Phy2 test - excersice

Physics 2 (Trường Đại học Quốc tế, Đại học Quốc gia Thành phố Hồ Chí Minh)

International University - VNUHCM
Department of Physics

Midterm Examination

Date: 09/12/2021 Duration: 120 minutes

Open Book and Online

SUBJECT: PHYSICS 2 (FLUID MECHANICS AND THERMAL PHYSICS)

(ID: PH014IU)

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Proctor 1 Signature Full name:	Proctor 2 Signature Full name:

STUDENT INFO

Student name:

Student ID:

INSTRUCTIONS: the total of point is 100 (equivalent to 20% of the course)

1. *Purpose:*
   - Test your understanding of basic knowledge from the chapter 1 (Fluid Mechanics) and the chapter 2 (Heat, Temperature and the First Law of Thermal Dynamics) (CLO 3).
   - Examine your skill in analysis and design a problem in science and engineering (CLO 2).
   - Test your ability in applying knowledge of mathematics and physics (CLO 1).
   - Evaluate your English skills in writing communication manner (CLO 4).
2. *Requirement:*
   - Read carefully each question and answer it following the requirements.
   - Write the answers and draw models CLEAN and TIDY directly in the exam paper.
   - Submit your exam including this cover page and the solutions of the following problems.

The exam has **five (5) questions in total**

QUESTION 1: (20 marks)

A large pipe with a cross-sectional area of 1 m^2 descends 5 m in height and narrows to 0.5 m^2, where it terminates in a valve at point 1 (see Figure 1). If the assumed pressures at point 1 and 2 are both atmospheric pressure (P_0), and the valve is opened wide and water allowed to flow freely, find the speed of the water leaving the pipe.

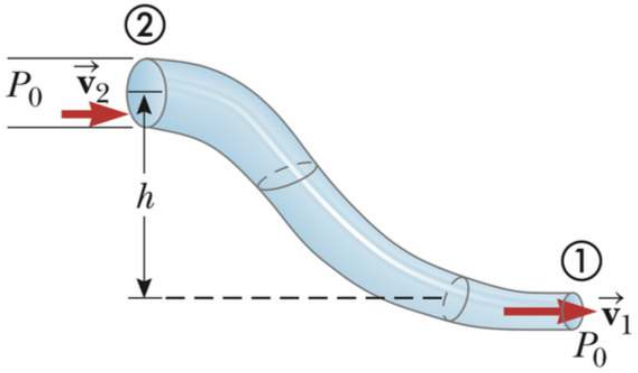

Figure 1

QUESTION 2: (20 marks)

(a) A solid substance has an isotropic density ϱ_0 at a temperature T_0. If its temperature is increased by an amount $\Delta T = T - T_0$, show that its density at the higher temperature is given by (10 marks):

$\rho = \frac{\rho_0}{1+\beta\Delta T} = \frac{\rho_0}{1+\beta(T-T_0)}$, where β is the coefficient of volume expansion.

(b) Assuming the substance is lead, which has a density of $\varrho = 11.3 \times 10^3$ kg/m^3 at 0°C and a coefficient of thermally linear expansion $\alpha = 29 \times 10^{-6}$ °C^{-1}. Note that we are still assuming the lead density is isotropic, then the condition $\beta = 3\alpha$ is valid. What is the density of lead at 90°C? (10 marks)

QUESTION 3: (20 marks)

3.1. A gas expands from I to F along the three paths indicated in Figure 2. Calculate the work done on the gas along paths (a) IAF, (b) IF, and (c) IBF. (10 marks)

3.2. A gas expands from I to F in Figure 2. The energy added to the gas by heat is 418 J when the gas goes from I to F along the diagonal path.

(a) What is the change in internal energy of the gas? (5 marks)

(b) How much energy must be added to the gas by heat for the indirect path IAF to give the same change in internal energy? (5 marks)

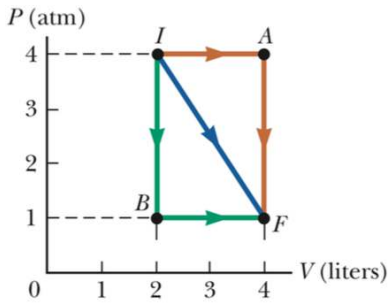

Figure 2

QUESTION 4: (20 marks)

A copper slug whose mass $m_c = 150$ g is heated in a laboratory oven to a temperature T = 312° C. The slug is then dropped into a glass beaker containing a mass $m_w = 110$ g of water. The heat capacity C_b of the beaker is 45 cal/K. The initial temperature T_i of the water and the beaker is 12° C. Assuming that the slug, beaker, and water are an isolated system and the water does not vaporize, find the final temperature T_f of the system at thermal equilibrium. Given the specific heat capacity of copper and water are $c_c = 0.0923$ cal/(g.K) and $c_w = 1.00$ cal/(g.K), respectively.
Caution: the heat capacity C_b of the beaker is accounted for its mass already in this problem, thus $C_b = c_b m_b$ and its unit is given by cal/K not cal/(g.K) as of the specific heat capacity of water and copper.

QUESTION 5: (20 marks)

Figure 3 shows the cross section of a wall made of three layers. The layer thicknesses are L_1, $L_2 = 0.7L_1$, and $L_3 = 0.35L_1$. The thermal conductivities are k_1, $k_2 = 0.9k_1$, and $k_3 = 0.8k_1$. The temperatures at the left side and right side of the wall are $T_H = 70°$ C and $T_C = -35°$ C, respectively. Thermal conduction is steady.
(a) What is the temperature difference ΔT_2 across layer 2 (between the left and right sides of the layer)? (10 marks)
(b) If k_2 were, instead, equal to $1.1k_1$, would the rate at which energy is conducted through the wall be greater than, less than, or the same as previously (10 marks)

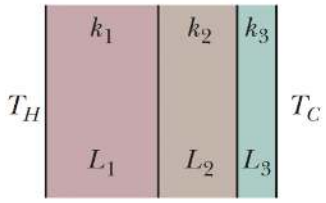

Figure 3

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