MŰEGYETEM 1782

FLUID MECHANICS

TESTS

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

Chapter 4: Applications

T.4.1.1 The differential equation for a stationary object in Earth's gravity field is (p [Pa] pressure, ρ [kg/m^3] density, g [N/kg] field force, y [m] vertical coordinate pointing upwards)

$a, dp = -pg\ dy$

$b, dp = -yg\ d\rho$

$c,\ dp = -\rho\ dy$

$d,\ dp = -\rho g\ dy$

$e,\ dp = yg\ d\rho$

The answer is:

T.4.1.2 The expression $\frac{p_1}{\rho} + U_1 = \frac{p_2}{\rho} + U_2$ is valid if

a, density is only a function of pressure.

b, density is a function of potential.

c, density is a function of only temperature.

d, density is the same at each point of the domain.

e, density is a function of pressure and temperature.

The answer is:

T.4.1.3 The difference between the pressure above the surface (p_0) and the pressure H [m] below the surface in sea water (ρ=constant) is

$a,\ p - p_0 = \rho H$

$b,\ p - p_0 = \rho g H$

$c,\ p - p_0 = -\rho H$

$d,\ p - p_0 = -\rho g H$

$e,\ p - p_0 = -gH$

The answer is:

T.4.1.4 The pressure gradient in Earth's gravity field

a, points upward.

b, points downward.

c, gives the increase of the magnitude of pressure with regard to the change of 1 m of height

d, its magnitude is inversely proportional to density.

e, its magnitude is directly proportional to density.

The answer is:

T.4.2.1 A cylinder, which is open at the top, is entirely filled with a liquid and rotated with an angular velocity that causes half of the liquid to spill out. Liquid density is ρ=850 kg/m^3. Along the axis of revolution, the overpressure at the bottom of the cylinder is

a, zero.

b, one-fourth of the overpressure in case of a full, stationary cylinder.

c, cannot be calculated due to lack of data.

d, less than in case of water (ρ=1000 kg/m^3).

The answer is:

T.4.2.2 A triangle shaped surfaced is submerged into water with its vertex pointing downward so that its side of length *b* falls in line with the water surface. The vertex is submerged to a depth of *h* below the water surface. What is the pressure force acting on one side of the triangle?

a, $\frac{\rho g b h^2}{6}$

b, $\frac{1}{3}\rho g b^2 h$

c, $\frac{1}{2}\rho g b h^2$

d, $\frac{1}{6}\rho g b^2 h$

e, None of the above are correct.

The answer is:

T.4.2.3 The overpressure in a pipe of diameter 0.2 m is $2 \cdot 10^6$ Pa. What is the necessary pipe thickness if the allowed stress for the pipe wall is $5 \cdot 10^7$ Pa?

a, 6 mm

b, 10 mm

c, 2 mm

d, 8 mm

e, 4 mm

The answer is:

T.4.2.4 A horizontal 3 m long cylinder filled with water (ρ=1000 kg/m^3) moves along its own axis, having an acceleration of a=15 m/s^2. What is the pressure difference between the two ends of the cylinder?

a, 50 000 Pa

b, 30 000 Pa

c, 4 500 Pa

d, 45 000 Pa

e, 15 000 Pa

The answer is:

T.4.3.1 The $\int_1^2 \underline{v} \times \text{rot}\underline{v}\text{d}\underline{s}$ term in the Bernoulli equation equals to zero if the following condition is fulfilled:

a, integration is carried out along a streamline.

b, the field force has a potential: $\underline{g} = -gradU$

c, the fluid parcels do not rotate about their own axis

d, the fluid is incompressible.

The answer is:

T.4.3.2 The $\left[\frac{v^2}{2} + \frac{p}{\rho} + U\right]_1^2 = 0$ form of the Bernoulli equation can be applied if

a, the flow is steady

b, density is a function of pressure

c, the flow is potential

d, Earth's gravity field affects the flow

e, integration is carried out along a streamline.

