



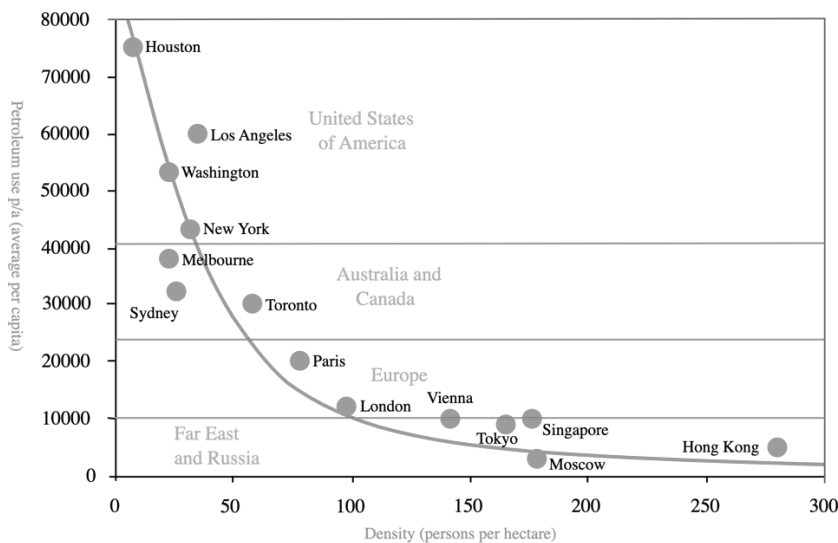
Name \_\_\_\_\_

Country OR State \_\_\_\_\_

**General instructions** - Respond to each of examination questions in the space provided on the answer document. Only answers written in the appropriate space on the answer document will be marked. Where appropriate, you should write sentences or phrases instead of single words. If a question or section asks for a specific number of reasons or answers, give only the number of answers specified. Show your work on all mathematical calculations. Please write clearly and legibly.

**Section 1 – Urban Sprawl and the Environment [13 points]**

Section 1 refers to the image below.



- Given the information on the graph, describe the relationship between petroleum use and population density. Be as specific as possible in the space provided.
- Describe TWO strategies cities like Houston and Los Angeles could reduce petroleum use per capita.
- Identify and explain TWO ways in which urban sprawl impacts human health.
- Identify and explain TWO environmental impacts of urban sprawl.
- Identify ONE way that a city could mitigate an environmental impact you identified in part D.
- Describe TWO strategies that cities could use to encourage increased population density and control urban sprawl.

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## Section 2 – Arable Land and Population [24 points]

### Background information –

The world's population is steadily increasing, and with it the demand for food is also on the rise. There is a finite amount of arable land on Earth, which the UN's FAO estimates is roughly 42.5 million km<sup>2</sup>. Use the information in the chart below to help answer the following questions about agriculture – the chart shows the amount of land needed to feed the world's population from 1900 to the projected amount needed in 2060.

Year	1900	1920	1940	1980	2000	2020	2060
Land needed (million km <sup>2</sup> )	4.0	5.0	6.0	12.5	16.0	25.0	47.5

- A. On the graph provided on the answer document, plot the data from the table. Connect the points on the graph with a smooth curve.
- B. Given the information on your graph, in what year will the world run out of arable land to feed its population if present trends continue?
- C. Identify and explain THREE realistic strategies that could be implemented to reduce the amount of land needed to feed the world's population.
- D. Define the term salinization. Why do modern agricultural practices often cause salinization? Identify and explain THREE detrimental effects of salinization on either agriculture or the environment.
- E. Identify TWO physical characteristics of soil that would make it unsuitable for agriculture.

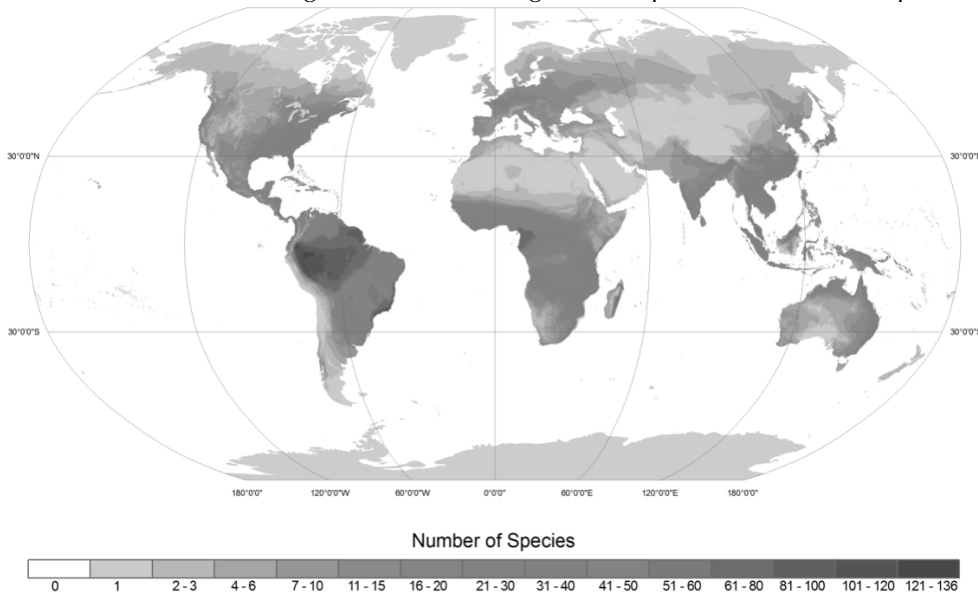
## Section 3 – Population Growth [12 points]

- A. Define the term total fertility rate.
- B. In the space provided, briefly explain how the Demographic Transition Model predicts total fertility rate will change as a country transitions from Stage 1 to Stage 2.
- C. Briefly explain how increasing access to educational opportunities for women is likely to affect the total fertility rate.
- D. Briefly explain how increasing access to health care and family planning for women is likely to affect the total fertility rate.
- E. Identify and explain TWO policies countries might enact to encourage people to have more children.

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#### Section 4 – Species Richness [11 points]

Section 4 refers to the image below. This image shows species richness of amphibians throughout the globe.



- Identify the biome in which species richness is the highest.
- Explain TWO reasons that amphibian richness would be the highest in this biome.
- Identify and explain TWO environmental threats to amphibian species in this biome.
- Identify and explain TWO anthropogenic reasons for deforestation in this biome.
- Briefly explain the link between species richness in an ecosystem and its ability to respond to environmental stressors or disruptions.

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## Section 5 – Agriculture and Climate Change [13 points]

Use the image in section 5 to complete the following.

### Change in potential average yields for corn, potatoes, rice, and wheat in 2050



- A. Given the information on the map, will agricultural production increase or decline by 2050 in each of these areas – the United States, Brazil, India, China, Canada
- B. Explain how climate change will affect crop biodiversity and how these changes will impact agricultural production. Be as specific as possible in the space provided.
- C. Explain how changes in the hydrologic cycle due to climate change will affect agricultural production in both Australia and the United States. Be as specific as possible in the space provided.
- D. Explain how climate change will affect growing seasons throughout the world for the four staple crops listed. Be as specific as possible in the space provided.
- E. In the space provided, define and briefly explain the concept of climate-smart agriculture.

Continue to the next page.

## Section 6 – Environmental Impact of Steel Production and Mining [27 points]

Use the information below to complete the following.

### Background information –

Steel is produced from pig iron through an industrial process that reacts molten pig iron with oxygen to remove impurities. Coal is a major component of the steelmaking process, since metallurgical coal is used as the main source of carbon in steel production. Pig iron is produced by passing iron ore through a blast furnace to remove impurities, creating rock waste as a byproduct.

Since both iron ore and coal must be mined for steel production, recycling steel reduces the need for both of these raw materials. It is estimated that roughly 50 million tons of steel were recycled in the US in 2020. For each ton of steel recycled, 1.25 fewer tons of iron ore and .75 fewer tons of coal must be mined, so steel recycling is an extremely effective way to reduce environmental impact.

In 2020, roughly 2.3 billion tons of iron ore were used to make pig iron, resulting in the production of 1.9 billion tons of pig iron. Of the iron ore mined each year, 95% is used in the production of steel. As of 2020, it is estimated that there are 780 billion tons of iron ore remaining in worldwide reserves.

- A. Calculate the weight in tons of both coal and iron ore that were saved in the US in 2020 as a result of recycling of steel. Show your work.
- B. If pig iron production numbers remain constant, how many years would it take for global iron ore reserves to be exhausted? Round your answer to the nearest whole number. Show your work.
- C. How much rock waste in tons was produced in 2020 from the production of pig iron from iron ore? Show your work.
- D. If all of the remaining iron ore in the world was used to make pig iron, how much pig iron would be produced? Show your work.
- E. Identify and explain two environmental impacts that result from the industrial production of steel.
- F. Identify and explain two environmental impacts of abandoned coal mining sites.
- G. Identify and explain two methods that specific environmental impacts you discussed in parts E or F could be mitigated.

**This is the end of the exam.**