



20th International Geography Olympiad

Maynooth, Ireland

19–24 August 2024

WRITTEN RESPONSE TEST

Marking Scheme

Instructions for Markers

1. **Check if the iGeo student numbers are on each sheet (on odd pages) before dividing up the Test.**
2. This test consists of 6 sections.
3. The maximum total mark is 90.
The mark for each question is given in the margin at the beginning of the question.
There is a maximum of 15 marks for each section.
4. One whole section per marker and double-checker.
Some lengthy (more than 2 pages) sections may be divided for two marker-pairs.
5. Get the hang of the full range of answers by reading through a few papers with your co-marker before you start your marking.
You can mark together (especially for level marking), or after establishing a consensus on how to mark for thoroughness and consistency, act as each other's double-checkers by marking half of the test and then swapping the pile.
We strongly recommend whenever in doubt, consult your marking partner and, if appropriate, the designated moderator(s).
6. Please develop your own marking/correcting notation system (using +/-, x/0, $\sqrt{\quad}$ marks), underlining, comments etc. to ease double-checking and sample marking.
7. **These answers here are not exhaustive. Credit any relevant answer.**
8. Check whether the answer continues outside the designated area, in the margins or as clearly marked on blank pages.
No credits will be given to answers in the Resource Booklet.
9. The test uses two marking systems: point and level marking.
10. Half marks can only be given where indicated as the total of 90 marks will yield only 40% of the total Olympiad result.
11. Mark only the required number of answers (reasons, examples etc.).
For instance, if the question asks for 2 reasons and there is more than 2, only the first 2 reasons should be marked.
12. Put your final mark next to the question number in the column on the left – it eases the work of the person who has to put the numbers into MS Excel.
Please write your numbers clearly.
13. Please write down any inconsistencies of the Marking Scheme, revisions and additional answers or answers not accepted on the Notes page at the end of the Booklet (e-mail is preferred) and hand them in after marking to improve the final Marking Scheme that will be uploaded to show the actual marking.
14. The moderator(s) will sample the marking of all teams.

Command Terms for use in Written Response Test

Terms	Meaning
Analyse	break down the content of a topic, or issue, into its constituent parts in order to provide an account of it
Annotate	add labels with short comments to a diagram, map or photograph in order to describe or explain
Describe	give a factual statement of the distinctive features of something, e.g. for a landform, its shape, dimensions, composition, location (do not explain)
Discuss	give a thorough account from different points of view
Draw	make a clearly defined diagram, flowchart or map, and include labels
Elaborate	give further detail
Estimate	approximately calculate the number
Explain	give a reason, a cause, an effect, a consequence for why or how something happens
Evaluate	consider several arguments or options and come to a conclusion about their importance or success
Forecast	predict or estimate (a future event or trend)
Identify	name, select, point out something
Justify	provide sound reasons or evidence on which your response is based
Label	add names to a map, diagram, sketch or table
Match	put something together with something else that is appropriate or related
Name	state or specify, using a word or words by which something is known
Outline	give the main points or general principles of something, omitting minor details, and usually emphasizing structure and relationships
Specify	identify clearly
Study	look closely at the details in
Suggest	put forward an idea or a reason
With the help of the information provided	base answer partly on information provided (refer to this material) and partly on own knowledge

In level marking in order to credit higher marks the response has to cover a multi-perspective view with a range of factors/impacts from different spatial and temporal scales forming a thorough and well-elaborated account.

Section A: Plastic pollution in oceans

Resource Booklet Figure A1 provides information on ocean gyres in the world.
Resource Booklet Figure A2 shows the plastic waste emitted to the ocean per capita by country in 2019.
Resource Booklet Figure A3 shows the share of global plastic waste emitted to the ocean by country in 2019.

1 m 1. Name the natural resource from which most plastics are produced.

Point marking.

Suggested answers (award **one** of the answers listed):

- Fossil fuels
- Crude oil
- Petroleum
- Natural gas

Award **1 mark** for a correct answer.

Accept any other relevant and complete answer.

2 m 2. Identify two sources used to produce bioplastics.

Point marking.

Suggested answers (award **two** of the answers listed):

- Renewable biomass sources
- Vegetable fats
- Vegetable oils
- Corn starch
- Proteins
- Sugar
- Cellulose (straw, woodchips, sawdust)
- Rubber trees
- Recycled food waste

Award **1 mark** for each correct answer.

Award a maximum of 2 listed sources.

Accept any other relevant and complete answer.

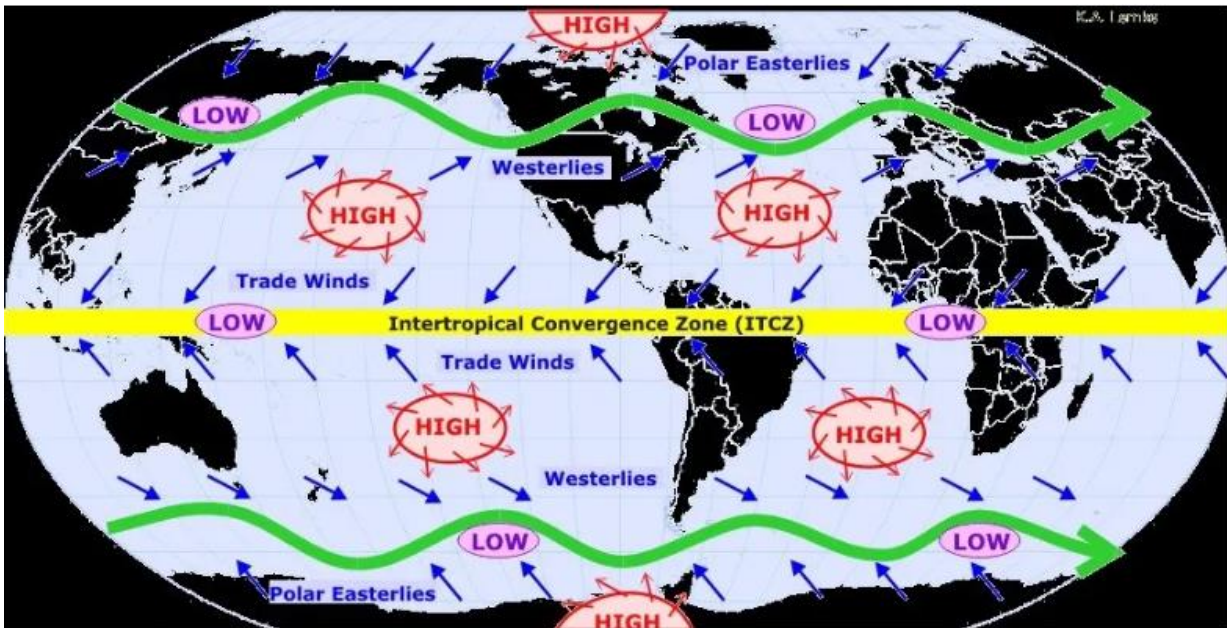
5 m

3. Study Resource Booklet Figure A1. Ocean gyres are locations where large amounts of plastic and other waste accumulate.

