

Past-paper walk-through

Energy Flow and the 10% Rule ■ 1.10

eXercise

Questions in this set

- 2026 Q3
- 2023 Set 1 Q2
- 2018 Q3

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 3

2026 ■ Q3

The following information applies to parts A, B, C, D, E, and F.

Ocelots are small wildcats that were previously found in 25 counties in Texas where shrubland is prevalent. As a result of land use changes, only 74 ocelots remain in 4 counties in Texas today. Rodents such as pocket mice are the main source of food for ocelots, but ocelots also prey on other small animals such as snakes and lizards.

3. Respond to parts A, B, C, D, E, and F, and all subparts.

(a) Identify one environmental consequence that could result from having a smaller population of ocelots.

Question 3

2026 ■ Q3

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3. Respond to parts A, B, C, D, E, and F, and all subparts.

(b) Calculate the percent change in the number of Texas counties where ocelots have been found historically as compared to today. **Show** your work.

Question 3

2026 ■ Q3

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3. Respond to parts A, B, C, D, E, and F, and all subparts.

(c) Researchers expect the ocelot population to grow at a constant rate of 2.8% per year. **Calculate** the number of years it will take for the ocelot population to double based on a constant rate of growth. **Show** your work.

Question 3

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3. Respond to parts A, B, C, D, E, and F, and all subparts.

(d) Pocket mice eat plants in the shrubland, while snakes are carnivores. **Explain** why the amount of primary production energy available to ocelots would change if ocelots ate only carnivores such as snakes and not pocket mice.

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3. Respond to parts A, B, C, D, E, and F, and all subparts.

(e) Ocelots need 720 grams of food per day. Pocket mice weigh an average of 43 grams each. If the ocelot diet consists of 46% pocket mice by weight, **calculate** how many pocket mice an ocelot would need to consume in one day, assuming each mouse weighs the average amount. **Show** your work.

Question 3

2026 ■ Q3

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3. Respond to parts A, B, C, D, E, and F, and all subparts.

(f)(i) As urbanization has increased in southern Texas, motor vehicle collisions have become the main cause of death in ocelots, which poses an added threat to the remaining ocelots.

Propose a realistic solution to reduce the number of ocelots killed by vehicles.

(f)(ii) Justify the solution proposed in part F (i) by explaining an additional advantage, other than reducing the number of ocelots killed by vehicles.

Question 2

2023 Set 1 ■ Q2

The diagram shows the movement of one adult manatee over a 12-hour period across an active shipping channel during the winter. Manatees are large, aquatic, herbivorous mammals that primarily eat seagrass. Manatees can travel several miles to graze.

Manatees mature slowly, have low biotic potential, and inhabit warm coastal waters. They cannot survive in water below 20°C for extended periods of time.

****Satellite Track and Water Temperature Log of the Movement of One Adult Manatee Over a 12-Hour Period****

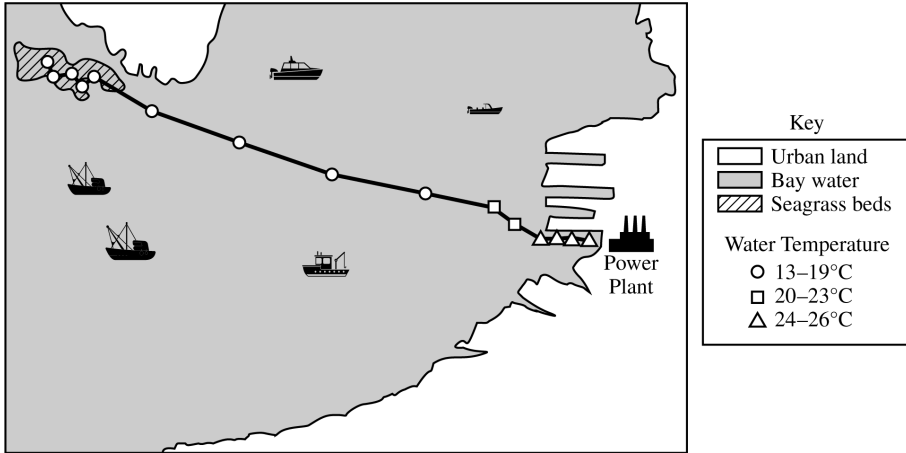
[Map diagram of a bay/river channel showing a coastline with urban land at upper left near a cluster of small circles (13-19°C markers) close to shore, and hatched "Seagrass beds" also near that shore. A black line with a series of point markers runs from the seagrass-bed/urban-land area near the top-left, diagonally down and to the right across open bay water, passing several boats (fishing boats and small craft scattered across

