Past-paper walk-through

Sources of Pollution ▪ 8.1

eXercise

Questions in this set

- 2024 Set 1 Q1
- 2022 Set 1 Q1
- 2017 Q1
- 2015 Q3
- 2014 Q1
- 2014 Q2

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 1

2024 Set 1 ▪ Q1

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Dissolved Oxygen and Biological Oxygen Demand in a Stream Ecosystem

[Diagram: a cross-section of a stream divided into five vertical zones (A through E) labeled left to right, with "Direction of Streamflow" arrow pointing right along the bottom axis. The y-axis (unlabeled numerically) ranges from "Low" at the bottom to "High" at the top, showing two curves: a solid line for "Dissolved oxygen" and a

Question 1

dashed line for "Biological oxygen demand". Common fish/macroinvertebrate species listed above each zone:

- Zone A: adult fish; mayfly, stone fly, and caddis fly larvae
- Zone B: blackfly and midge larvae
- Zone C: sludge worms; midge and mosquito larvae
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Question 1

Curve behavior: In Zone A, dissolved oxygen is High (solid line flat at top) and biological oxygen demand is Low (dashed line flat at bottom). Moving into Zone B, dissolved oxygen (solid line) drops sharply from High to Low while biological oxygen demand (dashed line) rises sharply from Low to High. In Zone C, dissolved oxygen remains Low (solid line near bottom) while biological oxygen demand remains High (dashed line near top), with the two curves close together at their extremes. Moving into Zone D, dissolved oxygen (solid line) rises back up from Low to High while biological oxygen demand (dashed line) falls back down from High to Low. In Zone E, dissolved oxygen is High (solid line flat at top) again and biological oxygen demand is Low (dashed line flat at bottom), mirroring Zone A.]
(a) Based on the information in the diagram, **identify** the zone with the lowest level of dissolved oxygen.

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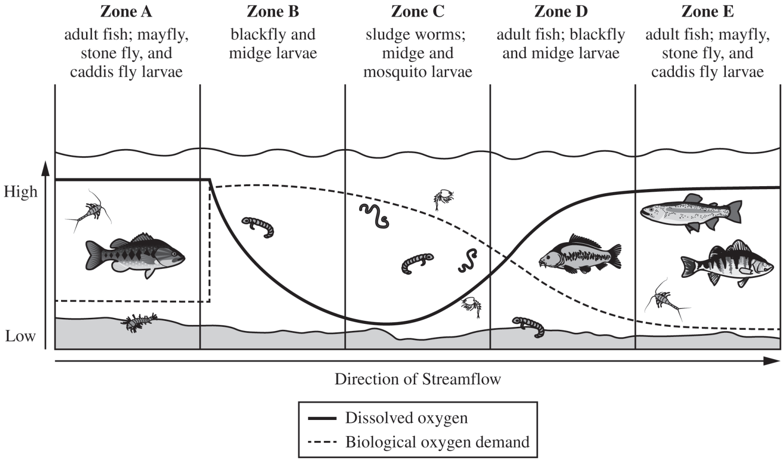
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adult fish; mayfly, stone fly, and caddis fly larvae
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blackfly and midge larvae
Zone C
sludge worms; midge and mosquito larvae
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adult fish; blackfly and midge larvae
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High
Low
Direction of Streamflow
Dissolved oxygen
Biological oxygen demand

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Low. In Zone E, dissolved oxygen is High (solid line flat at top) again and biological oxygen demand is Low (dashed line flat at bottom), mirroring Zone A.]

(b) Based on the information in the diagram, **describe** the relationship between biological oxygen demand and dissolved oxygen.

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(c) Based on the information in the diagram, **identify** the zone where there is most likely point-source water pollution discharged into the stream.

The research team is interested in investigating the relationship between dissolved oxygen levels and macroinvertebrate species richness in the stream. Researchers counted the number of macroinvertebrate species in zones A, B, and C during the summer months. The researchers selected zone A to serve as the control in the investigation.

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(d) Identify the dependent variable in the researchers' investigation.

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(e) Identify a testable hypothesis for the researchers' investigation.

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(f) Describe the reason the researchers selected zone A to serve as the control in the investigation.

The researchers decided to repeat their data collection during the winter months.

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(g) Explain how the modification to collect data in the winter months could alter the results of the investigation.

Stream ecosystems are affected by point-source organic pollution in a variety of ways.

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(h) Describe the effect that the introduction of raw sewage into the stream could have on the population of bacteria in the stream.

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(i) Identify an abiotic factor other than dissolved oxygen and organic pollution that could also influence the population size of bacteria in the stream.

Question 1

2024 Set 1 ▪ Q1

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(j) Explain how persistent organic pollutants can affect higher trophic levels in an aquatic food web.

Solution 1

(a)

Mark scheme

- Zone C has the lowest level of dissolved oxygen (based on the diagram).

Solution 1

(b)

Mark scheme

- Biological oxygen demand (BOD) and dissolved oxygen (DO) are inversely related: as BOD increases, DO decreases (equivalently, as DO increases, BOD decreases).

Solution 1

(c)

Mark scheme

- Zone B is where point-source water pollution is most likely discharged into the stream (based on the diagram).

Solution 1

(d)

Mark scheme

- The dependent variable is the number of macroinvertebrate species (macroinvertebrate diversity / macroinvertebrate species richness) — the researchers measured this in response to dissolved oxygen level.

Solution 1

(e)

Mark scheme

- A testable hypothesis relates dissolved oxygen level to macroinvertebrate species number, e.g.: 'As dissolved oxygen levels increase, the number of macroinvertebrate species increases' (or the inverse: as DO decreases, species number increases; or a general statement of a direct/inverse relationship between DO and macroinvertebrate species number). A null hypothesis of no relationship is also acceptable.

Solution 1

(f)

Mark scheme

- Zone A was chosen as the control because it is upstream from the pollution/organic waste source, so it is not affected by (not impacted by) the discharge — its dissolved oxygen levels reflect conditions unaffected by the pollution, giving a baseline for comparison.

Solution 1

(g)

Mark scheme

- Collecting data in winter could alter the results because: (1) cold water holds more dissolved oxygen, which could increase the number of species; or (2) colder temperatures may fall below the tolerance range of some organisms, decreasing the number of species; or (3) lower light levels in winter reduce plant photosynthesis, which lowers dissolved oxygen and could decrease the number of species.

Solution 1

(h)

Mark scheme

- Raw sewage introduces nutrients (and/or organic matter) that increase the bacteria population (more food source), and/or raw sewage directly contains bacteria that increases the bacteria population size in the stream.

Solution 1

(i)

Mark scheme

- Any abiotic factor other than dissolved oxygen and organic pollution that affects bacteria population size, e.g.: temperature, pH, light/sunlight, turbidity/sediment, salinity, or nitrate/phosphate concentration.

Solution 1

(j)

Mark scheme

- Persistent organic pollutants (POPs) bioaccumulate/biomagnify in the tissues of organisms at higher trophic levels because those organisms consume prey that have already accumulated the pollutants, so pollutant concentration increases up the food web (often concentrating in fatty tissue); this can cause effects such as neurological toxicity in top predators.

Question 1

2022 Set 1 ▪ Q1

Common snapping turtles, *Chelydra serpentina*, are primarily aquatic, but they lay their eggs on land. Researchers are interested in understanding the impact of pollution on turtle nesting sites. The researchers examined nesting sites at two agricultural areas along the floodplain of a river upstream and downstream from a chemical factory that is a known source of aqueous mercury pollution. Turtle eggs, soil, and vegetation samples taken from areas around turtle nests downstream from the chemical factory showed high levels of mercury in a previous study. Mercury was not detected in samples taken upstream from the chemical factory.

[Diagram: "DISTRIBUTION OF TURTLE NESTS ALONG RIVER." A map shows a river winding from top to bottom with an arrow labeled "Direction of Flow" pointing downstream. A "Chemical Factory" sits beside the river partway down, with a "Discharge Pipe" emptying into the river at that point. Along the riverbank are

Question 1

forested strips labeled “Forest Area” (trees drawn as small pine-tree and round-tree icons). “Area A” is a region upstream of the chemical factory’s discharge point (bounded by dashed lines), shown with many nest markers clustered together: a mix of filled circles ( ) labeled “Successful turtle nest” and X marks ( ) labeled “Unsuccessful turtle nest” in the legend — Area A shows a dense cluster of both successful ( ) and unsuccessful ( ) nests close together in the forest area. “Area B” is a region downstream of the chemical factory’s discharge point (bounded by dashed lines), shown with a sparser, more scattered mix of successful ( ) and unsuccessful ( ) nest markers, with unsuccessful ( ) nests appearing more numerous/closer to the river relative to successful ( ) nests, which sit farther back. Legend box: “ Successful turtle nest” and “ Unsuccessful turtle nest.”]

