element

(+0) = zero

(+4) = In $\pm x$ direction

Choose one from each column and enter your total (0-7)

OR

Enter (8) for none of these combinations are correct

darmofal:

2

Given a potential $\phi(x, y, z)$, the associated velocity field $\vec{v} = \nabla\phi$

(1) Satisfies conservation of mass for an incompressible flow

(2) Is irrotational

(3) Both of the above

(4) None of the above

darmofal:

1

Given two potentials ϕ_1 & ϕ_2, and the associated velocity fields, $\vec{v}_1 = \nabla\phi_1$ and $\vec{v}_2 = \nabla\phi_2$, we add the potentials to find a new potential, $\phi_3 = \phi_1 + \phi_2$. Assuming an inviscid, incompressible flow:

(1) $\vec{v}_3 = \vec{v}_1 + \vec{v}_2$

(2) $p_3 = p_1 + p_2$

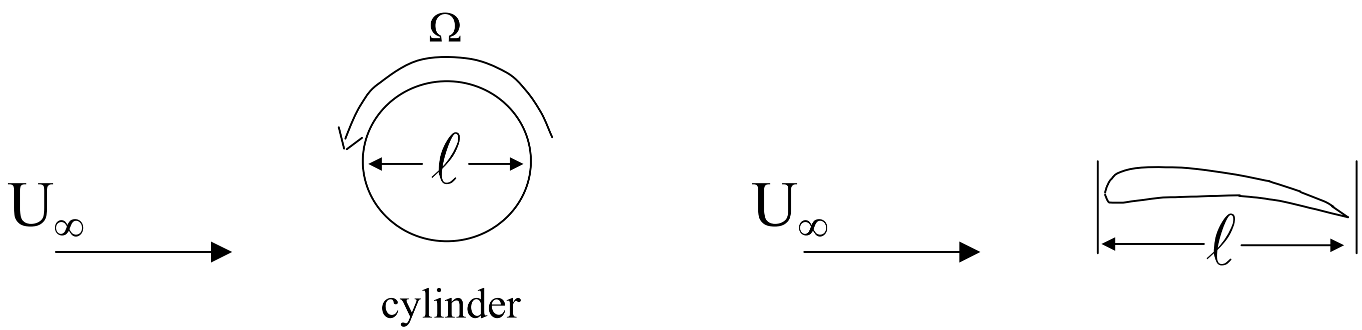
(3) Both of the above.

(4) None of the above.

darmofal:

3

In a 2-D incompressible, inviscid flow with a uniform freestream, which of the following is true?



(1) $\text{Drag}_{cyl} > \text{Drag}_{airfoil}$

(2) $\text{Drag}_{cyl} < \text{Drag}_{airfoil}$

(3) $\text{Drag}_{cyl} = \text{Drag}_{airfoil}$

(4) Not enough info

darmofal:

5

Which is true:

(1) The Kutta condition must be satisfied if $L' = \rho V_\infty \Gamma$ is true.

(2) The Kutta condition is always satisfied in a viscous flow.

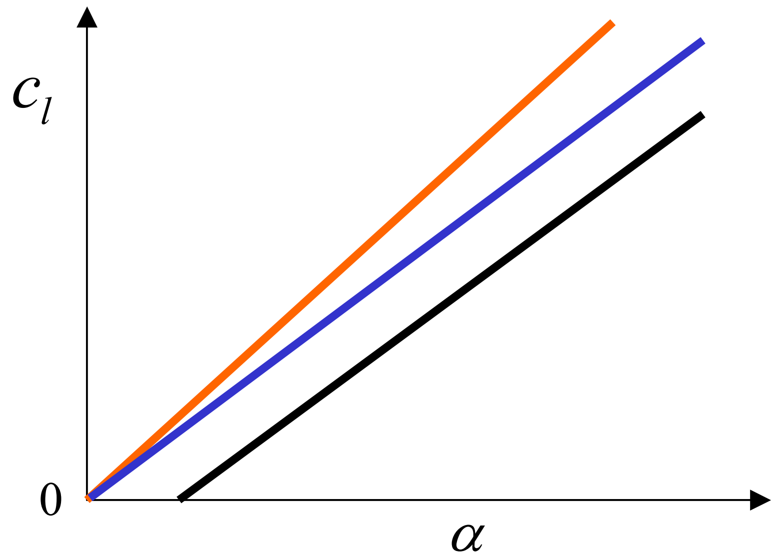
(3) Without the Kutta condition, $L' = 0$.

(4) All of the above.

(5) None of the above.

darmofal:

3



Two of the three lines **are** from thin airfoil theory, one line is not:

1) The **black** line is not thin airfoil theory

2) The **blue** line is not thin airfoil theory

3) The **red** line is not thin airfoil theory

4) Not enough information

darmofal:

1

According to thin airfoil theory, which is true:

(1) The moment at c/4 is constant with respect to angle of attack

(2) The moment at c/4 is zero when the lift is zero.

(3) Both of the above

(4) None of the above

darmofal:

2

For an airplane (or airfoil) which is statically stability, which of the following is true:

$(+0): x_{cp} < x_{ac}$ | $(+0): M_{ac} < 0$

$(+1): x_{cp} > x_{ac}$ | $(+2): M_{ac} > 0$

Choose one from each column and enter your total (0-3)

OR

Enter (4) if there is not enough information

darmofal:

3

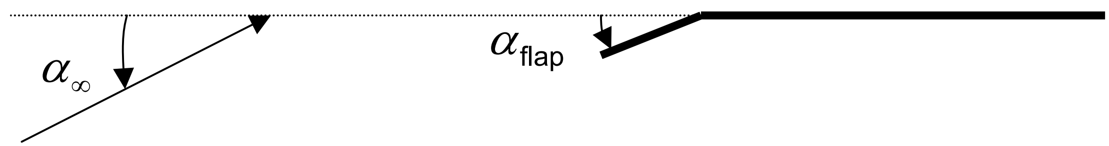
Consider a symmetric airfoil in a flow which is at an angle of attack. To eliminate the leading edge suction peak, the leading is deflected downwards using a flap. Which is true?

(1) $\alpha_{\text{flap}} < \alpha_{\infty}$

(2) $\alpha_{\text{flap}} \approx \alpha_{\infty}$

(3) $\alpha_{\text{flap}} > \alpha_{\infty}$

(4) Not enough information



darmofal:

1

Assuming Prandtl's lifting line is being applied:

C_L is at most a linear function of α

(1) True
(2) False
(3) Not enough info

darmofal:

6

For a 3-D incompressible potential flow, which is true:

(1) If L=0 then D=0

(2) If D=0 then L=0

(3) If L$\neq$ 0 then D$\neq$ 0

(4) 1+2

(5) 1+3

(6) 2+3

(7) All (1+2+3)

(8) None

darmofal:

1

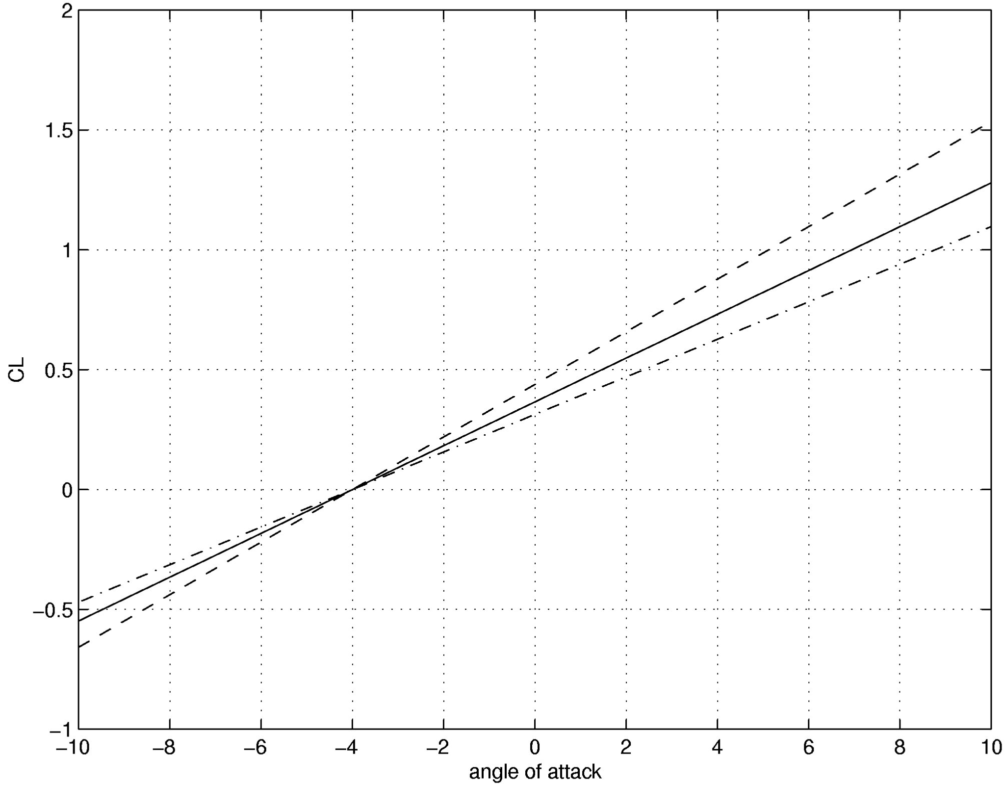
Assuming Prandtl's lifting line is being applied:

The span efficiency factor, e, is a function of angle of attack

(1) True
(2) False
(3) Not enough info

darmofal:

3



The following results are from a lifting line analysis of three wings **all** with the same cambered airfoil. Which wing is the **solid line:**

