



NATIONAL OPEN UNIVERSITY OF NIGERIA
PLOT 91, CADASTRAL ZONE, NNAMDI AZIKIWE EXPRESSWAY, JABI - ABUJA
FACULTY OF SCIENCES
DEPARTMENT OF PHYSICS
2025_2 EXAMINATIONS

COURSE CODE: PHY455
COURSE TITLE: LOWER ATMOSPHERIC PHYSICS
CREDIT UNIT: 3
TIME ALLOWED: (3 HRS)
INSTRUCTION: Answer question 1 and any other three questions

QUESTION ONE

- (a) (i) Briefly explain the term “Earth’s atmosphere” **4 marks**
(ii) Briefly explain five importance of the Earth’s atmosphere **5 marks**
(b) (i) List 3 major and 2 minor constituents by volume of atmospheric composition in the earth's lower atmosphere **5 marks**
(ii) List the main layers of the earth’s atmosphere in order of increasing altitude. **5 marks**
(c) (i) What is meant by “temperature profile” as applied to the Earth’s atmosphere?
(ii) Explain the term “lapse rate” as applied to the earth’s atmosphere. **3 marks**
(iii) What mechanism is responsible for lapse rate in the earth's lower atmosphere? **3 marks**

QUESTION 2

- (a) (i) Write down the differential form of the first law of thermodynamics **3 marks**
(ii) Write down the mathematical definition of the specific heat capacity at constant volume, c_v . **2 marks**
(b) (i) What is an isothermal thermodynamic process **2 marks**
(ii) Show that the work done by an ideal gas in an isothermal expansion process is given by

$$W = Q = RT \log_e \left(\frac{p_1}{p_2} \right). \text{ 8 marks}$$

QUESTION 3

- (a) (i) What is mixing ratio? (2 marks)
(ii) Write down the equation of the mixing ratio in terms of the partial pressure of water vapour and the ratio of the specific gas constant for dry air to the specific gas constant for vapour (3 marks)
(b) Distinguish between moisture and quality of the liquid-vapour saturation region. (5 marks)
(c) Sketch the Pressure-Temperature diagram and explain what is meant by critical point of pure water (5 marks)

QUESTION 4

- (a) (i) What is radio refractivity? **3 marks**
(ii) Apply Fermat’s principle to explain briefly, the phenomenon of radio propagation. **4 marks**
(b) (i) Write down the equation relating the refractivity N to the refractive index n of the atmospheric medium.
(ii) Given the following data:

$$k_1 = 77.6 \text{ K/mbar}$$

$$p_d = 1000 \text{ mbar}$$

$$T = 300 \text{ K}$$

where k_1 is a dimensionless constant; p_d is dry atmospheric pressure and T is absolute temperature, calculate the refractivity N_d for dry air. **8 marks**

QUESTION 5

- (a) Define the following: (i) Intensity **3 marks**
(ii) Flux **3 marks**
(b) Derive the equation of radiative transfer equation **9 marks**

QUESTION 6

Write short notes on the phenomena of

- (i) geomagnetic storms **7 marks**
(ii) aurorae **8 marks**