(a)(i) Identify the area with the greatest nest success rate, based on the information in the diagram.

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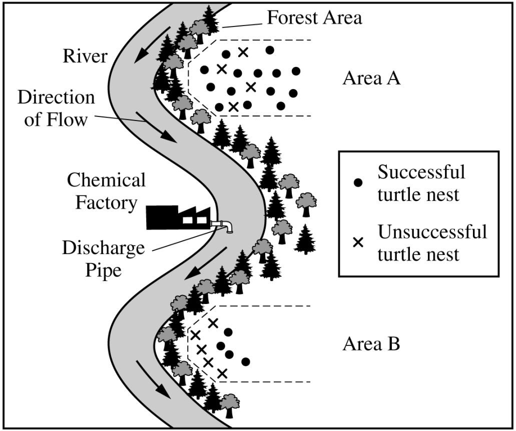
(a)(ii) Identify the dependent variable in the study.
(a)(iii) Based on the information provided, **identify** a likely scientific question for the study.
(a)(iv) Describe why researchers measured mercury levels in locations upstream from the factory.
(a)(v) There are plans to remove trees and other vegetation along the river bank. **Explain** how this modification could affect the location and number of successful turtle nests in Area B.

Question 1

DISTRIBUTION OF TURTLE NESTS ALONG RIVER



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factory's discharge point (bounded by dashed lines), shown with many nest markers clustered together: a mix of filled circles ( ) labeled "Successful turtle nest" and X marks ( ) labeled "Unsuccessful turtle nest" in the legend — Area A shows a dense cluster of both successful ( ) and unsuccessful ( ) nests close together in the forest area. "Area B" is a region downstream of the chemical factory's discharge point (bounded by dashed lines), shown with a sparser, more scattered mix of successful ( ) and unsuccessful ( ) nest markers, with unsuccessful ( ) nests appearing more numerous/closer to the river relative to successful ( ) nests, which sit farther back. Legend box: " Successful turtle nest" and " Unsuccessful turtle nest."]

(b)(i) Mercury can affect organisms and ecosystems in many ways. **Describe** how a persistent pollutant, such as mercury, can negatively affect an organism.

(b)(ii) **Describe** how a persistent pollutant, such as mercury, can negatively affect an ecosystem.

Question 1

(b)(iii) Researchers measured methylmercury in a location downstream from the factory. **Explain** how methylmercury could be present in the stream.
(b)(iv) Researchers claimed that the soil nearest to the river has higher levels of mercury than the field has, and those elevated levels have affected the nesting success for turtles. **Explain** how the pattern shown in the diagram supports or refutes this claim.

Question 1

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(c) The turtle study was conducted in an agricultural area. **Describe** how a specific agricultural practice changes the soil in an area.

Solution 1

(a)(i)

Mark scheme

- Area A (the site/area upstream from the factory) has the greatest nest success rate.

(a)(ii)

Mark scheme

- The dependent variable is turtle nesting success.

Solution 1

(a)(iii)

Mark scheme

- A likely scientific question: Does mercury content in the turtle's habitat affect common snapping turtle nest success? (Alternatively: Does mercury content in the turtle's habitat affect the location/site of common snapping turtle nests?)

Solution 1

(a)(iv)

Mark scheme

- The upstream locations acted as a control group in the study, used to compare against the high-mercury turtle nests found downstream.

Solution 1

(a)(v) Mark scheme

- Removing riverbank vegetation could affect nesting as follows (any one): with more open area closer to the river, turtles don't have to travel as far to nest, so they are exposed to higher mercury levels near the river, decreasing the number of successful nests; with less vegetation to take up/remove mercury (heavy metals/endocrine disruptors/pesticides), concentrations in the soil increase, decreasing successful nests; soil erosion along the stream increases, making nest-building harder and decreasing successful nests; or with less vegetation/shade, soil temperature increases and moisture decreases, decreasing successful nests.

Solution 1

(b)(i)

Mark scheme

- A persistent pollutant like mercury can harm an organism because it bioaccumulates in tissues (it does not break down easily and accumulates over time); mercury is a neurotoxin that disrupts the nervous system/neuron functioning; or it disrupts normal functioning of the brain/kidneys/liver/immune system/reproductive system and can lead to death.

Solution 1

(b)(ii)

Mark scheme

- A persistent pollutant can harm an ecosystem because it biomagnifies up the food chain, giving top predators very high concentrations (which can cause a trophic cascade if predators die off); or because decreased reproductive success in exposed organisms alters food webs/trophic structure and reduces biodiversity/ecosystem stability.

Solution 1

(b)(iii)

Mark scheme

- Mercury is likely released into the stream by the factory as a waste product; bacteria/microorganisms in the water and sediments then convert the inorganic mercury into methylmercury.

Solution 1

(b)(iv)

Mark scheme

- The diagram supports the claim: nests close to the river in Area B, where mercury levels are high, are not successful, while nests farther from the river are successful — supporting the claim that elevated soil mercury reduces nesting success. (Alternatively: Area B, closer to the river, has fewer total/successful nests than Area A, further supporting the claim.)

Solution 1

(c) Mark scheme

- Any one specific agricultural practice and its soil effect: tilling/plowing loosens/softens soil and/or removes organic matter, leading to erosion; monocropping removes nutrients and/or moisture; synthetic fertilizer use disrupts soil chemistry; irrigation can cause waterlogging, erosion, and/or salinization; slash-and-burn removes vegetation and upper organic soil layers (though it can add nutrients); heavy machinery use compacts soil; polyculture/cover cropping with nitrogen-fixing plants adds soil nutrients; or manure/organic fertilizer use increases soil moisture content.

Question 1

2017 ▪ Q1

Read the following article from the Fremont Daily Times and answer the questions that follow.

[Newspaper clipping, headed “Fremont Daily Times”, article title “Scientists Discuss Threats from Plastic Pollution”:] In testimony before the United States Senate Committee on Environment and Public Works, Dr. Duke Ewoldsen, an eminent toxicologist, discussed a new water pollutant that threatens aquatic life: microbeads. Ewoldsen noted that while posing a different threat than more conventional water pollutants such as nitrates, phosphates and PCBs, tiny beads of plastic contained in many products, especially cosmetics, now threaten plankton and small fish that ingest the particles because they mistake them for food. The microbeads cannot be digested and can fill or block the digestive tracts of the fish, leading to starvation. In addition, surfaces of these small spheres can adsorb organic pollutants such as PCBs and dioxin.

Question 1

When asked about steps to reduce this threat, Ewoldsen noted that the beads are so small that they are not easily removed by wastewater treatment plants and thus often enter aquatic ecosystems in wastewater discharges.

(a) Describe TWO effects that ingesting microbeads has on aquatic organisms.

Question 1

Fremont Daily Times

Scientists Discuss Threats from Plastic Pollution

In testimony before the United States Senate Committee on Environment and Public Works, Dr. Duke Ewoldsen, an eminent toxicologist, discussed a new water pollutant that threatens aquatic life: microbeads. Ewoldsen noted that while posing a different threat than more conventional water pollutants such as nitrates, phosphates and PCBs, tiny beads of plastic contained in many products, especially cosmetics, now threaten plankton and small fish that ingest the particles because they mistake them for food. The microbeads cannot be digested and can fill or block the digestive tracts of the fish, leading to starvation. In addition, surfaces of these small spheres can adsorb organic pollutants such as PCBs and dioxin.

When asked about steps to reduce this threat, Ewoldsen noted that the beads are so small that they are not easily removed by wastewater treatment plants and thus often enter aquatic ecosystems in wastewater discharges.

Question 1

2017 ▪ Q1

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Question 1

When asked about steps to reduce this threat, Ewoldsen noted that the beads are so small that they are not easily removed by wastewater treatment plants and thus often enter aquatic ecosystems in wastewater discharges.

(b) Dr. Ewoldsen states that nitrates pose different threats to aquatic ecosystems than microbeads do. Describe how nitrate levels can negatively affect water quality in some aquatic ecosystems.

Question 1

2017 ▪ Q1

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Question 1

When asked about steps to reduce this threat, Ewoldsen noted that the beads are so small that they are not easily removed by wastewater treatment plants and thus often enter aquatic ecosystems in wastewater discharges.

(c)(i) While wastewater treatment plants are ineffective at removing microbeads, they are very effective at removing large pieces of plastic waste and other pollutants. Identify one way large pieces of plastic are removed from wastewater during primary treatment.

(c)(ii) Prior to discharge, wastewater is often disinfected. Identify one technique commonly used to disinfect wastewater.

(c)(iii) Sludge or biosolids produced during the wastewater treatment process can be spread on agricultural fields. Identify one advantage and one disadvantage of this practice.

Question 1

2017 ▪ Q1

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Question 1

When asked about steps to reduce this threat, Ewoldsen noted that the beads are so small that they are not easily removed by wastewater treatment plants and thus often enter aquatic ecosystems in wastewater discharges.

(d)(i) Coastal ecosystems are threatened by other human activities in addition to wastewater disposal. Mangrove swamps are one such threatened ecosystem. Provide one reason why mangrove trees are being removed by humans.

(d)(ii) Identify one ecosystem service provided by intact mangrove ecosystems.

Question 3

2015 ▪ Q3

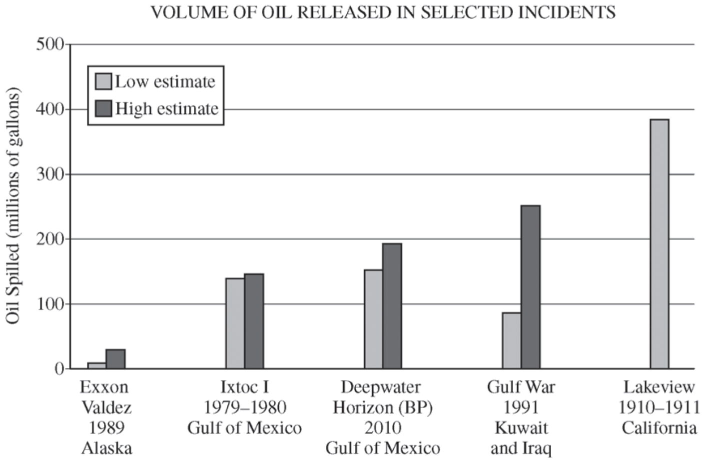
[Bar graph titled "VOLUME OF OIL RELEASED IN SELECTED INCIDENTS"; y-axis "Oil Spilled (millions of gallons)" from 0 to 500 in increments of 100; x-axis lists five incidents, each with a "Low estimate" (light gray) bar and a "High estimate" (dark gray) bar except where only one estimate is shown:

- Exxon Valdez, 1989, Alaska: Low estimate 11, High estimate 32
- Ixtoc I, 1979–1980, Gulf of Mexico: Low estimate 140, High estimate 148
- Deepwater Horizon (BP), 2010, Gulf of Mexico: Low estimate 152, High estimate 192
- Gulf War, 1991, Kuwait and Iraq: Low estimate 88, High estimate 252
- Lakeview, 1910–1911, California: single bar (low estimate only) 385]

Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.
(a) Using the data in the graph above, determine the maximum volume of oil estimated to have been spilled during the Deepwater Horizon (BP) incident.

Question 3


VOLUME OF OIL RELEASED IN SELECTED INCIDENTS
Oil Spilled (millions of gallons)
500
400
300
200
100
0
Low estimate
High estimate
Exxon Valdez 1989 Alaska
Ixtoc I 1979–1980 Gulf of Mexico
Deepwater Horizon (BP) 2010 Gulf of Mexico
Gulf War 1991 Kuwait and Iraq
Lakeview 1910–1911 California

Question 3

2015 ▪ Q3

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Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

(b) Describe TWO environmental problems that can result from oil spills in coastal areas.

Question 3

2015 ▪ Q3

[Bar graph titled "VOLUME OF OIL RELEASED IN SELECTED INCIDENTS"; y-axis "Oil Spilled (millions of gallons)" from 0 to 500 in increments of 100; x-axis lists five incidents, each with a "Low estimate" (light gray) bar and a "High estimate" (dark gray) bar except where only one estimate is shown:

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Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

(c) Identify one economic impact that results from oil spills in coastal areas.

Question 3

2015 ▪ Q3

[Bar graph titled “VOLUME OF OIL RELEASED IN SELECTED INCIDENTS”; y-axis “Oil Spilled (millions of gallons)” from 0 to 500 in increments of 100; x-axis lists five incidents, each with a “Low estimate” (light gray) bar and a “High estimate” (dark gray) bar except where only one estimate is shown:

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Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

(d) Chemical dispersants have been used in cleanup efforts following major oil spills.

(d)(i) Discuss both one advantage and one disadvantage of the use of chemical dispersants for oil spill cleanup.

(d)(ii) Identify either one biological or one physical method (other than chemical dispersal) used for oil spill cleanup in coastal waters or on beaches and describe how the method is used.

Question 3

2015 ▪ Q3

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Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

(e) Catastrophic spills make up less than 20 percent of the oil that pollutes marine waters. Identify one other source of oil contamination and explain how the oil from this source enters marine waters.

Question 3

2015 ▪ Q3

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Question 3

Oil spills can be devastating in scope and damage. Since 1900, there have been many oil spills around the world that have had significant ecological and economic impacts.

(f) Petroleum has many uses as a raw material for consumer goods. Identify one substitute for petroleum in a specific consumer product (other than fuel).

Question 1

2014 ▪ Q1

Read the article below and answer the questions that follow.
[Newspaper clipping] 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)(i) 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.

Question 1

“Nuclear power plants produce no dangerous solid waste.”
(a)(ii) 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.
“Using nuclear power avoids the release of greenhouse gases.”

Question 1

The Fremont Plaindealer — **May 1, 2013**

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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.

Question 1

2014 ▪ Q1

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Question 1

(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).

Question 1

2014 ▪ Q1

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

Question 1

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.

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

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

Question 1

2014 ▪ Q1

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

Question 1

2014 ▪ Q1

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Question 1

(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.

Question 2

2014 ▪ Q2

Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.

Recently parts of Fremont received 5 cm of rain in 60 minutes. The storm caused widespread flooding in the northeast section of town. Especially hard hit was the Shoppes at Fremont shopping center.

Use the data from the table below to answer the questions that follow. Show all calculations.

Question 2

| Fremont Water Data | |—| | The shopping center's parking lot is 200 meters long and 100 meters wide. | | Fremont has an area of 10 km^2. | | Impervious surfaces cover 20 percent of Fremont's area. | | The FWTP typically treats $5{,}000$ m^3 of domestic sewage per day. | | The FWTP has the capacity to treat $10{,}000$ m^3 of combined sewage and storm water per day. |

(a) Identify TWO specific pollutants in storm-water runoff that degrade the quality of surface water.

Question 2

Fremont Water Data
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Fremont has an area of 10 km^2.
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Question 2

2014 ▪ Q2

Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.

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Question 2

Fremont's area. | | The FWTP typically treats $5{,}000$ m^3 of domestic sewage per day. | | The FWTP has the capacity to treat $10{,}000$ m^3 of combined sewage and storm water per day. |

(b) Calculate the volume of water (in m^3) that runs off the Shoppes at Fremont parking lot after a 5 cm rainfall event. Assume that all the water that falls on the parking lot runs off.

Question 2

2014 ▪ Q2

Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.

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(c) Calculate the volume of storm-water runoff (in m^3) generated in all of Fremont by the 5 cm rainfall event. Assume that only the impervious surfaces generate runoff.

Question 2

2014 ▪ Q2

Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.

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Question 2

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(d) Assume that all the runoff that you calculated in part (c) is captured by the storm sewers in one day. Calculate the volume of untreated water (in m^3) that bypasses the plant as a result of the storm. (Note that the plant still receives $5{,}000$ m^3 of domestic sewage per day.)

Question 2

2014 ▪ Q2

Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.
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Question 2

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(e) Describe TWO ways that the volume of storm-water runoff can be reduced.

Question 2

2014 ▪ Q2

Like many communities, Fremont has a combined sewer system that collects both sewage and storm water. When storm water runs into storm drains that connect to the city's sanitary sewer system, the storm water and sewage flow together to the Fremont Wastewater Treatment Plant (FWTP). During a major storm event, however, the combined volume of storm water and sewage may exceed the plant's capacity, and the overflow bypasses the FWTP. The untreated overflow is discharged into Fremont Creek along with the treated waste.

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(f) Describe one environmental problem (other than pollution from runoff and from untreated sewage) that results from having extensive paved areas.