1) 2-D airfoil

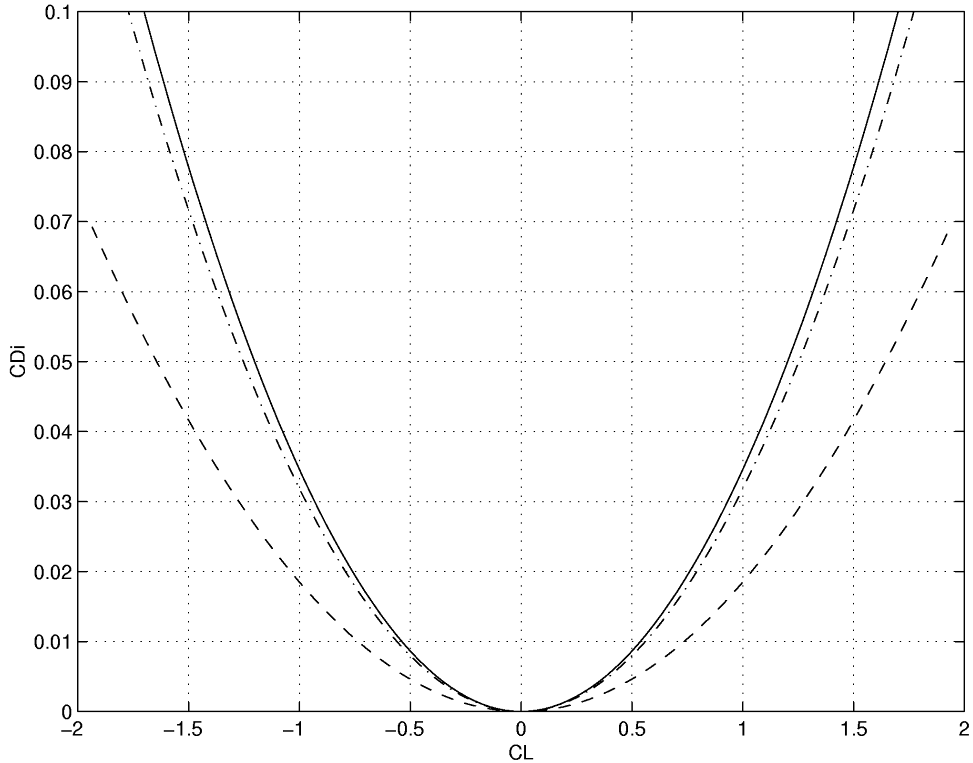
2) Elliptic planform, no geometric twist, AR=5

3) Elliptic planform, no geometric twist, AR=10

4) None of the above

darmofal:

1

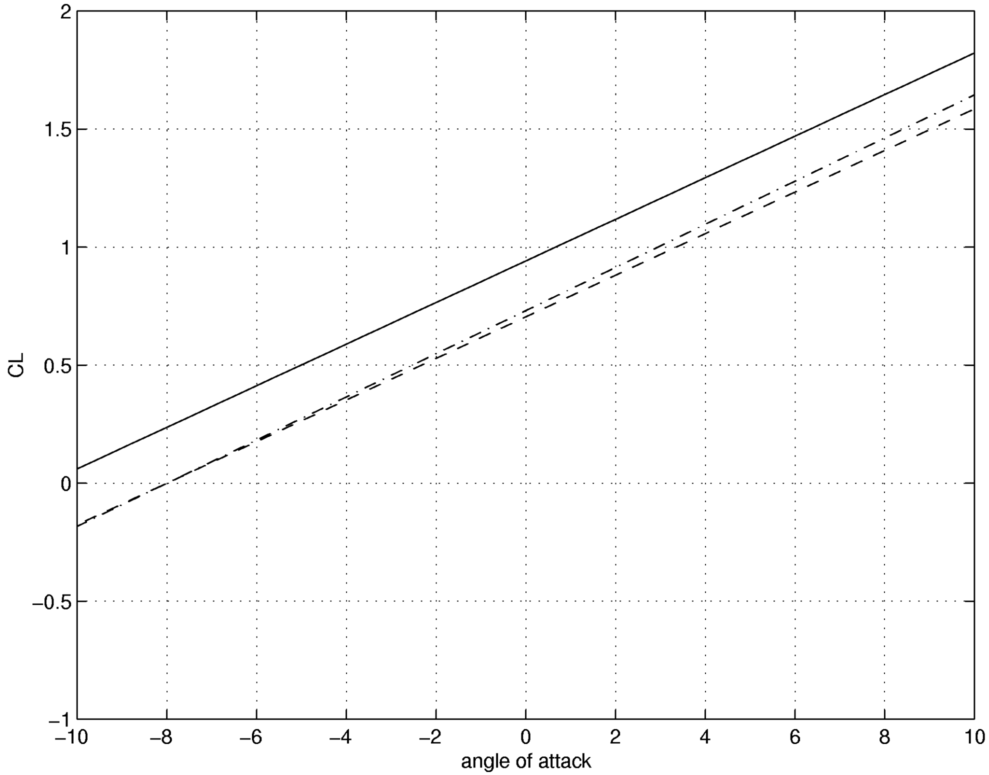


The following results are from a lifting line analysis of three wings **all** with the same airfoil and no geometric twist. Which wing is the **dash-dot line**:

1. Elliptic planform, AR=10
2. Rectangular planform, AR=10
3. Rectangular planform, AR=20
4. None of the above

darmofal:

1



The following results are from a lifting line analysis of three wings **all** with the same airfoil and AR=10. Which wing is the **dash-dot line**:

1. Elliptic planform, no geometric twist.

2. Rectangular planform, no geometric twist

3. Rectangular planform, with geometric twist

4. None of the above

darmofal:

1

Assuming Prandtl's lifting line is being applied:

Given a rectangular wing. The wing camber or twist distribution can be designed to provide elliptic lift.

(1) True
(2) False
(3) Not enough info

darmofal:

2

At its cruise flight speed, V_c, a general aviation aircraft has a drag polar which is well approximated by:

$$C_D \cong C_{D_0} + KC_L^2$$

During approach for landing (though still far from the ground), the velocity is about $\frac{1}{2}V_c$. Which do you think is most likely to be true:

(1) Approach Drag < Cruise Drag

(2) Approach Drag > Cruise Drag

(3) Approach Drag ≈ Cruise Drag

darmofal:

2

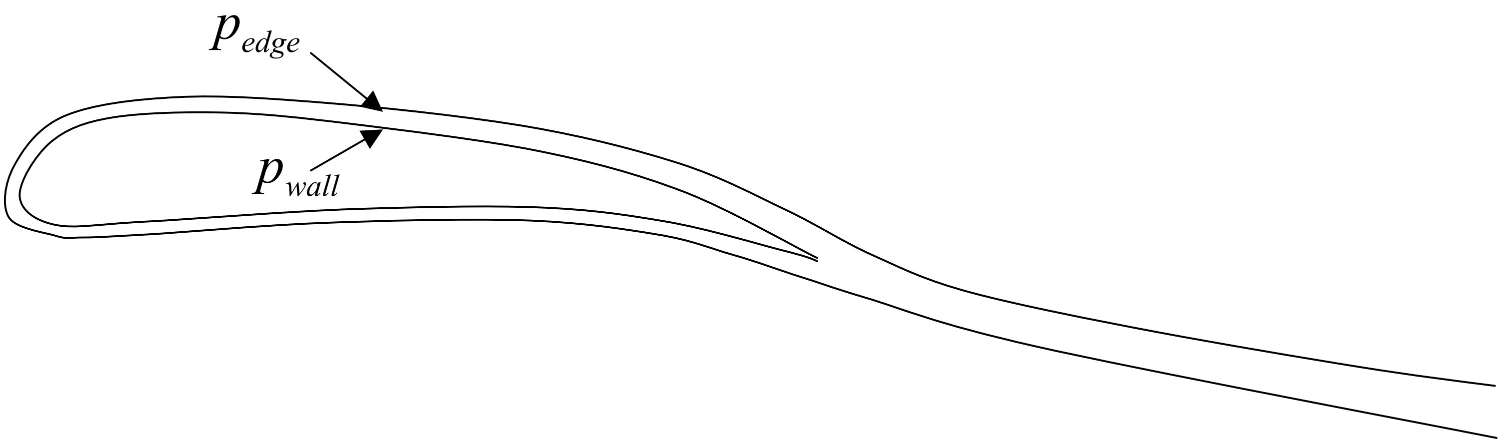
As an aircraft nears the ground, the induced drag tends to:

(1) Increase

(2) Decrease

darmofal:

2



Which is most likely true:

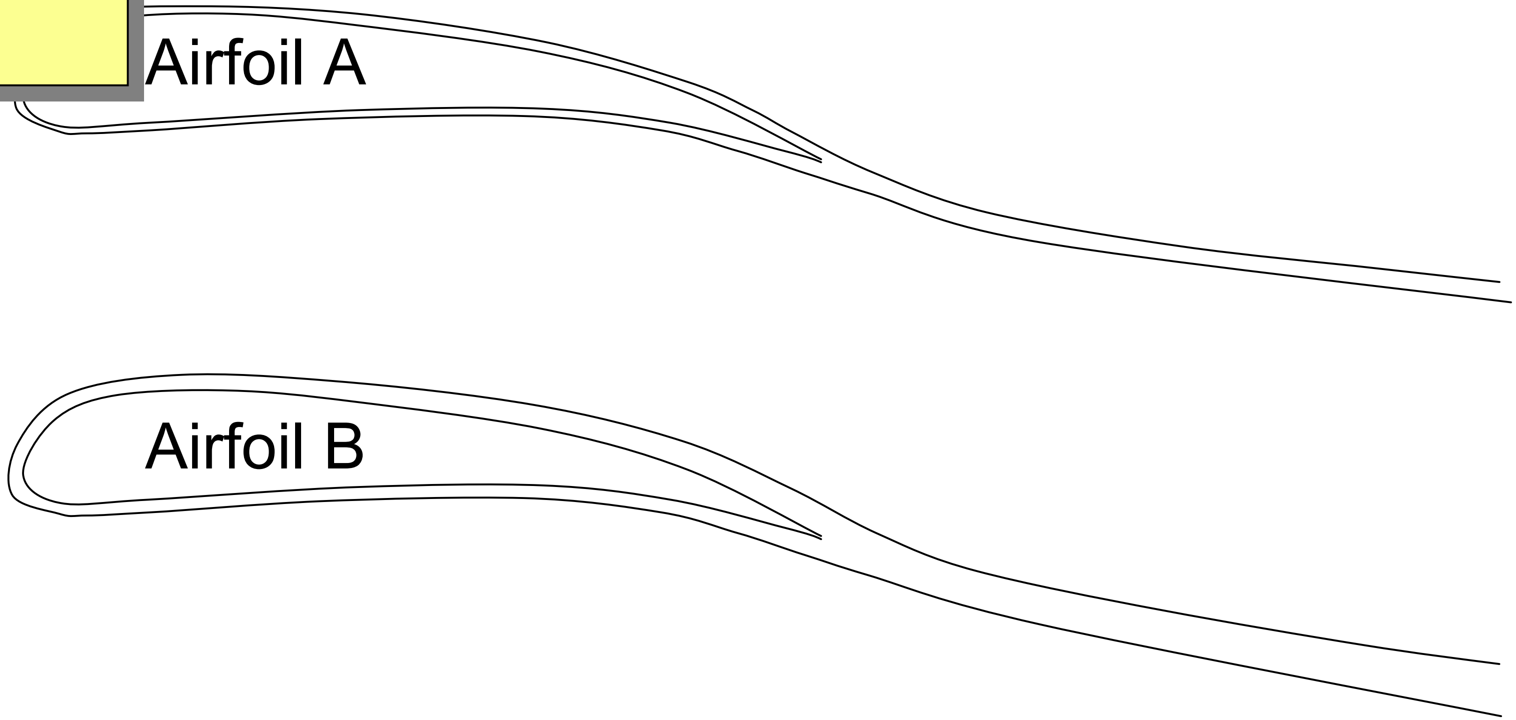
(1) $p_{edge} < p_{wall}$

(2) $p_{edge} \approx p_{wall}$

(3) $p_{edge} > p_{wall}$

darmofal:

