

ATOC 1060 section 001: Oct 5, 12:30pm-1:45pm, 2010

Exam 1

No books or notes are allowed. Choose the right answers (A, B, C, or D) on the answer sheet using a no. 2 pencil. Please make sure that you completely darken the appropriate bubble. **There is only one correct answer for each question (please fill only one bubble). Each question is 2 points.**

1. Greenhouse effect is:
 - A. a warming of a planet surface because greenhouse gases absorb outgoing *infrared radiation* and reradiate some of it back toward the planet surface;
 - B. a warming of Earth's atmosphere due to the increase of solar luminosity;
 - C. the same as global warming;
 - D. a warming of Earth's atmosphere caused by anthropogenic forcing.

2. *Climate* is:
 - A. a convection event;
 - B. the prevailing weather patterns of a planet or region over time.
 - C. a specific weather event;
 - D. global warming.

3. Atmospheric CO₂ concentration can be altered by
 - A. anthropogenic forcing, such as burning of fossil fuel;
 - B. natural process, such as volcanic eruption;
 - C. living plants that cycle the CO₂ back and forth;
 - D. All of the above.

4. The three major global environmental changes that are occurring today are:
 - A. global warming, sea level rising, and sea ice melting;
 - B. global warming, ozone depletion, and tropical deforestation;
 - C. ozone depletion, water shortage, and improper land use;
 - D. Global warming, flooding, and deforestation.

5. The Earth system consists of the following four fundamental components:
 - A. Atmosphere, ocean, land, and plant;
 - B. Atmosphere, ocean, mountains, and biota;
 - C. Atmosphere, hydrosphere, biota, and solid earth;
 - D. Atmosphere, biota, ocean, and rivers.

6. The stratospheric ozone layer is important for humans because:
 - A. it absorbs the Sun's harmful ultraviolet radiation;
 - B. it reflections the Sun's radiation;
 - C. it absorbs infrared radiation;
 - D. it reflects visible light.

7. Observations of stratospheric ozone concentration in recent decades show that
 - A. ozone has an increasing trend in the Earth's atmosphere;
 - B. ozone has a decreasing trend over the Antarctic;
 - C. ozone stays unchanged;
 - D. ozone has an increasing trend over the Arctic.

8. The most acceptable cause for the mass extinction at the K-T (Cretaceous and Tertiary) is:
 - A. global warming;
 - B. large impact by an extraterrestrial body;
 - C. changes of climate;
 - D. disease.

9. Ice cores data show that for the past 420,000 years, the Earth's surface temperature
 - A. remained constant;
 - B. co-varied with atmospheric CO₂ concentration: an increased (decreased) CO₂ corresponds to an increased (decreased) temperature;
 - C. fluctuated between glacial and interglacial periods, but did not co-vary with atmospheric CO₂ concentration;
 - D. was consistently cold before 1850 and warmed up after 1850.

10. Throughout the 4.6 billion years history, solar luminosity is believed to
 - A. have been increasing;
 - B. have been decreasing;
 - C. stay unchanged;
 - D. decrease at first and then increase in recent years.

11. Choose the correct statement.
 - A. Our present climate is in glacial period;
 - B. Our present climate is in interglacial period;
 - C. The Earth's surface temperature at the present is the highest throughout the Earth's history.
 - D. Both B and C.

12. The Gaia hypothesis states that:
 - A. the Earth system is composed of independent components that do not interact;
 - B. the Earth system is unstable;
 - C. the Earth is a self-regulating system in which the biota plays an integral role;
 - D. the Earth system cannot self-regulate.

13. Tropical deforestation will
- increase biodiversity;
 - reduce biodiversity and decrease atmospheric CO₂ concentration;
 - reduce biodiversity and increase atmospheric CO₂ concentration;
 - reduce biodiversity but does not affect CO₂ concentration.
14. Figure 1 shows measurements of atmospheric CO₂ concentrations over the past 1000 years. The observations tell us that
- CO₂ concentration has been steadily increasing since about year 1800, and the increasing rate is faster after 1960;
 - CO₂ concentration has been increasing since year 1800, but the increasing rate is slower after 1960;
 - CO₂ concentration has been steadily decreasing since 1800;
 - CO₂ concentration had increased before 1800, but decreased after 1800.

