AP® Environmental Science
2003 Scoring Guidelines

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AP® ENVIRONMENTAL SCIENCE
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Question 1

(a) Support Dr. Tate's assertion that "the leaf litter is critical to the survival of local species of forest plants." Include in your discussion the roles of leaf litter in a deciduous forest ecosystem. ***(2 points total)***

(1 pt.) Student must make one statement that pertains to plants

- Student may use the description taken directly from the article: "…This* sets the stage for the takeover by invasive exotics such as Japanese stilt grass." (*refers to the consumption of the entire layer of leaf litter in a single season)

OR

- Student provides another supporting role of leaf litter in a deciduous forest ecosystem that is tied to plants.

(1 pt.) Student provide another supporting role of leaf litter in a deciduous forest ecosystem (does not need to be tied to plants):

- Serves as ground cover
- Serves as habitat area: e.g., soil microorganisms/nitrogen-fixing bacteria/fungi, serves as a "home to a myriad of species" (statement is in the document; similar statement accepted)
- Provides shelter
- Reservoir for many nutrients: absorbs and releases
- Allows germination of seedlings
- Rooting area: especially important for shallow root perennials
- Helps maintain moisture/water retention
- Assists in the infiltration and percolation of water (by absorbing it/reducing water runoff)
- Contributes to humus production
- Growth/over-wintering area for bulbs, corms, etc.
- Provides shelter for seedlings
- Helps reduce erosion
- Serves as food source: e.g., for detritus feeders ⇒ increased surface area ⇒ decomposition

(b) Describe THREE abiotic changes that would be likely to result if the exotic worms consumed all the leaf litter in a single year. ***(3 points total)***

Student must describe, not just list; 1 pt. for each described; score only the first three

- Nutrient levels in soil would change/soil fertility reduced
- Erosion of soil would increase
- Fluctuations in soil temperature/change in soil temperature
- Forest soil pH changes
- Soil would be more compacted/aeration would decrease
- Soil surface light levels would increase
- Decreased moisture above and below ground /drier soil/desiccated soil
- Increased evaporation
- Loss of soil cover/less topsoil

Question 1 (cont'd.)

- Increased water runoff/formation of rivulets, rills, gullies
- Increased sedimentation in local waterways ⇒ increased turbidity in local waterways from runoff
- Leaching of topsoil layers (short term; due to absence of leaf litter/humus)
- Shelter area reduced
- Ground cover reduced
- Rate of movement of pollutants into the soil would increase (would not be absorbed by leaf litter)
- Altered soil texture/changes in soil porosity/changes in soil permeability
- Decreased nutrient-holding capacity of soil/decreased ion-exchange capacity
- Decreased chemical weathering of parent material and bedrock
- Mineralization may occur (loss of humus, subsequent collapse of topsoil fertility; soil becomes gritty due to high mineral content in absence of humus
- Decreased illuviation (long term) (deposition of material into lower soil layers from higher soil layers via leaching.)
- Reduced habitat area
- Decreased intensity/severity of forest fires

(c) For one of the changes you identified in part (b), explain how the change could set the stage for the takeover of Japanese stilt grass or other exotic species. ***(1 point total)***

The answer in part (c) must be based on an abiotic change in part (b). If part (b) is left blank or is incorrect, no point can be earned in part (c). Many acceptable responses are based on tolerance/range of tolerance and may include major characteristics of successful invader/exotic species, such as: generalists, "early successional species", high dispersal rate, the release of growth-inhibiting hormones into the soil, r-selected species, etc. Examples include: "the exotic species are often more tolerant than native species of drier soils, and therefore out-compete native species", "a lack of nutrients may decrease native plant growth, but not exotics.", and "exotic species can tolerate higher light levels(more intense ultraviolet light) than native species, and therefore the exotic species are at a distinct advantage in thriving in such conditions".

Question 1 (cont'd.)

