Past-paper walk-through

The Carbon Cycle ▪ 1.4

eXercise

Questions in this set

- 2024 Set 2 Q2
- 2014 Q4

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 2

2024 Set 2 ▪ Q2

The following graph shows how global uses of habitable land have changed since 1700. [Bar chart titled "Land Use Changes on Earth, 1700-2018". Y-axis: "Percentage of Habitable Land" from 0% to 100% in increments of 20%. X-axis: "Year", with stacked bars shown for 1700, 1800, 1900, 1950, 2000, and 2018. Each bar is stacked (from bottom to top) with five categories per the legend: Forest (light gray), Crops (dark gray), Grazing (diagonal hatched pattern), Wild grasslands (white), Built-up land (black, thin sliver at the very top). Approximate stacked values read from the graph:

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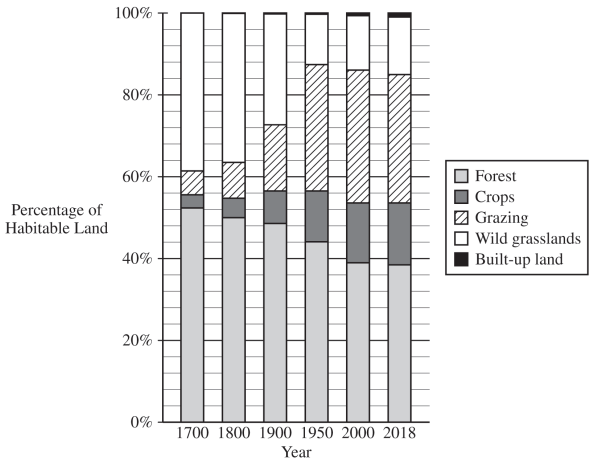
(a) Based on the data in the graph, identify the year with the highest percentage of forest.

Question 2


100%
80%
60%
40%
20%
0%
Percentage of Habitable Land
1700
1800
1900
1950
2000
2018
Year
Forest
Crops
Grazing
Wild grasslands
Built-up land

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(b) Based on the data in the graph, describe the relationship between the land use changes in the wild grasslands and grazing from 1700 to 1950.

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(c) Identify an environmental problem associated with overgrazing by livestock.

Question 2

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(d) A student hypothesized that the change in the percentage of forest from 1700 to 2018 has decreased atmospheric carbon dioxide concentrations. Explain whether the hypothesis is supported or refuted based on the data in the graph.

Question 2

2024 Set 2 ▪ Q2

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(e) Urban environments have accounted for an increasing percentage of land use within the last few decades.
Describe a water-related environmental problem associated with urbanization.

Question 2

2024 Set 2 ▪ Q2

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(f) Describe a potential response to mitigate the environmental problem identified in part (e).

Question 2

2024 Set 2 ▪ Q2

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Question 2

(g) Farmers who own large sections of cropland notice that bobcats, a medium-sized predatory forest cat, were present many years ago but are now virtually absent in the area. Instead, smaller mammal species now inhabit the area. Over time, the farmers have cleared nearly all of the forest on their property and converted it to farmland. Explain why there are fewer bobcats present on the farmland now compared to several decades ago.

Question 2

2024 Set 2 ▪ Q2

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Question 2

(h) The small mammal species are considered pests by the farmers. The farmers partner with a conservation group to increase the number of bobcats in the area. As a solution, the conservation group will introduce bobcats onto the few isolated patches of the original forested habitat left in the area. They can introduce only a small number of bobcats in each patch.
Describe a disadvantage of introducing only a small population of bobcats.

Question 2

2024 Set 2 ▪ Q2

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(i) Propose a solution to improve the chances that the bobcat reintroductions will be successful in reestablishing wild populations.

Question 2

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(j) Justify the solution proposed in part (i) by describing an additional advantage, other than reestablishing the bobcat population near the farms.

Solution 2

(a)

Mark scheme

- The year with the highest percentage of forest is 1700 (the earliest year shown, before land conversion to grazing/agriculture/urban use). Full credit for identifying 1700.

Solution 2

(b)

Mark scheme

- From 1700 to 1950, the percentage/amount of wild grasslands decreased while the percentage/amount of grazing land increased – the two variables have an inverse relationship (as one goes down, the other goes up). Full credit for describing this inverse relationship.

Solution 2

(c)

Mark scheme

- An environmental problem from overgrazing by livestock: any one of loss of vegetation, soil erosion, desertification, sedimentation/turbidity in waterways, or soil compaction. Full credit for naming one such problem.

Solution 2

(d)

Mark scheme

- The hypothesis is refuted/disproved/not supported. The percentage of forest has decreased from 1700 to 2018, so the amount of photosynthesis/carbon sequestration by forests has also decreased – this would tend to increase, not decrease, atmospheric CO2, contradicting the hypothesis. Full credit for concluding 'refuted' with reasoning tied to the graph.

Solution 2

(e)

Mark scheme

- A water-related environmental problem from urbanization: any one of (1) increased runoff/flooding because urban areas have more impermeable surfaces; (2) decreased groundwater/saltwater intrusion because urban areas have many people and groundwater is overused; (3) increased water pollution because precipitation/runoff carries contaminants/pollutants/waste; (4) destruction of aquatic habitats from increased development/land-use change. Full credit for describing one such problem.

Solution 2

(f) Mark scheme

- A potential mitigation matched to the problem named in part (e): if increased runoff/flooding – use permeable road/parking materials, set aside green spaces/parks/conservation areas, or construct green roofs/rain gardens/stormwater retention ponds; if decreased groundwater/saltwater intrusion – permeable materials, groundwater conservation/management plans, protected recharge zones, or green roofs/rain gardens/retention ponds; if increased water pollution – encourage walking/biking, reduce home pesticide/fertilizer use, reduce road salt/de-icing chemical use, pick up trash/litter along waterways, or properly dispose of toxic chemicals; if destruction of aquatic habitats – create conservation

Solution 2

areas/preserves/wetlands or restore degraded aquatic habitats. Full credit for any response that logically mitigates the problem identified in (e).

Solution 2

(g)

Mark scheme

- Fewer bobcats are present on the farmland now because: (1) loss of forest habitat (cleared for farmland) has decreased resources such as food, shelter, mates, or migration routes; or (2) trapping/hunting has reduced the bobcat population. Full credit for either explanation.

Solution 2

(h)

Mark scheme

- A disadvantage of introducing only a small bobcat population: any one of (1) lower genetic diversity; (2) genetic bottlenecks leading to inbreeding/passing on negative traits; (3) greater vulnerability to disease or disturbances like wildfire; (4) less effective control of small mammal/pest populations than a larger population; (5) lower likelihood of survival. Full credit for any one such disadvantage.

Solution 2

(i)

Mark scheme

- A solution to improve reintroduction success: (1) increase connectivity/build habitat corridors so bobcats can safely mate, find food, and build dens; or (2) restore/reforest/preserve areas of bobcat habitat. Full credit for either proposal.

Solution 2

(j) Mark scheme

- An additional advantage of the proposed solution (beyond reestablishing bobcats), matched to the answer given in (i): if habitat corridors – they can be used by other species, increase biodiversity/population of other species, attract species beneficial to farmers (pest predators/pollinators), or reduce roadkill/vehicle collisions with wildlife; if restoring/reforesting/preserving habitat – restored habitat can be used by other species, restoration can increase biodiversity/improve air or water quality, or added trees improve aesthetic value, tourism, reduce erosion, or serve as a carbon sink. Full credit for any advantage consistent with the part (i) solution.

Question 4

2014 ▪ Q4

Biogeochemical cycles describe the movement of certain elements (typically bound with other elements in compounds) through Earth's atmosphere, hydrosphere, biosphere, and lithosphere. These elements and their compounds are necessary components of all life, and because they cycle, they can be used repeatedly by new generations of organisms. Each biogeochemical cycle has different pathways with various reservoirs (sources and sinks) where elements may reside for days or millions of years.

(a)(i) The atmosphere is one important carbon reservoir.
Describe a biological process by which carbon is removed from the atmosphere and converted to organic molecules.

(a)(ii) Describe a biological process by which carbon is converted from organic molecules to a gas and returned to the atmosphere.

Question 4

2014 ▪ Q4

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(b)(i) Oceans and terrestrial systems are also important carbon reservoirs. Explain how atmospheric carbon is incorporated into two oceanic sinks.

(b)(ii) Identify one terrestrial sink, other than fossil fuels, that stores carbon for thousands to millions of years.

Question 4

2014 ▪ Q4

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(c) The burning of fossil fuels has been shown to increase the concentration of carbon in the atmosphere. Discuss TWO other human activities that increase the concentration of carbon in the atmosphere.

Question 4

2014 ▪ Q4

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(d) Identify an environmental problem that results from elevated atmospheric carbon concentrations. Discuss one consequence of the problem you identified.

Question 4

2014 ▪ Q4

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(e)(i) Phosphorus is another element important to all organisms.
Describe one major way in which the phosphorus cycle differs from the carbon cycle.

(e)(ii) Identify one reason that phosphorus is necessary for organisms.