

Name: _____

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AP Environmental Science — Practice Exam

Instructions: A calculator is permitted. Show all calculations with units.

Time Limit: 60 minutes

Multiple Choice (15 questions)

- [1 point] 1. Farmers who keep rice paddies flooded find that much of the nitrate fertilizer they apply is lost from the soil to the atmosphere as nitrogen gas. The process responsible and the soil condition that favors it are:
- A. nitrogen fixation, favored by the presence of legumes
 - B. nitrification, favored by well-aerated soil
 - C. denitrification, favored by waterlogged, oxygen-poor soil
 - D. ammonification, favored by rapid decomposition of organic matter
- [1 point] 2. Two islands lie the same distance from a mainland that supplies colonizing species. Island X has ten times the area of island Y. According to the theory of island biogeography, at equilibrium island X is expected to have:
- A. more species, because larger islands have lower extinction rates
 - B. fewer species, because larger islands support more predators
 - C. the same number of species, because distance from the mainland alone determines species richness
 - D. more species, because larger islands have higher extinction rates that drive faster evolution
- [1 point] 3. A country has a crude birth rate of 28 per 1,000 and a crude death rate of 14 per 1,000, with negligible net migration. Using the rule of 70, approximately how long will its population take to double?
- A. 70 years
 - B. 25 years
 - C. 5 years
 - D. 50 years

- [1 point]** 4. A country has a low and stable death rate, a birth rate that has begun to fall quickly, and a population that is still growing rapidly because a large share of its people are under 15. In the demographic transition model it is best placed in:
- A. Stage 1, the pre-industrial stage
 - B. Stage 3, the late transitional stage
 - C. Stage 2, the early transitional stage
 - D. Stage 4, the post-industrial stage
- [1 point]** 5. Along the western coast of South America, a chain of volcanic mountains runs parallel to the coast, and earthquakes occur at depths of several hundred kilometers beneath them. This pattern is produced by:
- A. a divergent boundary where new oceanic crust forms at a mid-ocean ridge
 - B. a convergent boundary where an oceanic plate subducts beneath a continental plate
 - C. a transform boundary where two plates slide past each other horizontally
 - D. a hot spot where a plume of mantle rock rises through the middle of a plate
- [1 point]** 6. A soil sample is 60% sand, 30% silt and 10% clay by mass. Compared with a soil that is mostly clay, this sample would be expected to have:
- A. more compaction and poorer aeration
 - B. slower drainage and higher nutrient-holding capacity
 - C. a higher cation exchange capacity, because large particles bind more ions
 - D. faster drainage and lower water-holding capacity
- [1 point]** 7. Most of the world's large deserts, including the Sahara and the deserts of central Australia, lie near 30 degrees north and south latitude. The main cause is that:
- A. air that rose and lost its moisture near the equator descends near 30 degrees, warming and drying as it sinks
 - B. the Coriolis effect deflects moist winds away from these latitudes
 - C. air rises near 30 degrees, creating low pressure that pulls dry air in from the poles
 - D. cold ocean currents at 30 degrees freeze water vapor out of the air
- [1 point]** 8. A farm in a hot, arid region has been irrigated for decades with groundwater. Over time a white crust has appeared on the soil surface and crop yields have fallen, even though water and fertilizer are still applied. The most likely cause is:
- A. desertification caused by overgrazing of the surrounding rangeland
 - B. waterlogging, as the groundwater table rises into the root zone
 - C. soil salinization, as irrigation water evaporates and leaves its dissolved salts behind
 - D. eutrophication of the soil caused by excess fertilizer

- [1 point] 9. A household runs a 1.5 kW electric heater for 4 hours a day for 30 days. Electricity costs 12 cents per kilowatt-hour. The cost of running the heater for the month is:
- A. 180 dollars
 - B. 0.72 dollars
 - C. 216 dollars
 - D. 21.60 dollars
- [1 point] 10. A coal-fired power plant releases 1,000 MJ of energy by burning coal and delivers 350 MJ of that as electricity to the transmission grid. The grid then loses 10% of the electricity it carries before it reaches homes. The overall efficiency from coal to home is:
- A. 31.5%
 - B. 35%
 - C. 25%
 - D. 45%
- [1 point] 11. Which sequence correctly describes how fertilizer runoff leads to a fish kill in a lake?
- A. Nutrient input, oxygen depletion, death of the algae, algal bloom, fish death
 - B. Nutrient input, algal bloom, death of the algae, decomposition by bacteria, oxygen depletion, fish death
 - C. Nutrient input, algal bloom, fish death from algal toxins, decomposition, oxygen increase
 - D. Nutrient input, acidification of the water, death of the algae, oxygen depletion, fish death
- [1 point] 12. In laboratory tests, a pesticide has an LD_{50} of 25 milligrams per kilogram of body mass in rats. If humans were equally sensitive, the single dose expected to be lethal to half of a group of 70-kilogram adults would be:
- A. 0.36 mg
 - B. 25 mg
 - C. 1,750 mg (1.75 g)
 - D. 17.5 g
- [1 point] 13. On a calm, clear winter morning, a city in a mountain valley records ground-level concentrations of particulates and carbon monoxide several times higher than on a typical day, even though emissions are unchanged. The most likely explanation is:
- A. a temperature inversion: a layer of warm air sits above cooler surface air and prevents vertical mixing
 - B. the cold air converts carbon monoxide into ozone more rapidly
 - C. stronger convection on clear days carries pollutants down to the ground
 - D. the ozone layer thins in winter, allowing more pollution to form