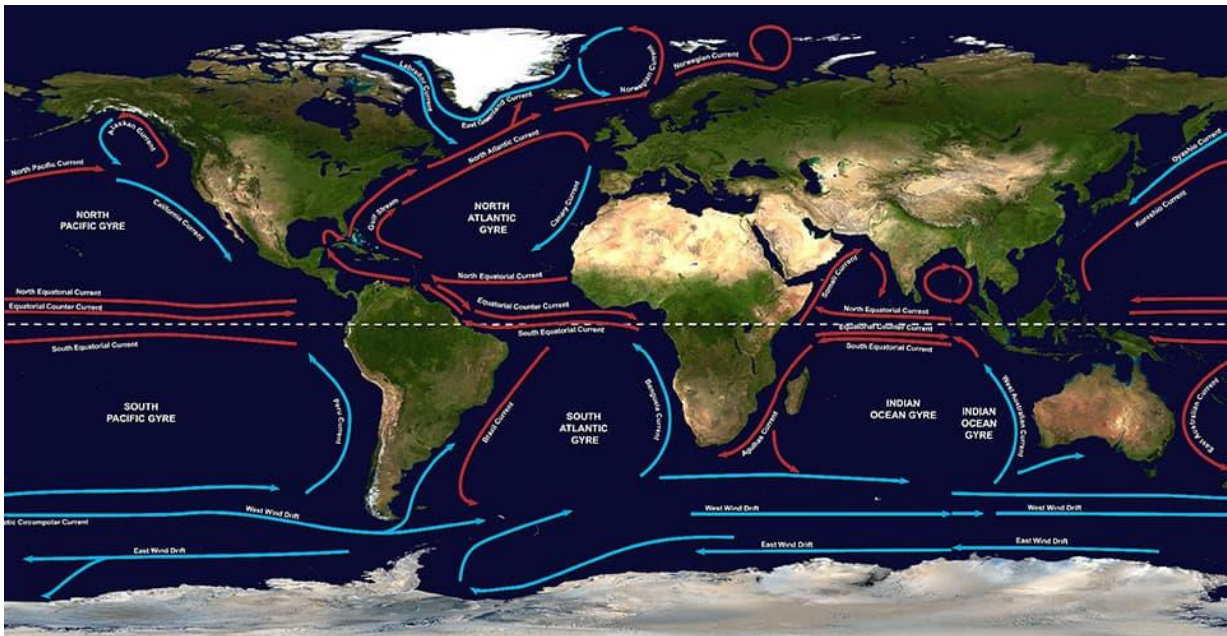
a) Choose **one** of the ocean gyres. Draw and label a diagram to show the wind patterns **and** ocean currents that contribute to the formation of your chosen gyre in the space below.

Point marking.

Use the following maps to assist in marking.



(https://encryptedtbn0.gstatic.com/images?q=tbn:ANd9GcS3bhM4ptJD_QIJ4tuVYJpJqbQBrExSq3Anqw&s)



(<https://oceanservice.noaa.gov/facts/gyre.jpg>)

The sketch must show a selected ocean gyre in a complete environment of winds and ocean currents with the surrounding continents. It must include the **following**:

- The ocean gyre is shown in a specific area with surrounding continents outlined.

- Location and movement/directions of wind patterns for the selected location.
- Labelled *trade winds* and *westerlies*.
- Location and movement/direction of ocean currents for the selected location.
- Cold and warm currents drawn in different ways (colours, lines...).

Award **5 marks** for the map – **1 mark** for each of the following key elements drawn on the map:

- setting of continents and ocean(s) for the selected location
- location and direction/movement of winds from the air pressure maximum on selected location
- labelled trade winds and westerlies
- location and direction/movement of ocean currents for the selected location
- cold and warm ocean currents labelled in a different way

Award **0.5 mark** for each partially marked element on the map.

Accept any other relevant and complete answer.

2 m

b) Explain the **reasons** for the accumulation of plastic pollution in the location you have chosen.

Point marking.

Suggested answer:

- The circular nature of **ocean currents** (convergence) formed by global **wind patterns** and forces created by **Earth's rotation** (Coriolis effect) then move the plastic (and other garbage) into ocean gyres.
- Poor management of **plastic disposal on land** leads to run-off into **rivers which empty into oceans**.

Key elements:

Accumulation of plastic waste into **ocean gyres**:

- convergence of ocean currents
- global wind patterns
- Earth's rotation (Coriolis effect)

Production and discharge of plastic waste into oceans:

- plastic disposal on land
- plastic discharged into rivers
- rivers empty plastic into oceans

Award **2 marks** for a complete answer that includes an explanation of both accumulation of plastic waste into ocean gyres and production and discharge of plastic waste into oceans.

Award **1 mark** for a complete explanation of the accumulation of the plastic waste in oceans that includes two key elements.

Award **0.5 mark** for an incomplete explanation of the accumulation of the plastic waste in oceans that includes one key elements

Award **1 mark** for a complete explanation of the production and discharge of the plastic waste that includes two key elements.

Award **0.5 mark** for an incomplete explanation of the production and discharge of the plastic waste that includes one key elements

Accept any other relevant and complete answer.

2 m

4. Study Resource Booklet Figures A2 and A3.

Describe two **spatial patterns** regarding the origin of plastic waste emissions into the oceans. Provide specific data from the sources. Your answer should refer to regions and/or multiple countries, not individual countries.

Point marking.

Suggested answers:

- Countries with a high percentage of plastic emissions do not necessarily have a high per capita of emissions (the larger percentage of plastic emissions is due to high human populations – e.g. India, China)
- Brazil, Philippines, Indonesia are high in per capita and percentage of plastic emissions.
- Many of the highest emitters are in LDCs or developing economies.
- The highest emitters are in SE Asia.
- Most of the highest emitters are countries on a sea or ocean or with large river systems.
- The highest emitters have limited efficient garbage handling systems and open landfills.
- Countries with a smaller geographical area, longer coastlines, high rainfall, and poor waste management systems are more likely to wash plastics into the sea.

A complete answer can refer to data from sources in a descriptive way (e.g. greater percentage of the world's plastic emissions) or in a quantitative way (e.g. more than 10% of the world's plastic emissions).

Award **2 marks** for two described spatial patterns.

Award **1 mark** for each pattern with a reference to data from sources.

Award **0.5 mark** for each pattern without reference to data from sources.

Accept any other relevant and complete answer.

3 m

5. Study Resource Booklet Figures A1-A3.

Using the sources provided and your geographical knowledge discuss why it is difficult to eliminate plastic pollution from **entering** the oceans. Give at least three arguments.

Point marking.

Suggested answers:

- Plastics continue to be produced and used all over the world. The demand for plastics remains high.
- Much of the plastic pollution is discarded on land, then ends up in rivers or landfill sites and from there into the oceans – a ban on the use of plastic in every country would reduce this problem.
- Better waste management on land would help reduce the amount of plastic that ends up in the oceans
- There is a global trade in plastic products and waste to places where there is insufficient infrastructure for safe and environmentally sound management.
- Incineration in combined heat and power plants, recycling, upcycling and downcycling are limited in their use and have restrictions or negative impacts.
- In many countries, plastic pollution is not a high priority for the government or citizens, so no action is taken.
- Lack of political will.
- Limited enforcement of existing laws.

- International nature of the problem – there are few treaties that are not honoured.
- Out of sight out of mind – the marine areas heavily affected by plastic pollution are far away from the sources of pollution and are not seen by people on a daily basis.

Answers must refer to stopping plastics from entering the oceans and not eliminating the plastics once it reaches the ocean.

Award **3 marks** for three elaborated arguments.

Award **1 mark** for each elaborated argument that includes students' knowledge **and** refers to sources.

Award **0.5 mark** for each argument that includes students' knowledge **or** refers to sources.

Section B: Amazon rainforest ecosystem

Resource Booklet Figure B1 shows an overview of tropical forest degradation processes in the Amazon.

Resource Booklet Figure B2 shows the distribution of PM_{2.5} persistent organic pollutants in the atmosphere in the Amazon Forest.

Resource Booklet Figure B3 shows the extent of deforestation in the Amazon Forest.

3 m

1. Study Resource Booklet Figure B1.

Identify **three main reasons** for the deforestation of the Amazon rainforest.

Point marking.

Suggested answers:

- Agriculture – clearing large areas of forest to get arable land to grow tropical cultures, particularly soy beans.
- Cattle ranching – large areas of forest are cleared to make way cattle raising, particularly to produce beef.
- Selective logging – for commercial purposes. Trees are cut down for timber used in furniture, paper, and other products.
- Mining – the demand for minerals like gold and iron ore drives mining in the Amazon. Mining activities are causing widespread destruction to the rainforest, including water pollution and soil degradation.
- Human activity (human settlements and infrastructure) – building settlements on the edge of rainforest increases the human pressure. Infrastructure development, such as roads, dams, and hydropower projects, is also contributing to deforestation.
- Fire – often caused by agricultural practices but can be exacerbated by extreme droughts
- Extreme droughts – become increasingly frequent in the Amazon as land-use change and human-induced climate change progress, affecting tree mortality, fire incidence, and carbon emissions to the atmosphere.
- Lack of governance / corruption.
- Population growth.

Award **3 marks** for three identified and explained reasons.

Award **1 mark** for each identified and explained reason.

Award **0.5 mark** for each identified reason without an explanation.

Accept any other relevant and complete answer.

3 m

2. Study the Resource Booklet Figures B2 and B3.

Analyse the **spatial relationship** between the intensity of PM 2.5 emissions and the extent of deforestation.

Point marking.

Suggested answer:

- The intensity of PM 2.5 emissions is generally positively correlated with the extent of deforestation.
- In the south-eastern part of the Amazon region, for example, the highest PM 2.5 emissions (> 0.02) are concentrated in the areas with the greatest deforestation (105 km²). The situation is similar in the south-western part of the Amazon, where the lowest concentration of PM 2.5 emissions coincides with the least deforestation.
- The cause of the above relationship is forest fire, which causes more PM to be released into the atmosphere and increases the PM concentration in the area of deforestation.
- On the other hand, areas with a low deforestation rate have a mean PM concentration that is higher than it should be. This could be due to the wind factor, which flows from east to west and brings the particulate matter with it. As a result, some areas with high deforestation in the east do not have high PM levels, while some areas in the centre have higher PM levels without significant deforestation.

A complete answer must contain the following **analysed elements**:

- positive correlation of 2.5 PM emissions and deforestation
- explained examples of the correlation of high/low 2.5 emissions and high/low deforestation using spatial references
- explanation of anomalies due to the wind effect with spatial effects

Award **3 marks** for three completely analysed elements.

Award **1 mark** for each completely analysed element.

Award **0.5 mark** for each partially analysed element.

Accept any other relevant and complete answer.

5 m

3. Study Resource Booklet Figures B1-B3. Using the information provided and your geographical understanding answer the following questions.

a) What is meant by the term **ecosystem services**?

Point marking.

Suggested answers:

- Direct and indirect contributions of ecosystems (known as natural capital) for human well-being and quality of life.
- The various benefits that humans derive from healthy ecosystems.

Award **0.5 mark** for a complete answer.

Accept any other relevant and complete answer.

b) Identify and explain the importance of three ecosystem services provided by the Amazon rainforest.

Point marking.

Suggested answers:

- **Climate regulation** (0.5 mark): The Amazon rainforest plays a crucial role in regulating global climate patterns. Through the process of photosynthesis, the trees and plants of the rainforest absorb carbon dioxide from the atmosphere, one of the main greenhouse gases responsible for climate change. This absorption helps to mitigate the effects of climate change by reducing the concentration of greenhouse gases in the atmosphere (1 mark).
- **Carbon storage** (0.5 mark): The Amazon rainforest is a significant carbon sink as it stores large amounts of carbon in its trees, plants and soils. The dense vegetation of the rainforest sequesters carbon dioxide and helps to offset man-made carbon emissions and reduce the greenhouse effect (1 mark).
- **Biodiversity support** (0.5 mark): The Amazon rainforest is known for its extraordinary biodiversity and is home to an astonishing number of plant and animal species. It serves as a habitat for countless species, including many endemic and endangered species (1 mark).
- **Water regulation** (0.5 mark): The Amazon rainforest plays an important role in regulating the water cycle. The extensive root systems of the trees help to anchor the soil, reduce erosion and maintain the stability of the riverbanks. The dense vegetation also acts like a sponge, absorbing and storing rainfall and gradually releasing it so that the rivers and streams have a steady flow of water all year round (1 mark).
- **Nutrient cycle** (0.5 mark): The Amazon rainforest facilitates the recycling and replenishment of nutrients in the ecosystem. Decomposition processes break down dead organic material and return it to the soil, enriching it with important nutrients (1 mark).

Award **4.5 marks** for three identified and explained ecosystem services.

Award **1.5 marks** for each identified and completely explained ecosystem service:

- Award **0.5 mark** for each identified ecosystem service.
- Award **1 mark** for each completely explained ecosystem service.
- Award **0.5 mark** for a partially explained ecosystem service.

Accept any other relevant and complete answer.

4. Study Resource Booklet Figures B1-B3. Specify two impacts of deforestation of the Amazon rainforest on its **ecosystem services** and two impacts on **human well-being**.

Point marking.

Suggested answers:

Ecosystem Services:	Human Well-being:
<ul style="list-style-type: none"> ● Deforestation disrupts the Amazon's ability to regulate global temperatures as trees are felled and the carbon stored in the biomass and soil is released back into the atmosphere. This contributes to rising global temperatures and exacerbates climate change and its associated impacts. ● Deforestation interrupts the carbon cycle process, as the Amazon rainforest acts as a carbon sink by absorbing carbon dioxide through photosynthesis and storing it in trees, plants and soil. Deforestation leads to the release of significant amounts of carbon into the atmosphere, which contributes to the greenhouse effect and further exacerbates climate change. ● Deforestation disrupts the water cycle, leading to reduced rainfall and altered rainfall patterns. This can lead to droughts, water scarcity and negative impacts on agricultural productivity and downstream ecosystems. 	<ul style="list-style-type: none"> ● The degradation of ecosystem services due to deforestation in the Amazon rainforest is contributing to global climate change. Rising temperatures, changing precipitation patterns and extreme weather events associated with climate change have negative impacts on people's livelihoods, food security, water availability and overall quality of life. ● Deforestation contributes to the deterioration of air quality, mainly through the release of pollutants and particulate matter during land burning and clearing. These emissions can exacerbate respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD), leading to an increase in respiratory diseases and an impairment of the general health and well-being of the local population. ● Deforestation destroys habitats and disrupts ecosystems, leading to the loss of numerous species, including those with potential medicinal, economic and cultural value. The loss of biodiversity negatively impacts the resilience of ecosystems and the potential for scientific discovery and sustainable economic opportunities.

Award **2 marks** for impacts of deforestation on ecosystem services and **2 marks** for impacts on well-being.

Award **1 mark** for each completely specified impact.

Award **0.5 mark** for each partially specified impact.

Do not award just giving a list of impacts without an explanation.

Accept any other relevant and complete answer.

Section C: Monsoon and weather phenomena in Dubai

Resource Booklet Table C1 provides climate data of Kathmandu and Dubai.

Resource Booklet Figure C1 shows Monsoon system mechanism in Indian ocean and surrounding continents.

Resource Booklet Text Box C1 gives information on the flood after a rainstorm in Dubai on 19 April 2024.

Resource Booklet Figure C2 shows satellite images before and during the deluge in the United Arab Emirates in April 2024.

Resource Booklet Figure C3 shows cars stuck on a flooded road after a rainstorm in Dubai on 19 April 2024.

Resource Booklet Figure C4 shows Dubai International Airport flooding in April 2024.

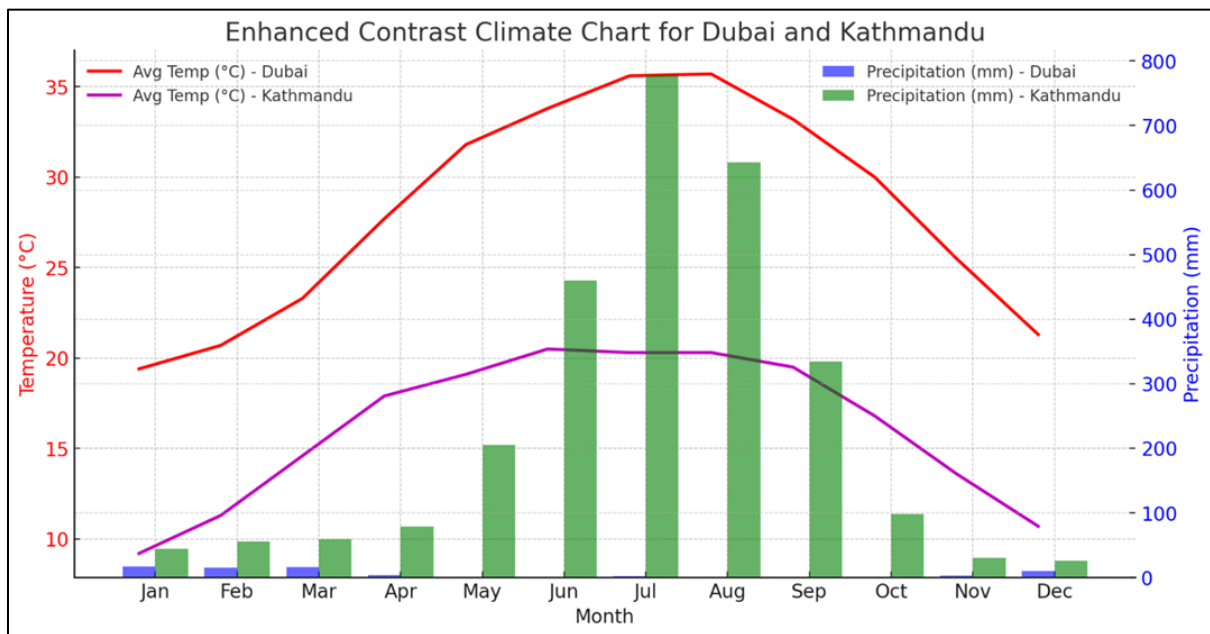
5 m

1. Study Resource Booklet Table C1.

Create a combined climate diagram that compares the precipitation and temperature data for both Dubai and Kathmandu **in one diagram**. Label your diagram appropriately.

Point marking.

Suggested answer:



Award **2 marks** for appropriate climate diagram that displays data of both climates on the same, combined axis.

- 0.5 mark is subtracted if the precipitation bars for both cities are not next to each other. The bars can also lie inside each other, but they must all start at 0 and there must be sufficient contrast between the values of the bars.
- 0.5 mark is subtracted if values are not plotted accurately. Allow a certain amount of rounding to adjust the scale, especially for the small values of precipitation in Dubai.
- 0.5 mark is subtracted if there is an empty space without values on the x- or y-axis (i.e. if the axis is longer than necessary).
- 1 mark is subtracted if the diagram is not drawn using a ruler or very precisely by hand.
- 1 mark (0.5 mark for each axis) is subtracted if the y axis does not start from 0.

Do not award any marks for any other type of diagram as it is not the most appropriate for the data and a key skill is for students to select the most appropriate type for the data.

Award **3 marks** for the following elements – **0.5 marks** for each of the following elements that have been drawn correctly:

- **0.5 mark** for a suitable title that includes reference to the climates of Kathmandu and Dubai.
- **0.5 mark** for the labels on the axes:
 - The x-axis labelled with months numerically (01, 02, etc.) or by name, full or abbreviated (January, Feb, M, etc.).
 - One y-axis labelled with the temperature with values in Celsius (°C).
 - The other y-axis is labelled as precipitation or rainfall in millimetres (mm).
- **1 mark** (0.5 mark for temperature and 0.5 mark for precipitation) expressing Kathmandu and Dubai's data differently and intuitively:
 - Preferably precipitation bars in cold colours (blue, purple, green).
 - Preferably temperature lines in warm colours (red, orange, yellow).
- **1 mark** for a clear legend explaining the colours used for the temperature lines and precipitation bars of the different cities.

Make sure that the design is close to the traditional, classic design of a climate diagram, so that it is easy and intuitive to understand.

Accept any other relevant and correct answer.

1 m 2. Study Resource Booklet Table C1 and the climate diagram you made.

Calculate the average annual temperature **amplitude/range** in Dubai and Kathmandu (round the value to one decimal place).

Point marking.

Answers:

- Dubai: 16.3°C
- Kathmandu: 11.3°C

The temperature amplitude must be calculated from the table data with maximum accuracy to one decimal place.

Award **1 mark** for both correct values.

Award **0.5 mark** for each correct value.

4 m 3. Study Resource Booklet Figure C1 and your climate diagram of Dubai and Kathmandu. Both cities are influenced by the Asian monsoon, but Dubai has completely different rainfall patterns from Kathmandu, which has more typical characteristics of the Asian monsoon climate. Explain the differences between the **rainfall patterns** in Dubai and Kathmandu, although both climates are influenced by the same wind patterns.

Level marking.

Suggested answers:

Dubai – answers should focus on explaining the dryness in general (no significant rainy season, atypical of climates otherwise affected by the Asian monsoon).

- **Dryness** – as the monsoon winds in both phases mainly pass over continents with minimal contact with open water (Persian Gulf or Red Sea compared to the vast Indian Ocean), these winds do not hold much moisture, especially in summer (April to September) when the winds blow from Africa and the Arabian Desert and eventually bring no water to Dubai.
- **Additional reasons** related to rainfall patterns in Dubai in relation to winter when it rains a little in Dubai (and marked as correct additions to the main answer):
 - **Small shift in wind patterns:** In winter, the prevailing winds can be interrupted by “westerly disturbances”, when the winds come from the Mediterranean and the Red Sea and bring more moisture than usual, compared to similar winds in summer.
 - **Lower Temperatures in winter:** Slightly cooler temperatures in winter reduce the evaporation rate. This allows the moisture in the air to condense more easily, which increases the likelihood of occasional rainfall.
 - **Terrain:** Although Dubai is generally flat, it is surrounded by the Hajar Mountains in the east. In winter, these mountains can help to intercept winds that bring in moisture from the east, leading to increased cloud formation and potential orographic rainfall.
 - **Topography and lack of sea breeze:** Dubai is located on the east coast of the Persian Gulf. Usual wind patterns, which are orientated southwest-northeast, rarely blow moist air as sea breezes onto the Persian Gulf coast, as Dubai's coastline and topography are orientated in the same direction and not perpendicular to it. Somali current – cold in winter, no evaporation.

Kathmandu – there are two main reasons that explain the heavy rains in summer that characterise the Asian monsoon in general.

- **Typical Asian monsoon**, which brings in huge quantities of warm, moist air from the Indian Ocean, which begins to condense and continuously produces precipitation as it flows over the continent (Indian subcontinent). The terrain also plays a decisive role, as the orographic effect significantly intensifies the humid monsoon winds. The wind pushes the moist air towards the Himalayan mountains, which act as a barrier. The winds are pushed upwards, which cools the air and condenses the moisture, leading to heavy rainfall in summer.
- **An additional reason** related to the dry winter season in the climate of Kathmandu (Asian monsoon) (and marked as a correct addition to the main answer):
 - **Winds from continent:** Like Dubai in both phases, the winds in Kathmandu in winter come from Asia and cross only relatively dry content that does not bind moisture. In addition, any further moisture is blocked by mountains within the continent (Tibetan Plateau etc.). Benguela current – warm all year, evaporation.

Notes for markers:

- One reason may be emphasised and explained in detail, or several may be given in concentrated form.
- The answer should give specific reasons that explain the characteristics and context within the Asian monsoon system.
- Answers should focus on the importance of wind patterns which, although similar in seasonal directions, affect each climate in different ways, generally because when these winds cross the ocean they bring moisture, but when they come more from the continent the air is dry and there is no rainfall.
- The importance of terrain and topography could also be counted, with precipitation resulting from the rain shadow (orographic effect) or the absence of an ocean breeze.

Award **2 marks** for the explanation of climate in Dubai and **2 marks** for Kathmandu.
Level marking should be applied for each of two answers.
Award **2 marks** for each and full explanation.
Award **1 mark** for each appropriate but insufficient explanation.

Accept any other relevant and correct answer.

1 m

4. Study Resource Booklet Figures C2 and C3 and Text Box C1. Since climate change has most likely increased the presence of warm, moist air in a region, atmospheric triggers are necessary to initiate large-scale cloud formation and significant precipitation events. Name one such primary atmospheric **mechanism** that can cause such conditions that lead to severe flooding.

Point marking.

Suggested answers:

- Low-pressure systems (cyclones, depression...)
- Frontal systems (cold weather fronts)
- Jet streams
- La Niña + Negative IOD (Indian Ocean Dipole)

Award **1 mark** for one of listed answers.

Accept any other relevant and correct answer.

2 m

5. Explain two reasons why, even after significant rain events, the landscape in Dubai **remains arid** and the surrounding desert does not transform into a green environment.

Point marking.

Suggested answers:

Main reasons – a complete answer must include at least one of the following:

- **Desert soil properties and lack of ground cover:** soils tend to be sandy and lack organic matter, which limits their ability to retain water and nutrients needed for plants to thrive, provide ground cover for vegetation, retain moisture better and allow it to infiltrate rather than run off the surface or simply evaporate.
- **High evaporation rates:** the high temperatures in the desert climate (e.g. in Dubai) lead to rapid evaporation of water. This means that even considerable rainfall can quickly disappear from the surface, limiting the availability of water to sustain vegetation.

Additional reasons:

- **Infrequency of rain:** Although the amount of rainfall is enormous, it is too rare to ensure sufficient vegetation growth. Even in arid regions, plants need a reasonably constant supply of water to survive and grow. A lack of frequent water means limited vegetation in the long term.
- **Adaptation of local vegetation:** Native desert plants are adapted to survive with little water. Sudden and infrequent heavy rains do not provide the constant moisture needed for the development of more typical green landscapes (grasslands, forests).

Award **2 marks** for two explained reasons.

Award **1 mark** for each completely explained reason.

Award **0.5 mark** for each partially explained reason.
Award **0.5 mark** for two correct reasons without an explanation.

Accept any other relevant and correct answer.

2 m

6. Discuss how the urban environment of Dubai contributed to the flooding in April 2024.

Point marking.

Suggested answers:

- Urban environment has extensive development and increased impermeable surfaces such as roads, buildings, and pavements (concrete, asphalt, etc.).
- These surfaces prevent water from naturally infiltrating into the ground, leading to higher runoff during rainfall.
- The lack of suitable drainage systems to cope with sudden, intense rainfall exacerbates the situation, causing water to back up and lead to flooding. Such systems are very expensive and need to be maintained, which might not be considered very effective if this is only necessary once every century or so.

The discussion must include at least two explained arguments.

Award **2 marks** for a complete answer.

Award **1 mark** for each explained argument.

Award **0.5 mark** for each partially explained argument.

Accept any other relevant and correct answer.

Section D: Periglacial landscape and climate change

Resource Booklet Figure D1 shows the map of permafrost zones in the Arctic area.
Resource Booklet Figure D2 shows satellite images of the site on Taymyr Island in Russian Siberia in July 1966 and July 2009.
Resource Booklet Table D1 gives data on main greenhouse gasses in the atmosphere.
Resource Booklet Figure D3 shows the contribution of greenhouse gases to global temperature rise (2010-2019 compared to 1850-1900).

2 m

1. Study Resource Booklet Figure D1.

a) Identify the area near the North Pole where there are no or only a few isolated permafrost areas.

Point marking.

Answer:

- Iceland; Spitzberger (Svalbard)

Award **1 mark** for the correct answer.

b) Suggest the **reason** why this area is free of permafrost.

Point marking.

Suggested answers:

- Warm ocean currents
- Gulf stream
- Norwegian warm current (North Atlantic Current)
- Stream drift

Award **1 mark** for a complete answer that includes warm ocean currents and the exact name of the current.

Award **0.5 mark** for mentioning only warm ocean currents.

Accept any other relevant and correct answer.

2 m

2. Study Resource Booklet Figure D1.

With the help of information provided and your geographical understanding outline **two reasons** why the extent of permafrost areas in North America differs significantly from that in Europe.

Point marking.

Suggested answers:

- Small relative distance to the sea (warms the surrounding land) (in Europe)
- Warm ocean currents that reach the northernmost continental part of Europe
- Wet and dry landscapes (is significant)
- Thickness of soil layers (is relative thin)
- Vegetation or lack of vegetation.

- Permafrost needs landmasses to develop

Award a maximum of two reasons.

Award **2 mark** for two outlined reasons.

Award **1 mark** for a completely outlined reason.

Accept any other relevant and correct answer.

1 m

3. Study Resource Booklet Figure D2 that shows a site on Taymyr Island in the north of Siberia. Describe the **change in the vegetation** from 1966 to 2009.

Point marking.

Suggested answers:

- The vegetation has been getting both taller and expanding in space and range.
- The vegetation is much denser in 2009, and there are almost no areas without forest, which indicates better vegetation conditions.
- Areas with tundra are being replaced by coniferous forests (taiga).

Award **1 mark** for any of suggested answers.

Award **0.5 mark** for a partial answer.

Accept any other relevant and correct answer.

3 m

4. Study Resource Booklet Figure D2.

- a) Explain how **climate change** has affected the described change in vegetation.

Point marking.

Suggested answer:

- Growing temperatures cause snow and ice to melt earlier in spring.
- Warming of the tundra climate (ET) enables growing taller and denser forest vegetation.
- Warming of the Artic Ocean enables increasing temperature on the surrounding land by emitting heat (compared to high albedo of ice).
- Permafrost changes – active layer will change (become thicker) due to thawing og the permafrost plants will get more nutrient (more fertile).

Award **2 marks** for a complete answer that contains at least suggested elements.

Award **1 mark** for an answer that contains only one suggested element or listed reasons without explanation.

Accept any other relevant and correct answer.

- b) Outline the **mechanism** by which this change in vegetation can affect the climate.

Level marking.

Suggested answer:

- As the shrubbiness increases its distribution, it creates its own warming effect by absorbing heat, rather than reflecting heat as snow does, leading to additional warming and perpetuating the effect (thawing more permafrost ice). Albedo is changing.

Award **1 mark** for a complete answer.

Award **0.5 mark** for an appropriate but insufficient answer.

Accept any other relevant and correct answer.

2 m

5. Study Resource Booklet Figure D3 and Table D1.

Analyse the **change in the concentrations** of carbon dioxide and methane in the atmosphere from pre-industrial times to the present day and their contribution to the **rise in temperature**. Use statistical data to justify your responses.

Point marking.

Change in the concentrations

Suggested answer:

- The concentration of carbon dioxide (CO₂) increased from 278 ppm to 416 ppm or by 47.5% (index 147.5).
- The concentration of methane (CH₄) increased from 729 to 1908 ppb or by 161.7% (index 261.7)

Contribution to the rise in temperature

Suggested answer:

- Carbon dioxide is responsible for the increase of 0.7-0.8°C and methane for 0.5°C.

Award **1 mark** for the change in concentrations that contains statistical indicators (rate or index) for both carbon dioxide and methane.

Award **0.5 mark** for the change in concentration with a statistical indicator for only one gas (carbon dioxide or methane).

Do not award answers only with absolute values.

Award **1 mark** for the contribution in the rise of temperature in °C for both carbon dioxide and methane.

Award **0.5 mark** for the contribution in the rise of temperature in °C for only one gas (carbon dioxide or methane).

Accept any other relevant and correct answer.

5 m

6. Study Resource Booklet Figure D3 and Table D1.

Evaluate the role of carbon dioxide and methane in global warming. Justify your answer with specific data.

Point marking/level marking.

Suggested answer:

- The concentration of carbon dioxide in the atmosphere is 416 ppm and that of methane is 1908 ppb or 1.87 ppm, i.e. more than 200 times lower.

- The relative concentration of methane has risen three times as much (150%) as that of carbon dioxide (50%) since pre-industrial times.
- Methane is responsible for a temperature increase of 0.5°C and carbon dioxide for 0.75°C.
- Methane has a much greater impact on climate change than carbon dioxide (27 up to 35 times) because it is an ozone precursor and reduces the production of sulphate and nitrate aerosols (and thus indirect cloud-aerosol effects), all of which increases its net warming effect.
- Per ppm, methane is 25 times more effective as a direct greenhouse gas. If the indirect effects are included, this effect increases 45-fold.
- Methane has an effect duration of around 12 years, while carbon dioxide has a much longer effect. This means that the emission of methane will stabilise if we stop emitting it. Carbon dioxide would remain in the atmosphere for much longer, even a few thousand years, and has a cumulative effect on temperature (temperature will continue to rise even if emissions are stopped).
- In the short term, the increased effectiveness of methane will be important, but on very long time scales the effects of CO₂ will dominate. Therefore, the greatest efforts must be made to reduce CO₂ emissions and achieve zero emissions.

Point marking – award **4 marks** for a complete answer that contains the following elements:

- explanation of the effects on the climate (GWP – 100-year global warming potential) (**1 mark**)
- explanation of the atmospheric lifetime (in years for methane; approximately for carbon dioxide) (**1 mark**)
- comparison of actual concentration and growth rate in ppm (not required if previous question was answered) – optional; can replace explanation of the effects on climate or the atmospheric lifetime only (**1 mark**)
- a comparison of the two gases in all aspects (**1 mark**)
- statistical data that justify the statements (**1 mark**)

Level marking – evaluation of short- and long-term effects on the climate:

- Award **1 mark** for a complete evaluation of short-term and long-term effects of both gases.
- Award **0.5 mark** for an appropriate but insufficient evaluation.

Accept any other relevant and correct answer.

Section E: Olympic Games

The Olympic Games are a global event that attracts attention worldwide. They bring athletes, tourists, politicians and others together to create a global spectacle and leave a certain legacy.

Resource Booklet Figure E1 shows the population and number of participants in London Summer Olympic Games in 2012 per continent.

Resource Booklet Figure E2 represents the ranking of Olympic cities according to ecological, social and economic sustainability.

Resource Booklet Figure E3 shows the aerial imagery of the site of the Olympic Village of Poblenou in Barcelona in 1977 and in 2022.

Resource Booklet Figure E4 gives an insight into the Barcelona urban regeneration project 1986-1992.

Resource Booklet Figure E5 shows the condition of one of the venues after the Olympic Games in Rio de Janeiro.

1 m

1. Study Resource Booklet Figure E1.

Name the continent that was most underrepresented at the London Olympics when comparing the ratio of Olympic participants to the world's population.

Point marking.

Answer – continent:

- Asia

Suggested answers – justification (data for Asia):

- 0.5 athlete per 1 million people
- 1 athlete per 2 million people
- 19.0% of participants compared to 60.7% of population

Award **1 mark** for the name of the continent and for the evidence.

Award **0.5 mark** for the correct name of the continent.

Award **0.5 mark** for one of suggested calculations.

Accept any other relevant and correct answer.

4 m

2. Study Resource Figure E2.

a) Describe the general trend of the overall **sustainability** of the Olympic Games 1992-2020. Your answer should not include only one aspect (pillar) of sustainability.

Point marking.

Suggested answers:

- The sustainability of the Olympic Games from 1992 to 2020 is not evaluated as high (or none of the Olympic Games from 1992 to 2002 was sustainable).
- Despite the measures of adopting the sustainability measures (e.g. SDGs), the overall sustainability of the Olympic Games has decreased over time.
- Economic sustainability has generally an increasing trend, while ecological dimension declining the most.
- The Summer and Winter Olympic Games have similar overall sustainability.

- Sustainability is fairly consistent across the three dimensions (ecological, economic, social).
- There is little consistency in how individual Olympic Games score on the indicators, with both very high and very low scores present.
- The sustainability record of the Winter Games fluctuates much more than that of the Summer Olympics (e.g. Salt Lake City in 2002 and Sochi in 2014).

A complete answer must contain at least **four elements**.

Award a maximum of **2 marks** for the described trend.

Award **0.5 mark** for each described element.

Accept any other relevant and correct answer.

b) Suggest two main **reasons** for the described trend.

Point marking.

Suggested answers (by topics):

- All Olympic Games are very different in terms of different elements of sustainability and none of them have reached the green zone of sustainability. Some may have better environmental dimensions, but they often fail in the social dimensions. None of the Olympic Games observed achieved a high level of sustainability in all three dimensions.
- Olympic cities are associated with major investment and reorganisation, often involving the construction of large facilities, the relocation of many people, corruption, high costs, social insecurity, etc., which results in reduced sustainability.
- 'New construction' and 'social safety' also receive poor ratings, indicating that extensive construction of new sports venues and the displacement of people are regular occurrences in the preparation for an Olympic Games.
- By contrast, the Olympic Games have a relatively strong record in finding adequate after-use for the key sports and non-sports venues, as expressed in the indicator 'long-term viability'.
- Some current cases show less sustainability (e.g. Rio de Janeiro 2016 or Sochi 2014) than some previous Olympiads (Salt Lake City 2002 or Albertville 1992). This shows that the organisation of the Olympic Games is very much dependent on the host city (and country) and, on the other hand, involves ever larger events with increasing impacts on sustainability.
- The promotion of the environment and sustainability to a pillar of the Olympic policy agenda, has not been able to stop or reverse the decline of sustainability over time. This result suggests that sustainability rhetoric does not match actual sustainability outcomes.
- The Winter Games have a significantly smaller visitor footprint than the Summer Games. The Winter Games have also grown much less than the Summer Games and displace fewer people, which is probably due to the smaller size of the required venues and urban infrastructure.
- As data show, the Olympics in Rio de Janeiro displaced a large number of residents for Olympics-related development and provided the occasion for the enactment of comprehensive legal exceptions. The resulting sports venues remained poorly used after the event, and cost overruns were the highest in the sample.
- Sochi is the only Olympics to fall into the bottom interval, or red zone. Next to extensive new construction and the high number of accredited participants, this is mostly due to its poor economic performance: Sochi suffered the second-highest cost overruns in the sample, while not finding meaningful after-use for most venues.

Award answers that are associated with described trends in the part a). Look for an explanation and not just a statement.

Award a maximum of **2 marks** for the explained reasons.

Award **1 mark** for each explained reason.

Award **0.5 mark** for a mentioned reason that is not explained.

Accept any other relevant and correct answer.

3 m

3. Study Resource Booklet Figures E3 and E4.

Outline the process of urban transformation of Barcelona between 1977 and the time of the 1992 Summer Olympics (in terms of general character, services, size/locations).

Point marking.

Suggested answer:

- Before the transformation, Barcelona's waterfront was inaccessible to the public and consisted of run-down industry that cut off the city centre from the sea.
- The urban redevelopment project mainly covered the coastal area of the city and included several neighbourhoods that were completely transformed. It also included the construction of new ring roads, a new airport, improved public transport and the remodelling of numerous green spaces in the city.
- The project included the construction of new sports facilities and the construction of a completely new Olympic Village in Poblenou, north of the centre, on the site of the old industry, which was completely removed.
- It included the construction of accommodation for the athletes, two skyscrapers (one of them a hotel), a marina, a coastal promenade, the construction of sandy beaches with imported sand, green areas, new roads, restaurants, bars, attractions...

Main elements:

- Removing run-down industry – opening the waterfront to public
- Focus on coastal area and infrastructural development inland
- New Olympic Village with services
- Building new sports and accommodation facilities

A complete answer must contain at least three main elements.

Award **3 marks** for three outlined/explained element.

Award **1 mark** for each outlined/explained element.

Award **0.5 mark** for a partially outlined element.

Accept any other relevant and correct answer.

2 m

4. Study Resource Booklet Figures E3 and E4.

Explain two ways in which the urban remodelling of Barcelona has improved the quality of life of its citizens.

Point marking.

Suggested answers:

- **City parks and green areas:** With Olympics in mind, many green spaces were remodelled. Ponds and fountains were constructed, including Barcelona's most famous fountain, Font Màgica de Montjuïc (the Magic Fountain). The most important green space to be renovated was Montjuïc Park. These became new meeting places and attractions for both the local population and tourists.
- **Beaches and coastal promenade:** On the site of the former industry and harbour, the most significant change to the city was the creation of a 4 km long seafront promenade with beaches made of sand imported from Egypt. The promenade connects the town from north to south and is used by walkers, cyclists and families with children.
- **Leisure and amusement services:** any bars, restaurants and discos opened along the coastal promenade and especially in the Olympic village of Poblenou, and it became a new local and tourist hotspot.
- **New living spaces:** The accommodation for athletes and visitors in the Olympic village of Poblenou was later sold to private owners who converted the area into new housing. Other facilities were converted into hotels and office buildings, giving these areas a new role.
- **Ring roads and airport:** The construction of new ring roads on the outskirts of the city or underground improved access to the city and relieved the urban roads of heavy traffic. The new El Prat airport enabled a higher number of flights and better connections to cities all over the world, leading to an increase in outgoing and incoming air traffic.
- **New sports facilities:** New sports facilities built for the Olympics – particularly in Montjuïc (Olympic Stadium, swimming pools with panoramic views) - were later given to the city for use by the citizens. The Olympic Stadium is also used for major concerts by world stars, which are attended by both national audiences and tourists.
- **Improved urban landscape:** The construction of new infrastructures, sports facilities, buildings, parks, etc. improved the appearance of the city, new public areas were created (promenades, beaches, public areas) and meant a reinvention of the urban space for its inhabitants.

Award **2 marks** for two fully explained impacts.

Award **1 mark** for each fully explained impact.

Award **0.5 mark** for each partially explained impact.

Accept any other relevant and correct answer.

5 m

5. Study Resource Booklet Figures E2-E5 and use your geographical understanding.

Evaluate whether major sporting events such as the Olympic Games have a positive or negative **socio-economic impact** on the target cities during and after these events. Use at least two positive and two negative socio-economic impacts as examples to support your ideas.

Point marking and level marking.

Suggested answers:

Positive socio-economic impacts:

- A large number of visitors during the event and a high level of spending allow for an increased impact of tourism and new (temporary or permanent) jobs.
- Urban regeneration of the destination cities and development of transport and other infrastructures.
- Stimulation of various economic activities related to construction and services.
- New accommodation facilities for athletes and visitors that can later be converted into housing for residents or accommodation for tourists.
- Promotion and development of the sporting and tourist image of the destination on the world market and attracting new visitors after the event.
- Sports facilities built for major events remain in the local community and can be used for the development of sports, tourism, events, concerts, etc
- Promotion of certain sports that were not so popular in the past and increased sporting activities among the local population.
- Increased investment in tourism.

Negative socio-economic impacts:

- Displacement of inhabitants to make room for new sports facilities and infrastructure.
- Saturation of the destination by visitors during and after the event.
- Investment for its own sake – this includes developers, construction companies, sponsors and other participants aiming to make a profit without considering the needs of the local community.
- Large carbon footprint due to the heavy construction work and the large number of visitors.
- High cost of maintaining sports infrastructure and disuse/neglect of expensive arenas and stadiums.

Evaluation:

- The overall assessment must include arguments as to why the students believe that positive/negative impacts outweigh negative impacts and why this is good or not good for both the destination and the local community.

A complete answer must include:

- two positive socio-economic impacts – point marking – **2 marks (1 mark for each)**
- two negative socio-economic impacts – point marking – **2 marks (1 mark for each)**
- final evaluation – level marking – **1 mark**

Accept any other relevant and correct answer.

Section F: Commuting mobility in the cities

Resource Booklet Figure F1 shows the map of the most frequent mode of transport for selected World cities. Each dot represents a city. The size of each dot is proportional to the population of the city.

Resource Booklet Figure F2 shows ABC modal share for selected 794 World cities. The size of the disc is proportional to the city's population, and the colour corresponds to the region.

2 m

1. Study Resource Booklet Figure F1.

Identify the **most frequently** used transport modes for commuters in cities in North America and Europe.

Point marking

Suggested answers:

North America:

- cars are dominant in commuting mobility in all selected cities

Europe:

- cars dominant but high share of selected cities has also active mobility as a dominant transport mode of commuting
- public transport more present in Eastern and Western Europe

Award **1 mark** for correct answer for North America and **1 mark** for correct answer for Europe.

Accept any other relevant and correct answer.

5 m

2. Study Resource Booklet Figure F2.

Give two **differences** between the way commuters travel in Tokyo and Dhaka. Explain **three** reasons for these differences.

Point marking.

Suggested answers:

Differences (2 marks):

- both Tokyo and Dhaka have similar percentage of cars participating in commuting (around 13-14%)
- around 50% of commuters in Tokyo use public transport in commuting, while in Dhaka it is around 29%
- active mobility in commuting in Tokyo is used by 35% of commuters, while in Dhaka that share is much higher – around 57%

Reason 1 (1m):

- Tokyo has higher income than Dhaka thus better organized and higher quality public transport

Reason 2 (1m):

- People in Tokyo must travel longer distances so using public transport is better option

Reason 3 (1m):

- Dhaka faces traffic jams, as well as Tokyo, but poorer quality of PT infrastructure in Bangladesh cannot support the large number of commuters (longer travelling time...)

Award **2 marks** for differences and **3 marks** for reasons.
Award **1 mark** for each correct answer.

Accept any other relevant and correct answer.

4 m

3. Explain the negative aspects of **the increase in commuting on** people and the economy.

Point marking.

Suggested answers:

People (2m):

- increased stress levels: commuting can be a stressful experience, whether it's dealing with traffic congestion or crowded public transport – people who commute longer have higher levels of stress and anxiety (depression), leading to lower levels of life satisfaction
- impact on health: longer commutes have been linked to lower levels of physical activity, and higher blood pressure (sitting in a car or on public transportation for extended periods can lead to back pain, headaches, and other physical problems)
- social isolation: commuting can also lead to social isolation – people who have longer commutes tend to have fewer social connections and less time for community engagement

Economy (2m):

- the cost of commuting (the cost of fuel, parking, tolls, or the cost of public transport tickets) can be a significant expense for many individuals
- longer commutes can lead to reduced productivity of commuters, which can affect economic growth

Award **2 marks** for people and **2 marks** for economy.

Award **2 marks** for each complete answer if the student has listed and explained.

Award **1 mark** for each answer where the student only listed reasons without explanation.

Accept any other relevant and correct answer.

4 m

4. To ensure **efficient and sustainable commuting**, public policymakers face many challenges. Suggest **4** possible solutions that policymakers may adopt to achieve this goal.

Point marking.

Suggested answers:

Solution 1: Encouraging alternative modes of transportation: one way to reduce congestion and air pollution is to encourage commuters to use alternative modes of transportation, such as bicycles, public transit, and carpooling

Solution 2: Investing in transportation infrastructure: the way to improve commuting is to invest in transportation infrastructure, such as roads, highways, and public transit

systems (e.g. new rail lines, road improvements, and bus rapid transit etc.). Smart / flexible infrastructure. Optimisation of existing systems.

Solution 3: Implementing congestion pricing: a policy that charges drivers a fee for driving in congested areas during peak hours. This policy can reduce congestion and encourage commuters to use alternative modes of transportation. Apart from a significant reduction in traffic congestion, it can also reduce air pollution. Subsidise public transport costs (lower fares or free PT).

Solution 4: Encouraging telecommuting: Telecommuting, or working from home, is becoming increasingly popular, and it can help reduce traffic congestion and air pollution. Policymakers can encourage telecommuting by providing incentives to employers who offer telecommuting options to their employees. Flexible working – staggered hours.

Award **4 marks** for four proposed solutions.

Award **1 mark** for each correct answer – proposed solution.

Accept any other relevant and correct answer.

Notes

end ■