ALUPE UNIVERSITY COLLEGE
...Bastion of Knowledge...
P. O.Box 845-50400 Busia(K)
principal@auc.ac.ke
Tel: +254 741 217 185
+254 736 044 469
off Busia-Malaba road

OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATION

For examiner's Use Only

Question	I.E	E.E
CAT		
EXAM		
TOTAL		

FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)

SCHOOL: EDUCATION AND SOCIAL SCIENCE

COURSE CODE: PHY 113

COURSE TITLE: HEAT AND THERMODYNAMICS

DATE: 11th December, 2017 **TIME:** 2.00Pm-5.00pm

INSTRUCTION TO CANDIDATES: SEE INSIDE

THIS PAPER CONSISTS OF 21 PRINTED PAGES **PLEASE TURN OVER**

Insert the numbers of the questions you have answered in the order done

Student Admission No.....Exam Card No.....Signature.....

INSTRUCTIONS TO CANDIDATES

1. Write your **Admission Number**, **Exam Card Number** and **Sign** in the spaces provided at the bottom of each page of the Examination Booklet. DO NOT write your name anywhere in this booklet.
2. Write on both sides of the pages.
3. All rough work must be done in the Answer sheets and crossed through.
4. If supplementary pages are used, they must be fastened all together at the end of this Booklet. Supplementary pages should be used only after all the leaves in the booklet have been exhausted.
5. It is a serious examination offence to cheat or to have unauthorized materials including **MOBILE PHONES** (whether on or off) in the examination venue.
6. In no circumstances must Answer Booklet used or unused, be removed from the examination room by a candidate.
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8. Do not pluck any page from this Booklet. Any extra/unused answer sheets should be returned to the **Examination Office.**
9. Candidates who come to examination room 30 minutes late will not be allowed to sit for the exam.
10. Candidates will not be allowed to leave the exam room once the exam commences.
11. Candidates are advised that importance is attached by examiners to accuracy and clarity of expression.
12. Committing any form of irregularity is prohibited and shall attract severe disciplinary action in accordance with Alupe University College Examination Regulations.

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INSTRUCTION TO CANDIDATES

i) Answer **QUESTION 1 and 2** from section A and **ANY OTHER THREE** from section B. Each QUESTION has 12 marks.

ii) Where necessary the following constants maybe used:

- One standard atmosphere pressure=$1.013\times10^{5}\,Nm^{-2}$
- Avogadro's constant, $N_A = 6.023\times10^{23}$
- Universal gas constant, R=$8.314\,JMOL^{-1}K^{-1}$
- Specific heat of ice=$2.0\times10^{3}\,JKg^{-1}C^{-1}$
- Specific heat of water=$4.2\times10^{3}\,JKg^{-1}C^{-1}$
- Specific latent heat of ice, $L_f = 3.35\times10^{5}\,JKg^{-1}$
- Specific latent heat of water, $L_v = 2.26\times10^{5}\,JKg^{-1}$

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SECTION A

QUESTION 1

a) i)Sketch a well labelled diagram of the system showing its surroundings and the system-boundary for a universe. (4 marks)

ii) Write down examples of adiabatic and diathermic walls. (2 marks)

b)Define triple point of water (1 mark)

c) State the zeroth law of thermodynamics (2 marks)

d) Calculate the work done when 1 mole of a gas at 300K expands isothermally from 0.002m^3 to 0.005m^3. (3 marks)

QUESTION 2

2. a) Distinguish between extensive and intensive properties, give examples of each property. (4 marks)

b) State three macroscopic quantities used to describe the state of an ideal gas (3 marks)

c) A mass of mercury at standard atmospheric pressure and temperature of 0 °C is kept at constant volume. If the temperature is raised to 10 °C, what will be the final pressure? Given that $\beta = 1.81\times10^{-4}\,K^{-1}$ and $K = 3.82\times10^{-11}\,Pa^{-1}$ of mercury. (3 marks)

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d) Consider 3 moles of an ideal gas kept at constant temperature of 0 °C. The gas compressed from a constant volume of 4 litres to 1 litre, how much work is done. (2 marks)

SECTION B

QUESTION 3

a) (i) Consider a system which changes from state 1 to state 2 by the process A and returns to state 1 by process B or C. Show that internal energy of a system is a point function and it is a property of the system. (6 marks)

(ii) In an adiabatic process between two equilibrium states a certain system does work of amount 400J on its surroundings. Calculate the corresponding change in internal energy of the system (2 marks)

b) 1 g of water (1 cm^3) becomes 1671 cm^3 of steam when boiled at constant pressure at $1.013\times10^5\,Pa$. The latent heat of vaporization at this pressure is $L_v = 2.256\times10^6\,J/kg$. Calculate

i) Work done by water when it vaporizes (2 marks)

ii) Its increase in kinetic energy (2 marks)

QUESTION 4

a)i)Consider a cube of initial dimensions L_o . As the temperature increases by ΔT, the length increases by ΔL. Show that $\beta = 3\alpha$, where β is the coefficient of volume expansion and α is the coefficient of linear expansion. (6 marks)

ii) An automobile has 60litres steel tank. The tank is filled with gasoline at 15°C from underground storage tank. If the automobile is then parked in a warm place until the tank is 37 °C, how much gasoline will spill out of the automobile tank? ($\alpha_{steel} = 1.2\times10^{-6}$ °C) and ($\beta_{gasoline} = 9.5\times10^{-4}$ °C). (3 marks)

b) Define thermal conductivity (1 mark)

c) Explain the cause of thermal stress (2 marks)

QUESTION 5

a) Distinguish between heat capacity at constant pressure (C_p) and heat capacity at constant volume (C_v) for gases. (2 marks)

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b) Enthalpy (H) is an internal property of a system. Derive the expression to show that for a reversible isobaric process any heat absorbed or emitted leads to a change in enthalpy, $Q = \Delta H$. (4 marks)

c) Explain why $C_P > C_v$ for ideal gases. (2 marks)

d) 40g of water is heated from 25 to 100°C and then vaporized. The heat of vaporization of water is 540cal/g. Calculate enthalpy change. (3 marks)

QUESTION 6

a) Show that for adiabatic process $T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$ and $P_1V_1^{\gamma} = P_2V_2^{\gamma}$ (5 marks)

b) If an ideal gas for which $C_v = 12.56J/Mol$ K and $C_p = 20.88J/Mol$ K expands reversibly and adiabatically from the initial state T_1=450 K to V_1= 3cm^3 to a final volume V_2=5cm^3, find the final temperature T_2 and the work done during the process. (5 marks)

c) Describe how adiabatic process can be achieved if needed. (2 marks)

QUESTION 7

a) Show that isothermal compressibility of an ideal gas reduces to k=1/P, while volume expansitivity reduces to $\beta = 1/T$. (6 marks)

b) The differential equation of state of a stretched wire whose coordinates are (τ, L, T) representing tension, length and temperature of the wire respectively is:

$dL = \left(\frac{\partial L}{\partial \tau}\right)_T \partial\tau + \left(\frac{\partial L}{\partial T}\right)_\tau d\tau$. Write an expression of linear expansitivity and the young's modulus of the material. (2 marks)

c) The volume of 100g of CO_2 at 1 atmosphere pressure is 55 litres.

i) Calculate temperature of the gas. (2 marks)

ii) If the volume is increased to 80 litres while temperature remains constant, determine new pressure. (2 marks)

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