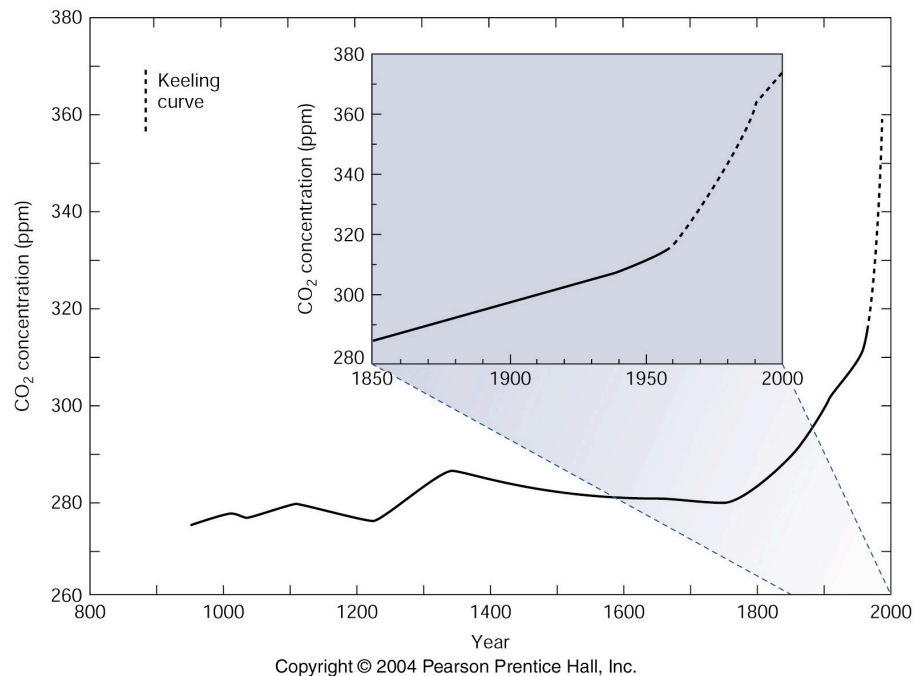


Figure 1.

15. The increased CO₂ in the Earth's atmosphere during recent decades are mainly attributed to
- natural variability without human influence;
 - volcanic eruption;
 - crops;
 - anthropogenic effects.

16. The most abundant greenhouse gas in the Earth's atmosphere is:
- A. CO₂;
 - B. CH₄;
 - C. O₃;
 - D. N₂O.
17. Water vapor H₂O and CO₂ are efficient greenhouse gases because
- A. they are good absorbers and emitters of infrared radiation;
 - B. they are good reflectors of solar radiation;
 - C. they are good absorbers of solar radiation;
 - D. they are good emitters of solar radiation.
18. What are the two most abundant gases in Earth's atmosphere today?
- A. Nitrogen (N₂) and Oxygen (O₂);
 - B. N₂ and Argon (Ar);
 - C. O₂ and CO₂;
 - D. N₂ and water vapor (H₂O).
19. The greenhouse gases that have been increasing in concentration in the Earth's atmosphere due to anthropogenic forcing in the past a few decades are:
- A. CH₄, CO₂ and N₂O;
 - B. CO₂ and N₂;
 - C. N₂O and N₂;
 - D. O₂ and N₂.
20. In the daisyworld climate system there are two components: daisy coverage and the earth's temperature. Before the optimum temperature is reached, an *increase in temperature results in an increase in daisy coverage*, and *an increase in daisy coverage will decrease the temperature* by increasing albedo (reflectivity). Choose the right statement below:
- A. This is a positive feedback loop, which tends to stabilize the system;
 - B. This is a negative feedback loop, which tends to destabilize the system;
 - C. This is a negative feedback loop, which tends to stabilize the system;
 - D. This is a positive feedback loop, which tends to destabilize the system.
21. The three major factors that determine the Earth's surface temperature are
- A. Size of the Earth, the Earth's albedo and distance from the Sun;
 - B. Mass of the Earth, the Earth's albedo and distance from the Sun;
 - C. Distance from the Sun, the Earth's albedo and greenhouse effect;
 - D. Greenhouse effect, distance from the Sun and the size of the Earth.