(d) Design a controlled experiment to determine whether the worms, in fact, do change the forest ecosystem. Identify the environmental factor you will measure, and include the specific hypothesis you will test and the data you will collect. ***(4 pts. total)***

(1 pt.) Hypothesis: student states a specific, testable explanation. Hypothesis must include the environmental factor measured and be tied to worms changing the forest ecosystem.
Environmental factors NOT accepted (too general): nutrients, food, habitat

(2 pts.) Student outlines valid/reasonable procedure for a controlled experiment:

1 point for outlining experimental procedures by including the following (three components are required to earn this point):

- control group required
- experimental group required
- one other from the following list required: specific time, specific area, specific materials, specific sample size

1 point for description of one of the following as part of the procedure (the design point above must be earned in order to earn this point):

- Repeated experiments
- Correlation to other experiments
- How other variables are controlled or tested
- How the experiment could be expanded or modified
- Data analysis
- Relate to/discuss additional research

(1 pt.) Data collected: student describes quantifiable data related to the dependent variable.

Note: An "Observational Experiment" is acceptable: must meet the same criteria as for a more traditional type of experiment where a variable is manipulated by the researcher in the experimental site.

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Question 2

(a) On the axes below, plot the crude birth rate data from 1855 to 1990. Now plot the crude death-rate data on the same axes. Clearly label the axes and the curves. ***(3 points total)***

1 point for correctly scaling and labeling axes: scales must include all provided data from 1855-1990

scales used may be different than what appears on the graph below – students may, for example, label the *y*-axis in increments of 10 from 0 to 100 or the *x*-axis in increments of 20 years

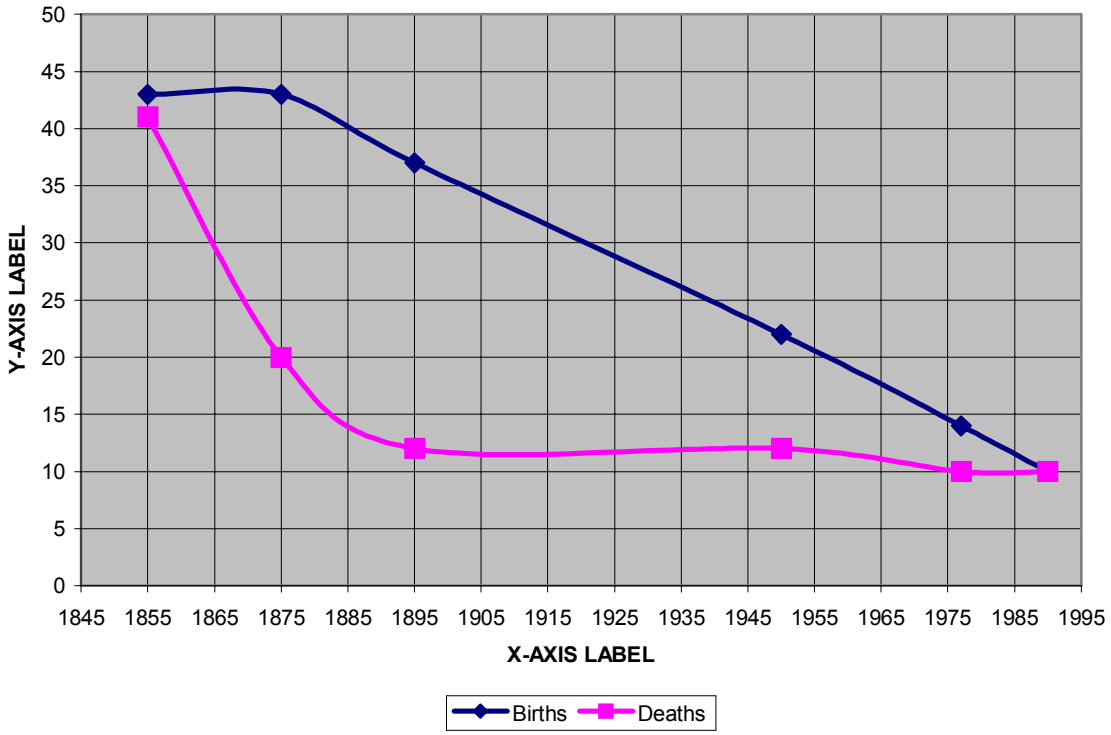
- Acceptable *x*-axis labels: year, date, or time
- Acceptable *y*-axis labels: births & deaths per 1,000, birth & death rate (percent, people per 1,000, rate per 1,000 only if curves are clearly labeled)

