

Climate Changes of the Past and Future
Pre & Post Test

1. About what percentage of the **solar radiation reaching the Earth is absorbed** at its surface?
(a) 80% (b) 70% (c) 60% (d) 50%
2. The Earth radiates energy back to space approximately like a **blackbody with a temperature of**
(a) 22 °C (b) 13 °C (c) 0 °C (d) -18 °C
3. Carbon dioxide is a powerful **greenhouse gas** because
(a) black carbon absorbs visible radiation
(b) it has many vibrational states
(c) it has a strong dipole moment
(d) it is a symmetrical molecule
4. The total **radiation received by the Earth's surface**
(a) is about 2/3 emitted infrared from the atmosphere and 1/3 from the Sun
(b) comes only from the Sun
(c) is about half emitted infrared from the atmosphere and half from the Sun
(d) is about 80% emitted infrared from the atmosphere and 20% from the Sun
5. **Blackbodies emit thermal radiation** at a rate proportional to
(a) their temperature
(b) their internal kinetic energy
(c) the square of their temperature
(d) the fourth power of their temperature
6. Over tens to hundreds of millions of years, **climate is fairly stable** because
(a) ice sheets melt and grow to compensate temperature changes
(b) changes in the Earth's orbit balance changes in the Sun
(c) CO₂ emitted by volcanic activity is balanced by CO₂ consumed by erosion and chemical weathering of rocks
(d) plant and animal extinctions regulate the Earth's albedo
7. The **timing of major ice ages** has been governed by
(a) Subtle changes in Earth's orbital geometry over the past few million years
(b) Occasional impacts of asteroids or comets
(c) Continental drift which brings land near the North Pole
(d) Volcanic eruptions throughout geologic time

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8. Give two examples of natural **radiative forcing** of Earth's climate
9. Give two examples of **positive feedback** mechanisms in the Earth's climate system
- _____
- _____
10. Past climate change and modern climate models agree that the Earth's **climate sensitivity** is about
- (a) 0.2 °C per $W m^{-2}$ of radiative forcing
 - (b) 0.4 °C per $W m^{-2}$ of radiative forcing
 - (c) 0.8 °C per $W m^{-2}$ of radiative forcing
 - (d) 1.2 °C per $W m^{-2}$ of radiative forcing
11. **Fossil fuel emissions** account for about
- (a) Half of the increase in atmospheric CO₂ over the past 50 years
 - (b) All of the increase in atmospheric CO₂ over the past 50 years
 - (c) Twice of the increase in atmospheric CO₂ over the past 50 years
 - (d) 10% of the increase in atmospheric CO₂ over the past 50 years
12. If China, India, and Africa build industrial economies based on fossil fuels, atmospheric CO₂ will reach **approximately what concentration by 2100?**
- (a) 450 ppm
 - (b) 700 ppm
 - (c) 1000 ppm
 - (d) 2000 ppm
13. List **three major expected impacts** of climate change on the US economy in the absence of strong policy to mitigate CO₂ emissions
14. Identify **two strategies for reducing global CO₂ emissions**, and list an advantage and a disadvantage for each one.