


<b>Name:</b>  <b>Enrolment No:</b>	
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**UNIVERSITY OF PETROLEUM AND ENERGY STUDIES**  
**End Semester Examination, May 2022**

**Course: Thermal Physics**  
**Program: B Sc (H) Physics**  
**Course Code: PHYS 1029**

**Semester: II**  
**Time : 03 hrs.**  
**Max. Marks: 100**

**Instructions:**

**All questions are compulsory (Q9 and Q11 have an internal choice)**  
**Scientific calculators can be used for calculations.**

**SECTION A**  
**(5Qx4M=20Marks)**

S. No.	Question	Marks	CO
Q 1	List all the Maxwell relations	4	CO2
Q 2	Explain physically why there is a cooling in Adiabatic demagnetization.	4	CO3
Q 3	Calculate the depression in melting point of ice per atmosphere increase of pressure, if ratio of the densities of ice and water at 0°C is 10/11. (given latent heat of melting L=80 Cal/ gm)	4	CO3
Q 4	A gas at 27°C is compressed suddenly to eight times its initial value. Calculate the rise in temperature. Take $\gamma=1.5$	4	CO1
Q 5	Define mean free path for a perfect gas.	4	CO1

**SECTION B**  
**(4Qx10M= 40 Marks): Q9 has an internal choice.**

Q 6	State the principle of increase of entropy and apply it to show that the entropy of Universe is always increasing.	10	CO2
Q 7	Describe Nernst Heat theorem. Show that the heat capacity vanishes at the absolute zero	10	CO1
Q 8	Given the molecular speed distribution equation- $n(v)dv = 4\pi N \left( \frac{m}{2\pi kT} \right)^{3/2} v^2 e^{-mv^2/2kT} dv$ Derive the expression for $v_{av}$ , $v_{rms}$ and $v_{mp}$	10	CO4
Q 9	Discuss any indirect method for the verification of Maxwell-Boltzmann Distribution law.  <p style="text-align: center;"><b>or</b></p> Calculate the fraction of oxygen, molecules within 1% of the most probable velocity at N.T.P. What is the effect of changing (i) the gas to hydrogen (ii) the temperature to 500°C.	10	CO4

<b>SECTION-C</b> <b>(2Qx20M=40 Marks): Q11 has an internal choice.</b>			
Q 10	Discuss Adiabatic Demagnetization. Give its experimental procedure, show theoretically that it produces cooling in paramagnetic substances.	<b>20</b>	<b>CO3</b>
Q 11	<p>(a) Describe Brownian movement. Give the Einstein's theory for the Brownian movement.</p> <p>(b) 14 grams of N<sub>2</sub> and 4 grams of He are mixed in a thermally insulated container. What will be the rms speeds of N<sub>2</sub> and He molecules after equilibrium is reached, if their rms speeds before mixing were respectively 500 ms<sup>-1</sup> and 1500 ms<sup>-1</sup>? The molecular weights of nitrogen and helium are respectively 28 and 4.</p> <p style="text-align: center;"><b>Or</b></p> <p>(a) Discuss Joule-Thomson Effect; obtain the expression of Joule Thomson coefficient. Analyze its variation for real and perfect gases.</p> <p>(b) A monoatomic Vander Waal's gas is contained in a cylinder of molar volume 0.8 litre/mol at a pressure of 36 atm. If <math>a = 4.05 \text{ lit}^2 \text{ mol}^{-2}</math>, <math>b = 0.037 \text{ lit/mol}</math> and <math>R = 0.082 \text{ atm.lit K}^{-1}\text{mol}^{-1}</math>, calculate internal pressure and temperature of the gas.</p>	<p><b>10+10</b></p> <p><b>10+10</b></p>	<b>CO4</b>