Advanced Climate Science Assessment

Climate Change · Answer Key · 25 Questions

1. Which specific absorption band is primary responsible for the greenhouse effect of carbon dioxide in the Earth's atmosphere?

A) 7.2 micrometers
B) 15 micrometers
C) 22 micrometers
D) 30 micrometers

2. The 'Suess Effect' is a distinct isotopic signature used to identify anthropogenic carbon dioxide. What does it describe?

A) A decrease in the ratio of Carbon-14 to Carbon-12
B) An increase in the ratio of Oxygen-18 to Oxygen-16
C) A decrease in total atmospheric Nitrogen
D) An increase in the concentration of CFCs

3. What is the physical mechanism by which the Earth's 'radiative forcing' is primarily altered by increasing methane concentrations?

A) Increased absorption of ultraviolet radiation in the stratosphere
B) Enhanced back-radiation of infrared energy in the troposphere
C) Direct reflection of solar shortwave radiation
D) Increased ionization of atmospheric aerosols

4. During the Last Glacial Maximum, what was the primary driver of the significant cooling recorded in ice cores?

A) Reduced volcanic activity
B) Changes in the Earth's orbital eccentricity and obliquity (Milankovitch cycles)
C) A collapse of the Amazon rainforest
D) Sudden increase in atmospheric sulfate aerosols

5. What is the primary geochemical process that removes carbon dioxide from the atmosphere on geological timescales (millions of years)?

A) Silicate rock weathering
B) Oceanic crust subduction
C) Photosynthesis in boreal forests
D) Methane clathrate release

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6. The 'AMOC' is a critical component of the climate system. What does this acronym stand for?

A) Atmospheric Meridional Oceanic Circulation
B) Atlantic Meridional Overturning Circulation
C) Antarctic Monsoon Oscillating Current
D) Arctic Mass Oceanic Convergence

7. Which feedback loop involves the conversion of high-albedo surfaces to low-albedo surfaces due to rising temperatures?

A) Water vapor feedback
B) Ice-albedo feedback
C) Lapse rate feedback
D) Cloud-radiative feedback

8. What is the 'Clausius-Clapeyron relation' in the context of climate change?

A) The relationship between pressure and temperature in gases
B) The rate at which the atmosphere's water-holding capacity increases with temperature
C) The mathematical model of ocean current velocity
D) The decay rate of radioactive isotopes in permafrost

9. What is the main source of atmospheric nitrous oxide (N_2O) emissions linked to human activity?

A) Refrigerant leakage
B) Agricultural soil management and fertilizer use
C) Cement production
D) Incomplete combustion of wood

10. Why is the stratosphere cooling while the troposphere is warming?

A) Increased solar activity
B) Enhanced greenhouse gas trapping of heat in the lower atmosphere, reducing upward infrared flux to the stratosphere
C) Increased volcanic emissions in the stratosphere
D) Decrease in stratospheric ozone depletion

11. What is the primary cause of modern sea-level rise according to IPCC data?

A) Increased runoff from inland lakes
B) Thermal expansion of seawater and glacial meltwater input
C) Reduction in seafloor tectonic activity
D) Increased underwater volcanic activity

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12. Which of the following describes the 'Hansen-Sato' observation regarding planetary energy imbalance?

A) The planet absorbs more solar energy than it radiates back to space
B) The planet radiates more energy than it receives
C) The energy budget is perfectly balanced at all times
D) Atmospheric heat is entirely dissipated into deep space

13. What is the role of dimethyl sulfide (DMS) produced by marine phytoplankton in the climate system?

A) It acts as a potent greenhouse gas
B) It promotes cloud condensation nuclei formation, increasing cloud albedo
C) It accelerates the melting of sea ice
D) It absorbs thermal radiation from the surface

14. Which carbon reservoir contains the largest amount of carbon on Earth?

A) The atmosphere
B) The terrestrial biosphere
C) The deep ocean sediments and rocks
D) The surface ocean

15. How does the 'Lapse Rate Feedback' affect the sensitivity of the climate system?

A) It increases the cooling rate in the upper troposphere, enhancing radiation to space
B) It stops all atmospheric movement
C) It increases the concentration of methane
D) It prevents the formation of precipitation

16. What is the 'Equilibrium Climate Sensitivity' (ECS) typically defined as?

A) The change in global mean surface temperature after a doubling of atmospheric CO2 concentration
B) The time it takes for ice to melt
C) The amount of solar radiation reaching the equator
D) The temperature of the core

17. What does the 'RCP' in IPCC climate projection scenarios (e.g., RCP 8.5) stand for?

A) Radiative Concentration Pathway
B) Representative Concentration Pathway
C) Regional Climate Projection
D) Radiation Coefficient Protocol

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18. Which atmospheric gas has the highest Global Warming Potential (GWP) over a 100-year time horizon?

A) Carbon dioxide
B) Methane
C) Nitrous oxide
D) Sulfur hexafluoride (SF6)

19. What is the primary factor limiting the ocean's ability to absorb excess atmospheric CO2?

A) The speed of ocean currents
B) The thermal stratification of the ocean and the slow mixing of surface waters with the deep ocean
C) The lack of salt in deep waters
D) The presence of too many fish

20. What is the significance of the 'Keeling Curve'?

A) It tracks the decrease in global forest cover
B) It measures the continuous increase of atmospheric CO2 concentrations since 1958
C) It maps the change in sea surface temperatures
D) It charts the extinction rates of polar species

21. What is meant by the 'Arctic Amplification' effect?

A) The Arctic experiences warming at a rate significantly higher than the global average
B) The Arctic experiences significantly more precipitation than the tropics
C) The Arctic is the only place cooling on Earth
D) The Arctic is not affected by greenhouse gases

22. Which aerosol type is known for having a net cooling effect on the Earth's climate?

A) Black carbon
B) Sulfate aerosols
C) Organic carbon
D) Brown carbon

23. What is the 'Thermal Inertia' of the oceans?

A) The speed at which the ocean evaporates
B) The resistance of the ocean to changes in temperature due to its high heat capacity
C) The rate at which icebergs melt in saltwater
D) The movement of tides

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24. How does ocean acidification primarily occur?

A) Increased absorption of CO_2, lowering the seawater pH

B) Excessive use of marine fertilizers

C) Increased volcanic sulfur emissions

D) The loss of coral reef biodiversity

25. Which orbital factor most directly contributes to the 100,000-year cycle of glacial-interglacial periods?

A) The precession of the equinoxes

B) Changes in eccentricity

C) Changes in obliquity

D) Variations in solar luminosity