MŰEGYETEM 1782

FLUID MECHANICS

TESTS

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

Chapter 8: Viscous flows

T.8.1.1 Newton's viscosity law defines a connection between the following quantities:

a,pressure, velocity and viscosity

b,shear stress and fluid deformation

c, shear stress, temperature, viscosity and velocity

d, pressure, viscosity and deformation velocity

e, shear stress, deformation velocity and viscosity

The answer is:

T.8.1.2A flat surface moves with velocity v parallel to a stationary flat surface. Between the two surfaces, there is a Newtonian fluid.

a,Shear stress acts on the surfaces.

b,Shear stress for a given v is directly proportional to the distance between the surfaces.

c,Shear stress for a given distance between surfaces is directly proportional to v.

d,Shear stress for a given distance between surfaces is inversely proportional to v.

e, Shear stress acts even if v=0.

The answer is:

T.8.2.1A 100 mm diameter shaft is concentrically located in a bearing. Rotation speed is 3000 RPM, radial gap size is 0.1 mm. What is the shear stress magnitude if μ=0.1 [kg/ms]?

a, $1.57\cdot10^4$ *Pa*

b, $1.57\cdot10^6$ *Pa*

c, $0.82\cdot10^4$ *Pa*

d, More parameters are needed.

e, None of the above is correct.

The answer is:

T.8.2.2 There is a developed laminar flow in a cylinder of diameter *d*. The velocity vectors point in the direction of the positive *x* axis. The relationship between pressure and wall shear stress τ_w [Pa] is:

$a, \frac{\mathrm{d}p}{\mathrm{d}x} = -\frac{4}{d}\tau_w$

$b, \frac{\mathrm{d}p}{\mathrm{d}x} = \tau_w\, d\, \pi$

$c, \frac{\mathrm{d}p}{\mathrm{d}x} = \frac{1}{\tau_w}\frac{d^2\pi}{4}$

$d, \frac{\mathrm{d}p}{\mathrm{d}x} = \frac{1}{d}\tau_w$

e, None of the above are correct.

The answer is:

T.8.2.3 The equation of motion for a real (viscous) fluid, assuming constant viscosity and density, is:

$a, \frac{\mathrm{d}\underline{v}}{\mathrm{d}t} = -\frac{1}{\rho}\mathrm{grad}p + \underline{g} + \mu\frac{\partial \underline{v}}{\partial t}$

$b, \frac{\mathrm{d}\underline{v}}{\mathrm{d}t} = -\frac{1}{\rho}\mathrm{grad}p + \underline{g} + \mu\frac{\partial^2 \underline{v}}{\partial t^2}$

$c, \frac{\mathrm{d}\underline{v}}{\mathrm{d}t} = -\frac{1}{\rho}\mathrm{grad}p + \nu\, \underline{g}$

$d, \frac{\mathrm{d}\underline{v}}{\mathrm{d}t} = -\frac{1}{\rho}\mathrm{grad}p + \underline{g} + \nu\, \Delta\underline{v}$

e, None of the equations are correct.

The answer is:

T.8.3.1 The Reynolds number corresponding to a flow in a pipe is calculated as (V mean velocity, d diameter, ν kinematic viscosity, ρ density, μ dynamic viscosity, l pipe length):

$a, Re = \frac{Vd}{\nu}$

$b, Re = \frac{\mu}{Vd\rho}$

$c, Re = \frac{Vd\rho}{\mu}$

$d, Re = \frac{Vd\rho}{\nu}$

$e, Re = \frac{Vl}{\nu}$

The answer is:

T.8.3.2 Apparent shear stress is calculated as:

$a, \tau_l = -\rho\overline{(v_t{}'v_n{}')}$

$b, \tau_l = -\mu\overline{(v_t{}'v_n{}')}$

$c, \tau_l = -\rho\overline{(v_t^2)}$

$d, \tau_l = -\rho\overline{(v_n^2)}$

$e, \tau_l = -\rho\overline{(v_t' + v_n{}')}$

The answer is:

T.8.4.1 What does the size of the smallest eddy in a turbulent flow depend on?

a, only on velocity

b, only on viscosity

c, on the Reynolds number

d, on the Euler number

e, on the Froude number

The answer is:

T.8.4.2 In a turbulent flow the expression $-\rho\overline{v_x{}'v_y{}'}$ gives

a, τ_{lxy}*, apparent shear stress*

b, the y direction transport of the x direction component of the momentum of the turbulent velocity fluctuation

c, the x component of momentum flow

d, the x direction transport of the y direction component of the momentum of the turbulent velocity fluctuation

e, None of the above are correct.

The answer is:

T.8.4.3 Turbulence models

a, are always algebraic equations

b, often express the turbulent transport

c, are valid for all types of flow

d, can be deduced in a purely theoretical way

e, depend on the flow characteristics

The answer is:

T.8.5.1 In a pipe of diameter d=100 mm, oil flows with mean velocity v=2 m/s. Oil density is ρ=900 kg/m^3, dynamic viscosity is μ=0.1 kg/ms. What mean velocity will give a similar flow in case of water flowing in a pipe of diameter d=20 mm? Density of water is ρ=1000 kg/m^3, dynamic viscosity is μ=10^{-3} kg/ms.

a, 0.09 m/s

b, 0.9 m/s

c, 1.9 m/s

d, 0.05 m/s

e, None of the above are correct.

