FLUID MECHANICS

TESTS

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

Chapter 1: Properties of fluids, physical quantities used in fluid dynamics and their description

T.1.1.1 The dimensions of kinematic viscosity ν are:

a,$\frac{\mathrm{kg}}{\mathrm{m^2 s}}$

b, $\frac{\mathrm{kg}}{\mathrm{m\ s}}$

c, $\mathrm{m^2 s^2}$

d, $\frac{\mathrm{m^2}}{\mathrm{s}}$

e, $\frac{\mathrm{m^2}}{\mathrm{s^2}}$

The answer is:

T.1.1.2 The dimensions of dynamic viscosity μ are:

a,$\frac{\mathrm{kg}}{\mathrm{m^2 s}}$

b, $\frac{\mathrm{kg}}{\mathrm{m\ s}}$

c, $\frac{\mathrm{kg\ m}}{\mathrm{s}}$

d, $\frac{\mathrm{kg\ m}}{\mathrm{s^2}}$,

e, $\frac{\mathrm{m^2}}{\mathrm{s^2}}$

The answer is:

T.1.2.1A real Newtonian fluid:

a, is inviscid

b, is incompressible

c, has a molecular structure

d, has nonzero friction when in a stationary state.

The answer is:

T.1.2.2 Choose the correct statement(s)!

a, A fluid at a constant temperature starts boiling when the pressure is decreased to p_s*, the pressure of the saturated steam.*

b, A fluid of pressure p_s *starts boiling when the temperature is sufficiently decreased.*

c, The lower the pressure of a fluid, the higher the boiling temperature.

d, A fluid of a given temperature starts boiling when the pressure is sufficiently increased.

The answer is:

T.1.2.3. Damage resulting from cavitation

a, might occur when the pressure of a gas stream containing liquid drops locally increases and gas condenses.

b, can only occur if the flowing fluid is saturated steam.

c, might occur when the liquid pressure locally reaches the pressure of saturated steam at the given temperature.

d, can only occur in liquids.

The answer is:

T.1.3.1 The Eulerian description of flow

a, gives the location of the fluid parcel that occupied the position $\underline{s}_0$ *at time instant* t_0 *as a function of time t:* $\underline{v} = f\left(\underline{s_0}, t\right)$

b, gives velocity magnitude as a function of location $\underline{r}$ *and time t:* $|\underline{v}| = f(\underline{r}, t)$

c, gives the velocity of the fluid parcel that occupied the position $\underline{s}_0$ *at time instant t as a function of* $\underline{r}$*:* $\underline{v} = f\left(\underline{r}, \underline{s_0}\right)$

d, gives the velocity vector of the fluid as a function of time t and location $\underline{r}$*:* $\underline{v} = f(\underline{r}, t)$

The answer is:

T.1.4.1 Assuming a force field $\underline{g}(\underline{r})$ with potential $U(\underline{r})$, density $\rho(\underline{r})$ and pressure $p(\underline{r})$:

a, $\underline{g} = f(\rho)$

b, $U = -div\underline{g}$

c, $\underline{g} = -\text{grad } U$

d, $p = -\rho \text{ grad } U$

e, none of the above are correct.

The answer is:

T.1.4.2. In a rotating coordinate system having an angular velocity ω the potential of the force field:

a, grows as radius r increases

b, decreases as radius r increases

c, does not depend on the radius

d, its absolute value grows proportionally to r

e, its absolute value grows proportionally to r^2.

The answer is:

T.1.4.3.A reservoir filled with water moves upwards in Earth's gravity field with acceleration $\underline{a}$. The direction of the force arising from the accelerating coordinate system in the relative system

a, is the same as the direction of gravity

b,is the opposite of the direction of gravity

c, would change if there was air in the reservoir.

The resultant potential, assuming axis z pointing upwards

d, $U = (a - g)z + constant$

e, $U = (a + g)z + constant$.

The answer is:

T.1.4.4 Assuming a potential flow with potential φ, the following statement(s) must be fulfilled:

a, $\mathrm{div}\underline{v} = 0$

b,$\mathrm{rot}\underline{v} = \underline{0}$

c,in a simply connected domain, the circulation is zero for all closed curves

d, the fluid parcels do not rotate in the flow

e, in the potential flow: $\underline{v} = div\ \varphi$

The answer is:

TZ.1.1 In a vortex-free flow of an ideal fluid

a, there exists a velocity potential

b,each fluid parcel travels along a straight path

c, the flow velocity has to be uniform

d, the flow is time-independent

e, there is no friction force exerted on a solid boundary.

The answer is:

TZ.1.2 The connection between the potential and the force field is given as:

$a,\ \underline{g} = -\mathrm{grad}\ U$

$b, \underline{g} = \mathrm{grad}\ U$

$c,\ U = -\mathrm{div}\underline{g}$

$d,\ U = -rot\ \underline{g}$

$e,\ \underline{g} = -\frac{1}{\mathrm{grad}\ U}$

The answer is:

TZ.1.3 An ideal fluid

a, has viscosity

b, can be described by Newton's viscosity law

c, can characterise a matter with friction

d, is incompressible and inviscid

e, none of the above are correct

The answer is:

TZ.1.4 The potential of Earth's gravity field ($\underline{g} = constant$)

a, grows linearly as the height grows

b, does not depend on the density of the fluid in the space

c, equals to the work done by the force field

d, assuming a coordinate z pointing upwards, is $U = \left|\underline{g}\right| z\ [m^2/s^2]$

e, equals to the work of lifting unit mass against the force field

The answer is:

TZ.1.5 Real gases

a, have zero viscosity

b, have constant viscosity

c, are incompressible

d, can be modelled with a good approximation using $\frac{p}{\rho} = R\ T$

The answer is:

TZ.1.6

a, The potential of Earth's gravity field (U) increases as the height increases.

b, The dimension of the potential is $\mathrm{m}^2/\mathrm{s}^2$.

c, In Earth's gravity field, horizontal surfaces have equal potential energy (are equipotential).

d, The potential decreases as the height increases.

e, The negative gradient of the potential gives the force field.

The answer is:

TZ.1.7

a, The $\underline{g}$ force field can be calculated from the potential U, if $\mathrm{rot}\underline{g} = \underline{0}$.

b, The potential increase is proportional to the work done against the force field.

c, In Earth's gravity field the potential U decreases as the height increases.

d, $\underline{g} = -\mathrm{grad}\, U$

The answer is:

TZ.1.8 The equation of state for gases is

a, $p\ \rho = R\ T$

b,$p = \rho\ R\ T$

c,$p\ \rho\ R = T$

d, $p\ \rho\ R\ T = 1$

e, $\frac{p}{\rho} = R\ T$

The answer is:

TZ.1.8 Circulation:

a, is the line integral of velocity along a closed path

b, is always zero

c, its magnitude depends on the amount of vorticity in a simply connected domain

d, only exists if the matter flows along a closed path

e, is defined as $\Gamma = \oint_G \underline{v}\mathrm{d}\underline{s}$

The answer is: