Diploma Programme
Programme du diplôme
Programa del Diploma

Environmental systems and societies
Standard level
Paper 2

Monday 31 October 2022 (morning)

Candidate session number

2 hours

Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[65 marks]**.

8822 – 6303

23 pages

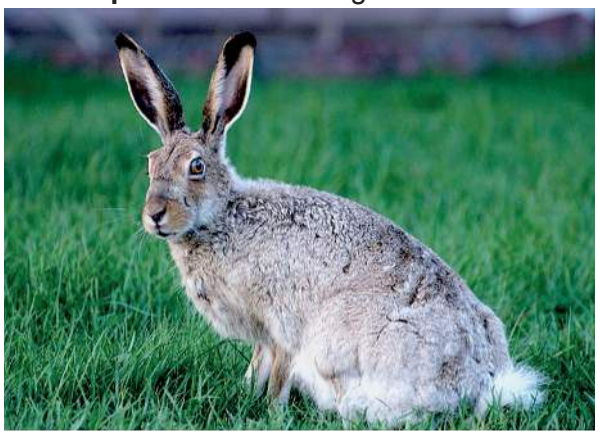
Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

1. The family *Leporidae* includes hares and rabbits. The figures show four species that can be found in western North America.

Figure 1(a): Four species of the family *Leporidae*

Species A: Length 55–66 cm



Species B: Length 35–40 cm

Species C: Length 46–63 cm

Species D: Length 25–29 cm

Figure 1(b): A dichotomous key for species A to D

1.	a.	Less than 30 cm in length	**pygmy rabbit** (*Brachylagus idahoensis*)
	b.	Greater than 30 cm in length	go to 2
2.	a.	Has black tail	**black-tailed jackrabbit** (*Lepus californicus*)
	b.	Has a mostly white tail	go to 3
3.	a.	Has short rounded ears	**Nuttall's cottontail** (*Sylvilagus nuttallii*)
	b.	Has ears at least 2.5 times as long as wide	**white-tailed jackrabbit** (*Lepus townsendii*)

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(Question 1 continued)

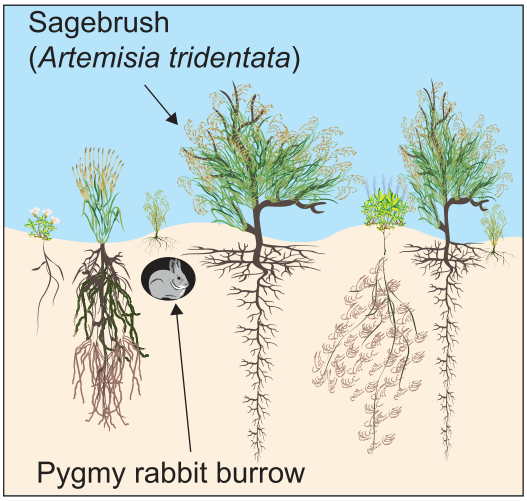
(a) Use **Figures 1(a)** and **1(b)** to identify Species B and Species C. [2]

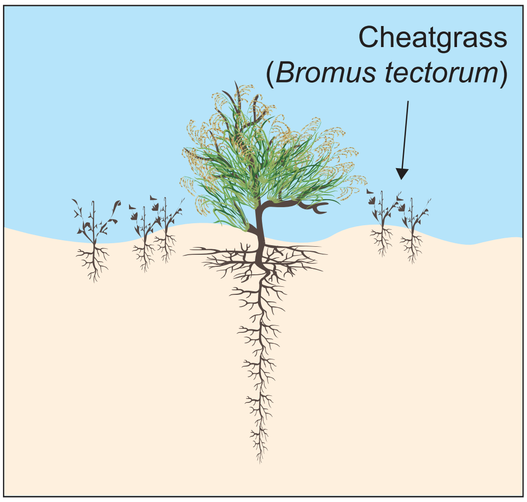
Species B:	. . . .
Species C:	. . . .

