



MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

SECOND YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR ENVIRONMENTAL SCIENCE

ENS 130: ENVIRONMENTAL PHYSICS

DATE: 8/5//2019

TIME: 8.30-10.30 AM

INSTRUCTIONS TO CANDIDATES

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

CONSTANTS:

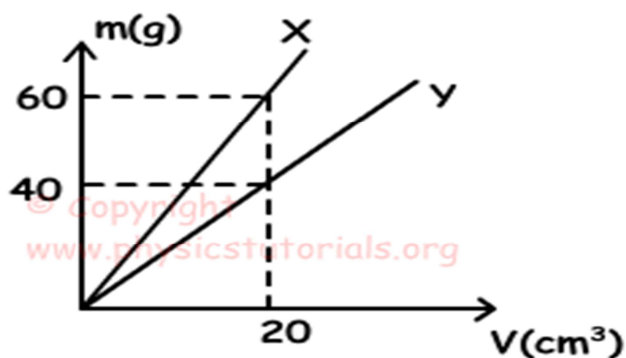
- Universal gas constant $R = 8.314 \text{ J/mol.K}$ or $0.0821 \text{ L.atm/mol.k}$
 - Wein constant for a black body $b = 2.9 \times 10^{-3} \text{ m.K}$
 - Stefans-Boltzman constant $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2.\text{K}^4$
 - Monoatomic gas $C_V = \frac{3}{2}R$ $C_P = \frac{5}{2}R$; Diatomic gas $C_V = \frac{5}{2}R$ $C_P = \frac{7}{2}R$
 - Speed of sound in air at 20°C is 343 m/s
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QUESTION ONE (30 MARKS)

- a) Briefly discuss the three common states of matter in terms of particle arrangement and kinetic energy of the particles (3 marks)

- b) The diagram in figure 1 shows a graph of mass and volume of two liquids

Fig:1



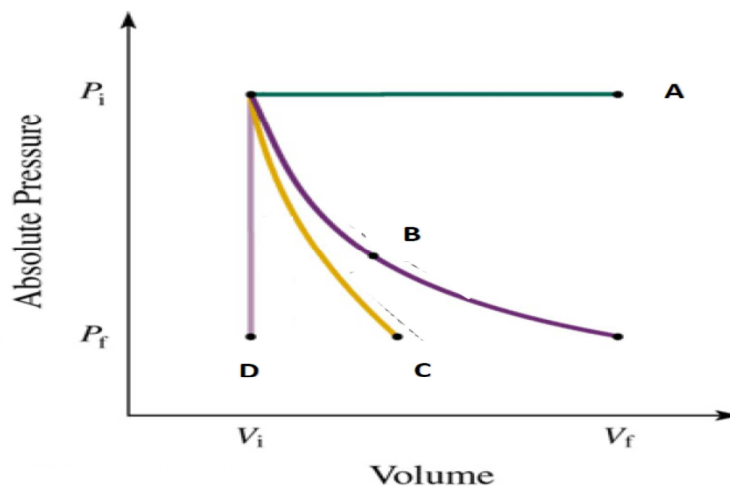
- If 160g of liquid X is mixed with 40cm³ of liquid Y find the density of the homogeneous mixture (3 marks)
- c) Give any two applications of force in real life situations (2 marks)
- d) Explain how greenhouse effect occurs in nature (2 marks)
- e) Distinguish between intensive and extensive physical properties of matter (2 marks)
- f) Give one difference and one similarity between a closed system and an open system (2 marks)
- g) A particle moving at a velocity of 5m/s accelerates at 3m/s² for 10 seconds. Calculate the distance covered and its final velocity (3 marks)
- h) Briefly explain the following classifications of waves
- i. Electromagnetic and mechanical waves (2 marks)
 - ii. Transverse and longitudinal waves (2 marks)

- i) i What is Doppler effect in sounds (1 mark)
- ii The horn is producing a pure 1000 Hz tone. Find the frequency as heard by the listener at rest when the source moves towards him at 10m/s. (3 marks)
- j) A sample of 3 moles of a gas was kept at 27°C during an isothermal expansion from 6 litres to 18 litres. Calculate work done by the gas in the process (3 marks)
- k) Define radioactivity and state the condition for an element to undergo radioactive decay (2 marks)

QUESTION TWO (20 MARKS)

- a) i State the first law of thermodynamics (1 mark)
- ii 100J of work is done by a system whose internal energy increases by 74J. Calculate the amount of heat transferred (3 marks)
- b) 4 moles of nitrogen gas are confined to a 6.0 L vessel at 177°C and 12.0 atm. If the vessel is allowed to expand isothermally to 36.0 L calculate the final pressure reached (3 marks)
- c) Three moles of helium (monoatomic gas) at 47°C and a pressure of $2 \times 10^5 \text{ Pa}$ undergoes isochoric process so that pressure increases to $3 \times 10^5 \text{ Pa}$. Determine the change in internal energy in the system (5 marks)
- d) The diagram in figure 2 shows a graph of pressure against volume and thermodynamic processes A, B, C and D. State and discuss each of the four processes (8 marks)

Fig 2



QUESTION THREE (20 MARKS)

- a) State the following laws of radiation (2 marks)
- Stefan-Boltzmann's law
 - Wein's displacement law
- b) The sun's surface has a temperature of approximately 6000K. If treated like a black body determine the peak intensity wavelength λ_{max} and the total radiation power per unit area (4 marks)
- c) A man is at a temperature of 37°C while his surrounding is at 23°C. If the emissivity of his skin is 0.85 and his surface area is 2.0 m² calculate the rate of energy loss from his body (4 marks)
- d) i Define half-life in radioactivity (1 mark)
- A nuclear reactor produced 102.4kg of Uranium-232. If the half-life of Uranium is 70 years, calculate the time Uranium-232 takes to decay to 0.1 kg. (3 marks)
 - Describe the three common types of radioactive decay (6 marks)

QUESTION FOUR (20 MARKS)

- a) Describe the following properties of waves (3 marks)
- Absorption
 - Dispersion
 - Diffraction

- b) Briefly describe the nature of sound and explain how temperature affects the speed of sound in air (4 marks)
- c) i Other than echolocation, discuss other two applications of ultrasound (4 marks)
- ii In echolocation, the speed of ultrasound in water is 1500 m/s. In locating shoal of fish a pulse of ultrasound is sent out from a boat and an echo heard 0.3 seconds later. Calculate the depth of the shoal from the boat. (3 marks)
- e) Discuss the impacts of the conventional sources of energy to the environment (6 marks)

QUESTION FIVE (20 MARKS)

- a) 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 4.23×10^7 m from the centre of the earth. Calculate the magnitude of acceleration experience by such satellites (4 marks)
- b) Discuss three factors that should be considered when installing a solar photovoltaic energy plant in a site (6 marks)
- c) State and by use of sketches describe the following gas laws to show the relationship between the variables (8 marks)
- i. Gay lussac's law
- ii. Charles law
- iii. Boyles law
- iv. Avogadro's law