KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2020/2021 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER
MAIN EXAMINATIONS

FOR THE DEGREE OFBED (SCIENCE)

COURSE CODE: SPH115

COURSE TITLE: HEAT & PROPERTIES OF MATTER

DURATION: 2 HOURS

DATE:17/02/2021   **TIME:2:00-4:00 PM**

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 **3** printed pages. Please Turn Over

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SPH115: HEAT & PROPERTIES OF MATTER

QUESTION ONE [30 Marks]

a) Distinguish between the concepts of heat and temperature. [2 Marks]
b) State the zeroth law of temperature [1 Mark]
c) State two parameters required for the establishment of a temperature scale [2 Marks]
d) Explain three factors affecting changes in fixed points [3 Marks]
e) Differentiate between steady flow and turbulent flow [2 Marks]
f) A platinum resistance thermometer has a resistance of 10.40 ohms at 0°C and 14.35 ohms at 100°C. Assuming that the resistance changes uniformly with temperature, what is
   i)   The temperature when the resistance is 11.19 ohms?
   ii) The resistance of the thermometer when the temperature is 45°C? [4Marks]
g) What is the body temperature of a normal human being on the Celsius scale? What will this value be on the Fahrenheit scale?[2 Marks]
h) Calculate the pressure exerted on the ground by a truck of mass 1600 kg if each wheel has an area of 0.02 m² in contact with the ground. [3 Marks]
i) State two properties of an ideal liquid [2 Marks]
j) Explain three factors that affect the surface tension of a liquid [3 Marks]
k) Differentiate between density and viscosity [2 Marks]
l) Explain why using a fan in the summer feels refreshing. [2 Marks]
m) A student comes to school by a bicycle whose tire is filled with air at a pressure 240 kPa at 27°C. She travels 8 km to reach the school and the temperature of the bicycle tire increases to 39°C. What is the change in pressure in the tire when the student reaches school? [3 Marks]

QUESTION TWO [20 Marks]

a) What is the total rate of radiation of energy from a human body withsurface area 1.2 m²and surface temperature 30°C=303 K Ifthe surroundings are at a temperature of 20°C, what is the netrate ofradiative heat loss from the body? The emissivity of the human bodyis very close to unity, irrespective of skin pigmentation [6 Marks]
b) A polystyrene foam icebox has a total area of $0.950m^2$ and walls with an average thickness of 2.50 cm. The box contains ice, water, and canned beverages at $0°C$. The inside of the box is kept cold by melting ice. How much ice melts in one day if the icebox is kept in the trunk of a car at $35.0°C$?[Take $k=0.010W/m·°C$][8 Marks]
c) Briefly describe the three mechanisms of heat transfer giving an example in each case[6 Marks]

QUESTION THREE [20 Marks]

a) Define the following terms giving their respective numerical values for water
   i)   Latent Heat of Fusion [2 Marks]
   ii) Latent Heat of Vaporization [2 Marks]
b) A calorimeter contains 0.30kg of water at 12°C. When poured in, the temperature of the mixture is found to be 52°C. What is the heat capacity of the calorimeter? [5 Marks]
c) A piece of iron of mass 0.20kg is heated to 64°C and then dropped gently into 0.15kg of water at 16°C. If the temperature of the mixture is 22°C, what is the specific heat capacity of iron? [5 Marks]

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d) How much heat is given out when 50g of steam at 100°C cool to water at 28°C? (Specific latent heat of vapourization of water = 2.3 x 10⁶J/kg). [6 Marks]

QUESTION FOUR [20 Marks]

a) What is Absolute Temperature?[2 Marks]

b) Find the pressure on a diver working at the depth of 10m in the sea on a day when the barometer stands at 750mmHg. (Density of sea water = 1050kgm^{-3}). Express your answer in (a) mmHg and (b) Nm^{-2} [6 Marks]

c) A balloon contains 1.5 m^3 of helium at a pressure of 100 kPa and at a temperature of 27 °C. If the pressure is increased to 250 kPa at a temperature of 127 °C, calculate the new volume of the balloon. [3 Marks]

d) Explain the three gas laws in relation to kinetic theory of gases [9 Marks]

QUESTION FIVE [20 Marks]

a) Define (i) tensile stress (ii) tensile strain (iii) young modulus. What are the units and dimensions ofeach of the above? [3 Marks]

b) A 4.0 m long copper wire of cross-sectional area 1.2 cm^2 is stretched by a force of 4.8 x 10^3 N. If Young modulus is Y = 1.2 x 10^{11}N/M^2, calculate (i) stress (ii) strain (iii) increase in length of the wire.[6 Marks]

c) i) The surface tension of soap solution is 2.0 x10-2 N/m. How much work will be done in making a bubble of diameter 2.0 cm by blowing?[3 Marks]

   iii) A big drop is formed by coalescing 1000 small droplets of water. What will be the change in surface energy?[4 Marks]

d) A metal plate of area 2.5×10^{-4}m^2 is placed on a 0.25×10^{-3}m thick layer of castor oil. If a force of 2.5 N is needed to move the plate with a velocity 3×10^{-2}m s^{-1}, calculate the coefficient of viscosity of castor oil. [4 Marks]

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