JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

UNIVERSITY EXAMINATION FOR THE DEGREE OF BARCHELOR IN EDUCATION SCIENCE WITH IT

MAIN

REGULAR

COURSE CODE: **SPB 9106**

COURSE TITLE: **THERMAL PHYSICS (FUNDAMENTAL PHYSICS I)**

EXAM VENUE: **STREAM: BACHELOR OF EDUCATION**

DATE: **EXAM SESSION:**

TIME: 2:00HRS

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1. **Instructions: Answer question 1 (Compulsory) in Section A and ANY other 2 questions in Section B.**
2. **Candidates are advised not to write on the question paper.**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION 1 (30 MARKS)

a. Define the following terms

I. Thermal heat balance [2marks]

II. Ideal Gas [2marks]

b. State the **First law of thermodynamics** [2marks]

c. A copper rod of length 50cm and radius 2cm has one end dipped in an ice-water mixture and the other in boiling water. What is the heat flow dQ/dt? [4marks]

d. Explain briefly heat transfer between two objects [2marks]

e. How much heat flows out per second through a concrete roof of area 100 m^2 and thickness 20cm if the outside is at 0^o C and the inside is at 17^o C [5marks]

f. A spherical air bubble of radius 2cm is released 30m below the surface of a pond at 280K. What is its volume when it reaches the surface, which is at 300K assuming it is in thermal equilibrium the whole time? Ignore the size of the bubble compared to other dimensions like 30m.

[5marks]

g. An energy saving stove when burning steadily has an efficiency of 80%. The stove melts 0.3kg of ice at 0^o C in 120 seconds.

Calculate; –

i. The power rating of the stove [4marks]

ii. The heat energy wasted by the stove [4marks]

QUESTION 2 (20MARKS)

a. Differentiate between the following

h. Heat capacity and specific heat capacity [4marks]

ii. Latent heat of vaporization and specific heat of fusion [4marks]

b. How much heat is needed to convert 1 kg of ice at -10° C to steam at 100° C? Remember ice and water do not have the same specific heat [6marks]

c. If 400g of ice at -2° C is placed in 1 kg of water at 21° C what is the end product when equilibrium is reached? [6marks]

QUESTION 3 (20MARKS)

a. Explain how heat transfers by radiation [4mks]

b. Define black body radiation [3mks]

c. By defining all the terms, show that the rate of heat transfer by radiation is given by Stefan-Boltzmann Law $P = e\sigma AT^4$ [8mks]

d. The Sun radiates energy at the rate P = 3.9 x 10^{26} W and its diameter is 1.4x10^8m. Assuming that it is a perfect emitter, what is its surface temperature? [5mks]

QUESTION 4 (20 MARKS)

a. Define what is meant by heat flow [2marks]

b. Using the kinetic theory, explain heat flow by conduction [4marks]

c. State and explain the factors that affect heat flow by conduction [4marks]

d. By defining all the terms, show that heat flow by conduction is given by $H = -kA\frac{dT}{dx}$ [5marks]

e. A 2m rod of gold is connected to a 2m rod of silver. The gold end is connected to a boiling water while the silver end is connected to ice. Where is it at 50^{o}C? [5marks]

QUESTION 5 (20 MARKS)

a. Distinguish between **heat capacity** and **specific heat capacity** [4marks]

b. A burn from steam is more severe than one from water boiling at the same temperature. Give reasons [4marks]

c. An electric kettle with a 4.0 kW heating element has a heat capacity of 400 JK^{-1}. 1.0 kg of water at 20^{o}C is put in the kettle. The kettle is switched on and it is found that 6.5 minutes later, the mass of the water in it is 0.5 kg. Ignoring heat losses, determine the specific latent heat of vaporization of the water. [6marks]

d. How much heat is needed to convert 1 kg of ice at -10^{o} C to steam at 100^{o} C? Remember ice and water do not have the same specific heat. [6marks]