1 point for correctly labeling and plotting crude birth rate

- 5 data points must be clearly shown on the graph (not including the 1977 data point)
- 1977 data point is optional since it was not provided in this part, but is requested in part (b)
- If the 1977 data point is present, it must be plotted correctly at y = 14

1 point for correctly labeling and plotting crude death rate

- 6 data points must be clearly shown on the graph



Note: Since the student is not instructed to plot a curve of best fit, either a smoothed curve or a straight-line curve is acceptable; however, if the curve(s) does not pass through all data points, 0 points for labeling curve(s) are awarded. If the student truncates the *x*-axis or the *y*-axis, the data lines must also be truncated accordingly.

Question 2 (cont'd.)

(b) What was the annual growth rate of Industria in 1950 ? What was the birth rate in Industria in 1977 ? ***(2 points total)***

1 point for correct annual growth rate in 1950

Student shows calculations using the formula: $r = b - d$

$\frac{22}{1000} - \frac{12}{1000} = \frac{10}{1000}$

or, $2.2\% - 1.2\% = 1\%$ **or,** $0.022 - 0.012 = 0.01$ **or,** calculations are stated in words

OR,

student shows calculations using the formula: $r = \frac{\text{CBR} - \text{CDR}}{10}$

$\frac{22\,\% - 12\,\%}{10} = 1\%$ **or,** calculations are stated in words

1 point for the birth rate in 1977, which may be determined graphically, by calculations, or as presented in words

If determined graphically, the 1977 data point must be marked on the curve (a range of 12-17 per 1,000 is acceptable) ***OR,*** the student must state that the value was obtained from the graph and the value must have been correctly interpolated. The answer must be in the same units of measurement as the axis unless clearly converted by the student.

Student shows calculations using the formula $r = b - d$ (which must be shown or presented in words)

$0.4\% = b - 1.0\% \Rightarrow 1.4\% = b$ **or,** $\frac{4}{1000} = b - \frac{10}{1000} \Rightarrow \frac{14}{1000} = b$

or, $0.004 = b - 0.01 \Rightarrow 0.014 = b$ **or,** calculations are stated in words

OR,

student shows calculations using the formula $r = \frac{\text{CBR} - \text{CDR}}{10}$

$0.4 = \frac{\text{CBR} - 10}{10} \Rightarrow 14 = \text{CBR}$ **or**, calculations stated in words

Note: Other algebraic formulas, or derivatives of those above, may be used provided all work is shown.

Question 2 (cont'd.)

(c) Indicate TWO factors that might have accounted for the rapid decline in the death rate in Industria between 1855 and 1895. Indicate one specific reason why the birth rate might have been so high in 1855 and was so slow to decrease between 1855 and 1950. ***(4 points total)***

1 point each for identifying two factors that might have accounted for a rapid decline in the death rate. Only the first two factors provided are considered.

Acceptable factors for rapid decline in death rate include:

Improved medical care (antibiotics not accepted for given time period)
Improved sanitation
Improved personal hygiene
Improved water supply
Improved food or nutrition
Improved agriculture or food production
Improved food preservation
Improved transportation to deliver food or to provide medical services
Improved prenatal or neonatal care
Cessation of military conflict

1 point for indicating one specific reason why birth rate was so high

Acceptable reasons for high birth rate include:

To compensate for high infant mortality
To assure care for aging parents (including reference to lack of institutionalized social security programs)
To provide a labor force
Cultural/religious practices that prohibited birth control
Cultural/religious practices that favored large families
Lack of contraceptives (not general statements about birth control)
Lack of education about family planning
Lack of women's rights

