



18th International Geography Olympiad

Paris, France

12 July – 18 July 2022

Written Response Test
Suggested Marking Guide

Section A: Air transport and greenhouse gases

Resource A1 shows the primary greenhouse gases (dynamics, longevity and potential impact). Resource A2 shows the carbon dioxide emissions from air travel in the world by country in 2018. Resource A3 shows the number of air passengers in Europe in 2019 by country.

- (a) Study Resource A1. Define the term *greenhouse effect*. [2 marks]

Point marking.

Suggested answer:

- The atmosphere allows most of the visible light from the Sun to pass through and reach Earth's surface. As Earth's surface is heated by sunlight, it radiates part of this energy back toward space as infrared radiation. This radiation, unlike visible light, tends to be absorbed by the greenhouse gases in the atmosphere, raising its temperature. The heated atmosphere in turn radiates infrared radiation back toward Earth's surface.

Award 2 marks for a complex explanation that contains at least four of the following elements:

- short-wave radiation (visible light from the Sun)
- heating of the Earth's surface
- long-wave (infrared) radiation emitted from Earth's surface
- greenhouse gases in the atmosphere that trap the heat
- emitting the trapped heat back toward Earth's surface

Award 1 mark for a simple explanation that contains at least two elements listed above.

Accept any other relevant and correct answer.

- (b) Study Resource A1. Outline **three** impacts of selected greenhouse gases on climate change. [3 marks]

Point marking.

Suggested answers:

- Carbon dioxide is not the most powerful greenhouse gas (its global warming potential is 1 compared to 320 for N₂O, but it is the largest contributor to climate change because it is so common (its concentration is 41 ppm vs N₂O with 0.335).
- Since the Industrial Revolution, concentration of methane in the atmosphere has increased the most (164%) compared to CO₂ (49%) and N₂O (24%).

- Although the concentration of N₂O in the atmosphere is small (0.335 ppm), it is the most powerful greenhouse gas since its GWP is 320. It means that a single nitrous oxide molecule has 320 times the global warming potential of a carbon dioxide molecule.
- The longevity of N₂O in the atmosphere is the highest (120 years), which means that long term effects of its increase would be very serious for the global climate.

Award 1 mark for each outlined effect accompanied by specific statistical evidence.
Award 0.5 mark for a listed effect without specific evidence.

Accept any other relevant and correct answer.

- (c) (i)** Study Resource A2. Name the countries that have the highest carbon footprints in international and domestic air travel. [1 mark]

Point marking.

USA (0.5 marks)
China (0.5 marks)

- (ii)** Study Resource A2. Outline **two** reasons why some countries have very high carbon dioxide emissions per capita from domestic air travel. [2 marks]

Point marking.

Suggested answers:

- Large surface area of the country.
- Parts of the country are remote from the mainland/main territory (exclaves) (e.g. USA, Russia, Chile).
- Ribbon-like shape of the country with long distances between furthestmost points (e.g. Chile, Norway).
- High GDP/GDP per capita/personal income so people can afford flying.
- No high-speed trains (covering the whole territory).

Award 1 mark for each correct reason.

Only one answer can relate to size or shape of the country (first three bullets).

Accept any other relevant and correct answer.

- (d)** In addition to carbon dioxide, other greenhouse gases and aerosols are emitted from air transport. Explain the effect of condensation trails on climate. [2 marks]

Point marking

Suggested answer:

- Condensation trails (contrails or vapor trails) are line-shaped clouds produced by aircraft engine exhaust. They consist of condensed water produced by the combustion of fuel in airplane engines. Their effect on climate is similar to clouds (in case of intensive air transport). They absorb long-term (infrared) radiation and prevent the cooling effect because they reflect radiation back to Earth's surface.

Award 1 mark for the explanation (definition) of condensation trails and 1 mark for the explanation of effect of condensation trails on climate.

Award 1 mark for the explanation of condensation trails that contains at least two of the following elements:

- line-shaped clouds
- condensed water
- produced by the combustion of aviation fuel

Award 0.5 mark for an answer that contains only one of these elements.

Award 1 mark for the explanation of effect of condensation trails on climate that contains at least two of the following elements:

- absorption of long-wave (infrared) radiation from Earth's surface
- preventing cooling effect
- reflecting long-wave radiation back to Earth's surface
- effect similar to clouds

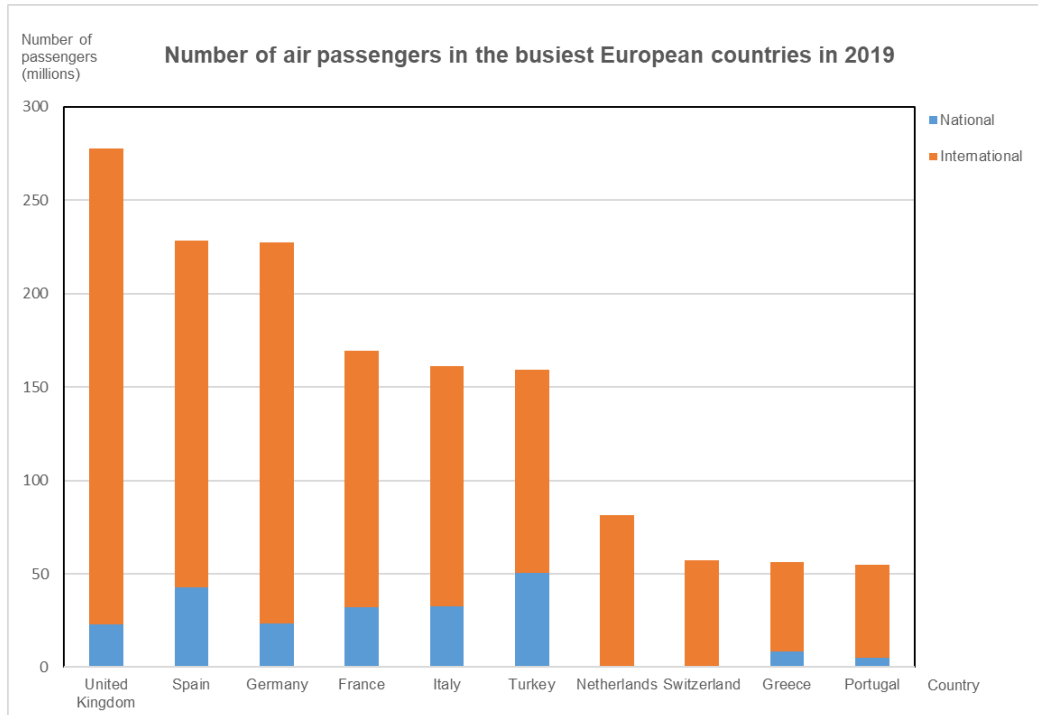
Award 0.5 mark for an answer that contains only one of these elements.

Accept any other relevant and correct answer.

- (e)** Study Resource A3. Use an appropriate data representation method to display the total number of passengers in air travel and their profile (national and international passengers) in European countries with more than 50 million total passengers. [5 marks]

Point marking

Suggested answer



Award 2 marks for appropriate diagram. It can be vertical (as above) or horizontal. 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 2 marks only for a diagram with values ordered from highest to lowest (or vice versa), with no empty space on axes and drawn using a ruler (or precisely by hand).

- 0.5 mark is subtracted if values are not ordered from highest to lowest (or vice versa)
- 0.5 mark is subtracted if there is empty space on x/y axis with no values (i.e. if the axis is longer than needed)
- 0.5 mark is subtracted if the diagram is not drawn using a ruler or very precisely by hand
- 0.5 mark is subtracted if values are not plotted accurately (check visually a couple of high and low values). Allow for small amounts of rounding to suit the scale.

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

- 0.5 mark for suitable title (must have reference to air passengers /in European countries/) and “2019” (when).
- 0.5 mark for the names of the countries on the x axis (or y axis on the bar diagram). The general label “country” may be omitted.
- 0.5 mark for the label “Number of passengers” or “Number” (if the title contains the word “passengers”) on the y axis (or x axis on the bar diagram). The label can be placed horizontally as displayed or vertically.

- 0.5 mark for accurately displayed values on y axis (or x axis on the bar diagram). Values can be expressed in existing values or in millions with the unit “millions” clearly expressed.
- 0.5 mark for expressing national and international passengers in a different way (e.g. different colours of bars/columns).
- 0.5 mark for a legend that contains colour and name of each displayed category (national and international passengers).

Section B: South Pacific Ocean

A 2016 animated movie “*Moana*”, produced by Walt Disney, tells the story of a strong-willed girl, Moana, who lives in a Polynesian village. Since the location of this story is set in the South Pacific Ocean, many unique geographic features can be found in this movie. Resource B1 shows a rock type ‘A’ and a water body ‘B’. Resource B2 shows the climate data for an island in the South Pacific Ocean. Resource B3 shows the global distribution of natural hazards. Resource B4 shows the international arrivals of overnight and same day visitors to various places in the world in 2008 and 2018.

- (a) (i) Study Resource B1. Identify the type of rock represented by ‘A’. [1 mark]

Point marked

Award 1 mark for following answer:
Basalt

- (ii) Study Resource B1. Identify the type of water body represented by ‘B’. [1 mark]

Point marked

Award 1 mark for following answer:
Lagoon

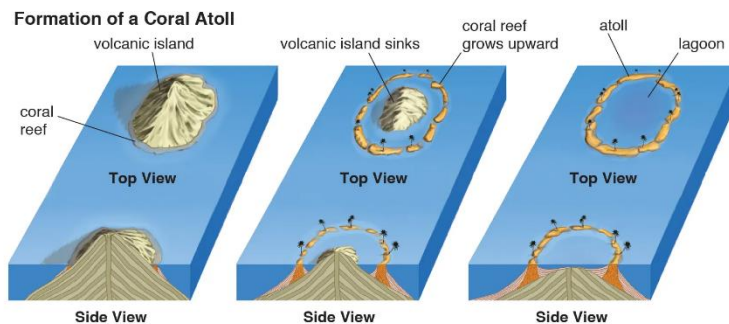
- (b) An atoll is a unique feature in the South Pacific Ocean. With the use of an annotated diagram, explain clearly how an atoll is formed. [4 marks]

