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國立臺灣大學108學年度碩士班招生考試試題
科目：氣候學
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**Multiple Choice Questions (單選選擇題: 每題五分，共 25 分)** 注意：請於試卷內之「選擇題作答區」依序作答。

1. What fraction of the solar radiation that arrives at the top of the atmosphere is absorbed in the atmosphere? a) 80%, b) 50%, c) 20%, d) 3%
2. What fraction of the solar radiation that arrives at the top of the atmosphere is absorbed at the Earth's surface? a) 80%, b) 50%, c) 20%, d) 3%
3. What fraction of the solar radiation that is absorbed at the Earth's surface is used to evaporate water? a) 80%, b) 50%, c) 20%, d) 3%
4. At what latitude and during what season is the daily-averaged insolation at the top of the atmosphere the greatest? a) Equator at Equinox, b) Equator on Jan. 5, c) South pole on Dec. 21, d) North pole on June 21,
5. The energy balance in the troposphere is an 'approximate' balance between the two largest terms which are, a) heating by ozone and cooling by emission from water vapor, b) heating by ozone and cooling by emission from carbon dioxide, c) heating by condensation of water and cooling by longwave emission from water vapor, d) heating by absorption of solar radiaton by water vapor and cooling by longwave emission from water vapor

Problem Solving and Short Essay Answers (計算題與簡答題：第六題 15 分，第七至 12 題每題 10 分，共 75 分)

6. The schematic on the right demonstrates a simple greenhouse model, comprising a surface at temperature T_S, and two atmospheric layers at temperature T_a and T_b, subject to incoming solar radiation $S_0/4$. Let's first assume: the atmosphere is completely transparent to shortwave solar radiation, and it is completely opaque to terrestrial radiation emitted by the ground. As a starting point, let's also assume planetary albedo for shortwave solar radiation is zero.
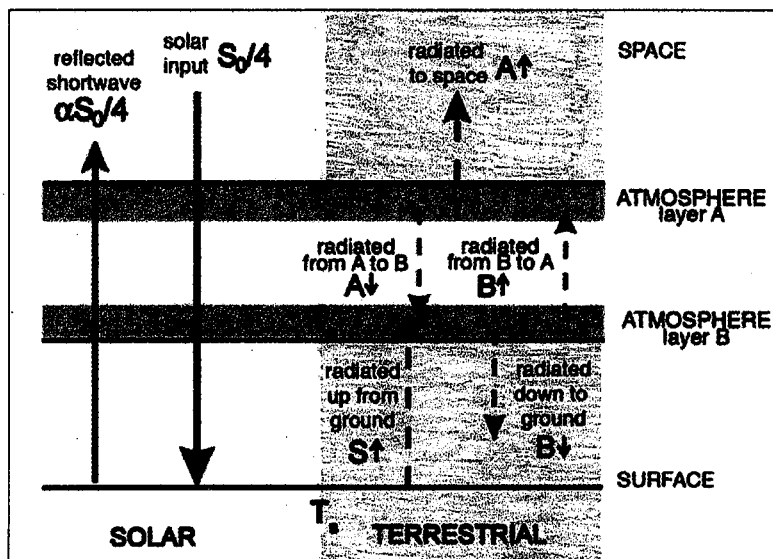
(a) Please write down energy balance at TOA, at the surface, and for the atmospheric layer A and B.

(b) Why should we divide the solar constant S_o by 4 when considering the energy budget at the top of the atmosphere?

(c) Please calculate atmospheric temperature at layer A (emission temperature) T_a, layer B T_b and surface temperature T_S. ($S_0 = 1367 W/m^2$, Stefan-Boltzmann constant $\sigma = 5.67 \times 10^{-8}$ W m^{-2}K^{-4})

見背面

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7. The troposphere is close to neutral to moist convection and therefore the lapse rate above the boundary layer is approximately equal to the saturated adiabatic lapse rate. (a) How do you think the lapse rate in free troposphere (say at around 500hPa) may change with global warming? Why? (b) Would the change in lapse rate be a positive or negative feedback on the climate sensitivity of surface temperature to a doubling of CO_2? Explain your reasoning.

8. Calculate the zonal velocity of an air parcel at 30S, if it has conserved angular momentum while moving to 30S from the equator, where it was initially at rest relative to the surface. (Use thin atmosphere approximation: neglect the thickness of the atmosphere) (Rotation speed of the earth 7.292×10^{-5} rad/s, Radius of the earth 6.37×10^6 m)

9. Please sketch zonal mean mass streamfunction (as a function of pressure and latitude) and zonal mean zonal wind (as a function of pressure and latitude) for a planet that's almost identical to earth but rotates in the opposite direction (spins toward the west). Please mark the direction of the streamfunction (clockwise or counterclockwise) and wind (easterly or westerly) clearly.

10. Please use mathematical equations and some schematics to explain why the subtropical gyre (in the ocean) in Northern Hemisphere is clockwise?

11. Please use 3~5 sentences to explain the primary causes of the Pacific cold tongue and cold sea surface temperature (SST) near the eastern Pacific. Why is SST over the cold tongue lower than SST in the west?

12. What is El Nino-Southern Oscillation? Please explain its physical mechanism. What are the positive feedbacks involved in maintaining an El Nino event? How does the system switch from El Nino to La Nina condition?

試題隨卷繳回