1 point for indicating why birth rate was so slow to decrease

Acceptable reasons for slow decrease include:

Cultural/religious practices that prohibited birth control took time to change
Cultural/religious practices that favored large families took time to change
Immigration of women of child-bearing age
Changing the status of women was slow to gain broad acceptance
Educational opportunities for women were slow to appear
Employment opportunities for women were slow to appear
Slow advances/technological production relating to birth control resulted in a slow decline
Slow implementation of government polices to reduce the need for children to provide support for their parents in their later years (eg. social security, health care, pensions, etc.)

Question 2 (cont'd.)

(d) Determine what the population size of Industria would have been in 1951 if the population had continued to grow at the annual rate of growth for Industria in 1895. ***(1 point total)***

1 point for correctly calculating the population size in 1951

Student shows calculations using the Rule of 70

70/2.5 = 28 years
1951–1895 = 56 years
56 years /28 years = 2 doublings
$2.5 \times 10^6 \times 2 = 5.0 \times 10^6 \Rightarrow 5.0 \times 10^6 \times 2 = 10 \times 10^6$
or, $2{,}500{,}000 \times 2 = 5{,}000{,}000 \Rightarrow 5{,}000{,}000 \times 2 = 10{,}000{,}000$ **or,** calculations are stated in words

Alternate Solutions:

1 point for correct set-up using the formulas: $N_t = N_0 e^{(rt)}$, $N_t = N_0(1+r)^t$, or $P = A_0 e^{kt}$, even if the equation is not solved, provided that all specific values, namely N_0 or A_0, r or k, and t are correctly inserted into the equation and derivation of "t" (which is 56) is provided

Note: If a student recognizes that $0.025 \times 56 = 1.4$, and that $e^{(1.4)}$ or $2.72^{(1.4)}$ is approximately 4, and solved the equation as approximately 10×10^6 or 10,000,000, the point is awarded.

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Question 3

(a) Discuss TWO important causes for the variation in the temperature and/or salinity of an estuary. Be sure to include the connection between each cause and temperature and/or salinity. ***(2 points total)***

1 point for each cause and connection – 2 point maximum

2 points can be earned for:

- 2 causes and connections for temperature **OR**
- 2 causes and connections for salinity **OR**
- 1 for temperature and 1 for salinity

Cause/Variation in	Temperature connection with direction of change	Salinity connection with direction of change
Daily tidal cycle	Mixing of waters of different temperatures	Fluctuations due to mixing of waters of different salinities.
Seasonal/diurnal flow of freshwater from rivers, streams and runoff from land including snow melt & ice melt	Mixing of waters of different temperatures	Fluctuations due to mixing of waters of different salinities.
Suspended solids/turbidity	Increased solar absorption resulting in higher temperatures	Warmer temperatures increase evaporation which would increase salinity
Storms (rainfall), hurricanes or typhoons	Mixing of waters of different temperatures	Influx of additional freshwater, lowering salinity levels Influx of ocean water from onshore storms, hurricanes and typhoons, raising salinity levels
Seasonal air temperature variations Seasonal solar influx Seasonal variation in vegetation	Water is colder in the winter and warmer in the summer (Shallow waters have low capacity to store heat over time)	Warmer temperatures increase evaporation which would increase salinity Warmer water has increased salt solubility
Rate of evaporation	Evaporation is a cooling process and therefore lowers the temperature of surface layers	Loss of water due to evaporation increases salt concentration
Wind (Seiche-wind driven tides)	Promotes mixing of the water column	Onshore wind would bring in ocean water and raise salinity Offshore wind would bring in freshwater from tributaries and lower salinity
Color of substrate	The darker the substrate, the greater the solar absorption and therefore the greater the increase in water temperature	Warmer temperatures increase evaporation which would increase salinity
Cloud cover	Greater cloud cover results in reduced solar input and cooler water temperatures	

Question 3 (cont'd.)

Cause/Variation in	Temperature connection with direction of change	Salinity connection with direction of change
Diurnal air temperature variations	Solar input during the day increases water temperatures Lack of solar input at night allows cooling of the water	Warmer temperatures increase evaporation
Drought	Mixing of water of different temperatures	Decrease in freshwater flow to estuary or increased influx of ocean water will lead to increased salinity

(b) Discuss TWO roles that coastal wetlands play that are ecologically important, and TWO roles that wetlands play that are economically important. ***(4 points total)***

1 point for each ecologically important role discussed for a total of 2 points and 1 point for each economically important role discussed for a grand total of 4 points

Ecologically Important Roles

ecologically important role	discussion
High productivity (net primary) Carbon Dioxide Sink	Supports complex food webs, high rate of photosynthesis absorbs large amounts of CO_2 & releases O_2
High species diversity/Biodiversity	Promotes ecosystem stability, resilience and nutrient cycling
Nursery for fish & crustaceans	Sustain/support marine ecosystems & life cycles
Nesting/Migration sites	Sustain/support marine ecosystems & the life cycles of waterfowl, shorebirds, & other appropriate wildlife
Filters/Sponges	Contributes to water quality by trapping suspended solids, sediments, sediment (toxic) pollutants (toxins), and/or nutrients
Reduction of flooding	Slowing the flow of water from ocean to upland ecosystems
Reduction of erosion	Absorbing erosive energy of wave action or slowing the flow of floodwater
Unique habitat	Provides habitat for organisms with specific needs such as moisture, salinity, temperature, flat water

Question 3 (cont'd.)

economically important role	discussion
Recreational income (tourism)	Boating, fishing, hunting, bird-watching, photography, and/or outdoor recreation
Property protection	Absorbing the flow of water and/or buffering shores from damage and erosion
Fishing industry	Commercial harvesting and/or processing of fish (shellfish); provides employment, tax base, or the selling of the catch
Intercoastal waterway	Protected passage for commerce which is cheaper and safer than ocean passage
Filters/Sponges	Contribute to water quality by trapping suspended solids, sediments, sediment pollutants and/or nutrients that would otherwise be subjected to water purification processes that would be supported financially by the local community
Employment opportunities	Such as wetland ecologists, wildlife managers, tour guides, and nature or recreational store owners
Sewage treatment or storm water treatment	Wastewater treatment that would otherwise be paid for by the local community
Agriculture	Haying or grazing in salt marshes, seaweed harvesting; rice paddies and the sale of (appropriate) agricultural products
Aquaculture/Mariculture	Raising, harvesting, & selling of fish & shellfish
Aesthetic value	Leads to increased property values
High biodiversity	Leads to increased bioprospecting for commercial use
Cooling of power plants/industrial facilities	Use of brackish water allows power plants to use land that is less expensive than upstream land with freshwater accessibility
Tidal power	Provides an alternative energy source in an area protected from open ocean
Carbon dioxide sink	Removes & sequesters CO_2 from the atmosphere that might otherwise be subjected to expensive removal methods
Source of methane gas	Might be collected and sold as a fuel

Question 3 (cont'd.)

(c) Identify and explain THREE ways in which humans have had a negative impact on or have degraded coastal wetlands. ***(3 points total)***