1



Consider the pressure distribution on the airfoils for the boundary layers sketched above. Which airfoil's pressure distribution will be most similar to the inviscid flow pressure distribution over the airfoil:

(1) Airfoil A

(2) Airfoil B

(3) Not enough information

darmofal:

1

Assume that the boundary layer on an airfoil is attached and laminar. Which is most likely to be true:

(1) The skin friction is largest at the leading-edge and decreases toward the trailing edge

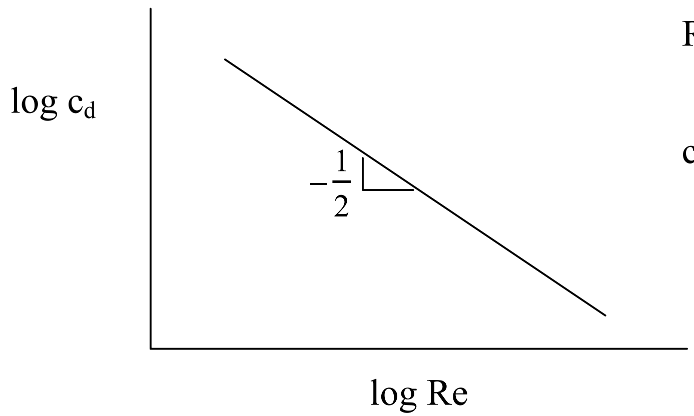
(2) The skin friction is smallest at the leading-edge and increases toward the trailing edge

(3) The skin friction is largest near the location of maximum camber

darmofal:

3

l has the following C_d vs. Re



$$Re = \frac{V_\infty c}{\nu_\infty}$$

$$c_d = \frac{D'}{q_\infty c}$$

At $V_\infty = V_1$, the drag on the airfoil is D'_1 .

For $V_\infty = 2V_1$, the drag on the airfoil is D'_2 .

(1) $D'_1 > D'_2$

(2) $D'_1 = D'_2$

(3) $D'_1 < D'_2$

(4) Not enough info

darmofal:

4

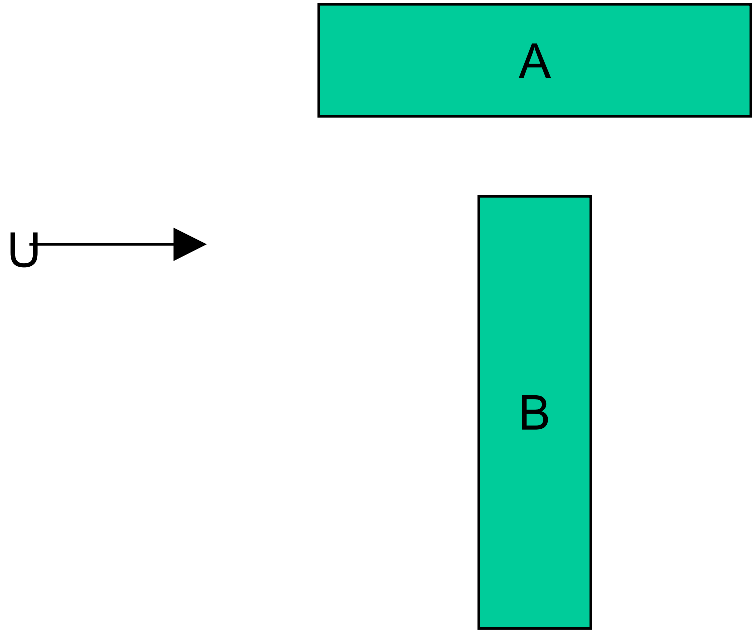
Given two identical flat plates at zero angle of attack and oriented as shown, which of the following is true

(1) Drag A > Drag B

(2) Drag A < Drag B

(3) Drag A = Drag B

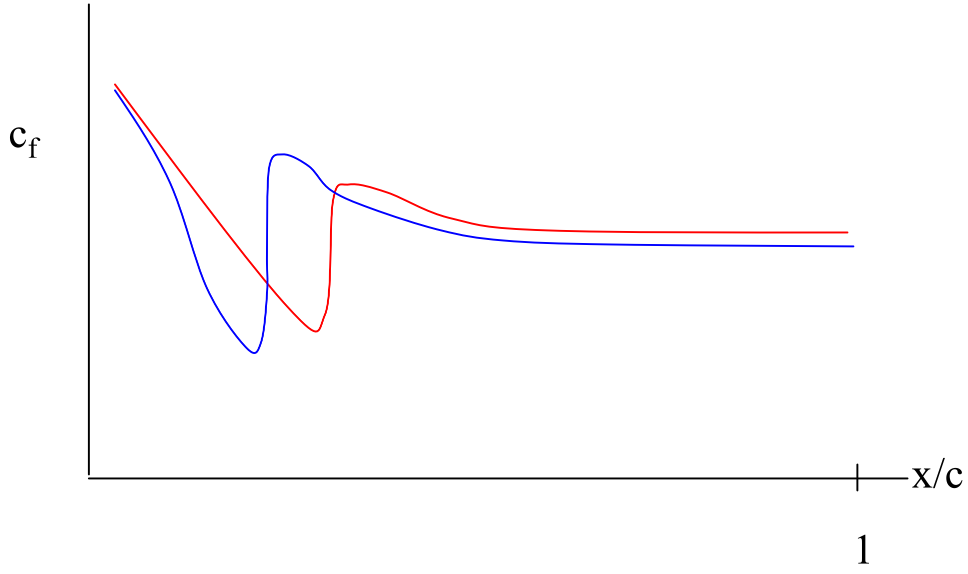
(4) Not enough information



darmofal:

