
Q-1:

1) The buoyant force on a floating body is equal:

a. To the weight of the removed fluid.

b. To the weight of the immersed part of the body.

c. To the weight of the body itself.

d. There is no force is acting on the body since it's floating.

e. None.

Answer: d

2) Cavitation can occur when:

a. The fluid pressure is higher than the atmospheric pressure.

b. The fluid pressure is less than the vapor pressure.

c. The fluid pressure is less than atmospheric pressure.

d.The fluid pressure is higher than the vapor pressure.

e. None.

Answer: b

3) Reynolds number is a dimensionless number which describe the ratio between:

a. Gravity force to the kinetic force.

b. Compressive force to the gravity force.

c. Viscous force to the shear stress.

d. Kinetic force to the viscous force.

e. None.

Answer: d

4) A fluid is a substance that:

a. always expands until it fills any container.

b. is practically incompressible.

c. cannot be subjected to shear forces.

d. cannot be remained at rest under action of any shear force.

e. has the same shear stress at any point regardless of its motion.

Answer: d

5) One-dimensional flow is:

a. steady uniform flow.

b. uniform flow.

c. flow which neglects changes in a traverse direction.

d. restricted to flow in a straight line.

e. none of the answers.

Answer: d

6) A clean glass tube is to be selected in the design of a manometer to measure the pressure of kerosene. Specific gravity of kerosene = 0.82 and surface tension of kerosene = 0.025 N/m. If the capillary rise is to be limited to 1 mm, the smallest diameter (cm) of the glass tube should be most nearly:

a. 1.25.

b. 1.50.

c. 1.75.

d. 2.00.

e. None of the above.

Answer: a.

$$h = \frac{4\sigma}{\gamma d} \rightarrow d = \frac{4\sigma}{\gamma h} \rightarrow d = \frac{4 \times 0.025}{0.82 \times 9810 \times 1 \times 10^{-3}} \rightarrow d = 1.24\ cm \approx 1.25 cm$$

7) If a gage tapped into a tank indicated a vacuum pressure of 31.0 kPa. If the atmospheric pressure is 101 kPa, the absolute pressure in the tank (in kPa) is most nearly

a. -31.

b. -70.

c. 132.

d. 70.

e) None of the above.

Answer: d.

$P_v = P_{atm} - P_{abs} = 101 - 31 = 70\ kPa$

8) An open tank contains brine to a depth of 2 m and a 3-m layer of oil on top of the brine. Density of brine is 1,030 kg/m3 and the density of oil is 880 kg/m3. The gage pressure (kPa) at the bottom of the tank is most nearly

a) 18.7.

b) 20.2.

c) 56.2.

d) 46.1.

e) None of the above.

Answer: d.

$p = \gamma_{oil} h_{oil} + \gamma_{brine} h_{brine} = 9.81 \times 880 \times 3 + 9.81 \times 1030 \times 2 = 46.1\ kPa$

Q-2:

For a certain two-dimensional flow field, the velocity is given as:

$V=4xy\hat{\imath}+ 2(x^2-y^2)\,\hat{\jmath}$

Determine

a- if this satisfies the continuity equation?
b- if this flow is rotational or irrotational?

Answer:

a) To know if the flow satisfies continuity equation:

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}\overset{?}{=}0 \rightarrow 4y\ -4y\ =\ 0$$

So, the equation satisfies the continuity equation.

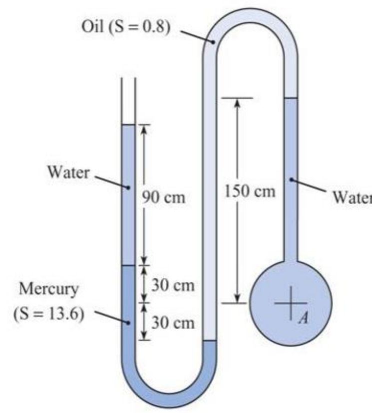
b) To know if the flow is rotational:

$$\omega=\frac{1}{2}\left(\frac{\partial v}{\partial x}-\frac{\partial u}{\partial y}\right)\neq 0 \rightarrow \frac{1}{2}(4x-4x)=0$$

So, the flow is irrotational.

Q-3:

Find the gage pressure at the center of pipe A. The specific weight of water is 9810 N/m³.



Answer:

$$\gamma_{mercury} = 1000 \times 9.81 \times 13.6 = 133416 \ {}^{N}/_{m^3}$$

$$\gamma_{oil} = 1000 \times 9.81 \times 0.8 = 7848 \ {}^{N}/_{m^3}$$

$$P_A = P_B + \sum_{Down} \gamma h - \sum_{Up} \gamma h$$

$$P_A = 0 + (0.9 \times 9810) + (0.6 \times 133416) - (1.5 \times 7848) + (1.5 \times 9810)$$
$$= 91.82 \ kPa$$

Q-4:

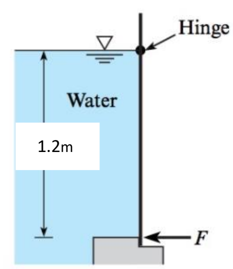
A rectangular gate is hinged at the water line, as shown. The gate is 1.2 m high and 2.4 m wide. The specific weight of water is 9810 N/m³.

(a) The depth of the centroid measured from the surface in m.

(b) The hydrostatic force on the gate in N.

(c) The depth of the center of pressure measured from the surface in m.

(d) The necessary force F (in N) applied at the bottom of the gate to keep it closed.



Answer:

a) $h_c = \frac{1}{2} \times 1.2 = 0.6 \ m$

b) $F_h = \gamma h_c A = 9810 \times 0.6 \times (2.4 \times 1.2) = 16951.68 \ N$

c) $I_{xx} = \frac{1}{12} \times 2.4 \times 1.2^3 = 0.3456 \ m^4 \rightarrow y_p = y_c + \frac{I_{xx}}{y_c A} = 0.6 + \frac{0.3456}{0.6 \times (1.2 \times 2.4)} =$
$0.8 \ m$

d) $\sum M_{Hinge} = 0 \rightarrow F_h(y_p) = F(1.2) \rightarrow F = \frac{16951.68 \times 0.8}{1.2} = 11301.12 \ N$