22. Flux of electromagnetic radiation is defined as
- the amount of energy in an electromagnetic wave that is received by the entire Earth's surface;
 - the amount of energy in an electromagnetic wave that passes perpendicularly through a unit surface area per unit time;
 - the amount of energy in an electromagnetic wave that passes through a unit surface area at a 45degree angle;
 - none of the above.
23. Choose the correct statement.
- Convection is a very important process for heat transfer between the Earth's surface and its atmosphere;
 - Thermal conduction is the MOST important way of heat transfer between the Earth's surface and its atmosphere;
 - Convection does not transfer heat between the Earth's surface and its atmosphere;
 - Both A and B.
24. 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, and $c = 3 \times 10^8 m/s$ is the speed of electromagnetic waves. Figure 2 shows the wavelengths of Ultraviolet (UV), visible light, infrared radiation (IR), etc. Choose the correct statement below.
- A photon of x-ray has a lower energy than IR;
 - A photon of visible light has a lower energy than IR;
 - A photon of UV has the lowest energy among UV, visible light, and IR;
 - A photon of x-ray has the highest energy among x-ray, UV, and IR.

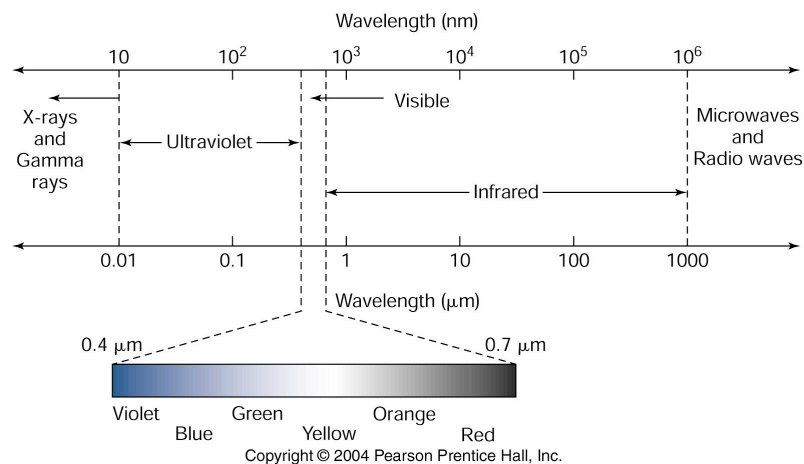


Figure 2

25. The Wien's law states that the flux of radiation emitted by a blackbody reaches its peak value at a wavelength λ_{max} , which is inversely proportional to the body's temperature T : $\lambda_{max} = \frac{2898}{T}$. Choose the right statement below.
- λ_{max} for the Sun is shorter than λ_{max} for the Earth;
 - λ_{max} for the Sun is longer than λ_{max} for the Earth;
 - λ_{max} for the Sun is sometimes longer and sometimes shorter than λ_{max} for the Earth;
 - λ_{max} is the same for the Sun and for the Earth.
26. According to Wien's law:
- The Sun's radiation peaks in the infrared range, and the Earth's radiation peaks in the visible light range;
 - The Sun's radiation peaks in the UV range;
 - The Earth's radiation peaks in the UV range;
 - The Sun's radiation peaks in the visible light range, and the Earth's radiation peaks in the infrared range.
27. The Stefan-Boltzmann law is: $F = \sigma T^4$. If object A has a temperature of T_a and energy flux of F_a , object B has a temperature of T_b and energy flux of F_b , and $T_b = 2T_a$. According to Stefan-Boltzmann Law:
- $F_b = 2F_a$;
 - $F_b = 4F_a$;
 - $F_b = 8F_a$;
 - $F_b = 16F_a$
28. An increased surface temperature of the Earth will
- increase water vapor in the atmosphere which will further increase the Earth's surface temperature;
 - decrease water vapor in the atmosphere, which will further increase the Earth's surface temperature;
 - increase water vapor in the atmosphere, which will decrease the Earth's surface temperature;
 - decrease water vapor in the atmosphere, which will decrease the Earth's surface temperature.
29. The four layers of the Earth's atmosphere are
- Troposphere, stratosphere, mesosphere, and thermosphere;
 - Troposphere, turbulent layer, mixed layer, and thermosphere;
 - Troposphere, mixed layer, mesosphere, and stratosphere;
 - Stratosphere, mesosphere, troposphere, and mixed layer.
30. Atmospheric pressure
- increases with altitude above the Earth;
 - decreases with altitude above the Earth;
 - stays constant in the Earth's atmosphere;
 - decreases in the troposphere but increases above the troposphere.

31. Atmospheric temperature
- A. decreases with altitude within the stratosphere;
 - B. increases with altitude within the troposphere;
 - C. decreases with altitude within the troposphere and increases with altitude within the stratosphere;
 - D. Both A and B.
32. The earth's surface is the most important heating source for the tropical troposphere because