1 point for each identification and explanation of the negative impact

Identification	Explanation
Construction/Building/Development	Filling in/ draining of wetlands, modification of shorelines, increase in impervious surfaces causing more runoff, point & non-point source pollution. Habitat destruction; habitat fragmentation; loss of native flora and fauna.
Industrial/Commercial enterprises	Point source pollution including heavy metals, organic chemicals, thermal pollution, PCBs. Acid deposition upwind of estuary causes a decrease in pH releasing heavy metals.
Housing, agriculture, golf courses & commercial/popular-use beaches	Non-point source pollution such as fertilizers, pesticides, or pet waste. Fertilizers lead to eutrophication; pesticides weaken or kill native species; hypoxia; habitat destruction; loss of native flora & fauna; sedimentation
Roads and bridges	Increased traffic adds NOx and particulates to the air and contributes to ground-level ozone. Point & nonpoint source pollution such as heavy metals, fuel, & antifreeze. Bridges restrict the flow of water and modify sedimentation patterns; salt runoff from roadways & bridges
Dredging (deepen channels for navigation, water exchange, and species access to spawning grounds)	Sediment covers benthic vegetation, spawning sites, and fouls feeding apparatus of filter feeders Habitat destruction; loss of native flora and fauna Stirring up of toxic material & heavy metals in sediment
Petroleum drilling Transportation of petroleum	Contamination of water from oil spills degrades habitat Sediment covers benthic vegetation, spawning sites, and fouls feeding apparatus of filter feeders Habitat destruction; loss of native flora and fauna
Oyster shell, aggregate, or fill material dredging (including dredging to replenish beaches)	Increased wave action contributes to erosion and/or turbidity of the water Sediment covers benthic vegetation, spawning sites, and fouls feeding apparatus of filter feeders Habitat destruction; loss of native flora and fauna Stirring up of toxic material & heavy metals in sediment
Over-harvest/over-hunting of commercial & sport species	Reduction of commercial & sport species populations that may create ecosystem instability and impact food webs; decrease in biodiversity
Dam construction & water diversion projects (levees, channelization, irrigation)	Redistributes fresh water & nutrients; interferes with fish migration; restricts sediment flow

Question 3 (cont'd.)

Identification	Explanation
Organic matter from sewage treatment plant effluent, septic systems leakage, bilge/ship sewage pumping, fish farms	Diminishes water quality by increasing BOD, leads to eutrophication, decreasing DO; possible fish kills; decrease biodiversity Possible introduction of exotic species from ballast water
Boat traffic including wave runners	Increased wave action contributes to erosion and/or turbidity of the water Noise pollution from boat engines; water pollution from engine exhaust & engine leakage of oil & gas, harm to marine animals (propellers)
Deforestation upstream	Leads to increased erosion and increased sediment load of fresh water from river; habitat destruction; loss of native flora and fauna
Increased production of greenhouse gases (CO_2, CH_4, N_2O, CFCs)	Contributes to global warming which will raise sea levels and destroy coastal wetlands
Introduction of invasive species	Invasive species compete with and/or displace native species
Pesticide spraying to control disease spread	Pesticides weaken and kill native species; loss of native flora & fauna; decrease in biodiversity
Landfill (sanitary), illegal dumping	Leaching of toxic substances; habitat destruction; loss of native flora & fauna; decrease in biodiversity
Off-road vehicles, such as dune or swamp buggies	Air pollution from engine exhaust, engine leakage of oil and gas, habitat destruction, loss of native flora & fauna, decrease in biodiversity
Deforestation of mangrove/cypress swamps	Eliminates filtering capacity, disrupts food webs, loss of native flora and fauna, decrease in biodiversity

Question 3 (cont'd.)

(d) Choose one of the negative human impacts you identified in part (c), and explain one environmental policy and one economic incentive that could have prevented it. ***(2 points)***

1 point for the explanation of an environmental policy and 1 point for the explanation of an economic incentive that could have prevented the negative human impact selected from part(c)

Explanation could include a specific law or policy, but just naming the law or policy is not sufficient.

- If part (c) is unanswered then no points will be awarded for part (d)
- If an incorrect identity from part (c) is chosen for part (d), then no points will be awarded for part (d)
- If a negative human impact is not specifically identified from part (c), then no points will be awarded for part (d)

Environmental Policy – "official rules or regulations concerning the environment adopted, implemented, and enforced by some governmental agency", Cunningham & Saigo, 6th edition.

