

Exam of Physics 2

Course questions: (10 Pt)

- 1- List the types of fluid.
- 2- What are the most important characteristics that distinguish a fluid.
- 3- Write the following equations:
 - a- The continuity equation,
 - b- Bernoulli's theorem,
 - c- Euler's theorem.
- 4- Depending on increasing Reynolds numbers, four main regimes are distinguished, mention **her**.
- 5- How many meters of water are needed to achieve a pressure difference of 1 bar?
gravity $g = 9.81 \text{ m/s}^2$ - the density of water $\rho = 1000 \text{ kg/m}^3$

Exercise1: (3Pt)

A container holds water to a depth of 20 cm and oil to a depth of 50 cm. The pressure at point A is equal to atmospheric pressure. Calculate the pressure at points B and C, given that $\rho_{\text{water}} = 10^3 \text{ kg/m}^3$ and $\rho_{\text{oil}} = 900 \text{ kg/m}^3$.

Exercise2: (1Pt)

A liquid is compressed with the following parameters in its initial state: $P_1 = 50 \text{ bar}$ and $V_1 = 30.5 \text{ dm}^3$ and the following parameters in its final state: $P_2 = 250 \text{ bar}$ and $V_2 = 30 \text{ dm}^3$

- Calculate the compressibility coefficient β of this liquid.

Exercise3: (6Pt)

Oil with a viscosity $\mu = 0.11 \text{ Pa}\cdot\text{s}$ and a density of $d=0.9$ flows through a pipe $L=1650 \text{ m}$ long and $D=25 \text{ cm}$ in diameter at a volumetric flow rate of $q_v=19.7 \text{ L/s}$.

- 1-Determine the kinematic viscosity ν of the oil.
- 2-Calculate the flow velocity v and the mass flow rate q_m .
- 3-Calculate the Reynolds number R_e and deduce the nature of the flow.
- 4-Determine the linear head loss coefficient λ and calculate the head loss H in the pipe.

Physics 2 exam correction**Course questions: 10pt**

1- The types of fluid.

Perfect fluid, Real Fluid, Compressible Fluid, Incompressible Fluid (0,5x4)

2- The most important characteristics that distinguish a fluid are:

Compressibility, Volumetric mass, Density, Specific Gravity, Specific Volume, Viscosity (0,25x6)

3- The equation of:

a- The continuity equation: $S_1 V_1 = S_2 V_2$ (1)

b- Bernoulli's theorem: $\frac{p_1}{\rho} + \frac{v_1^2}{2} + g Z_1 = \frac{p_2}{\rho} + \frac{v_2^2}{2} + g Z_2$ (1)

c- Euler's theorem: $\vec{\rho F} - \text{grad } p = \rho \frac{d\vec{V}}{dt}$ (1)

4- Depending on increasing Reynolds numbers, four main regimes are distinguished, Stokes regime, laminar regime, transient regime, turbulent regime. (0,5x4)

5- How many meters of water are needed to achieve a pressure difference of 1 bar.

$$\Delta P = \rho g h \quad \text{soit} \quad 10^5 = 10^3 \cdot 9.81 \cdot h \quad h = 10.19 \text{ m} \quad (1,5)$$

Exercise 1: 3pt

The pressure at points B and C:

$$P_A = P_{\text{atm}} = 10^5 \text{ Pa}$$

$$P_B = P_A + \rho_b g H_2 = 10^5 + 900 \cdot 9.81 \cdot 0.5 = \underline{104500 \text{ Pa}} \quad (1,5)$$

$$P_C = P_B + \rho_c g H_1 = 104500 + 1000 \cdot 9.81 \cdot 0.2 = \underline{106482 \text{ Pa}} \quad (1,5)$$

Exercise2: 1 Pt

$$\beta = -\frac{dV/V}{dp} = -\frac{dV}{dpV} = -\frac{(30.5 - 30)}{(250 - 50) * 30.5} = -8.2 * 10^{-5} \text{ bar}^{-1} \quad (\Lambda)$$

Exercise3: 6 Pt

$$1/ \nu = \frac{\mu}{\rho} \quad \nu = \frac{0.11}{900} = 1.22 * 10^{-4} \text{ m}^2 / \text{s} \quad (\Lambda)$$

$$2/ V = \frac{4 * 19.7 * 10^{-3}}{\pi(0.25)^2} = 0.40 \text{ m/s} \quad (\Lambda)$$

$$q_m = \rho * q_v = 0.9 * 10^3 * 19.7 * 10^{-3} = 17.73 \text{ kg/s} \quad (\Lambda)$$

$$3/ \text{Re} = \frac{VD}{\nu} = \frac{0.4 * 0.25}{1.22 * 10^{-4}} = 820 \quad (\Lambda)$$

Puisque $\text{Re} < \text{Rec} (2000)$ (0,5) laminaire $\lambda = 64/\text{Re} = 64/820 = 0.078$ (0,5)

$$4/\Delta H = \lambda \frac{LV^2}{2gD} = 0.078 \frac{1650 * (0.40)^2}{2 * 9.81 * 0.25} = 4.2 \text{ m} \quad (0,5)$$