Question 2

the bay), and ending at the lower right near a "Power Plant" (with smokestack icon) on the opposite shore. The markers along this track are open circles ($13-19^{\circ}\text{C}$) for most of the track's length across the open bay, changing to open squares ($20-23^{\circ}\text{C}$) near the shore closer to the power plant, and open triangles ($24-26^{\circ}\text{C}$) immediately adjacent to the power plant outflow. Key: Urban land = open/white box; Bay water = gray shaded box; Seagrass beds = diagonal-hatched box. Water Temperature legend: circle = $13-19^{\circ}\text{C}$, square = $20-23^{\circ}\text{C}$, triangle = $24-26^{\circ}\text{C}$.]

(a) Based on the information in the diagram, identify the temperature range of the water through which the majority of the adult manatee's daily movement occurs.

Question 2



Question 2

2023 Set 1 ■ Q2

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(b) Large groups of manatees are often observed in shallow waters near the waste water released by the electrical power plant during the winter. Based on the information in the diagram, identify a characteristic of the power plant waste water that would attract the manatees.

Question 2

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(c) Based on the information in the diagram, describe a potential negative impact of the waste water released by the power plant on other aquatic species.

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(d) Seagrass beds have declined significantly over the last several years. In 2021 manatee mortality was three times higher than the previous five-year average.

(d)(i) Describe a characteristic of the manatees that increases their vulnerability to the recent decline of seagrasses.

(d)(ii) Describe the change in energy flow through the trophic levels that occurs when there is a significant loss of seagrasses.

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(e) Research has shown increased nutrient and sediment runoff can cause seagrass beds to decline.

(e)(i) Propose a solution to reduce nutrient or sediment pollution in an estuary that is surrounded by urban development.

(e)(ii) Justify the solution proposed in part (e)(i) by providing an additional advantage of reduced nutrients in an estuary, other than one related to manatees.

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(f) Urban areas have a heavy dependence on automobiles and often experience photochemical smog.

Describe how summertime weather conditions can increase the frequency of photochemical smog.

Question 2

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(g) Identify one ecological problem that results from exposure to photochemical smog.

Question 2

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(h) A potential solution to reduce photochemical smog in urban areas with high automobile traffic is to replace gasoline-powered cars with cars powered by hydrogen fuel cells.

Describe a potential disadvantage of using hydrogen fuel cells to power automobiles.

Solution 2

(a)

Mark scheme

- 13-19 degrees C, based on the temperature range through which the majority of adult manatee daily movement occurs in the diagram.

Solution 2

(b)

Mark scheme

- The waste water is warm (approximately 24-26 degrees C), which is why manatees are attracted to it in winter.

Solution 2

(c)

Mark scheme

- Any one of: warming of the water near the outfall reduces the dissolved oxygen available for aquatic organisms to use/breathe; the warming could impact the survival/health of species with a range of tolerance for the original (lower) water temperature; or the warming could alter/affect the timing of reproductive cycles for aquatic species.

Solution 2

(d)

Mark scheme

- This line is introductory/context text (seagrass decline and the 2021 manatee mortality spike) setting up parts (d)(i) and (d)(ii) below; it carries no points of its own – see 2di and 2dii.

Solution 2

(d)(i)

Mark scheme

- Any one of: manatees are herbivores/eat seagrass, so they would have less food and could starve; they require a lot of energy to survive, so a reduced food supply threatens them; they inhabit warm water, so they would need to travel farther to colder waters to find remaining seagrass/food; or they have a low reproductive/maturation rate, so they would take longer to recover from the loss of their food source.

Solution 2

(d)(ii)

Mark scheme

- Less energy flows to/is available for organisms at higher trophic levels, because less energy from the Sun is captured/stored by producers (seagrass) once seagrass is significantly lost.

Solution 2

(e)

Mark scheme

- This line is introductory/context text (nutrient and sediment runoff causing seagrass decline) setting up parts (e)(i) and (e)(ii) below; it carries no points of its own – see 2ei and 2eii.

Solution 2

(e)(i)

Mark scheme

- Any one solution: replace existing pavement with permeable pavement; add vegetation (e.g., a riparian buffer) where it will intercept runoff; reduce fertilizer use in the area; install barriers/construct fences where they will intercept runoff; or improve wastewater treatment plants in the area.

Solution 2

(e)(ii)

Mark scheme

- Any one additional advantage (not related to manatees): reduces eutrophication; increases biodiversity/species richness; improves water clarity; increases ecotourism; reduces the cost of water treatment; or increases profits for commercial fishermen.

Solution 2

(f)

Mark scheme

- Any one of: sunlight is more intense/there is more sunlight in summer, so more primary pollutants (nitrogen oxides/ NO_x) react in sunlight; summertime temperatures are warmer than other seasons, and chemical reactions occur more quickly at warmer temperatures; or trees release more VOCs in summer, leading to more reactions that form photochemical smog.

Solution 2

(g)

Mark scheme

- Any one ecological problem: causes respiratory problems/eye irritation in animals; reduces photosynthesis; slows/inhibits/stunts plant growth; or increases the susceptibility of plants to pests and disease.

Solution 2

(h)

Mark scheme

- Any one disadvantage: high cost to manufacture hydrogen-fuel-cell automobiles; obtaining hydrogen requires a lot of energy and may consume more energy than the hydrogen fuel can produce; hydrogen is explosive/flammable (may catch fire); there is a lack of infrastructure (such as fueling stations) for hydrogen fuel; or hydrogen must be obtained by separating it from natural gas or water (often using fossil fuels).

Question 3

2018 ■ Q3

An Arctic food web includes the following organisms.

[Food-web diagram showing organisms connected by arrows pointing from prey to predator (from what is eaten to what eats it), labeled: “Orca”, “Polar Bear”, “Arctic Cod”, “Ringed Seal”, “Krill (zooplankton)”, “Diatom (phytoplankton)”. Arrows: Diatom (phytoplankton) → Krill (zooplankton); Diatom (phytoplankton) → Ringed Seal; Krill (zooplankton) → Arctic Cod; Arctic Cod → Orca; Arctic Cod → Polar Bear; Ringed Seal → Polar Bear; Ringed Seal → Orca; Polar Bear → Orca. Note: Figures not drawn to scale.]

(a)(i) Refer to the food web above to complete the following table.

Question 3

Organism from Arctic food web

- (i) Identify a primary producer
 - (ii) Identify a primary consumer
 - (iii) Identify a secondary consumer
-

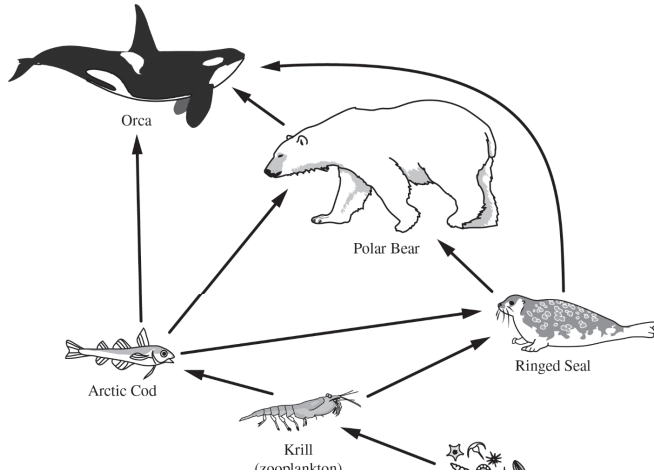
Identify a primary producer.

(a)(ii) Identify a primary consumer.

Question 3

(a)(iii) Identify a secondary consumer.

Question 3



Question 3

.....
(zooplankton)



Diatom
(phytoplankton)

Note: Figures not drawn to scale.

Question 3

	Organism from Arctic food web
(i) Identify a primary producer	
(ii) Identify a primary consumer	
(iii) Identify a secondary consumer	

Question 3

2018 ■ Q3

An Arctic food web includes the following organisms.

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(b) Other than showing which organisms are consumed by other organisms, describe what is indicated by the direction of the arrows in the diagram.

Question 3

2018 ■ Q3

An Arctic food web includes the following organisms.

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(c) As the amount of sea ice has decreased, larger expanses of the Arctic Ocean are now completely free of sea ice for several weeks each summer. Ringed seals, the preferred prey of polar bears, come to holes in the sea ice to breathe.

Describe how the change in sea ice habitat is affecting polar bears’ ability to hunt and feed.

Question 3

2018 ■ Q3

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(d) Explain how melting sea ice leads to a feedback loop that increases Arctic warming.

Question 3

2018 ■ Q3

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(e)(i) Many species, including some whales and birds, will travel thousands of kilometers during annual migrations.

Provide one reason a species may migrate a long distance.

(e)(ii) The North Atlantic right whale migrates between subtropical and polar waters annually. Nearly 50 percent of right whale deaths are due to human activities.

Question 3

Describe one commercial activity, other than whaling, that may result in the death of right whales.

(e)(iii) Describe one strategy that could reasonably be implemented to decrease right whale deaths caused by the commercial activity you described in part (ii).

Solution 3

(a)(i)

Mark scheme

- 1 point for correctly identifying a primary producer from the Arctic food web:
Diatom (phytoplankton).

(a)(ii)

Mark scheme

- 1 point for correctly identifying a primary consumer from the Arctic food web:
Krill (zooplankton).

Solution 3

(a)(iii)

Mark scheme

- 1 point for correctly identifying a secondary consumer from the Arctic food web: Cod or seal.

Solution 3

(b)

Mark scheme

- 1 point for a correct description of what the arrow direction indicates, other than which organisms are consumed by others. Accept: shows the flow of energy among trophic levels; OR shows the flow of matter through trophic levels.

Solution 3

(c) Mark scheme

- 1 point for a correct description of how the changing sea ice habitat affects polar bears' ability to hunt/feed. Accept any one of: decreasing area of hunting ground (fewer seal breathing holes/less ice for hauling out) makes it more difficult for polar bears to get food; increasing distance between hunting grounds means polar bears must exert more energy to swim to find food, causing physical exhaustion and less energy available for hunting; increasing physiological stress (dehydration, exhaustion, cub mortality) because polar bears are not physiologically adapted to warmer temperatures; increasing the time between successful kills means bears spend more time waiting/hunting for prey.

Solution 3

(d)

Mark scheme

- 2 points: 1 point for explaining the connection between melting ice and increased absorption of the sun's energy, and 1 point for explaining that this increased absorption leads to further ice melt (completing the positive feedback loop). Melting of sea ice leads to a decrease in albedo/reflectivity, causing water surfaces to absorb more of the sun's energy; AND this increasing absorption of the sun's energy warms the water surface further, which leads to further ice melt (completes the positive feedback loop).

Solution 3

(e)(i)

Mark scheme

- 1 point for a correct reason a species may migrate a long distance. Accept any one of: limited food/water supply leads to migration to locations with more food/water supply; food supply migrates and the species follows its prey; more hospitable climate during certain seasons; availability of mates/breeding/birthing occurs in a different location; protection of offspring from predators.

Solution 3

(e)(ii)

Mark scheme

- 1 point for a correct description of a commercial activity, other than whaling, that may result in right whale deaths. Accept any one of: fishing nets entangle whales as by-catch/fishing gear can accidentally trap whales; ships and whales use the same channels, which can increase the number of ship strikes; noise pollution from seismic surveys/sonar/engine noise can disrupt a whale's internal navigational system.

Solution 3

(e)(iii) Mark scheme

- 1 point for a correct strategy linked to the activity named in part (ii). If fishing gear/by-catch was named: require a change of fishing method (location, timing, or materials) that traps whales, to reduce the number of whales trapped in nets/gear; OR fines for discarded fishing gear so less gear is discarded, reducing whales trapped in gear. If ship strikes were named: improved navigational technology to spot whales close to ships to avoid collisions; OR increased education of ship captains/crews about whale habitat/migration routes/feeding behaviors; OR expansion of low-speed navigational zones around ports. If noise pollution was named: reduction of seismic survey activity/sonar use in coastal areas; OR installation of quieter motors to reduce/eliminate noise pollution.