Figure 1(c): Sagebrush ecosystem without invasive cheatgrass

Figure 1(d): Sagebrush ecosystem with invasive cheatgrass

Figures not to scale





(b) The sagebrush ecosystem provides a habitat for pygmy rabbits. Suggest **one** reason why there might be a greater number of pygmy rabbits in the ecosystem shown in **Figure 1(c)** than in the ecosystem shown in **Figure 1(d)**. [1]

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(Question 1 continued)

(c) Describe **one** method to determine the impact of invasive cheatgrass on sagebrush density. [3]

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(d) Distinguish between the biodiversity of the sagebrush ecosystems in **Figures 1(c)** and **1(d)**. [2]

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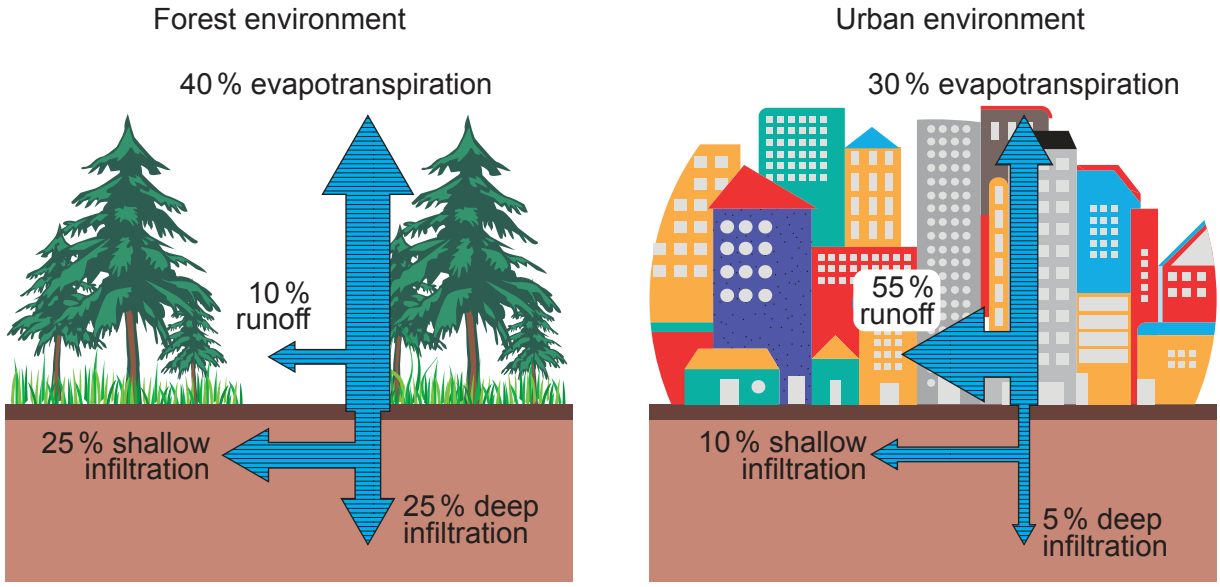
Figure 2(a): Water transfers and transformations after rainfall in forest and urban environments



2. (a) Identify **one** transformation shown in **Figure 2(a)**. [1]

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(b) Calculate the difference in water infiltration between the forest and urban environments. [1]

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(c) Outline how **one** storage in the hydrological cycle decreases with urbanization. [1]

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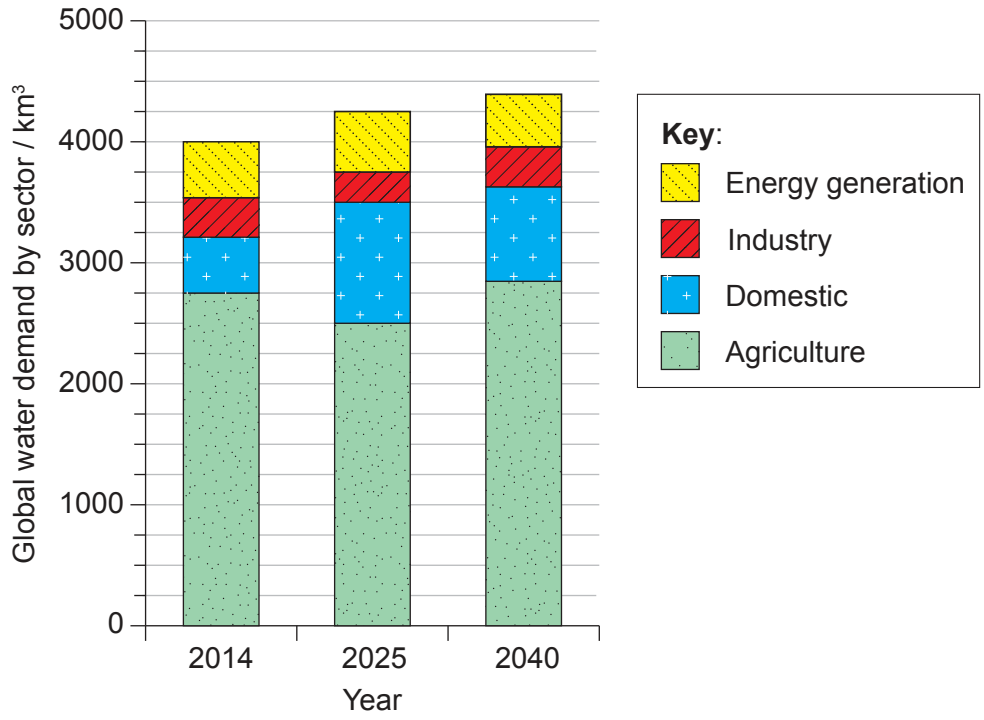
(Question 2 continued)

Figure 2(b): Global water demand by sector for 2014, and projected for 2025 and 2040



(d) Calculate the percentage of water projected to be used for agriculture in 2025, shown in **Figure 2(b)**. [1]

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(e) Suggest **one** reason for the projected decrease in the demand for water in agriculture between 2014 and 2025, shown in **Figure 2(b)**. [1]

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(Question 2 continued)

(f) Outline **two** reasons why water demand shown in **Figure 2(b)** is projected to increase globally from 2014–2040. [2]

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(g) Outline **two** strategies to meet an increasing demand for domestic water. [2]

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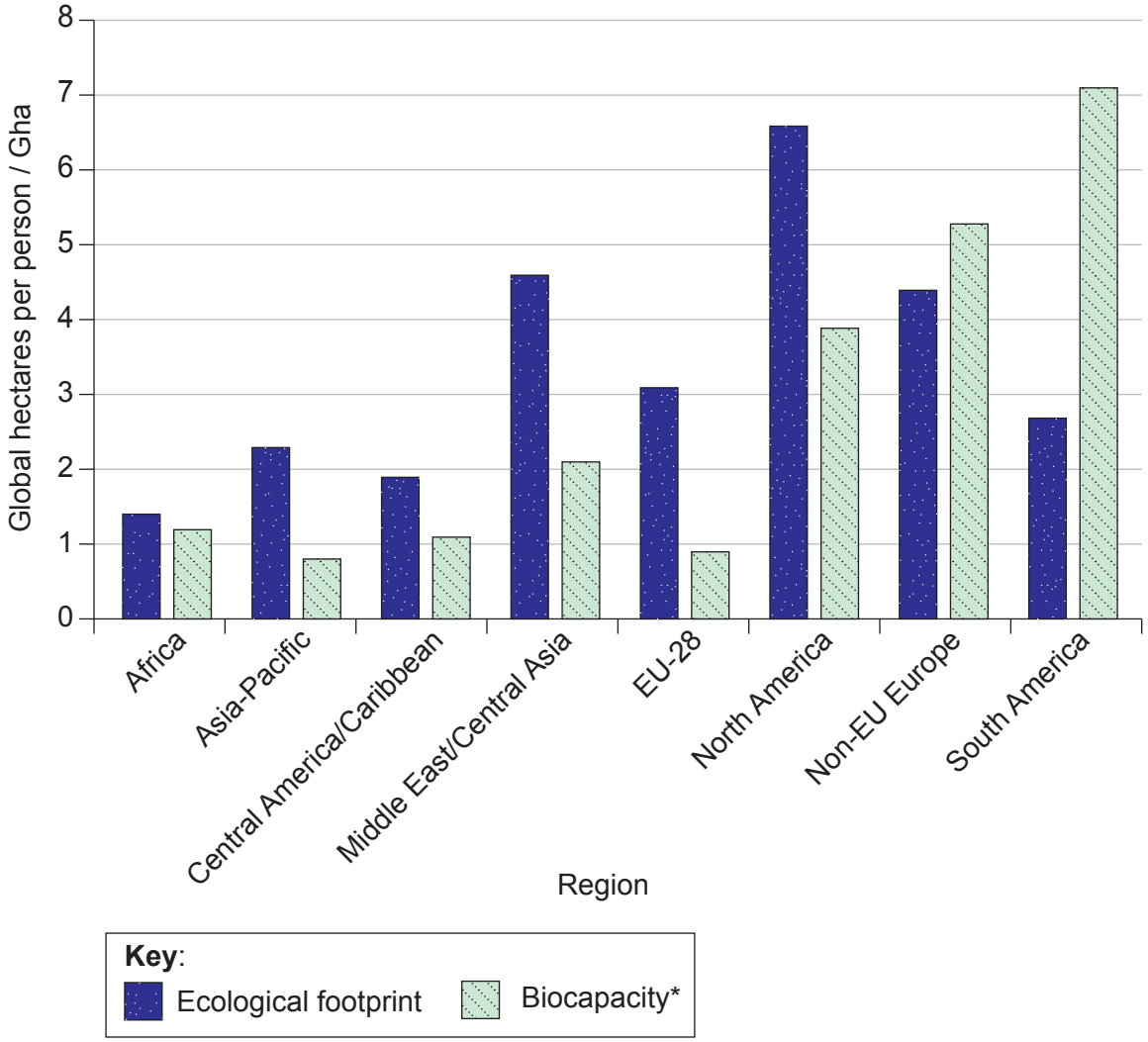
Figure 3: The ecological footprint and biocapacity* for selected world regions, 2016



*Biocapacity: amount of biologically productive land, measured in total hectares per person

3. (a) Identify **one** region shown in **Figure 3** that has an ecological footprint less than its biocapacity. [1]

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(b) Outline **one** reason why a region whose ecological footprint is greater than its biocapacity is considered unsustainable. [1]

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(Question 3 continued)

(c) Outline **one** way in which a region can exceed its carrying capacity. [1]

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(d) Productivity contributes to the biocapacity of land. Outline **one** climatic factor that limits the primary productivity of a region. [1]

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(e) Evaluate the use of the ecological footprint as a model. [4]

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Section B

Answer **two** questions. Answers must be written within the answer boxes provided.

4. (a) Distinguish between point and non-point sources of pollution with reference to **named** examples. [4]

(b) For a **named** water pollutant, evaluate **two** management strategies to maintain the sustainability of water sources. [7]

(c) Human activities have improved global air quality during the past 50 years. With reference to examples, discuss this statement. [9]

5. (a) Describe biotic and abiotic factors with reference to a **named** ecosystem. [4]

(b) Using a system diagram, explain the transfer and transformation of energy as it flows through an ecosystem. [7]

(c) With reference to **named** societies, to what extent do environmental value systems influence the use of resources? [9]

6. (a) Outline the role of the greenhouse effect in regulating the temperature on Earth. [4]

(b) Using examples, evaluate **two** solid domestic waste disposal strategies as methods to mitigate climate change. [7]

(c) Using examples, discuss the potential impacts of climate change on ecosystem services. [9]

7. (a) Outline the mechanism of natural selection. [4]

(b) Explain the link between soil fertility, primary productivity and human activity. [7]

(c) Using examples, discuss how social, cultural, political and economic factors influence societies in their choice of food production systems. [9]

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References:

Figure 1(a) Nuttall's Cottontail (*Sylvilagus nuttallii*). Public domain image by Justin Wilde. https://commons.wikimedia.org/wiki/File:Nuttall%27s_Cottontail_(Sylvilagus_nuttallii).jpg.

Pygmy Rabbit (*Brachylagus idahoensis*) - Photo Public Domain by Beth Waterbury, Idaho Fish and Game. https://idfg.idaho.gov/species/taxa/17243.

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Figure 2(a) U.S. Environmental Protection Agency, Washington, D.C., 2003. *Relationship between impervious surfaces and surface runoff*. [online] Available at: https://en.wikipedia.org/wiki/Stormwater#/media/File:Natural_&_impervious_cover_diagrams_EPA.jpg [Accessed 10 September 2020].

Figure 2(b) International Energy Agency (2016), *Water Energy Nexus: Excerpt from the World Energy Outlook 2016, IEA*. Licence: Creative Commons Attribution CC BY-NC-SA 4.0. Based on data from International Energy Agency (2016), as modified by International Baccalaureate Organization.

Figure 3 Global Footprint Network, n.d. Free public data set. [online]. Data used to create ecological footprint and biocapacity graph. Available at: https://www.footprintnetwork.org/licenses/public-data-package-free/. Under copyright and licensed under a Creative Commons Attribution-ShareAlike 4.0 International License. https://creativecommons.org/licenses/by-sa/4.0/.