



**RAJARATA UNIVERSITY OF SRI LANKA**  
**FACULTY OF APPLIED SCIENCES**

B.Sc. (General) Degree in Applied Sciences  
Third Year – Semester I Examination – June/July 2018

**PHY 3301 – ATMOSPHERIC PHYSICS**

Time allowed: Three (03) hours

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**Answer all Questions.**

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1.
  - a) What is meant by greenhouse effect and human enhanced greenhouse effect? (5 Marks)
  - b) Discuss the effect of water vapour in relation to the global warming. (4 Marks)
  - c) Briefly describe the consequences of global warming. (3 Marks)
  - d) Some scientists argue that, global warming is a hoax. How would you argue against them?  
Present the facts to support your argument. (2 Marks)
  - e) The top 10 % of the ocean is mostly affected by temperature change. Calculate the sea level rise as a result of thermal expansion of ocean water, if the average temperature of the earth is increased by  $3^{\circ}\text{C}$  over 100 years. Assume that the initial ocean surface area and the final surface area are equal, the mean ocean depth is 3600 m and the average coefficient of volume expansion in the upper water is  $1.5 \times 10^{-4} \text{ }^{\circ}\text{C}^{-1}$ .  
[Hint: Volume thermal expansion equation is given by  $\Delta V = \beta V_i \Delta T$ , where  $\Delta V$ -Change of volume,  $\beta$ -Volume thermal expansion coefficient,  $V_i$ -Initial volume of the object,  $\Delta T$ -Change in temperature in Kelvin.] (6 Marks)
2.
  - a) What is it meant by dry adiabatic lapse rate? (3 Marks)
  - b) Derive an expression for the dry adiabatic lapse rate of the atmosphere. Hence calculate an approximate value for dry adiabatic lapse rate in the troposphere. (Specific heat at constant pressure  $\sim 10^3 \text{ J Kg}^{-1} \text{ K}^{-1}$ ) (4 Marks)
  - c) What can you say about the dry adiabatic lapse rate of a planet whose gravitational acceleration is equal to that of Earth, but the atmospheric composition is entirely different. (3 Marks)

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d) Derive an expression for the saturated lapse rate and compare it with the dry adiabatic lapse rate. (5 Marks)

e) Discuss the stability of the atmosphere, by comparing the dry adiabatic lapse rate with the environment lapse rate. (5 Marks)

3. a) State the Stephan-Boltzmann Law of Black body radiation. Write down a mathematical expression for the Stephan-Boltzmann Law and identify the terms involved. (3 Marks)

b) Assuming the Sun to be a perfect black body at a temperature of 5785 K, calculate the total energy emitted by the Sun per unit time. (Assume the radius of the Sun is  $6.96 \times 10^8$  m and Stephan-Boltzmann constant is  $5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$ ) (4 Marks)

c) Calculate the solar flux density per unit time at a distance of  $1.5 \times 10^{11}$  m from the center of the Sun, which is equal to the radius of the Earth's orbit. (5 Marks)

d) However, the average solar flux density reaching the surface of the Earth (neglecting the effect of the atmosphere) is taken as one fourth the value obtained at (c). How would you explain this? (2 Marks)

e) Assuming that the Earth is in a thermal equilibrium state, calculate the average temperature of the Earth stating clearly any assumptions made. (4 Marks)

f) Does your answer for part (e) agree with the average temperature of the earth? Give reasons. (2 Marks)

4. a) Explain the process of lightning and thundering with their charge separation in cloud. (4 Marks)

b) Briefly explain six (6) different types of lightning according to their appearance. (6 Marks)

c) Describe how weather forecasting is done. Explain the techniques which are used for weather predictions. (6 Marks)

d) Discuss the importance of weather forecasting. (4 Marks)

5. a) Precipitation is any product of the condensation of atmospheric water vapour that falls under gravity. Write down (5) types of precipitation and describe three (3) of them. (3 Marks)

b) Dew and fog are not forms of precipitation. form. (4 Marks)

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- c) Briefly explain four (4) different types of fog. (2 Marks)
  - d) Describe the methods of cloud seeding. (3 Marks)
  - e) Discuss advantages and disadvantages of cloud seeding. (3 Marks)
  - f) Cloud types can be categorized into two parts. They are based on appearance and height.  
Write down ten (10) types of clouds and their features. (5 Marks)