1

The skin friction coefficient on a symmetric airfoil at V_∞ & $2V_\infty$ are shown below:



Which is true:

(1) The red curve is for $V = V_\infty$

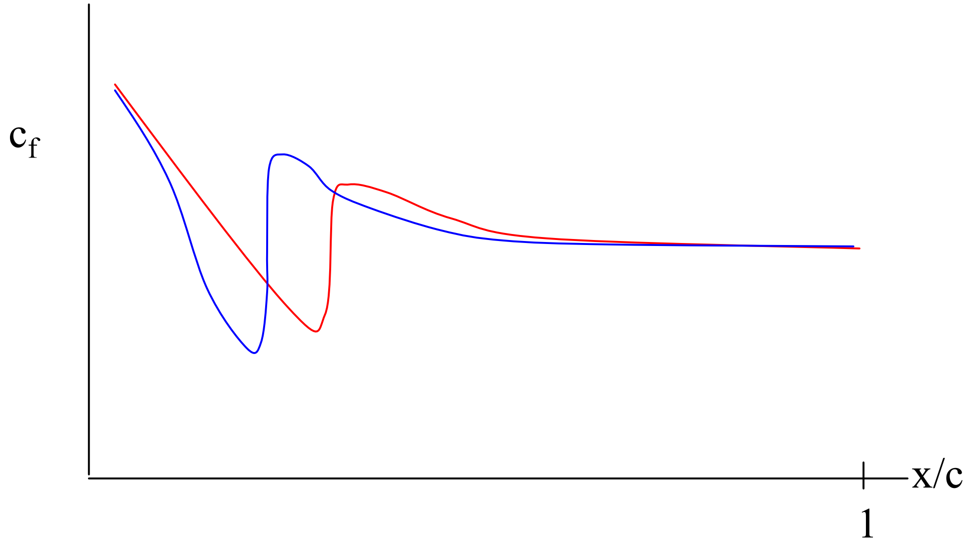
(2) The red curve is for $V = 2V_\infty$

(3)Not enough info

darmofal:

1

The skin friction coefficient on two symmetric airfoils with chords c_0 & $2\,c_0$ from a wind tunnel test at the same velocity is:



Which is true:

(1) The red curve is for the airfoil with $c = c_0$

(2) The red curve is for the airfoil with $c = 2\,c_0$

(3) Not enough info

darmofal:

6

Which are true:

(1) A separated flow must be turbulent.

(2) A turbulent flow must be separated.

(3) If the boundary layer thickness of an attached flow increases along the airfoil surface, the skin friction decreases.

(4) All of the above.

(5) 1 and 2.

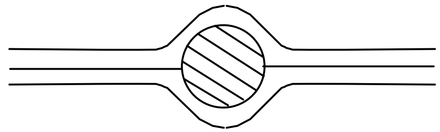
(6) None of the above.

darmofal:

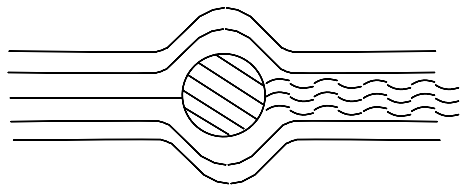
4

Given a cylinder at two different flow conditions

(a) $Re \approx 10^{\circ}$



(b) $Re \approx 10^{7}$



Which of the following is true:

(1) Drag A > Drag B

(2) Drag A < Drag B

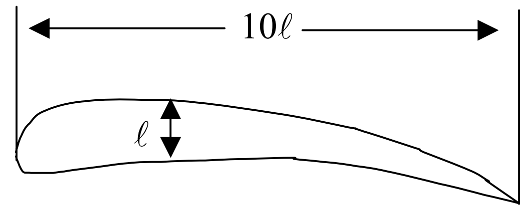
(3) Drag A = Drag B

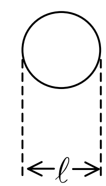
(4) Not enough info

darmofal:

2

If the airfoil and cylinder are moving with speed V_∞ in air at sea level conditions such that $M_\infty \cong 0.1$ and $\frac{V_\infty \ell}{V_\infty} \cong 10^7$. If the drag per unit length of the cylinder is 10 lb/ft and the airfoil is at approximately zero degrees angle of attack.





