International University - VNUHCM
Department of Physics

Final Exam

Date: 22/02/2022 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 30% of the course)

1. *Purpose:*
   - Test your understanding of basic knowledge of The Kinetic Energy of Ideal Gas and the Second Law of Thermal Dynamics (CLO3).
   - Examine your skill in analysis and design a problem in science and engineering (CLO2).
   - Test your ability in applying knowledge of physics (CLO1).
   - Evaluate your English skills in writing communication manner (CLO4).
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.

Q1: (20 marks):

a. The latest heat of fusion of a material is 6 kJ/mole and the heat capacity (C_p) in solid and liquid phases of the material is a linear function of temperature $C_p = 30.6 + 0.0103T$, with units J/mole/K. How much heat is required to increase the temperature of 1 mole of the material from 20^0C to 200^0C if the fusion phase transition occurs at 80^0C?

b. Show that for a monatomic ideal gas undergoing an adiabatic process, $PV^{5/3}$ = constant.

Q2 (20 marks): A water with mass $m = 0.5$ kg, specific heat capacity $c = 4{,}187$ J/kg.K, and initial temperature $T_1 = 25^0$ K is supplied a heat until its temperature rises to $T_2 = 50^0$C. Calculate the change in entropy of the water?

Q3 (20 marks):

a. Heat Q = 3,000 J is added to a monatomic ideal gas under conditions of constant volume, resulting in a temperature change ΔT. How much heat will be required to produce the same temperature change, if it is added under conditions of constant pressure?

b. A balloon will carry a total load of 175 kg when the temperature is of 273 K and pressure is of 76 cm of mercury. What load will the balloon carry on rising to a height at which the barometric pressure is 50 cm of mercury and the temperature is -10^0C, assuming the envelope maintains a constant volume?

Q4 (20 marks): One mole of a real gas that obeys the van der Waals equation of state $\left(p + \frac{a}{V^2}\right)(V - b) = RT$, where a and b are constants. If the gas undergoes an isothermal expansion at temperature T_0 from volume V_1 to volume V_2.

a. Proving the work done is given by $W = RT_0 \ln\left(\frac{V_2-b}{V_1-b}\right) + a\left(\frac{1}{V_2} - \frac{1}{V_1}\right)$.

b. The coefficient of cubical expansion is defined as $\beta = -\frac{1}{V}\frac{(\frac{dp}{dT})V=const}{(\frac{dp}{dV})p=const}$, prove $\beta = \frac{RV^2(V-b)}{RTV^3-2a(V-b)^2}$.

Q5 (20 marks): **Figure 1** shows the *P*-*V* diagram of one mole of an ideal gas, undergoing the reversible cycle ABCA; here, the procedure AB is an isotherm. The molar heat capacities are C_P at constant pressure and C_V at constant volume.

a) Prove that the net heat added to the gas during the cycle is $Q_{\text{ABCA}} = RT_h \ln\left(\frac{V_2}{V_1}\right) - R(T_h - T_c)$.

b) Prove that the above net heat formula can be rewritten as $Q_{ABCA} = (C_P - C_V)[T_h \ln\left(\frac{V_2}{V_1}\right) - (T_h - T_c)]$.

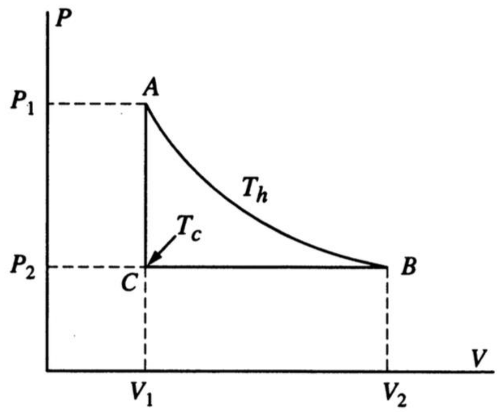

Figure 1

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