DEPARTMENT OF PURE AND APPLIED SCIENCE

OCT/NOV 2019 EXAMINATIONS

COURSE CODE: **PHY 455**
COURSE TITLE: **LOWER ATMOSPHERIC PHYSICS**
CREDIT UNIT: **3**
TIME ALLOWED: **(2½ HRS)**

INSTRUCTION: *Answer question 1 and any other four questions*

QUESTION 1

(a) (i) Differentiate between the homosphere and the heterosphere **(3 marks)**
   (ii) Briefly describe the exosphere **(3 marks)**

(b) 1.00 kg of liquid water at 100°C is converted to steam at 100°C by
   boiling at standard atmospheric pressure (which is 1.00 atm or 1.01×10^5 Pa).
   If the volume of that water should change from an initial value of 1.00×10^{-3} m^3
   as a liquid to 1.671 m^3 as steam,
(i) How much work is done by the system during this process? **(2 marks)**
(ii) How much energy is transferred as heat during the process? **(2 marks)**
(iii) What is the change in the system's internal energy during the process? **(2 marks)**

(c) (i) Highlight differences between an isothermal process and an adiabatic process **(2 marks)**
   (ii) The highest theoretical efficiency of a certain engine is 30%. If this engine uses the atmosphere which has a temperature of 300 K as its cold reservoir, what is the temperature of its hot reservoir? **(2 marks)**

(d) (i) Define the quality x, and the moisture y, of the saturation region **(2 marks)**
   (ii) State the four phases in which ordinary water exists. **(4 marks)**

QUESTION 2
(a) In terms of temperature variation with height. List the layers of the atmosphere **(4 marks)**
(b) Briefly describe any two of the layers listed above. **(8 marks)**

QUESTION 3
(a) Briefly describe the ionosphere **(4 marks)**
(b) Write short note on any two of the ionospheric layers **(8 marks)**

QUESTION 4
(a) Write short note on Aroras.   (4 marks)
(b) (i). Briefly explain the solar wind.   (4 marks)
   (ii) What are the factors that enhance the potency of the solar
       wind to shape the magnetosphere?   (2 marks)
(iii). List four events which occur during the solar maximum that have
       strong influence on communications and other technologies here on earth.   (2 marks)

QUESTION 5
 (a) State the second law of thermodynamics   (2 marks)
(b) An engine transfers 2.00×10^3 J of energy from a hot reservoir during a
    cycle and transfers 1.50×10^3 J as exhaust to a cold reservoir.
(i) Find the efficiency of the engine.   (2 marks)
(ii) How much work does the engine do in one cycle?   (2 marks)

(c) A 1.0-mol sample of an ideal gas is kept at 0.0°C during an expansion
    from 3.0 L to 10.0 L.
(i)How much work is done on the gas during the expansion?   (2 marks)
(ii)How much energy transfer by heat occurs between the gas and its
    surroundings in this process?   (2 marks)
(iii)If the gas is returned to the original volume by means of an isobaric process,
    how much work   is done on the gas? (Take R = 8.31 J/mol.K).   (2 marks)

QUESTION 6
(a) (i) What is line broadening?   (2 marks)
   (ii) List the three classes of line broadening   (3 marks)
   (iii)Write short note on Doppler line broadening   (4 marks)
(b)   Define Doppler width and give its mathematical representation in terms of
       the wavelength of the line centre.   (3 marks)