(1) $D'_{airfoil} \approx 0.1\, lb/ft$

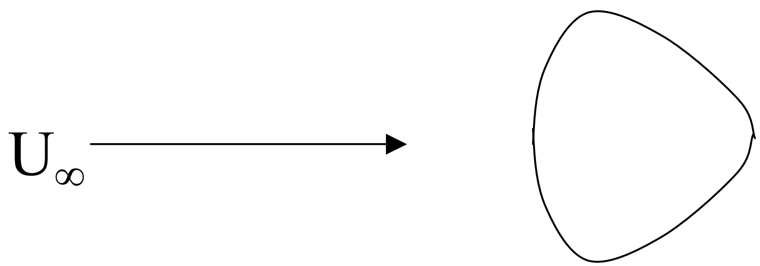
(2) $D'_{airfoil} \approx 1\, lb/ft$

(3) $D'_{airfoil} \approx 10\, lb/ft$

(4) $D'_{airfoil} \approx 20\, lb/ft$

(5) $D'_{airfoil} \approx 100\, lb/ft$

A major concern in the design of vehicles for re-entry in Earth's atmosphere is heating. Often, blunt body shapes are used such as:



Which of the following is true:

(1) Everything else being the same, a laminar boundary layer will tend to decrease the heat transfer to the vehicle at its base

(2) Everything else being the same, a turbulent boundary layer will tend to increase the heat transfer to the vehicle at its base

(3) Not enough information

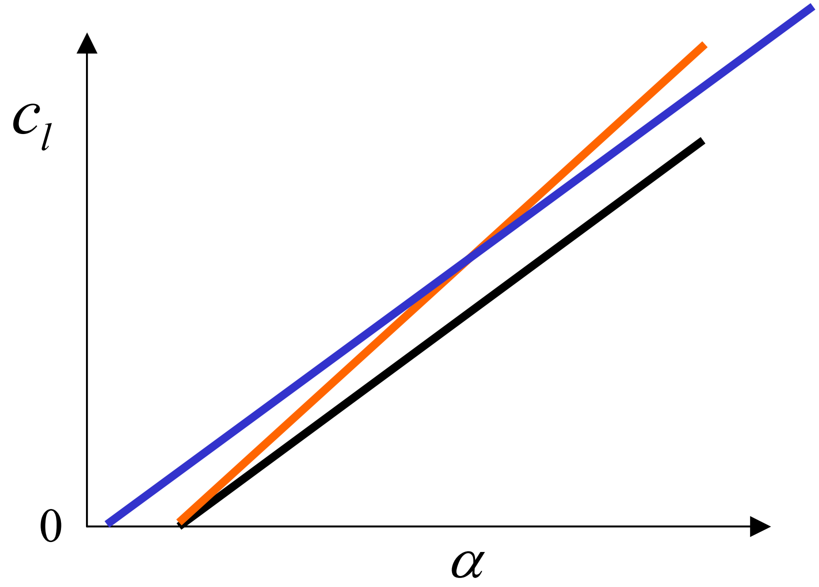
For the flow of an ideal gas, the total pressure, P_0, and the static pressure, p, are related by:

1) $P_0 = p + \frac{1}{2}\rho\left|\vec{V}\right|^2$

2) $P_0 = p\left(1 + \frac{\gamma - 1}{2}M^2\right)^{\gamma/(\gamma-1)}$

3) Both 1) and 2)

4) Neither



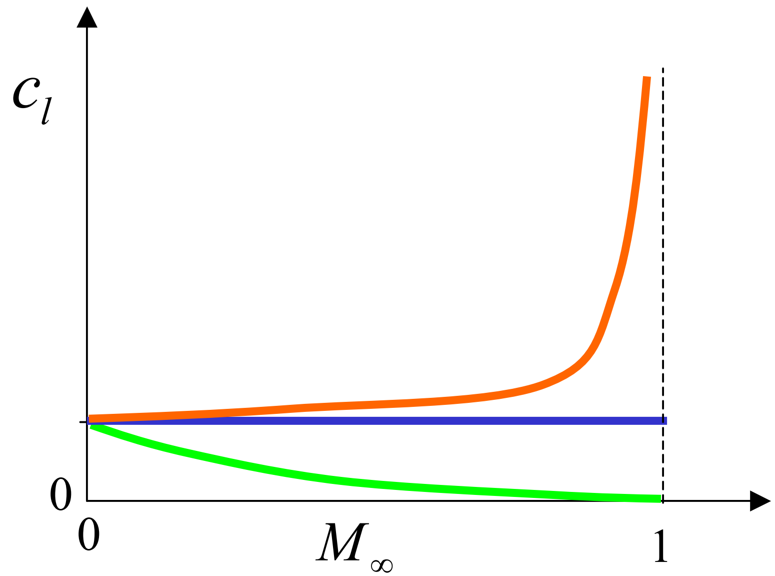
The above results are from a small disturbance, potential flow analysis of an airfoil under three conditions. Which is the **red line**:

