FLUID MECHANICS

TESTS

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

Chapter 9: Boundary layers

T.9.1.1 In a turbulent boundary layer

a,the fluid parcels do not mix

b,pressure barely changes in the direction perpendicular to the wall

c, mixing length is constant

d, there is a viscous layer on the bottom.

e, the universal law of the wall describes the whole turbulent part.

The answer is:

T.9.1.2 Choose the correct expression for the universal law of the wall!

$a, \frac{v_x}{u^*} = \frac{1}{\kappa} \ln \frac{yu^*}{\nu}$

$b, v = \frac{1}{\kappa} \ln \frac{yu^*}{\nu} + K$

$c, \frac{v_x}{u^*} = -\frac{1}{\kappa} \ln \frac{yu^*}{\nu} + K$

$d, \frac{v_x}{u^*} = \frac{1}{\kappa} \ln \frac{yu^*}{\nu} + K$

$e, \frac{v_x}{u^*} = \frac{1}{\kappa} \ln yu^* + K$

The answer is:

T.9.2.1 The velocity profile of laminar pipe flow is “pointier” than a turbulent one because

a, in a laminar flow the wall shear stress is lower than in a turbulent flow

b, pressure loss in a turbulent flow is greater than in a laminar flow

c, the radial distribution of shear stress is significantly different in the two cases

d, turbulent viscosity is significantly larger than material viscosity

e, in a turbulent boundary layer the flow is turbulent up to the wall

The answer is:

T.9.2.2 Displacement thickness

a, shows how thick the boundary layer is

b, shows what distance the streamlines are displaced due to the particles being decelerated by the wall as compared to the inviscid case

c, is larger if the boundary layer is "more filled"

d, is calculated as $\delta_1 = \int_0^{\delta} \left(1 - \frac{v_x}{V}\right) \mathrm{d}y$

e, always decreases along the boundary layer length

The answer is:

T.9.3.1 Loss in a diffuser

a, is a direct consequence of the wall shear stresses

b, is mainly the consequence of the thickening or separating boundary layer due to the decelerating flow

c, can be reduced by decreasing the diffuser angle

d, can be increased by decreasing the diffuser angle

e, also results from the fact that parts of the fluid do not decelerate as much as the cross-section ratio would indicate.

The answer is:

T.9.3.2 Necessary condition for the existence of secondary flow:

a, curved streamlines

b, straight streamlines

c, in case of curved streamlines, there has to be a flat surface parallel to the plane of the streamlines on which a boundary layer forms

d, in case of curved streamlines, there has to be a flat surface perpendicular to the plane of the streamlines on which a boundary layer forms

The answer is:

T.9.3.3 Boundary layer separation can be decreased or avoided

a, on the side wall of a bus, by applying a larger radius rounding on the upper edge

b, by making the flow laminar

c, in some cases, by increasing the Reynolds number

d, by increasing the slope of the rear window

e, by removing the decelerated fluid parcels via boundary layer suction

f, by decelerating the flow

The answer is:

TZ.9.1 Choose the correct form of the boundary layer equation!

a, $v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_y}{\partial x} = \frac{1}{\rho}\frac{\partial p}{\partial x} + \nu \frac{\partial^2 v_x}{\partial y^2}$

b, $v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_y}{\partial x} = -V \frac{\partial p}{\partial x} + \nu \frac{\partial^2 v_x}{\partial y^2}$

c, $v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y} = V \frac{\mathrm{d}V}{\mathrm{d}x} + \nu \frac{\partial^2 v_y}{\partial x^2}$

d, $v_x \frac{\partial v_x}{\partial x} + v_y \frac{\partial v_x}{\partial y} = V \frac{\mathrm{d}V}{\mathrm{d}x} + \nu \frac{\partial^2 v_x}{\partial y^2}$

The answer is:

TZ.9.2 Choose the correct statements regarding a turbulent boundary layer!

a, It contains only turbulent flow.

b, It has a viscous layer at the bottom.

c, The universal law of the wall is valid in it if $\frac{yu^*}{\nu} \cong 10$.

d, The universal law of the wall is valid in it if $30 \leq \frac{yu^*}{\nu} \leq 300$.

e, The thickness of the viscous sublayer is $\frac{yu^*}{\nu} \cong 10$.

The answer is:

TZ.9.3 Choose the correct statements!

a, Turbulent viscosity is 1-2 orders of magnitude less than molecular viscosity.

b, Turbulent viscosity is 1-2 orders of magnitude greater than molecular viscosity.

c, In a turbulent boundary layer turbulent mixing is the predominant cause of heat and material transport.

d, In a turbulent boundary layer molecular diffusion is the predominant cause of heat and material transport.

e, The boundary layer friction coefficient is greater in a laminar flow than in a turbulent flow for all Reynolds numbers.

The answer is: