00221

The Open University of Sri Lanka
B.Sc. Degree Programme -Level 05
Final Examination 2015/2016
PYU 3162 / PYE 5162/ PHU 3145 /PHE 5145 - Atmospheric Physics
Duration: *Two (2) hours*

Date: 8th July 2016 **Time: 9.30 a.m. to 11.30 a.m.**

$g=9.8ms^{-2}$ $\Gamma_{dry}= 9.8\ ^{o}C/km$, $R = R_d = 287\ J\ deg^{-1}\ kg^{-1}$ $C_p = 1004\ J\ deg^{-1}\ kg^{-1}$

Stephan's constant = $5.67\times10^{-8}\ W\ m^{-2}\ K^{-4}$
Wien's displacement constant = 2.897×10^{-3} meter-kelvin

Answer 4 questions only.

01.

a. What is the relationship between air pressure and weather?

b. What is the average pressure over the earth surface in Pascal? The radius of the earth is 6.4×10^{6} m and the mass of the atmosphere is 5.4×10^{18} kg.

c. A deep column of air is in hydrostatic balance. If the air below a certain level **H** in the column cools, while the air above level **H** remains at the same temperature, will the pressure at level **H** increase, decrease or remain unchanged? Explain the answer.

d. Briefly explain the "magnetic mirror".

02.

a. Derive hydrostatic equation

b. Starting from hydrostatic equation, show that the pressure changes with height according to $P = P_o \exp^{(-gz/RT)}$. Where P and P_o are the pressure at height z and sea level respectively

c. State hypsometric equation and use it to derive reduce pressure at any level to sea level.

d. If the pressure is 1020 hpa at the ground level and 510 hpa at a height of 4 km, what is the temperature of the atmosphere for isothermal conditions.

03.

a. Derive the equation for potential temperature.

b. What will happen to the potential temperature if an air parcel is subject to only adiabatic changes as it moves in the atmosphere?

c. An airplane was filled with air from the environment while flying at a level 200 mb, keeping the cabin pressure constant at 700 mb. At that height the environment temperature was around -60° C. Assuming no heat exchange with the surrounding, what could be the new temperature of the cabin of the aircraft?

d. What caused this temperature change of the filled air when it was brought into the cabin of the aircraft?

04.

a. What is meant by earth's radiation budget?

b. Define absorptivity and emissivity

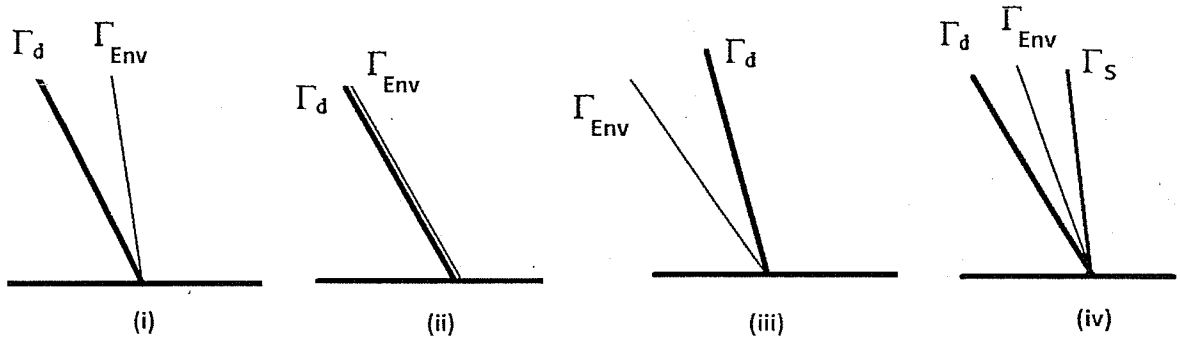
c. State kirchoff's law.

d. A container with boiling water has an emissivity of 0.8. How much energy is it emitting? What is the wavelength of the peak energy emission? What part of the electromagnetic spectrum is this in?

05.

a. What is the difference between actual or environmental lapse rate and adiabatic lapse rates?

b. Discuss the stability conditions of following diagrams considering lapse rates, temperature and air density.



c. What are the conditions for atmospheric situations that
   (i) absolutely stable
   (ii) absolutely unstable

06.

a. Name and sketch the main set of lines in a thermodynamic diagram?

b. Select the coordinate A of tephigram in terms of potential temperature (θ) while the other coordinate is temperature (T). Use the relationship $A = R \ln \alpha + F(T)$ where α is specific volume and R is the gas constant.

c. State main characteristics of a tephigram