MŰEGYETEM 1782

FLUID MECHANICS
TESTS

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

Chapter 1: Kinematics and the continuity equation

T.2.1.1A flow is steady if

a, the velocity direction of a fluid parcel does not change with location

b, the velocity of a fluid parcel is the function of location only

c, at each location the velocity of the passing fluid parcel is constant in time

d, in two arbitrary points, at the same time instant, the velocities are equal

The answer is:

T.2.1.2 If the flow is

a, steady, then streamlines and pathlines are different

b, unsteady, then streamlines, pathlines, and streaklines are the same

c, steady, then streamlines, streaklines, and pathlines are the same

d, unsteady, then streamlines, streaklines, and pathlines are the same only in some special cases

The answer is:

T.2.1.3 The flow observed from a fixed system is steady

a, around a ship travelling on a lake

b, around a bridge pier

c, in case of a uniformly accelerating flow in a pipe

d, in the vicinity of a propeller rotating with constant angular velocity

e, in case of the gas ascending in a chimney

The answer is:

T.2.1.4

a, The tangent of a streamline is parallel to the velocity at the tangential point.

b, The streamline is always the same as the pathline of a fluid parcel.

c, The pathline is a curve connecting the instantaneous positions of the fluid parcels that have travelled through the same point.

d, The streakline is a curve connecting the positions assumed by the same fluid parcel.

The answer is:

T.2.2.1 In case of a potential vortex, where the velocity is described by the equation $|\underline{v}| = \frac{K}{r}$, where $\underline{v}$ is the velocity, K is a constant and r is the radius,

a, the streamlines are concentric circles with radius r

b, the velocity magnitude is inversely proportional to the radius

c, the flow is everywhere vortex-free

d, the fluid parcels (with the exception of the centre) do not rotate about their own axis

e, the circulation along concentric circles is zero.

The answer is:

T.2.2.2 In a singly connected domain (simply connected domain) the φ velocity potential must exist,

a, if the flow is vortex-free

b, if the streamlines are parallel

c, if the force field $\underline{g}$ has potential

d, if $\int_G \underline{v} \mathrm{d}\underline{s} = 0$ *along all paths*

e, if there is friction in the fluid.

The answer is:

T.2.4.1 The following form of the continuity equation: div $\underline{v} = 0$

a, is only valid for inviscid fluids

b, is valid for incompressible fluids too, but only if the flow is steady

c, is only valid for steady flow

d, is valid for compressible flows as well, but only if the flow is steady

e, is valid for incompressible flows.

The answer is:

T.2.4.2 The equation of continuity

a, $A_1 v_1 = A_2 v_2$*, if* ρ = *constant*

b, $\mathrm{div}\, \rho + \frac{\partial \rho}{\partial t} = 0$

c, $\frac{A_1 v_1}{\rho_1} = \frac{A_2 v_2}{\rho_2}$

d, $\mathrm{grad}\, \rho + \frac{\partial \rho}{\partial t} = 0$

e, $\mathrm{div}(\rho\, \underline{v}) + \frac{\partial \rho}{\partial t} = 0$

The answer is:

T.2.4.3 In a 2D flow the distance between two streamlines is 21 mm, the mean velocity in the area between them is 18 m/s. At a further away position the distance between the same streamlines reduces to 14 mm. What is the mean velocity in the area between them? (ρ=constant)

a, 27 m/s

b, 12 m/s

c, 18 m/s

What is the difference between the stream functions which can be associated with the two streamlines (ΔΨ)?

d, 0.378 m^2/s

e, 0.857 m^2/s

The answer is:

T.2.4.4 Choose the correct statement(s)!

a, The stream function exists if $\mathrm{rot}\underline{v} = \underline{0}$.

b, The stream function only exists in the case of 2D flow of a constant density fluid.

c, The potential function only exists in the case of 2D flow.

d, The value of the potential function along a streamline is constant.

e, The value of the stream function along a streamline is constant.

The answer is:

TZ.2.1 Choose the correct statement(s)!

a, The $\underline{\underline{D}}$ *derivate tensor can be written as a sum of a* $\frac{\underline{\underline{D}}+\underline{\underline{D}}^T}{2}$ *symmetric and an* $\frac{\underline{\underline{D}}-\underline{\underline{D}}^T}{2}$ *antisymmetric tensor.*

b, The symmetric tensor describes the deformation of the fluid parcels.

c, The antisymmetric tensor defines the angular velocity $\underline{\Omega}$ *of the fluid parcel.*

d, The angular velocity is given as $\underline{\Omega} = \frac{\underline{\underline{D}}-\underline{\underline{D}}^T}{2}$.

e, The rotational angular velocity of the fluid parcels is given as $\underline{\Omega} = \frac{1}{2}\mathrm{rot}\underline{v}$.

The answer is:

TZ.2.2 The continuity equation

a, is related to the energy of the fluid

b, expresses the change of velocity and pressure along a streamline

c, expresses the conservation of volume

d, expresses the conservation of mass

e, is only valid for ρ=const cases.

The answer is:

TZ.2.3 Do unsteady flows have vortices?

a, Yes, always.

b, No, never.

c, Could be vortex-free or could have vortices as well.

d, If the fluid is compressible, it has vortices as well.

e, If the fluid has friction, then it is vortex-free.

The answer is:

TZ.2.4 When deducing the equation of continuity, the initial thought is the following:

a, The investigated domain is fixed in space and the mass inside it is constant in time.

b, The investigated fluid parcel is fixed in space and the mass inside it is constant in time.

c, The investigated fluid parcel moves. The sum of the temporal change of mass inside it and the excess mass outflow is zero.

d, The investigated volume is fixed in space and fluid flows through it.The sum of the temporal change of mass inside it and the excess mass outflow is zero.

The answer is:

TZ.2.5 A flow is steady if

a, there is no temporal change at any point.

b, the neighbouring points are the same.

c, the variables change uniformly.

d, $\frac{\partial v}{\partial t} = constant$

e, None of the above are correct.

The answer is:

TZ.2.6 The equation $\rho_1 A_1 v_1 = \rho_2 A_2 v_2$

a, could be valid if A_1 *and* A_2 *are the areas of two cross-sections of a stream tube in arbitrary position, as compared to the velocities*

b, is only true if $\rho_1 = \rho_2$

c, is valid for A_1 *and* A_2 *in arbitrary positions in the fluid*

d, could be valid if A_1 *and* A_2 *are the areas of two cross-sections of a stream tube perpendicular to the velocities, and* v_1 *and* v_2 *are mean velocities*

e, None of the above are correct.

The answer is:

TZ.2.7 Choose the correct example for steady flow in an absolute coordinate system!

a, The flow around a boat travelling in a lake.

b, The flow around a bridge pier.

c, Flow in a pipe having increasing velocity.

d, The flow around the blade of a table fan.

e, The flow around a car travelling in still air.

The answer is:

TZ.2.8 In a steady case, the continuity equation can be expressed in the following form: (q_V [m^3/s], p [Pa], A [m^2], ρ [kg/m^3])

a, $q_V = \rho\ A\ v$

b, $p_1\ A_1\ = p_2\ A_2$

c, $p_1\ A_1\ v_1\ = p_2\ A_2\ v_2$

d, grad $p\ = 0$

e, $\rho_1\ A_1\ v_1\ = \rho_2\ A_2\ v_2$

The answer is: