MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER PART-TIME EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF EDUCATION (SCIENCE)

COURSE CODE: **SPH 113**

COURSE TITLE: **THERMAL PHYSICS**

DATE: THURSDAY 21ST APRIL, 2022   **TIME: 9:00 AM – 12:00 PM**

INSTRUCTIONS TO CANDIDATES
- Question ONE is compulsory and carries 30 marks
- Attempt any two of the remaining questions. Each carries 20 marks.
- Symbols used here hear their usual meaning
- All symbols used have their usual meaning.

MMUST observes ZERO tolerance to examination cheating

You may use the following constants

- $\sigma = 5.670 \times 10^{-8} \; Wm^{-2}K^{-4}$
- $\alpha_{Cu} = 17 \times 10^{-6} {}^o C^{-1}$
- $\lambda_{Ag} = 4.20 \times 10^2 Wm^{-1}K^{-1}$
- $\lambda_{Cu} = 3.90 \times 10^2 Wm^{-1}K^{-1}$
- $\lambda_{glass} = 8 \times 10^{-1} Wm^{-1}K^{-1}$
- $Room \; temp. = 27 \; {}^oC.$

QUESTION ONE (30 MARKS)

a. Briefly explain why aquatic animals can survive in cold countries even though temperatures fall below zeroe. (4 marks)

b. Explain why you feel warmer in still wind as compared to moving wind even though the temperatures are the same. (3 marks)

c. Calculate the temperature at which the celcius scale and Fahrenheit scale coincide at the same value θ.

d. From first principles ,derive the SI units of thermal conductivity λ. (3 marks)

e. Define the following terms and state there significance in thermal physics
   (i) Absorptivity
   (ii) Steady state temperature (4 marks)

f. Give the celcius statement of the second law of themodynamics. (1 mark)

g. Two identical rods are made of silver and the other copper are soldered together .The extreme end of the silver rod is kept at 80 oC and that of the copper rod at -50Oc.Assume sides are well lagged.
   (i) Calculate the steady state temperature T at the silver copper junction. (5 marks)
   (ii) Determine the effective value of λ

h. A given mass of gas has a volume of 480 cm3 aat STP, calculate its new volume tha the new temperature and pressure are 39 oC and 800 mmHg respectively. (3 marks)

i. The emissivity ε of a body other than a black body is $0 < \varepsilon < 1$ .Explain. (2 marks)

QUESTION TWO (20 MARKS)

a. The temperature of a body on the kelvin scale is found to be 10x K. When it is measured by the Fahrenheit thermometer ,it is found to be x oF. Calculate x. (6 marks)

b. Explain with illustrations how land breeze occurs. (10 marks)

c. Briefly explain the steps that comprise the cycle of a carnot engine (4 marks)

QUESTION THREE (20 MARKS)

a. Give the statement of Stefan-Boltzman law   (2 marks)
b. Determin the time in hours ,taken by perfect black-body cube (1 cm on a side at 30 °C) to radiate the amount of energy that a 100W light bulb uses in one minute?   (8 marks)
c. A boy stands unclothed in a room whose walls are at temperature of 18 °C. Calculate the rate at which heat is radiated by the body assuming a skin temperature of 36 °C. Take $\varepsilon = 0.7$,and the surface area of the body to be 1.2 m2. What is the quantity of heat radiated?
                                                                                                            (10 marks)

QUESTION FOUR (20 MARKS)

a. State the zeroth law of thermodynamics hence explain the meaning of thermal equilibrium.
                                                                                                            (2 marks)
b. Derive the formula for the work done by any gas which expands isobarically. (4 marks)
c. State the postulates of Ideal gases. Explain each one of them briefly   (10 marks).
d. Calculate the rate which the internal energy of a system is increasing if an electric stove supplies heat to this system at a rate of 1000W. Assume the system performs work at a rate of $25Js^{-1}$.   (4 marks)

QUESTION FIVE (20 MARKS)

a. State the first law of thermodynamics .What is its importance in heat transfer?(4 marks)
b. A copper telephone wire has essentially no sag between two poles 35m apart on cold day when temperature is -20°C .How much longer is the wire on a hot day when the temperature is 35 °C.   (4 marks)
c. During an experiment in the physics laboratory ,two first year students heated a 100cm long metal rod to 60 °C. They found that the length of the rod expanded to 100.12cm. Calculate coefficient of linear expansion of the metal.   (6 marks)
d. Mention and explain briefly three real life applictions of of expansion of matter.(6 marks)