Regulations Pertaining to Wetlands	Description
Clean Water Act	Regulates placement of all dredge and fill materials, sets national water goals, requires projects to meet water quality standards; requires replacement of damaged or destroyed wetlands
Federal River and Harbor Act	Regulates construction activities in navigable waters
National Environmental Policy Act (NEPA)	Requires full disclosure of the potential effects of proposed federal action (environmental impact statement)
Coastal Zone Management Act	Federal funds will be awarded to projects that comply with the coastal zone management plan
Endangered Species Act	Prohibits any land use that will threaten the survival of an endangered or threatened species (fines, seizures, imprisonment)
"Safe Harbor Agreements"	Landowners voluntarily agree to maintain habitats for endangered or threatened species who inhabit their land with technical support from the government
Marine Protection Act	Regulates waste disposal into coastal waters
Fifth Amendment, Eminent Domain	Private landowners must sell property to the government if the area is needed for the public good, must be purchased at a fair market value
Clean Air Act	Includes provisions for primary & secondary air pollutants; trading emissions credits
Migratory Bird Conservation Act	Protection & preservation of migratory bird habitats

Question 3 (cont'd.)

Other Environmental Policies:

- rolling easements; prioritize public access to the shore over properties rights to build seawalls
- zonings
- increase number of wildlife refuges and/or coastal wetlands
- local and regional governments adopt policies guided by the "precautionary principle" (if potential harm is suspected, then precaution measures should be taken)
- local/regional policies or ordinances that are applicable

Economic Incentives:

- taxes (reductions, increases, or waiving) or government backed bonds to promote preservation of coastal wetlands
- fines/penalties for noncompliance
- government subsidies to promote preservation of coastal wetlands
- land trade-offs to discourage development of coastal wetlands
- charge user fees to discourage development of coastal wetlands
- waiving of permit fees in lieu of damaging environmental practices
- use green taxes or effluent fees to internalize harmful environmental costs of production and consumption of industrial products
- reduce property taxes on wetlands maintained in their natural state
- nontaxable profits from land sales to conservancy based organizations
- establish performance /assurance bonds to mitigate any damages to coastal wetlands that occur during the construction and/or operation of a business or industry; deposit is returned minus the actual or estimated environmental costs
- trading of emission credits for industries

Total of 11 available points: Part (a) 2 points, Part (b) 4 points, Part (c) 3 points, Part (d) 2 points

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Question 4

(a) Identify and describe TWO major causes for the original decline of these species. (You may describe one cause for each species or two causes for one species.) ***(2 points total)***

1 point for each identification of a cause of a specific bird's decline and a proper description of the decline (no points earned without proper description)

If habitat is mentioned, it must tied to a specific type of habitat loss and be appropriate to the species and the correct effect on the decline of the species. Students must identify two different causes for the decline if they use one cause per species. (i.e., cannot use habitat loss due to urbanization for both species, but could use habitat loss due to urbanization for condor and habitat loss due to wetland draining for the whooper)

Whooping Crane	California Condor
Habitat loss due to urbanization, wetland destruction, agricultural modification of flyway, mineral fossil fuel extraction, natural disaster leading to • loss of food resources • food web disruption • loss of breeding/nesting/migration habitat or cover Hunted for feathers, meat, eggs, skins, trophies, sport, or unintentionally due to mistaken identification	Natural Causes: • climate change • loss of ice age megafauna • restricted range due to shifting vegetative zones Anthropogenic Causes: • habitat loss due to urbanization, limiting range, • grassland (agricultural conversion or fire suppression), old growth forest removal leading to loss of food resources food web disruption loss of breeding/nesting habitat or cover reduction of food source (bison/deer/elk) lead poisoning from shotgun pellets in carrion incidental poisoning due to predator control Hunting for eggs, skin, trophies, sport, or due to mistaken identification

Question 4 (cont'd.)

(b) Describe TWO measures that have been taken to protect these species. (Specify which of the species benefited from each measure.) ***(2 points, 3 points maximum)***

Student must specify the species
Unless specified below, these measures apply to either bird
Potential elaboration point for detailed description of protection methods

Legislative Measures

Student can list law/policy/practice with an explanation or simply a description of how it protects the species without stating the law.

