



KIBABII UNIVERSITY

**UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR**

**FIRST YEAR FIRST SEMESTER
MAIN EXAMINATIONS**

FOR THE DEGREE OF BSC (PHYSICS)

COURSE CODE: SPH 115

COURSE TITLE: HEAT AND PROPERTIES OF MATTER


DURATION: 2 HOURS

DATE: 3/02/2022

TIME: 8-10AM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 4 printed pages. Please Turn Over 

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Question One (30 Marks)

- a) State Charles' law of gases. (1 mark)
- b) What is streamline flow of a fluid? (1 mark)
- c) What is seebeck effect in a thermometer? (1 mark)
- d) Explain the following terms as used in heat;
- I. Diathermic wall. (1 mark)
- II. Adiabatic wall. (1 mark)
- e) Explain the following terms as used in quantity of heat;
- I) Heat capacity. (1 mark)
- II) Specific latent heat of vaporization. (1 mark)
- f) Differentiate between brittle and ductile materials. (2 marks)
- g) Which changes are likely to happen when gas temperature is raised? (2 marks)
- h) State provost's theory of heat exchange. (2 marks)
- i) What is Pascal principle of transmission of pressure? Give any practical application of this principle. (2 marks)
- j) There is a change in length, area and volume when a solid is heated. Which factors does these changes depend on? (3 marks)
- k) Convert $-100^{\circ}C$ into Fahrenheit scale. (3 marks)
- l) Explain the concept of temperature. (3 marks)
- m) An Oxygen cylinder has temperature and pressure of $-20^{\circ}C$ and 2.5 atmospheres respectively. When its temperature is raised to $-105^{\circ}C$, find its pressure. (3 marks)
- n) Name any three application of convection in liquids. (3 marks)

Question Two (20 Marks)

- a) What is linear expansivity of a solid? (1 mark)
- b) An Aero plane gets lifted into air from the runway. Explain. (2 marks)
- c) Explain the following terms as used in properties of matter. (3 marks)
- I. Stress
- II. Strain
- III. Young modulus
- d) Write down the gas equation and explain all the variables in the equation. (4 marks)
- e) A piece of iron of mass 0.20kg is heated to $64^{\circ}C$ and then dropped gently into 0.15kg of water at $16^{\circ}C$. If the temperature of the mixture is $22^{\circ}C$, what is the specific heat capacity of iron? Take specific heat capacity of water to be $4.2J/Kg/K$. (5 marks)
- f) The power of a thermocouple is given by $P = (\frac{1}{2} + 0.2t)J/s$.

- g) If the thermometer works in the limits of $-1^{\circ}C$ to $2^{\circ}C$, find the electromotive force of the thermometer. (5 marks)

Question Three (20 Marks)

- a) A platinum resistance thermometer reads $5.5 \times 10^{-4} K\Omega$ and $8.02 \times 10^{-4} K\Omega$ in melting ice and pure steam respectively. Find the temperature when the thermometer reads 0.2Ω . (3 marks)
- b) A thin square steel plate 10 cm on a side is heated in a blacksmith forge to a temperature of $800^{\circ}C$. If the emissivity is unity, calculate the total rate of radiation of energy? (5 marks)
- c) A force of 2000N is exerted normally on minimum area of a solid measuring 10cm by 8m by 2cm causing a compression of 0.1mm. Find;
- I. The stress in the material. (3 marks)
 - II. The strain. (3 marks)
 - III. Modulus of elasticity. (3 marks)
 - IV. Elastic constant of the material. (3 marks)

Question Four (20 Marks)

- a) Explain the following terms as used in thermometers;
- I. Upper fixed point. (1 mark)
 - II. Lower fixed point. (1 mark)
- b) What is thermal equilibrium? (2marks)
- c) The pressure of the hydrogen gas in a constant volume hydrogen thermometer is 12mmHg and 54mmHg respectively in pure melting ice and steam. Find the thermometer reading when the temperature is $80^{\circ}C$. (3 marks)
- d) Explain the concept of heat. (3 marks)
- e) Show that $t_F = \left[\frac{9}{5}t_C + 32 \right]^{\circ}F$

Where, symbols have their usual meanings. (10 marks)

Question Five (20 Marks)

- a) A mass of 10kg is attached to the end of the metal wire of length 1m with a diameter of 0.7mm causing an extension of 0.2m. Find;
- i) The strain (3 marks)
 - ii) The stress. (3 marks)
 - iii) The young modulus. (3 marks)

b) A material of cross-sectional area 2cm^2 at a room temperature of 24°C is heated to 84°C . If the metal linear expansivity and young modulus are $10 \times 10^{-6} \text{K}^{-1}$ and $1.5 \times 10^{10} \text{N/m}^2$ respectively, find the force exerted on the material during expansion. (5 marks)

c) A vertical wire suspended from one end is stretched by attaching a weight of 20N to the lower end. If the weight extends the wire by 1mm , find the energy gained by the wire during stretching. Take the length of the wire to be 10m and its cross-sectional area to be 0.05mm^2 . (6 marks)