MŰEGYETEM 1782

FLUID MECHANICS

TESTS

Attention: there might be more correct answers to the questions.

Chapter 11: Force acting on bodies in a flow

T.11.1.1 Choose the correct form of the drag coefficient!

$a,\ c_d = \frac{F_d}{\rho\, v_\infty^2\, l\, d}$

$b,\ c_d = \frac{F_d}{\frac{\rho}{2} v_\infty^2\, l\, d}$

$c,\ c_d = \frac{F_d}{\frac{\rho}{2} v_\infty^2\, d}$

$d,\ c_d = \frac{\frac{\rho}{2} v_\infty^2\, l\, d}{F_d}$

$e,\ c_d = \frac{F_d}{\frac{\rho}{2} v_\infty\, l\, d}$

The answer is:

T.11.1.2 Choose the correct statements!

a, At low Reynolds numbers inertial forces dominate.

b, At low Reynolds numbers viscous forces dominate.

c, If the boundary layer is turbulent on a cylinder surface, it separates sooner.

d, If the boundary layer is turbulent on a cylinder surface, it separates later.

The answer is:

T.11.1.3 Choose the correct statements!

a, A cylinders drag coefficient increases as the Reynolds number increases.

b, At the critical Reynolds number the boundary layer on the front surface of a cylinder gets turbulent.

c, Above a certain critical Reynolds number the drag coefficient of a square pillar decreases significantly.

d, The sharp edges of a square pillar prevent the movement of the separation point, therefore the drag coefficient does not decrease significantly.

e, The rougher the cylinder surface and the more turbulent the upstream flow, the lower the value of the critical Reynolds number.

The answer is:

T.11.1.4 Choose the correct statements!

a, In the case of a cylinder, periodic vortex separation occurs only over Re=10^5.

b, There is no periodic vortex separation behind cylinders in the Re=100-1000 range.

c, Reducing the cylinder length, the drag coefficient increases.

d, Reducing the cylinder length, the drag coefficient decreases.

e, In the case of a large Reynolds numbers (say Re=*10*^{6}*) periodic vortex separation occurs behind cylinders.*

The answer is:

T.11.2.1 Choose the correct expression for Stokes formula! (μ dynamic viscosity, ν kinematic viscosity, w relative velocity, d_p particle diameter, A_p particle cross-section size)

a, $F_d = 3\,\pi\,\mu\,d_p w^2$

b, $F_d = 3\,\pi\,\nu d_p\,w$

c, $F_d = 3\,\pi\,\mu\,A_p\,w$

d, $F_d = 3\,\pi\,\nu A_p w$

e, $F_d = 3\,\pi\,\mu\,d_p w$

The answer is:

T.11.2.2 Choose the correct statements!

a, Lift force acting on a wing is perpendicular to the chord.

b, Lift force acting on a wing is perpendicular to the flow velocity.

c, Drag force acting on a wing is parallel to the chord.

d, Drag force acting on a wing is perpendicular to the flow velocity.

e, Drag force acting on a wing is parallel to the flow velocity.

The answer is:

T.11.2.3 Choose the correct statements regarding a sharp edged square pillar with flow velocity parallel to the pillar axis.

a, Drag coefficient increases as the length increases.

b, Drag coefficient is the highest when the pillar is the thinnest (a flat plate).

c, Drag coefficient mainly depends on the drag acting on the front surface.

d, Drag coefficient mainly depends on drag acting on the rear surface.

e, Drag coefficient has a minimum at a certain length.

The answer is:

T.11.3.1 A vehicle of cross-section *A* and mass *m* travels in air (ρ density) with velocity *v*. Calculate the necessary *P* power assuming c_d drag coefficient and f_r rolling resistance coefficient.

$a, P = v\left(\frac{\rho}{2} v^2\, A\, c_d - m\, g\, f_r\right)$

$b, P = \left(\frac{\rho}{2} v^2\, A\, c_d + m\, g\, f_r\right)$

$c, P = v\left(\frac{\rho}{2} v^2\, A\, c_d + m\, g\, f_r\right)$

$d, P = \frac{\rho}{2} v^3\, A\, c_d + v\, m\, g\, f_r$

$e, P = v\left(\frac{\rho}{2} v^3\, A\, c_d + m\, g\, f_r\right)$

The answer is:

T.11.3.2 The first and second eras of auto body development were:

a, application of aircraft development results (streamlining) and shape optimisation

b, using shapes of other objects and shape optimisation

c, using shapes of other objects and application of aircraft development results (streamlining)

d, application of aircraft development results (streamlining) and auto body development based on aerodynamically ideal shapes

e, shape optimisation and auto body development based on aerodynamically ideal shapes

The answer is:

T.11.3.3 Choose the correct statements!

a, Front surface drag can be decreased by rounding the leading edges.

b, A spoiler below the front surface can decrease flow velocity in the gap below the vehicle underbody, therefore the drag of the underbody decreases.

c, Sinking the trunk door decreases aerodynamic drag.

d, Decreasing the width in the rear part of the autobody decreases the front surface drag.

e, A front surface spoiler and leading edge rounding applied together causes a larger decrease of drag than the sum of drag decrease when they are applied separately.

The answer is:

TZ.11.1 Aerodynamic drag force

a, is mainly due to pressure forces in case of bluff bodies.

b, is mainly due to shear forces in case of bluff bodies.

c, is zero in an inviscid fluid.

d, is non-zero in viscous fluids.

e, can be well approximated based on the pressure distribution in case of streamlined bodies.

TZ.11.2 Drag force acting on a cylinder

a, is mainly caused by wall shear stresses at large Reynolds numbers.

b, is directly proportional to velocity at very low Reynolds numbers.

c, changes periodically in a given Reynolds number range.

d, the drag coefficient increases when the front surface boundary layer gets turbulent.

e, the drag coefficient decreases when the front surface boundary layer gets turbulent.

TZ.11.3 Choose the correct statement(s)! In case of a wing

a, the ratio of drag force and lift force gives the lift-to-drag ratio.

b, the ratio of lift force and drag force gives the lift-to-drag ratio.

c, lift decreases and drag increases when the boundary layer separates because of an increased angle of attack.

d, both lift and drag decrease when the boundary layer separates because of increased angle of attack.

e, flow around the wing tip decreases lift and increases drag.