

What is Fluid Pressure and Force?

Worksheet

Hydrostatic pressure $P = \rho gh$ (pressure at depth h), and total pressure force on a surface is $F = PA$ or the integral of pressure over area.

$$P = \rho gh \text{ and } F = PA$$

Questions

1. At 20 m depth in water, pressure is

- A) 20 kPa
- B) 100 kPa
- C) 196 kPa
- D) 980 kPa

2. Hydrostatic pressure depends on

- A) surface area
- B) container shape
- C) depth and density
- D) all of above

3. Seawater vs freshwater at same depth, pressure is

- A) same
- B) higher in seawater
- C) lower in seawater
- D) unpredictable

4. Total force on submerged flat plate

- A) $P A$
- B) integral of $P dA$
- C) depends on shape
- D) none

5. Water at 10 m depth ($\rho = 1000 \text{ kg/m}^3$, $g = 9.81 \text{ m/s}^2$). Find pressure.

6. Dam wall 50 m area at average depth 8 m. Average pressure force?

7. Submarine at 300 m depth (seawater $\rho = 1025 \text{ kg/m}^3$). Pressure?

8. Define: Hydrostatic pressure formula?

9. Define: Why does pressure increase with depth?

10. Define: Pressure force formula?

Answer Key

1. C) 196 kPa - $P = 1000 \cdot 9.81 \cdot 20 = 196 \text{ kPa}$.
2. C) depth and density - $P = \rho gh$ depends only on depth and fluid properties, NOT area or shape.
3. B) higher in seawater - Seawater $1025 >$ freshwater 1000 kg/m^3 , so pressure is higher.
4. A) $P = \rho gh$ - For uniform pressure, $F = PA$. For varying pressure, integrate.
5. $P = \rho gh$ $P = 1000 \cdot 9.81 \cdot 10 = 98,100 \text{ Pa} = 98.1 \text{ kPa}$
6. $P_{\text{avg}} = \rho gh_{\text{avg}} = 1000 \cdot 9.81 \cdot 8 = 78,480 \text{ Pa}$ $F = P_{\text{avg}} A = 78,480 \cdot 50 = 3,924,000 \text{ N} = 3.9 \text{ MN}$
7. $P = 1025 \cdot 9.81 \cdot 300 = 3,016,575 \text{ Pa} = 3.02 \text{ MPa} = 30 \text{ atm}$
8. $P = \rho gh$ - pressure is proportional to density, gravity, and depth.
9. Weight of fluid above presses down, creating higher pressure.
10. $F = PA$ (or integrate P over area if pressure varies).

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