- A. the earth's surface absorbs 51% of solar radiation and thus becomes the heat source;
 - B. the earth's surface reflects a big portion of the solar radiation;
 - C. the earth's surface reflects a big portion of infrared radiation from the Sun;
 - D. none of the above.
33. The two most important effects of clouds on the Earth's radiation budget are:
- A. reflecting and absorbing solar radiation;
 - B. absorbing and reflecting the Earth's infrared radiation;
 - C. reflecting the solar radiation back into the space and absorbing the Earth's outgoing infrared radiation;
 - D. Absorbing and reflecting UV.
34. In the Earth's climate system,
- A. feedback due to clouds are certain: they tend to reduce the Earth's surface temperature due to its high albedo;
 - B. feedback due to clouds are certain: they tend to increase the Earth's surface temperature due to its strong absorption of infrared radiation;
 - C. feedback due to clouds are uncertain because of their complex effects on reflection and absorption;
 - D. none of the above.
35. Choose the correct statement.
- A. Since snow and ice have higher albedo than soil, increased snow and ice cover will increase the Earth's albedo (or reflectivity);
 - B. Since snow and ice have lower albedo than soil, increased snow and ice cover will decrease the Earth's albedo;
 - C. Snow and Ice have the same albedo as soil;
 - D. none of the above.

36. Snow/ice in the Earth's climate system has a positive feedback loop, which is:
- A. An increased temperature will reduce snow and ice cover; the reduced snow and ice cover will increase the Earth's albedo and thus decrease the temperature.
 - B. An increased temperature will increase snow and ice cover; the increased snow and ice cover will decrease the Earth's albedo and thus increase the temperature.
 - C. An increased temperature will increase snow and ice cover; the increased snow and ice cover will increase the Earth's albedo and thus decrease the temperature.
 - D. An increased surface temperature will reduce snow and ice cover; the reduced snow and ice cover will decrease the Earth's albedo and thus increase the Earth's surface temperature.
37. Convection often occurs in the tropics where sea surface temperature is high. This is because when the air is heated from below
- A. it gains negative buoyancy and thus rises;
 - B. it gains negative buoyancy and thus sinks;
 - C. it gains positive buoyancy and thus rises;
 - D. it gains positive buoyancy and thus sinks.
38. Observations show that the Earth's surface temperature is generally high in the tropics and low at high latitudes. This is because
- A. there is a deficit of energy in the tropics and a surplus at high latitudes;
 - B. there is a surplus of energy in the tropics and a deficit at high latitudes;
 - C. energy distribution does not change with latitudes;
 - D. none of the above.
39. The ITCZ is formed by
- A. the divergence of surface winds associated with the Hadley cell's lower branches in the tropics;
 - B. the convergence of surface winds associated with the Hadley cell's lower branches, which flow from subtropical high pressure toward tropical low pressure;
 - C. the convergence of upper level winds in the tropical troposphere;
 - D. the convergence of winds in the tropical stratosphere.
40. The southeasterly and northeasterly trade winds at the surface result from
- A. winds blowing from subtropical high surface pressure to tropical low pressure without effects of the Earth's rotation;
 - B. winds blowing from subtropical low surface pressure to tropical high pressure without effects of the Earth's rotation;
 - C. winds blowing from subtropical high surface pressure to tropical low pressure under the influence of the Earth's rotation;
 - D. winds blowing from subtropical low surface pressure to tropical high pressure under the influence of the Earth's rotation.

