Climate Change, Evidence and Indicators

Use this key to check answers and read the explanations.

1. Which observation describes weather rather than climate?
   A. It rained for an hour this afternoon.
   B. Summers are usually dry in this region.
   C. Winters here average several freezing weeks over many decades.
   D. The region’s typical spring rainfall was calculated from decades of records.
   Correct answer: A. It rained for an hour this afternoon.
   Weather describes short-term conditions. Climate describes patterns and averages measured over longer periods.

2. An analyst wants to use NOAA’s conventional U.S. climate normals for a station. How long is the standard period used for those normals?
   A. 5 years
   B. 1 year
   C. 30 years
   D. 100 years
   Correct answer: C. 30 years
   NOAA’s conventional normals average measurements over a defined 30-year period. The same period lets people compare stations consistently.

3. Which of these is a common greenhouse gas that absorbs outgoing infrared radiation?
   A. Nitrogen gas
   B. Carbon dioxide
   C. Oxygen gas
   D. Argon
   Correct answer: B. Carbon dioxide
   Carbon dioxide absorbs infrared radiation at particular wavelengths. The other options are major or minor air constituents that do not play this role in the same way.

4. After Earth’s surface absorbs sunlight, it emits energy. Which step explains why greenhouse gases affect surface temperature?
   A. They cool Earth by preventing all incoming sunlight from reaching the surface.
   B. They permanently stop the surface from emitting any energy.
   C. They make the Sun emit more visible light.
   D. They absorb and re-emit some outgoing infrared energy.
   Correct answer: D. They absorb and re-emit some outgoing infrared energy.
   The surface emits infrared radiation. Greenhouse gases absorb and re-emit some of that radiation, which changes how efficiently energy leaves the Earth system.

5. Which record is best suited to comparing global sea level across a period of several decades?

A. The height of a single wave during a storm
B. Yearly estimates of global mean sea level across those decades
C. One afternoon’s tide reading at one pier
D. A map showing wind direction on one day

Correct answer: B. Yearly estimates of global mean sea level across those decades
A long series of average sea-level estimates can show how the global level changes over time. A single wave or tide reflects short-term local conditions.

6. Which human activity directly adds carbon dioxide to the atmosphere and contributes to the long-term warming assessed by the IPCC?

A. Burning fossil fuels for transportation or energy
B. Measuring air temperature at weather stations
C. Mapping the length of daylight
D. Monitoring the direction of ocean currents

Correct answer: A. Burning fossil fuels for transportation or energy
Fossil fuels contain carbon. Burning them releases carbon dioxide, and the IPCC links human greenhouse gas emissions to observed warming.

7. For a fictional station, the long-term July average is 12.0 degrees Celsius. One July averages 13.1 degrees. What is the temperature anomaly relative to that baseline?

A. 13.1 degrees Celsius above the baseline
B. 1.1 degrees Celsius below the baseline
C. 12.0 degrees Celsius above the baseline
D. 1.1 degrees Celsius above the baseline

Correct answer: D. 1.1 degrees Celsius above the baseline
A temperature anomaly is the difference from a defined baseline average. The fictional July is 13.1 minus 12.0, or 1.1 degrees Celsius warmer than the baseline.

8. A fictional town’s annual average rises from 16.0 to 16.6 degrees Celsius when comparing two 30-year periods. The town also records a very cold day during the later period. Which statement fits both observations?

A. A warmer average means each day must be warmer.
B. The cold day proves the two period averages are equal.
C. The cold day can occur while the multiyear average rises.
D. A cold day changes the meaning of the 30-year average to a daily reading.

Correct answer: C. The cold day can occur while the multiyear average rises.
A long-term average can change even though individual days still vary. One cold day is compatible with a higher average in the later period.

9. In a simplified model, a parcel of seawater with typical ocean salinity warms while its mass stays the same. Which effect helps explain a contribution to sea-level rise?

A. The warmer parcel occupies more volume.
B. The warmer parcel gains mass from being heated.
C. The warmer parcel occupies less volume.
D. The warmer parcel turns completely into salt.

Correct answer: A. The warmer parcel occupies more volume.
Warming ocean water generally expands. The same mass of water can take up more space without added water.

10. Which change transfers water previously stored on land into the ocean and directly contributes to rising global sea level?

A. A tide rises and then falls at a harbor.
B. An already floating ice floe breaks into smaller pieces.
C. Wind temporarily pushes water toward one beach.
D. Meltwater from a land glacier flows into the ocean.

Correct answer: D. Meltwater from a land glacier flows into the ocean.
A land glacier stores water outside the ocean. Meltwater flowing into the ocean adds water, unlike a temporary redistribution of ocean water.

11. A fictional record has three consecutive 10-year averages of 12.0, 12.1 and 12.2 degrees Celsius. The next three consecutive 10-year averages are 12.5, 12.6 and 12.7. By how much does the average rise between the two groups of three decades?

A. 0.7 degrees Celsius
B. 0.1 degrees Celsius
C. 0.5 degrees Celsius
D. 1.5 degrees Celsius

Correct answer: C. 0.5 degrees Celsius
Each decade has the same weight in this simplified example. The early average is 12.1 and the later average is 12.6, a rise of 0.5 degrees Celsius.

12. Over the same period, a fictional tide gauge shows a local rise of 40 millimeters while a fictional global mean series rises by 25 millimeters. What is the sound interpretation?

A. The global mean must rise by 40 millimeters because one coast did.
B. Local relative sea level can change by a different amount from the global mean.
C. The gauge must be wrong whenever it differs from the global mean.
D. The figures prove that all other coastlines fell by 15 millimeters.

Correct answer: B. Local relative sea level can change by a different amount from the global mean.
A coastal gauge measures water level relative to the land there. Local land movement and ocean conditions can make that reading differ from the global mean.

13. In a simplified Arctic illustration, bright sea ice retreats and darker open water takes its place. With incoming sunlight unchanged, what happens to the share absorbed at the surface?

A. The absorbed share becomes zero once the sea ice is gone.
B. A smaller share is absorbed because open water reflects more sunlight.
C. The absorbed share cannot change while incoming sunlight stays the same.
D. A larger share is absorbed because open water reflects less sunlight.

Correct answer: D. A larger share is absorbed because open water reflects less sunlight.
Sea ice reflects more sunlight than open water. Exposing darker water allows more incoming sunlight to be absorbed, a change that can reinforce warming.

14. A fictional local dataset shows that carbon dioxide and average temperature both rose during three periods. Which statement best distinguishes that dataset from a climate attribution study?

A. The two trends can be compared, while attribution also tests physical mechanisms and other influences.
B. The two rising trends prove carbon dioxide caused every local temperature change.
C. Three rising measurements are enough to identify the exact contribution of each influence.
D. The record proves that carbon dioxide has no effect unless temperature rises every year.

Correct answer: A. The two trends can be compared, while attribution also tests physical mechanisms and other influences.
The fictional trends alone cannot isolate a cause. Climate attribution assesses physical mechanisms and multiple lines of evidence, including the effects of greenhouse gases and other influences.

15. A fictional sea-level index reads 100 millimeters in 1980, 120 in 1990 and 180 in 2010. What are the average rises per year from 1980 to 1990 and from 1990 to 2010, in that order?

A. 3 and 2 millimeters per year
B. 20 and 60 millimeters per year
C. 2 and 3 millimeters per year
D. 2 and 6 millimeters per year

Correct answer: C. 2 and 3 millimeters per year
The first interval rises 20 millimeters over 10 years. The second rises 60 millimeters over 20 years. Dividing by the length of each interval gives 2 and 3 millimeters per year.