The answer is:

T.4.4.1 In order to be able to use the expression $\frac{v_2^2 - v_1^2}{2} + g(z_2 - z_1) + \int_{p_1}^{p^2} \frac{\text{d}p}{\rho(p)} = 0$ the following conditions have to be fulfilled:

a, steady flow, inviscid and incompressible fluid, integration along a streamline

b, uniform pressure distribution, inviscid fluid, integration along a streamline, density is a function of pressure

c, steady, vortex-free flow, incompressible fluid, integration along a streamline

d, steady flow, inviscid fluid, integration along a streamline, density is a function of pressure

e, None of the above are correct.

The answer is:

T.4.4.2 A glass pipe that is open at both ends and bent in 90° is placed into flowing water in a way that one of the ends is horizontal and the opening points against the flow, while the other is vertical and the opening is above the fluid surface. The water level in the vertical pipe is 200 mm higher than the flow surface. What is the flow velocity? (*g*=10 [N/kg])

a, cannot be determined

b, 5 m/s

c, 2 m/s

d, 3.75 m/s

e, None of the above are correct.

The answer is:

T.4.5.1 The following statements are true regarding the Bernoulli equation in the form $\left[\frac{w^2}{2}+\frac{p}{\rho}+gz-\frac{r^2\omega^2}{2}\right]_1^2=0$ (w is the relative velocity, v is the absolute velocity):

a, Assumes that Earth's gravity field acts on the fluid.

b, Assumes that rot$\underline{v}$=0.

c, Assumes that the fluid density does not change.

d, It can be used in a rotating coordinate system.

e, Assumes that the relative flow is steady.

The answer is:

T.4.5.2 The correct form of Euler's turbine equation is:

a, $\Delta p_{t,id}=\rho(v_{2u}u_2-v_{1u}u_1)$

b, $\Delta p_{t,id}=(v_{2u}u_2-v_{1u}u_1)$

c, $\Delta p_{t,id}=\mu(v_{2u}u_2-v_{1u}u_1)$

d, $\Delta p_{t,id}=\rho(v_2u_2-v_1u_1)$

e, None of the above are correct.

The answer is:

TZ.4.1 Assumptions: steady flow in a horizontal plane, streamlines are concentric circles, density is constant, inviscid fluid. Flow velocity increases as distance from the centre increases. In the absolute coordinate system the Bernoulli equation is written as

$$\int_1^2\frac{\partial\underline{v}}{\partial t}\mathrm{d}\underline{s}-\int_1^2\underline{v}\times\mathrm{rot}\underline{v}\,\mathrm{d}\underline{s}+\frac{v_2^2-v_1^2}{2}+\frac{p_2-p_1}{\rho}-\frac{r_2^2-r_1^2}{2}\omega^2=0$$

between points 1 and 2 on different radii. The following terms can be neglected:

a, First.

b, Second.

c, Third.

d, Fourth.

e, Fifth.

The answer is:

TZ.4.2 Neglecting the effect of Earth's gravitational field, in case of curved streamlines, the pressure along a line that is perpendicular to the streamlines and goes outwards from the centre of curvature

a, is constant.

b, increases outward from the centre of curvature.

c, increases going towards the centre of curvature.

d, In case of curved streamlines, the convective acceleration of fluid parcels is zero.

The answer is:

TZ.4.3 In a rotating cylinder having a vertical axis the fluid rotates like a solid body, such that at a point on the axis the pressure is the same as in a point at a radius of 0.2 m and 0.2 m higher. What is the angular velocity? (g=10 [N/kg])

a, 15 [1/s]

b, 20.5 [1/s]

c, There is not enough data.

d, 14.1 [1/s]

e,None of the above are correct.

The answer is:

TZ.4.4 In the isothermal atmosphere as you go upward the pressure

a, is constant.

b, decreases linearly.

c, grows exponentially.

d, changes proportionally to density.

e, increases linearly.

The answer is:

TZ.4.5 The pressure distribution p in a stationary fluid of density ρ and viscosity ν subjected to a field of force g can be determined as:

a, $grad\rho = p\underline{g}$

b, $gradp = -\rho\underline{g}$

c, $grad(\nu p) = \rho\underline{g}$

d, $gradp = \rho\underline{g}$

e, None of the above are correct.

The answer is: