



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SEMESTER SUPPLEMENTARY EXAMINATION FOR

BACHELOR OF ENVIRONMENTAL SCIENCE

ENS 130: ENVIRONMENTAL PHYSICS

DATE: 26/9/2019

TIME: 2:00 – 4:00 PM

INSTRUCTIONS TO CANDIDATES

Answer **QUESTION ONE** which is **COMPULSORY** and **ANY OTHER TWO** questions.

Question 1 carries **30**marks and the others carry **20**marks each.

CONSTANTS:

Universal gas constant $R = 8.314 \text{ J/mol.K}$ or $0.0821 \text{ L.atm/mol.k}$

Wein constant for a black body $b = 2.9 \times 10^{-3} \text{ m.K}$

Stefans-Boltzman constant $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2.\text{K}^4$

Monoatomic gas $C_V = \frac{3}{2}R$ $C_P = \frac{5}{2}R$; Diatomic gas $C_V = \frac{5}{2}R$ $C_P = \frac{7}{2}R$

QUESTION ONE [30 MARKS]

- a) By use of a well labelled diagram describe a thermodynamic system (3 marks)
- b) State the first and the second Newton's laws of motion (2 marks)
- c) Distinguish between intensive and extensive physical properties of matter giving one examples in each (3 marks)
- d) Define the flowing systems in thermodynamics (3 marks)
 - i. Open system
 - ii. Closed system
 - iii. Isolated system

- e) Give two advantages of hybrid renewable energy systems in energy production (2 marks)
- f) A 2kg ball on a string is rotated about a circle of radius 10m. The maximum tension allowed in the string is 50N. Calculate the maximum speed of the ball (3 marks)
- g) Define the following states of matter (2 marks)
 - i. Condensates
 - ii. plasma
- h) Briefly explain the following classifications of waves giving one example of each
 - a. Transverse and longitudinal waves (2 marks)
 - b. Electromagnetic and mechanical waves (2 marks)
- i) A sample of 3 moles of a gas was kept at 27°C during an isothermal expansion from 5 litres to 18 litres. Calculate work done by the gas in the process (3 marks)
- j) Distinguish between nuclear fission and nuclear fusion in radioactivity (2 marks)
- k) A particle moving at a velocity of 5m/s accelerates at 3m/s^2 for 10 seconds. Calculate the distance covered (3 marks)

QUESTION TWO (20 MARKS)

- a) Distinguish between rotatory and translational motions (2 marks)
- b) Explain the greenhouse effect and briefly discuss how it leads to global warming (6 marks)
- c) A satellite is said to be in a geosynchronous orbit if it rotates round the earth once every day.
 - i) Give two applications of geosynchronous orbits (2 marks)
 - ii) The satellites in this orbit must rotate a distance of $4.23 \times 10^7\text{m}$ from the centre of the earth. Calculate the magnitude of acceleration experienced by such satellites (5 marks)
- d) The process of nuclear fusion, unlike nuclear fission has not been greatly utilized in harnessing energy. Discuss the reasons for the failure of nuclear fusion energy harvesting process (5 marks)

QUESTION THREE (20 MARKS)

- a) Describe the following properties of sound (3marks)
 - i. Pitch
 - ii. Quality
 - iii. Loudness
- b) Briefly describe the nature of sound propagation and explain two factor that affect its speed in air (5 marks)
- c) A pulse of ultrasound is sent out from the boat an echo is heard 0.3 seconds later.
 - i. The speed of ultrasound in water is 1500 m/s. Calculate the depth of the shoal of fish. (3 marks)
 - ii. Discuss any two applications of ultrasound in real life (4 marks)
- d) Briefly describe the electromagnetic spectrum and give two properties of electromagnetic radiations (5 marks)

QUESTION FOUR (20 MARKS)

- a) State the Stefan-Boltzmann's law of radiation (1 mark)
- b) A man is at a temperature of 37°C while his surrounding is at 21°C . If the emissivity of his skin is 0.900 and his surface area is 2.5 m^2 calculate the rate of energy loss from his body (4 marks)
- c) (i) Wein's displacement law of radiation (1 mark)
(ii) The sun's surface has a temperature of approximately 5800K. If treated like a black body determine the peak intensity wavelength λ_{max} and the total radiation power per unit area (4 marks)
- d) (i) Define half-life of a samples (1 mark)
(ii) A sample of Ac-225 originally contained 80 grams and after 50 days only 2.55 grams of the original Ac-225 remain. Find the half-life of Ac-225 (3 marks)
(iii) Radioactivity is a necessary evil in view of this fact, discuss the impacts of radioactivity to the environment (6 marks)

QUESTION FIVE (20 MARKS)

- a) (i) State the first law of thermodynamics (1 mark)
- (ii) 100j of work is done on a system whose internal energy increases by 74j.
Calculate the amount of heat transferred (3 marks)
- b) 0.2 moles of monoatomic gas at 27°C are in a closed container is heated at constant volume to a final temperature of 400k. Calculate the heat added to the gas (4 marks)
- c) Three moles of helium (monoatomic gas) at 47°C and a pressure of $2 \times 10^5 \text{ Pa}$ undergo isochoric process so that pressure increases to $3 \times 10^5 \text{ Pa}$. Determine the change in internal energy in the system (4 marks)
- d) Discuss the following four processes in thermodynamics (8 marks)
- i) Isothermal Process
 - ii) Adiabatic Process
 - iii) Isovolumetric Process
 - iv) Isobaric Process