[1 point] 14. As the ocean absorbs more carbon dioxide from the atmosphere, corals and shellfish find it harder to build their calcium carbonate skeletons and shells. The direct chemical reason is that:

- A. carbon dioxide reacts with dissolved oxygen, leaving less oxygen for calcification
- B. dissolved carbon dioxide displaces calcium ions from seawater
- C. the lower pH kills the phytoplankton that these organisms feed on
- D. hydrogen ions from carbonic acid combine with carbonate ions, lowering the concentration of carbonate available for calcium carbonate

[1 point] 15. A single chlorine atom released in the stratosphere from a chlorofluorocarbon (CFC) molecule can destroy tens of thousands of ozone molecules. This is because the chlorine atom:

- A. absorbs the ultraviolet light that would otherwise form ozone
- B. acts as a catalyst: it breaks an ozone molecule apart and is then regenerated to react again
- C. combines permanently with oxygen to form a stable compound, removing it from the ozone cycle
- D. reacts with nitrogen to form acids that dissolve ozone

Short Answer (1 question)

[10 points] 16. Design an investigation. A stream flows past a large field where a farmer applies nitrogen and phosphorus fertilizer each spring. Students at a nearby school notice that every summer the stream below the field turns green with algae, while the stretch above the field stays clear. The students have a dissolved oxygen probe, a nitrate test kit, thermometers, sample bottles and a map of the stream with the field marked.

[1 point] (a) Describe the process by which fertilizer applied to the field reaches the stream.

[2 points] (b) Explain how an increase in nutrients in the stream could lead to a decrease in dissolved oxygen below the field.

[1 point] (c) Identify a testable hypothesis for an investigation into whether the farm affects the stream.

[2 points] (d) Identify the independent variable and the dependent variable in the investigation described by your hypothesis.

[2 points] (e) Describe a procedure the students could follow, including how they would use a control and replication.

[1 point] (f) Identify one variable that must be held constant during the investigation and explain why.

- [1 point]** (g) Describe one practice the farmer could adopt to reduce nutrient runoff into the stream.

Calculations (1 question)

- [10 points]** 17. Analyze an environmental problem with calculations. The town of Riverton has 12,000 households. In 2016 the average household used 900 kilowatt-hours (kWh) of electricity per month; after an efficiency program, in 2026 the average household uses 750 kWh per month. All of the town's electricity comes from a coal-fired power plant that emits 0.9 kilograms of carbon dioxide for every kilowatt-hour it generates. The town council is considering a 20-megawatt (MW) solar farm. In Riverton's climate, each kilowatt of installed solar capacity produces an average of 4 kWh of electricity per day over the year. Show all calculations.

- [1 point]** (a) Calculate the percent change in average monthly household electricity use between 2016 and 2026.

- [1 point]** (b) Calculate the total electricity used by Riverton's households in 2026, in kWh per year.

- [1 point]** (c) Calculate the mass of carbon dioxide, in metric tons, released by the coal plant in 2026 to supply the households (1 metric ton = 1,000 kg).

[2 points] (d) Calculate the electricity the 20 MW solar farm would produce in one year, in kWh.

[1 point] (e) Calculate the percentage of the households' 2026 electricity use that the solar farm could supply.

[1 point] (f) Describe one environmental benefit, other than lower carbon dioxide emissions, of replacing part of the coal-generated electricity with solar.

[1 point] (g) Describe one environmental drawback of building the solar farm.

- [2 points]** (h) Identify one reason the actual reduction in the coal plant's carbon dioxide emissions might be smaller than the percentage calculated in part (e), and explain why.