ENVIRONMENTAL SCIENCE
SECTION II
Time—90 minutes
4 Questions

Directions: Answer all four questions, which are weighted equally; the suggested time is about 22 minutes for answering each question. Write all your answers on the pages following the questions in this book. Where calculations are required, clearly show how you arrived at your answer. Where explanation or discussion is required, support your answers with relevant information and/or specific examples.

1. Read the article below and answer the questions that follow.

The Fremont Plaindealer **May 1, 2013**

Last night the county council discussed a motion to support the construction of a new nuclear power plant on the Fremont River to address the rising demand for electrical power in Fremont County. Councilperson Pamela Kull spoke in support of the plant, remarking that "nuclear power plants produce no dangerous solid waste" and "using nuclear power avoids the release of greenhouse gases."

Councilperson Chinh Serach said that Dr. Kull's remarks were incorrect and then introduced a different motion to provide funding to help Fremont homeowners and businesses reduce electricity use. He stated that such steps could make building the nuclear plant unnecessary.

(a) State whether you agree or disagree with each of the following remarks made by Dr. Kull. For each remark, provide one justification for your position.

(i) "Nuclear power plants produce no dangerous solid waste."

(ii) "Using nuclear power avoids the release of greenhouse gases."

(b) If the plan for a nuclear power plant in Fremont is approved, it will take several years for the plant to be built. **Describe** TWO environmental problems that could result from the construction of the plant (i.e., prior to operation).

(c) Suppose that the nuclear power plant is constructed on the Fremont River site.

(i) **Identify** the most likely pollution threat that the plant will pose to the Fremont River as a result of the plant's normal daily operation.

(ii) **Discuss** one potential ecological consequence of the pollution threat that you identified in part (i).

(iii) **Identify** a system often used in nuclear power plants to reduce the pollution you identified in part (i).

(d) **Describe** TWO specific steps that Fremont residents and/or businesses could take to reduce the use of electricity.

(e) **Identify** a specific nuclear power plant at which a major accident has occurred. **Explain** one environmental consequence (other than effects on human health) of a nuclear power plant accident.

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Question 1

(a) State whether you agree or disagree with each of the following remarks made by Dr. Kull. For each remark, provide one justification for your position.

(i) "Nuclear power plants produce no dangerous solid waste."
(1 point can be earned for disagreeing along with one of the following justifications)

- Radioactive wastes are produced (must be stored for long periods of time)
- Spent fuel rods are radioactive
- Clothing, gloves, tools are radioactive
- Radioactive waste results from accidents

(Note: No point can be earned if the student states that they agree with the argument.)

(ii) "Using nuclear power plants avoids the release of greenhouse gases."
(1 point can be earned for a correct justification of the stated position)

Position	Justification
Agree	• Fossil fuels are not combusted • The normal operation involves no combustion
Disagree	• GHGs are released when fossil fuels are used during the mining, transportation, enrichment processes of fuel, construction, and decommissioning of nuclear power plants • Water vapor is released

(b) If the plan for a nuclear power plant in Fremont is approved, it will take several years for the plant to be built. Describe TWO environmental problems that could result from the construction of the plant (i.e., prior to operation).
(2 points: 1 point for each correct description. Only the first two descriptions can earn a point)

- Habitat or riparian area destruction/fragmentation at the construction site
- Disruption of habitat caused by the installation of power lines
- Water pollution/stormwater runoff
- Soil compaction from the construction process or by machinery use
- Sediment runoff/erosion in wet weather
- Noise pollution from machinery
- Construction waste disposal/landfill
- Gases/pollution emitted from machinery such as CO_2, NO_2, SO_2, CO, PM

(Note: Only problems relating to the construction of the power plant can earn a point.)

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Question 1 (continued)

(c) Suppose that the nuclear power plant is constructed on the Fremont River site.

(i) Identify the most likely pollution threat that the plant will pose to the Fremont River as a result of the plant's normal daily operation.
(1 point can be earned for correctly identifying thermal pollution as the most likely pollution threat. Release of radioactive wastes is NOT part of the normal operation of a nuclear power plant)

(ii) Discuss one potential ecological consequence of the pollution threat that you identified in part (i).
(1 point can be earned for discussing an ecological consequence of thermal pollution)

- Decline in dissolved oxygen (DO)
- Impacts on biodiversity
- Thermal shock in organisms
- Increased rates of metabolism in organisms
- Increased bacterial growth
- Increased incidence of disease in fish
- Increased algal growth

(iii) Identify a system often used in nuclear power plants to reduce the pollution you identified in part (i).
(1 point can be earned for identifying an acceptable system)

- Cooling towers
- Cooling ponds and canals
- Longer discharge pipes (increase the distance between the power plant and the discharge point)

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Question 1 (continued)

(d) Describe TWO specific steps that Fremont residents and/or businesses could take to reduce the use of electricity.
(2 points: 1 point for each correct description of a valid step to reduce *the amount of electricity being used in Fremont)*

- Replace existing appliances with more efficient appliances (e.g., air conditioners, heat pumps, refrigerators, stoves, hot water heaters)
- Replace electrical appliances with gas appliances (e.g., stove, hot water heater)
- Switch to passive solar heating or cooling techniques
- Replace incandescent light bulbs with CFLs or LEDs
- Replace a conventional water heater with a tankless hot water heater
- Increase insulation (e.g., walls, ceiling, hot water heater)
- Turn thermostats down in the winter or up in the summer
- Turn off electrical appliances when not in use
- Unplug chargers
- Develop a series of public service announcements (PSAs) to educate the public about how to reduce electrical consumption
- Other appropriate techniques

(Note: points earned for reducing electrical use, not for replacing the source of the electrical power.)

(e) Identify a specific nuclear power plant at which a major accident has occurred. Explain one environmental consequence (other than effects on human health) of a nuclear power plant accident.
(2 points: 1 point for identifying a plant where a major accident has occurred and 1 point for explaining an environmental consequence of a nuclear accident)

The following are acceptable nuclear power plant accident sites:
- Three Mile Island
- Chernobyl
- Fukushima Daiichi

Correct explanations of environmental consequences due to radiation leaks include the following:
- Cancer/tumors in animals
- Radioactive contamination of plants or animals in food webs
- Genetic mutations
- Death of plants or animals
- Impacts on biodiversity
- Impacts on plant or animal population size

(Note: The explanation **does not** have to be linked to the specific accident; however, if the explanation is linked, it must be correct.)