41. Polar front zones are formed because
- A. the equatorward-moving cold air from the poles meets the warm air moving poleward from the subtropics, producing a zone of steep temperature gradients;
 - B. the equatorward-moving warm air from the poles meets the cold air moving poleward from the subtropics, producing a zone of steep temperature gradients;
 - C. the poleward-moving cold air from the poles diverges from the warm air moving poleward from the subtropics;
 - D. the poleward-moving cold air from the poles diverges from the warm air moving equatorward from the subtropics;
42. Observations conducted by NASA show that the October Antarctic stratospheric ozone in recent decades
- A. has been increasing with the decrease of ClO;
 - B. has been decreasing with the increase of ClO;
 - C. has been remaining stable;
 - D. has been decreasing with a stable ClO concentration.
43. Possible consequences of global warming are:
- A. a rise of sea level, possible increase in hurricane intensity, etc;
 - B. increase of snow and ice cover in polar area;
 - C. increase in land area for people to live on;
 - D. reduction of the ocean covered region on Earth.
44. Generally, right after the large volcanic eruptions, the earth's surface temperature:
- A. Increases due to increased CO₂;
 - B. Decreases due to decreased CO₂;
 - C. Decreases due to increased SO₂ aerosols, which reflect solar radiation;
 - D. Increases due to increased SO₂.
45. Choose the correct statement:
- A. The earth's atmosphere is an efficient absorber of visible light;
 - B. The earth's atmosphere is an efficient emitter of visible light;
 - C. The earth's atmosphere is an efficient absorber of infrared radiation;
 - D. The earth's atmosphere is an efficient emitter of UV.
46. Choose the correct statement.
- A. CH₄ and N₂O have their maximum absorptions of radiation in the visible light range;
 - B. Water vapor (H₂O), CO₂ and N₂ are important greenhouse gases;
 - C. CO₂ is an important greenhouse gas because it is a good absorber of the Earth's IR;
 - D. Both A and C.

47. Net Radiation distribution with latitudes on the Earth's surface
- A. Cools the poles and cools the tropics
 - B. Cools the poles and warms tropics
 - C. Warms the poles and cools the tropics
 - D. Warm the poles and warm the tropics
48. Choose the correct statements.
- A. The ITCZ is associated with strong convection & precipitation;
 - B. The Hadley cell rises in the tropics and sinks in the subtropics;
 - C. The Hadley cell sinks in the tropics and rises in the subtropics;
 - D. Both A and B.
49. The one dimensional (1-D) climate models:
- A. Consider the Radiative-convective effect;
 - B. Consider the vertical structure of the Earth's atmosphere;
 - C. Consider the spatial (horizontal) variations of the Earth's atmosphere;
 - D. Both A and B.
50. Greenhouse gases are the gases that warm a planet's surface by:
- A. absorbing solar radiation;
 - B. absorbing the outgoing infrared radiation from the Earth's surface and emitting some of it back toward the Earth's surface;
 - C. reflecting infrared radiation;
 - D. emitting visible light.