

NTNU

ENGLISH

Department of Physics

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EXAMINATION IN : MNFFY 221/SIF 4082 Energy and Environmental Physics

Monday 3. December 2001

DURATION: 09.00-15.00

Permitted aids: Mathematical tables,

B1 – Calculator, no memory , reference NTNU.

Number of pages: 3

Grades to be announced in week 1 of 2002

Problem 1.

a)

What does "Radiative forcing" mean?

b)

The term "feedback mechanisms" is used in climate science. What does it mean ? Please give some examples.

c)

What kind of models are coupled when different future climate scenarios are made ?

Problem 2

a)

Make a figure showing the different energy fluxes received and emitted from the earth surface and the atmosphere, the so called zero-dimensional greenhouse model, which means there is no space co-ordinate in the model. Describe the physical background for the different energy fluxes.

b)

Write the equation describing the energy balance for a 1 m^2 black surface, placed outdoors horizontally on the ground.

c)

When using geothermal energy it is desirable to find the heat content in a rock down to a certain depth. The following equation may be used:

$$E_o = \int_{z=z_1}^{z_2} \rho_r A c_r G(z-z_1) dz$$

Explain the factors in the equation. Use the equation to calculate the heat per km² in dry rock down to 7 km. The geothermal gradient is 40 K km⁻¹, lowest useful temperature is 140 K above the surface temperature.

$$\rho_r = 2700 \text{ kgm}^{-3}, c_r = 820 \text{ J kg}^{-1}\text{K}^{-1}.$$

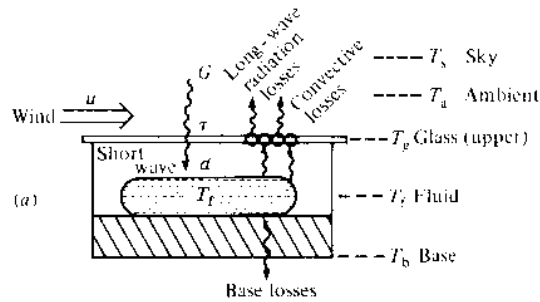
Problem 3

a)

How is the solar cell working ? Discuss the factors limiting the cell efficiency.

b)

The figure below is from the textbook and shows a simple solar heater (black bag).



Draw the analogous electrical circuit showing the heat resistance. Can you give the equation (expression) for the total heat resistance in this system.

c)

In most solar collectors selective surfaces are used. What does it mean and why are such surfaces used ?

Problem 4

a)

Nuclear power is important on a global scale. Can you describe the process going on in a nuclear reactor. Which parameters are important to have a controlled process.

b)

Multiplication factor of the reactor is given by the following equation

$$k_{\infty} = \epsilon \eta p f$$

What are the factors included in the equation ? What is the order of magnitude of k_{∞} ?

c)

The units Bq, Gray and Sv are used when radioactivity and radiation are described. What are the difference between the three units? What is the largest natural source for radioactivity injurious to health in the Western world?

Please note:

Students are kindly asked to inform themselves about grades on the special service phone at NTNU, phone number, number 815 48014. The service is in Norwegian. The examination office does not answer these inquiries. Please contact the Department of Physics if you need assistance.