

ATOC 1060: Review guide for exam 1

Exam 1 will cover lectures 1-12, HW1 and HW2, and the corresponding chapters of the textbook *that are covered by the lectures*. We will not test the content of Lecture 11, which is the guest lecture. For lecture 12, exam 1 will cover the “Coriolis effect”, but will NOT include the concepts of “geostrophy” and “geostrophic wind”. The exam questions are multiple choices.

1. Concepts and laws

Understand the concepts and laws. You are not required to memorize the exact words and numerical values of the concepts we have covered, but you are required to fully understand them.

For example: Greenhouse effect, global warming, glacial and interglacial periods, buoyancy, positive buoyancy, neutral buoyancy, negative buoyancy, ITCZ, Hadley cell, the Wien’s law, Stefan-Boltzmann law, etc.

2. Interpretation of charts (figures)

Understand the figures. You should understand and be able to interpret figures and charts.

3. Processes

You should be able to explain some physical processes. For example, how are Hadley Cells formed? How are the northeasterly and southeasterly trades are formed?

4. Example questions

Below are some example questions. The exam, however, will cover all materials in lectures 1-12 (except for the guest lecture) as mentioned above.

- 1) What are greenhouse gases?
- 2) What is greenhouse effect?
- 3) What is global warming?
- 4) What are the four fundamental components of the Earth system?
- 5) What are the three major global environmental changes that are occurring today?
- 6) What do Figure 1-2 and Figure 1-3 tell us about the concentrations of greenhouse gases?
- 7) What does Figure 1-4 tell us about the Earth’s temperature? What is the relationship between the Earth’s temperature and greenhouse gases’ concentration?
- 8) What are the possible consequences of global warming?

- 9) What is the Antarctica ozone hole? What are the possible consequences of ozone depletion?
- 10) To what two global environmental problems does tropical deforestation contribute?
- 11) Why do we need to know global change in the past?
- 12) What are glacial periods? What are interglacial periods?
- 13) Why is iridium a good indicator of impacts by extraterrestrial bodies?
- 14) According to Figure 1-12, what is believed to occur at the K-T boundary? Why did dinosaurs disappear?
- 15) What does the event at the K-T boundary tell us about present day climate? (hint: dramatic changes caused by external forcing can change the Earth's climate from one equilibrium state to another)
- 16) How has solar luminosity changed during the past 4.6 billion years?
- 17) What is the Gaia hypothesis, and what does it say about the importance of life on this planet?
- 18) What is a system? What are the components of a system?
- 19) What is positive coupling? What is negative coupling?
- 20) What is a positive feedback loop? What is a negative feedback loop?
- 21) What are equilibrium states? What is a stable equilibrium state? What is an unstable equilibrium state?
- 22) Which one has a higher albedo (reflectivity), fresh snow or grass? (see Table 2-1)
- 23) Understand the feedback loops of the daisyworld climate system (Figure 2-10 and Figure 2-11).
- 24) What are the three major factors that determine the Earth's surface temperature? (see lecture 8);
- 25) The energy E of a photon of electromagnetic radiation is inversely proportional to its wavelength (λ):

$$E = \frac{hc}{\lambda},$$
 where h is a constant called Planck's constant.
 Which photons have higher energy, UV or visible light?
- 26) Which photons have higher energy, visible light or infrared radiation (IR)? (hint: UV has the shortest wavelength, IR has the longest wavelength, and visible light is in between; Reference Figure 3-3 of the text book)
- 27) How is electromagnetic radiation flux defined?
- 28) What is the inverse-square law of electromagnetic radiation? What does it tell us? [you're required to understand it, but not required to remember the formula]
- 29) How many temperature units (or scales) do we often use? [Hint: Celsius, Kelvin, and Fahrenheit]
- 30) What is Wien's law? [Note: you need to understand the law; but not required to remember the formula]
- 31) Why is the Sun's maximum radiation in the visible light range, and the Earth's maximum radiation in the IR range?
- 32) What is Stefan-Boltzmann law? [you are required to understand the law]
- 33) According to Stefan-Boltzmann law, which one has a higher energy flux, the

Sun or the Earth?

- 34) Why does the Earth's atmosphere produce greenhouse effect? [hint: strong absorber of IR radiation from the Earth's surface, and part of the IR is emitted back to the Earth's surface]
- 35) What are the three most abundant gases in Earth's atmosphere today? Is any one of them greenhouse gas? [see Table 3-2]
- 36) What are the important atmospheric greenhouse gases? [Table 3-3]
- 37) Based on observational evidence, what greenhouse gases are currently increasing in concentration in the Earth's atmosphere?
- 38) How does atmospheric pressure vary with altitude (increase or decrease)?
- 39) How does temperature vary with altitude in the Earth's atmosphere? (Figure 3-9 of the textbook)
- 40) List the four layers of the Earth's atmosphere? [troposphere, stratosphere, mesosphere, thermosphere]
- 41) The ozone layer is located in which of the four layers mentioned above?
- 42) What is convection? What is latent heat?
- 43) Why is the Earth's surface the heating source for the atmosphere?
- 44) Why are H₂O and CO₂ efficient greenhouse gases?
- 45) Why aren't N₂ and O₂ greenhouse gases?
- 46) How does clouds affect atmospheric radiation budget? [reflection of solar radiation and absorption of IR]
- 47) Why are effects of clouds on Earth's radiation budget so complicated?
- 48) Identify two positive feedback loops in Earth's climate system.
- 49) Identify the negative feedback loop in Earth's climate system. Why is Earth's climate stable despite the destabilizing, positive feedbacks?
- 50) How is the Hadley cell formed?
- 51) How are the northeasterly trades and southeasterly trades are formed?
- 52) How are the mid-latitude westerly winds formed?
- 53) What is the driving force for global atmospheric circulation (see Figure 4-2 of the text book)?
- 54) How is the polar front zone formed?