KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: PHYS 121

COURSE TITLE: HEAT AND THERMODYNAMICS

STREAM: SESSION I

DAY: FRIDAY

TIME: 2.00 – 4.00 P.M.

DATE: 13/08/2010

INSTRUCTIONS:

1. *This paper contains four questions. Answer **Question 1** and any other **two** questions.*
2. *Question 1 contains **40** marks and the rest contain **15** marks each.*
3. *Where needed use the constants; specific heat capacity of copper, $C_C = 390J/kg^0C$, specific capacity of aluminum $C_A = 900J/Kg^0C$ and specific heat of water $C_w = 4187J/kg^0C$*

PLEASE TURN OVER

QUESTION 1 (40 MARKS)

a.) Define
   i.) Thermodynamic equilibrium (1 mark)
   ii.) Isentropic process (1 mark)

b.) Give two properties of an ideal gas. (2 marks)

c.) A metal rod 2m long is heated from 20^0C to 60^0C. If it has a diameter of 7mm and coefficient of thermal conductivity is 385 $Js^{-1}m^{-1}(C^0)^{-1}$. Calculate
   i.) Temperature gradient giving its correct SI units (2 marks)
   ii.) Determine the rate of heat flow in the metal rod (3 marks)

d.) How does thickness of a frying pan affect the way it cooks? (2 marks)

e.) Express the following temperatures in degrees Celsius and degrees Fahrenheit; 77.3K, 300K and 1356K (6 marks)

f.) Two bodies A and B are placed near to each other. State condition necessary for heat to be transferred between them (2 marks)

g.) State the Zeroth law of thermodynamics (2 marks)

h.) Calculate the heat loss rate per square meter through a 150mm thick concrete wall where the inner surface temperature is 21^0C and the outer surface temperature is -1^0C. Assume the thermal conductivity of concrete is 1.5 W/mK and give correct SI units (4 marks)

i.) When water is boiled under a pressure of 2 atmospheres the heat of vaporization is $2.2x10^6$J/kg and boiling point is 120^0C. At this pressure one kg of water has a volume of $10^{-3}m^3$ and 1 kg of steam is $0.824m^3$.
   1. Compute the work done when 1 kg of steam is formed at this temperature (3 marks)
   2. Calculate the increase in internal energy (2 marks)

j.) Give two types of commonly used thermometers (2 marks)

k.) i.) Define the specific heat capacity C_V (1 marks)
   ii.) A metal of mass 70g is heated from 18^0C to 90^0C with heat amount of 2100J. Determine the specific heat capacity of the metal (3 marks)

l.) Explain what you understand by the term adiabatic process (2 marks)

QUESTION TWO (15 MARKS)

a.) Define the term system (2 marks)

b.) A 175g copper block at 90^0C is dropped into an aluminum calorimeter cup initially at 20^0C. The calorimeter cup has a mass of 400g and contains 430g of water, also at 20^0C. What is the final temperature of the system? (5 marks)

c.) i.) Show that work done by expansion of a gas in a pump is given as

$$W = P(V_2 - V_1)$$

At constant pressure, where P is pressure and V is volume (4 marks)

ii.) A cylinder piston at $0.2m^3$ of air at $5.0x10^3$Pa and 70^0C. The air expands to $0.6m^3$ at a constant temperature. Determine the work done in this process. (4 marks)

QUESTION THREE (15 MARKS)

a.) State three state coordinates used to determine temperature scale (3 marks)

b.) In an experiment to determine the specific heat of some metal a student weighed the following and recorded her data results as shown below;

Weight of calorimeter = 36g

Weight of calorimeter + water = 70g

Weight of calorimeter + water + iron = 80g

The initial temperature of water was 22^0C. The iron was heated in a test tube with water till water boiled at 98^0C. The iron was then quickly transferred to calorimeter and stirred. The temperature then changed to 34^0C. Calculate the specific heat capacity of the metal given that specific heat capacity for calorimeter is 800J/kgK and that of water is 4200Jkg^{-1}K^{-1}. Assume there are no heat losses. (7 marks)

c.) State the kinetic theory of gases (2 marks)

d.) Give three factors that affect condition (3 marks)

QUESTION FOUR (15 MARKS)

a.) With a well labeled diagram show how a gas thermometer operates (5 marks)

b.) Give two reasons why the thermometer in (a) above is not commonly used (2 marks)

c.) Explain why ice is less dense than water (3 marks)

d.) Calculate the specific heat capacity of copper given that 204.75J of energy raises the temperature of 15g of copper from 25^0C to 60^0C (3 marks)

e.) State when a thermodynamic system is said to

i.) Reversible (1 mark)

ii.) Irreversible (1 mark)