

SAMPLE

CIVE1400: Fluid Mechanics. MCQ Test questions: Properties of Fluids and Statics

Name:	Date:
Tutor	Signature:

These answer assumes the following: Gravitational acceleration, $g = 9.81 \text{ m/s}^2$
Mass density of water, $\rho = 1000 \text{ kg/m}^3$

1. If 5.6 m^3 of oil weighs $46\,800 \text{ N}$, what is the mass density in kg/m^3 ?

- a) 1.2×10^{-4} b) 852.0 c) 8357.1 d) 8.52 e) 8.36

a b c d e

$$\text{Weight of unit volume} = \rho g = \frac{46800}{5.6} = 8360 \text{ N / m}^3$$

$$\text{Density} = \rho = \frac{\rho g}{g} = \frac{8360}{9.81} = 852 \text{ kg / m}^3$$

2. What is the relative density of the oil in question 1?

- a) 0.852 b) 83.57 c) 8357.1 d) 8.36 e) 1.2×10^{-4}

a b c d e

$$\text{Relative density} = \sigma = \frac{\rho_{oil}}{\rho_{water}} = \frac{852}{1000} = 0.852$$

3. A fluid has absolute viscosity, μ , of 0.048 Pa s . If at point A, 75 mm from the wall the velocity is measured as 1.125 m/s , calculate the intensity of shear stress at point B 50 mm from the wall in N/m^2 . Assume a linear (straight line) velocity distribution from the wall.

- a) 15 b) 0.048 c) 0.72 d) 0.0032 e) 0.032

a b c d e

For a straight line assumption the velocity gradient is constant for all distances from the wall and given by,

$$\text{Velocity gradient} = \frac{dV}{dy} = \frac{1.125}{0.075} = 15 \text{ s}^{-1}$$

From Newton's law of viscosity

$$\text{Shear stress} = \tau = \mu \frac{dV}{dy} = 0.048 \times 15 = 0.72 \text{ Pa}$$

4. Determine the *absolute* pressure in Pa at a depth of 6 m below the free surface of a tank of water when a barometer reads 760 mm mercury (relative density 13.57)

- a) 101172 b) 58860 c) 160 032 d) 82.42 e) 160.032

a b c d e

Absolute pressure = Atmospheric pressure + Gauge pressure

$$\text{Gauge Pressure} = p_G = \rho g h = 1000 \times 9.81 \times 6 = 58860 \text{ N / m}^2$$

$$\begin{aligned} \text{Atmospheric pressure, } p_A &= \text{pressure due to } 760 \text{ mm of mercury} \\ &= (13.57 \times 1000) \times 0.76 \times 9.81 \\ &= 101172 \text{ N / m}^2 \end{aligned}$$

$$\begin{aligned} p &= p_G + p_A = 58860 + 101172 \\ &= 160\,032 \text{ N / m}^2 \end{aligned}$$

5. Determine the pressure in *bar* at a depth of 10 m in oil of relative density 0.750.

- a) 735575 b) 0.736 c) 735575×10^5 d) 73.575 e) 98100

a b c d e

$$\text{Pressure} = p = \rho g h = (0.75 \times 1000) \times 9.81 \times 10 = 73575 \text{ N / m}^2$$

This must be converted to *bar* where $1 \text{ bar} = 10^5 \text{ N/m}^2$

$$p = \frac{73575}{10^5} = 0.736 \text{ bar}$$

6. What depth of oil (in m), relative density 0.75, will give a gauge pressure of 275000 Pa

- a) 37.38 b) 367 c) 0.027 d) 20.2×10^4 e) 28.03

a b c d e

$$\text{Gauge pressure} = p = \rho g h$$

$$h = \frac{p}{\rho g}$$

$$\begin{aligned} h &= \frac{275000}{(0.75 \times 1000) \times 9.81} \\ &= 37.38 \text{ m} \end{aligned}$$

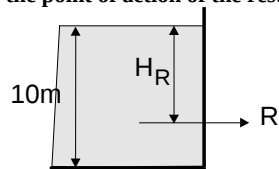
7. Express the pressure head of 15m of water in metres of oil of relative density 0.75

- a) 110.36 b) 11.25 c) 11 250 d) 15.0 e) 20.0

a b c d e

$$\begin{aligned}
 p &= \rho_{\text{oil}} g h_{\text{oil}} = \rho_{\text{water}} g h_{\text{water}} \\
 h_{\text{oil}} &= \frac{\rho_{\text{water}} h_{\text{water}}}{\rho_{\text{oil}}} \\
 &= \frac{\rho_{\text{water}} h_{\text{water}}}{0.75 \rho_{\text{water}}} \\
 &= \frac{15}{0.75} = 20.0 \text{ m}
 \end{aligned}$$

8. A square tank with sides 5m long and vertical walls contains water to depth of 10m, as shown. What is the depth, H_R , in meters to the point of action of the resultant force, R , due to the liquid?



- a) 5.0 b) 6.67 c) 3.33 d) 2.0 e) 10.0

a b c d e

$$H_R = 2H/3 = 2 \times 10/3 = 6.67 \text{ m}$$

9. What is the magnitude of the resultant force, R , in Newton's per metre in the previous question?

- a) 654 000 b) 981 000 c) 98 100 d) 49 050 e) 490 500

a b c d e

$$\begin{aligned}
 R &= \text{pressure at centroid} \times \text{area} \\
 R &= \rho g (H/2) \times (H \times 1) \\
 R &= 1000 \times 9.81 \times 5 \times 10 \\
 R &= 490500
 \end{aligned}$$