1) Mach = 0.05

2) Mach = 0.30

3) Mach = 0.05, with a trailing edge flap deflected

4) None of the above



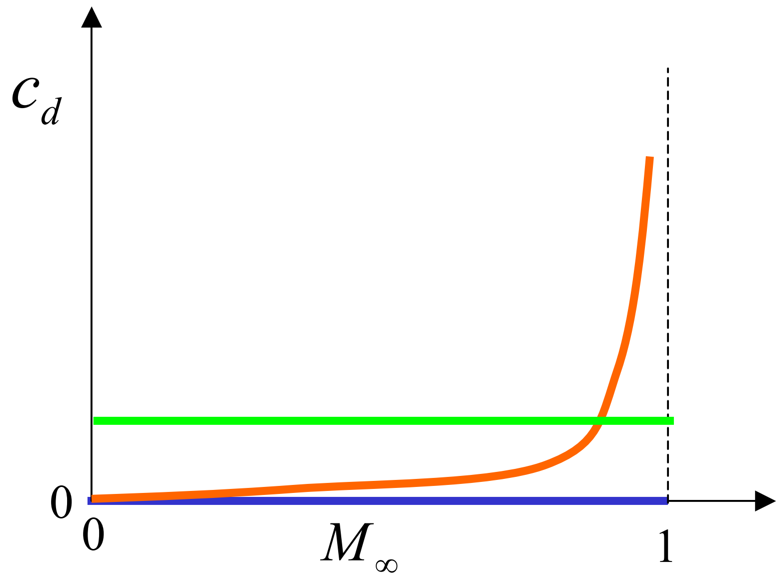
The above is a plot of the lift coefficient of an airfoil versus Mach number at a fixed angle of attack. Which line is the result of small disturbance potential flow theory:

1) **Blue line**

2) **Red line**

3) **Green line**

4) None of the above



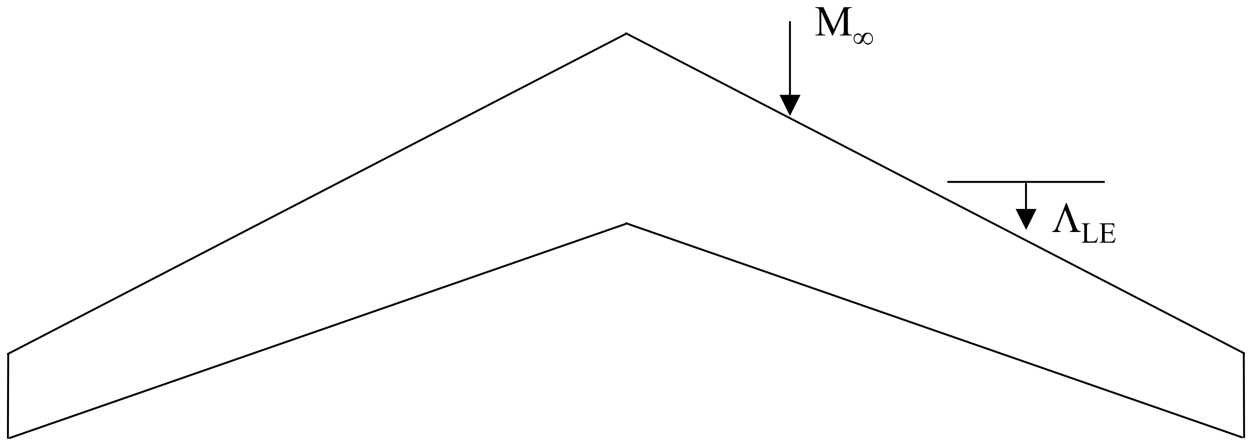
The above is a plot of the drag coefficient of an airfoil versus Mach number at a fixed angle of attack. Which line is the result of small disturbance potential flow theory:

1) **Blue line**

2) **Red line**

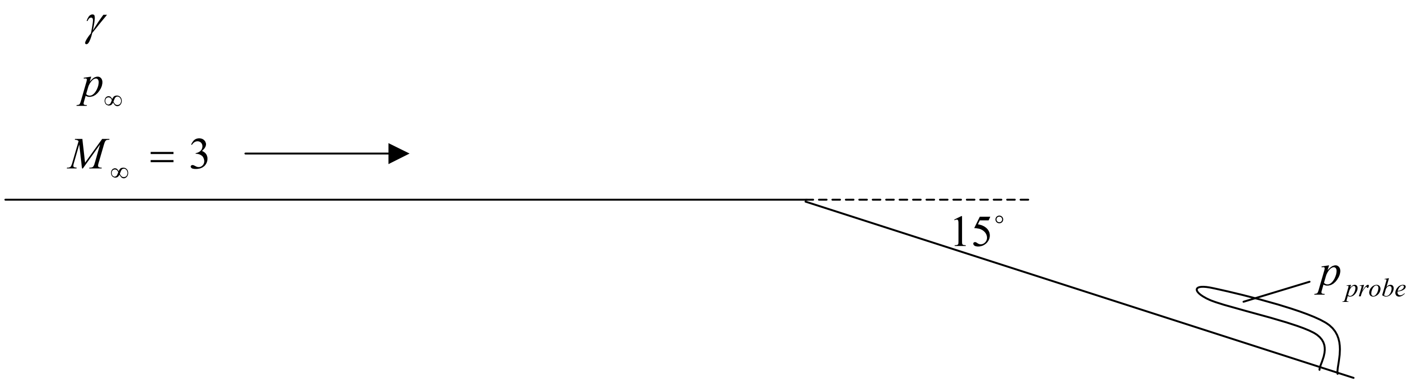
3) **Green line**

4) None of the above



Given a swept, high *AR* wing, at fixed α:

(1) M_{crit} increases with Λ_{LE}
(2) M_{crit} decreases with Λ_{LE}
(3) M_{crit} is independent of Λ_{LE}
(4) Not enough info



A pitot tube is used to measure to pressure downstream of the ramp shown above. Approximately, what will the probe pressure be:

(1) $p_{probe} = p_\infty + \frac{\gamma}{2} p_\infty M_\infty^2$

(2) $p_{probe} = p_\infty \left(1 + \frac{\gamma - 1}{2} M_\infty^2\right)^{\gamma/(\gamma-1)}$

(3) Both of the above

(4) Neither of the above