The answer is:

T.8.5.2 In which case are inertial forces negligible?

a, flow through an overflow

b, flow in a diffuser

c, waves near the shore

d, flow in a long capillary

e, flow through a half-opened valve

The answer is:

T.8.5.3 In an experiment with a submarine model that does not cause significant waves on the surface

a, Reynolds numbers have to be equal

b, Froude numbers have to be equal

c, Weber numbers have to be equal

d, the equality of Euler numbers is a result of the similarity between the flows.

The answer is:

T.8.5.4 Assuming v_0 is the reference velocity, l is the characteristic length, g is the magnitude of the gravitational field of force, f is the frequency of a periodic phenomenon, and ν is the kinematic viscosity:

a, $\frac{\nu l}{v_0} = Re$ *is the Reynolds number*

b, $\frac{v_0\sqrt{l}}{g} = Fr$ *is the Froude number*

c, $\frac{fl}{v_0} = Str$ *is the Strouhal number*

d, $\frac{v_0^2}{lg} = Fr^2$ *is the Froude number squared*

e, $\frac{\nu}{v_0 l} = \frac{1}{Re}$ *is the reciprocal of Reynolds number*

The answer is:

TZ.8.1 If the pressure loss in a 50 m long pipe having a diameter of 0.5 m is $\Delta p' = 4000$ Pa, then the wall shear stress $\tau\ [Pa]$ is:

a, 547 Pa

b, 1.5 Pa

c, 50.9 Pa

d, 12 Pa

e, None of the above are correct.

The answer is:

TZ.8.2 Which forces are the most important in case of a laminar flow between two flat surfaces close to each other?

a, inertial and viscous forces

b, pressure forces and inertial forces

c, weight and pressure forces

d, viscous forces and pressure forces

e, inertial forces and weight

The answer is:

TZ.8.3 Reynolds number is defined as

a, the ratio of inertial and viscous forces

b, the ratio of viscous forces and weight

c, the ratio of weight and inertial forces

d, the force resulting from elastic deformation and pressure forces

e, None of the above are correct.

The answer is:

TZ.8.4 Euler number is defined as (ρ density, g field of force, μ dynamic viscosity, L length, Δp pressure difference, v velocity):

a, $\frac{\Delta p}{\rho g L}$

b, $\frac{\Delta p}{\rho v^2}$

c, $\frac{\Delta p}{\mu L v}$

d, $\frac{\rho \Delta p}{\mu^2 L^4}$

e, None of the above are correct.

The answer is:

TZ.8.5 In the small scale experiment of a l=100 m long ship travelling at v_0=5 m/s the l_m=1 m long model has to be towed with the following velocity to ensure the equality of the Froude numbers:

a, $v_{0m} = 0.5 \text{ m/s}$

b, $v_{0m} = 5 \text{m/s}$

c, $v_{0m} = 50 \text{m/s}$

d, $v_{0m} = 500 \text{m/s}$

e, $v_{0m} = 5000 \text{m/s}$

The answer is:

TZ.8.6 The necessary and sufficient condition for similarity in case of an experiment regarding unsteady flow inside a petrol engine carburetor:

a, equality of only the Weber numbers

b, equality of only the Reynolds numbers

c, equality of only the Weber and Reynolds numbers

d, equality of the Weber, Reynolds and Strouhal numbers

e, equality of only the Strouhal numbers

The answer is:

TZ.8.7 For a developed laminar flow in a cylindrical pipe the flow velocity

a, is uniform in the entire cross-section

b, is zero at the wall and linearly increases towards the centre

c, has a second order parabolic distribution

d, is proportional to the radius raised to the power of 3/2

e, None of the above are correct.

The answer is:

TZ.8.8 The absolute value of shear stress in case of a flow in a cylindrical pipe

a, is constant in the cross-section

b, is zero at the wall and linearly increases towards the centre

c, has a second order parabolic distribution

d, is zero in the centre and increases linearly along the radius

e, None of the above are correct.

The answer is:

TZ.8.9 A flat surface moves with velocity *v* parallel to a stationary flat surface. Between the surfaces, there is a Newtonian fluid.

a, Because of viscosity, a force parallel to the direction of motion will act on both surfaces

b, In case of a viscous fluid the force acting on the stationary surface points against v.

c, In case of a viscous fluid the force acting on the moving surface points against v.

d, If the fluid is ideal (inviscid), no force parallel to v acts on any of the surfaces.

e, In case of an ideal (inviscid) fluid, a force parallel to v acts on both surfaces.

The answer is:

TZ.8.10 The definition of dynamic viscosity μ in terms of τ shear stress, *v* velocity in direction *x* in a 2D flow with straight streamlines and *y* being the coordinate perpendicular to *x* is:

$a,\ \mu = \frac{\mathrm{d}\tau}{\mathrm{d}y} v$

$b,\ \mu = \frac{\mathrm{d}v/\mathrm{d}y}{\tau}$

$c,\ \mu = \frac{\tau}{\mathrm{d}v/\mathrm{d}y}$

$d,\ \mu = \frac{\tau}{\mathrm{d}y/\mathrm{d}v}$

e, None of the above are correct.

The answer is: