

EASTERN UNIVERSITY, SRI LANKA

THIRD YEAR SECOND SEMESTER EXAMINATION IN SCIENCE -

2020/2021

(July/August - 2024)

PH 3091 ENERGY AND ENVIRONMENT

Time: 01 hour.

Answer ALL Questions

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1.

(a) Sketch the temperature profile of the Earth's atmosphere as a function of height, and describe how temperature varies in each of the atmospheric layers. State the advantages of the two principle layers closest to the Earth's surface.

[30 Marks]

(b) Discuss the principles underlying the formation of the ozone layer in the Earth's atmosphere, and explain how catalytic species lead to the destruction of the ozone layer.

[25 Marks]

(c) Show that the light flux intensity after passing through absorbing ozone gas in the stratosphere can be determined by the Beer-Lambert law:

$$I_t = I_0 \exp(-\sigma N x),$$

where  $I_t$  is the transmitted light flux at a specific wavelength,

$I_0$  is the incident light flux,

$N$  is the concentration of ozone gas,

$x$  is the path length of the radiation through the ozone gas, and

$\sigma$  is the photo-absorption cross-section.

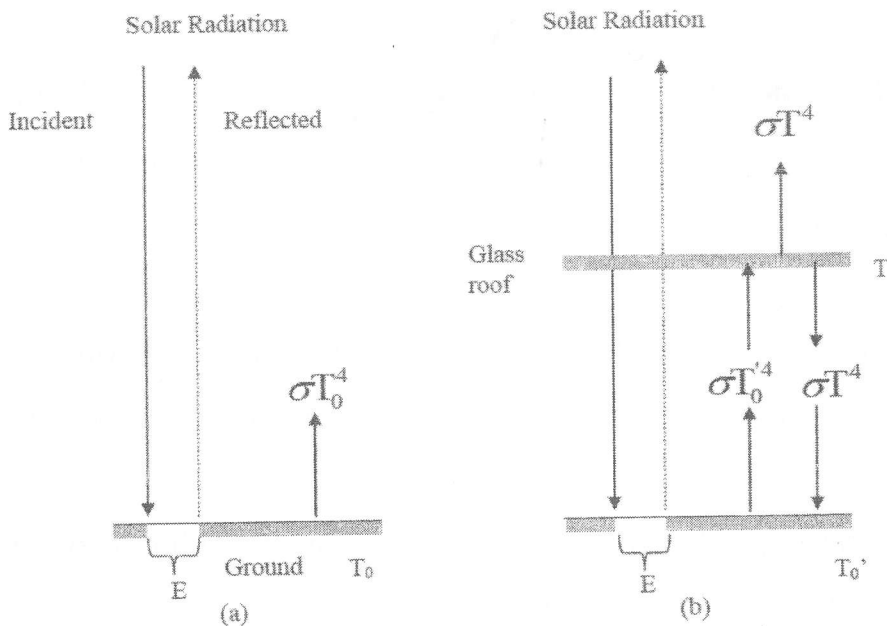
In a sample with an absorbance of 1 at a specific wavelength, what is the relative amount of light that was absorbed by the sample?

[25 Marks]

(d) With the aid of a schematic diagram, explain how solar radiation breaks down and maintains energy balance on Earth.

[20 Marks]

2. (a) The figure below illustrates a simple model of the *greenhouse effect* on planet, where the Earth acts as a black-body.  $T_0$  is the surface temperature of the ground,  $T$  is the temperature of the glass roof, and  $T'_0$  is the final equilibrium temperature of the ground under the greenhouse effect.



Describe the physical processes involved in the *greenhouse effect*, and show that as a consequence of the effect, the ground reaches the final equilibrium temperature of  $T'_0 = \sqrt[4]{2}T_0$ . Propose three possible ways to reduce the concentration of greenhouse gases.

[35 Marks]

(b) Define renewable energy. Name five renewable energy sources currently available and describe one of these sources in detail, focusing on its potential as a future global energy provider.

[35 Marks]

(c) Distinguish between the purpose and mode of action of a *flat-plate solar collector* and a *photovoltaic cell*, both of which are designed for exposure to solar radiation.

[30 Marks]

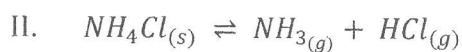
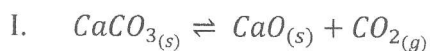
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2. Answer **all** parts.

a) i. State the phase rule and name the terms involved in it.

[10 Marks]

ii. Based on the phase rule calculate the number of phases, number of components, and degrees of freedom of the following systems,



[30 Marks]

iii. Draw and label the phase diagram of a two-component system (solids) that are miscible in the liquid phase.

[20 Marks]

iv. Calculate the pressure difference across the surface of the water droplet with a radius of 200 nm at 20 °C using the Laplace equation.

Surface tension ( $\gamma$ ) for water at 20 °C is  $0.072 \text{ Nm}^{-1}$ .

[10 Marks]

b) i. Briefly explain.

I. Critical Micelle Concentration (CMC).

II. Role of Surfactant in cleaning processes.

[20 Marks]

ii. Name two important properties of surfactants.

[10 Marks]

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**END**