- Lacey Act — prohibits transport of live animals, dead animals or parts across state lines without federal permit
- Endangered Species Act — cannot be hunted, killed, collected, harmed or injured
- Listed on CITES — cannot be traded commercially as live specimens or wildlife products
- Clean Water Act (whoopers only) — protects wetlands
- Migratory Bird Treaty (whoopers only) — agreement b/w US and Canada to protect migratory birds
- Migratory Bird Conservation Act (whoopers only) — protects migratory species
- Wetland preservation measures (whoopers only)
- Creation of wildlife refuges/establishment of critical habitat
- Restriction of construction in flyways and migratory areas (whoopers only)
- Ban of use of specific pesticides such as DDT
- Ban use of lead bullets/shot

Artificial Population Measures

- Captive breeding/incubation of eggs including:
  Establishment of experimental populations
  Hazard avoidance measures
  Teaching of alternative flyways using ultralights (whoopers only)
- Public education — to raise public awareness of the endangered status of the species
- Research into life history of the species
- Population monitoring including
- Tagging
- GPS/radio telemetry
- Public reporting of sightings

Example of elaboration: whoopers – removal of extra egg, captive incubation and artificial imprinting on puppets/models/stuffed birds, release and teaching of alternative flyways

Note: If student uses the term "preserve", since it is given within the text of the question, the student must specifically explain HOW the preserve serves to protect the species – the term "preserve" is not enough.

Question 4 (cont'd.)

(c) Describe TWO important characteristics of an endangered species that would cause it to be slow to recover. ***(2 points total)***

A description or specific example is required for each of the following characteristics and the characteristic must be linked to the slow recovery of the species:

- low fecundity/reproductive success
- late reproduction/sexual maturity
- specialized mating including: rituals — nest building, dancing, mating for life, limited breeding/nesting habitat
- specialized feeding requirements
- long term parental care
- high infant mortality rate
- low population density (difficult to find mates)
- genetic drift (limited gene pool)
- may have minimum viable population
- species w/ maladaptive behavior (slow to recognize environmental hazards)
- carnivores/predators including: disruption of food chain biomagnification/bioaccumulation
- large body size
- large range requirements
- limited or specialized habitat/range due to competition
- long/fixed migration routes
- high sensitivity to environmental conditions

Note: the terms "specialist" or "*K* strategist" are not sufficient as descriptors.

(d) Make one economic or ecological argument for protecting the condor, the whooping crane, or another endangered species that you identify and make one economic or ecological argument against protecting it. (4 points total)

1 one point for each argument for and against and one point for the additional support of each of the arguments The answer must be connected to whooper, condor or specific endangered species and each argument must be for the same species.

An argument must include an identified economic or ecological factor with the economic or ecological impact (1 point) linked with at least one supporting detail (1 point) within the context of a paragraph. If the student does not clearly identify the argument as for or against, they will be scored in the order of for or against.

Question 4 (cont'd.)

Species accepted were those on state/provincial, national or international recognized endangered or threatened species lists

Economic

For	Against
Ecotourism Reestablish population for commercial harvest Economic sanctions against countries that are not enforcing CITES Debt for nature swap (land bank, tax relief, etc.)	Expensive due to: • allocation of funds to protect species • developmental restrictions • decrease value of land • loss of tax revenue on protected land Useful economically for a specific purpose tied to economic benefit (i.e., selling the endangered eastern prairie fringed orchid for profit) Goods produced have value (ivory, skins, etc) Species dangerous or destructive to humans or property Funding priorities based on emotion or aesthetics, not importance of organism's ecological role No allocation of money to save organisms that will inevitably become extinct

Ecological

For	Against
Maintain biodiversity linked to: • evolutionary value • genetic diversity • synergism with other species • keystone species Niche value: • matter cycling (scavenger/decomposer) • trophic level • pollination • soil formation • pest control	Background extinction Focus is on species instead of on habitat Protection stresses another species that might have chance for recovery Other species may occupy the same fundamental niche