Point marked:

Award 1 mark for each bullet point:

- Drawing is in correct order of formation of an atoll
- Evidence of volcanic island surrounded by coral reef
- Volcanic island sinks and coral reef grows upward
- Volcanic island disappeared and coral reef becomes an atoll

Suggested drawing:



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- (c) Study Resource B2. Identify the climate type of the island in the South Pacific Ocean using the Köppen climate classification. [1 mark]

Point marked

Award 1 mark for following answer:
Tropical Monsoon climate **OR** Am climate

- (d) Study Resource B3. Explain **two** natural hazards occurring in the South Pacific Ocean which might affect the local economies of the South Pacific Ocean islands. [4 marks]

Point marked

Award 1 mark for each natural hazard. Maximum of 2 marks to be awarded.

Award 1 mark for explanation on how each natural hazard affects the local economies of the South Pacific Ocean islands. Maximum of 2 marks to be awarded.

Suggested answers:

Natural hazards: volcano, sea level rise, El Nino/La Nina, tsunami, etc.

Reasons: toxic gases, destroying local infrastructure, shrinking living areas, floods.

Maximum of 4 marks to be awarded. Accept any other relevant answer.

- (e) Study Resource B4. To what extent do you agree that tourism is beneficial for the Pacific Least Developed Countries (LDCs)? [4 marks]

Levels marked.

Award 4 marks if answer shows both benefits and disadvantages of tourism for the Pacific LDCs and is well-explained. Might demonstrate understanding of long-term and short-term impacts, scale of the impacts and how impacts might be interconnected.

Award 3 marks if answer shows both benefits and disadvantages of tourism for the Pacific LDCs but might lack elaboration for one or more points.

Award 2 marks if answer is only focused on benefits OR disadvantages of tourism for the Pacific LDCs.

Award 1 mark if answer is only focused on benefits OR disadvantages of tourism for the Pacific LDCs but lacks elaboration.

Award 0 marks if answer is irrelevant.

Suggested answers:

Benefits	Disadvantages
Incentive to preserve natural environment	Mainly provides low level jobs
Promotes international connections	Seasonal nature of tourism
Helps to put nations on the global map	Small businesses might not be able to keep up
Local businesses might gain profit	Natural environment can be polluted or threatened
Local employment might increase	Exploitation of culture
Tourism spending can be invested to improve local education, health and other services	Poor behaviour from tourists
	Unequal infrastructure growth focused on tourism and other sectors ignored

Accept any other relevant answer.

Section C: Lower Mekong Basin

Resource C1 shows the map of the Mekong Basin. Resource C2 shows the average wet season precipitation in the Mekong Basin in 2019, as compared to 2000-2018. Resource C3 shows the satellite image of part of the Mekong River in Thailand in 2015 and 2020. Resource C4 shows future scenarios (i.e. B1, M1 and M3) for land subsidence in the Vietnamese Mekong Delta between 2030 and 2100. Resource C5 shows the Vietnamese government's future vision for the sustainable development of the Mekong Delta. This plan was developed in consultation with the Dutch government.

- (a) Study Resources C1 and C2. Describe the average wet season precipitation in the Mekong Basin in 2019, as compared to 2000-2018. [3 marks]

Point marked

Award 1 mark for each of the following:

- Drier than usual weather occurring in Mekong basin of Cambodia, Lao – or in the majority of the Mekong Basin
- Average precipitation occurring in Mekong basin of China, eastern Thailand/SW Laos and southernmost of Vietnam
- Wetter than usual weather occurring mostly at upstream section of Mekong in China, just after mid-way of the Mekong river in China, eastern Thailand/SW Laos and southernmost of Vietnam

Maximum of 3 marks to be awarded. Accept any other relevant answer.

- (b) (i) Study Resource C3. Describe the change(s) observed in this part of the Mekong River in Thailand between 2015 and 2020. [1 mark]

Point marked

Award 0.5 marks for the following:

- The colour of the Mekong River changed from muddy brown to blue; or less sediment in the river
- Loss of vegetation cover

Maximum of 1 mark to be awarded. Accept any other relevant answer.

- (ii) Study Resource C3. Explain **two** reasons to account for the change(s) observed in this part of the Mekong River in Thailand between 2015 and 2020. [2 marks]

Point marked

Award 1 mark for each reason to explain colour change OR loss of vegetation cover. Students must explain both colour change and loss of vegetation cover to get maximum of 2 marks.

Suggested answers to explain colour change:

- Shallow and slow-moving river flows less able to carry sediment
- Upstream dam development which blocks sediment
- Drought/lack of rain leads to less flow so less able to carry sediment
- Growth of algae
- Erosional management techniques upstream, eg afforestation

Need to 'explain', so for 1 mark students need to explain why lack of rain, slow-moving river etc leads to colour change.

Suggested answers to explain loss of vegetation cover:

- Deforestation
- Agricultural expansion
- