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UNIVERSITY EXAMINATIONS 2022/2023

SECOND YEAR, SECOND SEMESTER SPECIAL/SUPPLEMENTARY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND PHYSICS AND BACHELOR OF EDUCATION SCIENCE

SPH 3252: THERMAL PHYSICS I

DATE: AUGUST 2023 **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Explain any two disadvantages of liquid in glass thermometer (2 Marks)

b) A copper block of mass 400 g and temperature 300^0C was immersed in ice of mass 50 g at a temperature of -10^0C. The final temperature at equilibrium was found to be 30^0C. Calculate the specific heat capacity of copper. (5 Marks)

c) Explain the working of a thermocouple (5 Marks)

d) A homemade thermometer showed a mercury column length of 24 cm when the temperatures were 20^0C and 74 cm when the temperature was 120^0C. Determine the temperature of a liquid in which the mercury column of the same thermometer was 94 cm. (5 Marks)

e) State the first law of thermodynamics. (1 Mark)

f) A gas contains 1.24×10^{22} $atoms$, if the pressure of the gas is 1280 mmHg and the temperature is 27^0C. Find the volume occupied by the gas. (4 Marks)

g) State any three assumptions of the Kinetic theory of gases (3 Marks)

h) Find the heat energy required to melt a ball of ice of 300 g at-8^0C to water 4^0C. (5 Marks)

QUESTION TWO (20 MARKS)

a) Show that the average translation al Kinetic energy of a molecule is directly proportional to the absolute temperature of the gas. (8 Marks)

b) A container of volume 8000 cm^3 is filled with nitrogen gas at a pressure of 640 mmHg. Calculate:

i. The absolute temperature of the gas. (4 Marks)

ii. Root mean square speed of the molecules (4 Marks)

iii. What would be the pressure if the same container was filled with oxygen gas at the same temperature (N_2=28, O_2=32) (4 Marks)

QUESTION THREE (20 MARKS)

a) Show that for a uniform cube of a material the volume expansivity is 3 times the linear expansivity. (8 Marks)

b) Derive the relationship between the molar heat capacity of a gas at constant volume, molar heat capacity at constant pressure and the universal gas constant. (12 Marks)

QUESTION FOUR (20 MARKS)

a) Show that for an ideal gas $PV = NKT$ where N is the number of gas molecules, K is the Boltzman constant and T is the absolute temperature of the gas. (10 Marks)

b) Starting with the first law of thermodynamics show that for an adiabatic process the work done at the expense of internal energy of the gas. (5 Marks)

c) 2.4 moles of an ideal gas enclosed in a cylinder with a movable frictionless piston at is heated at constant pressure constant causing a temperature rise of 120K. if the molar heat capacity at constant pressure is $20.4\ J/mol/K$ find the work done by the gas. (5 Marks)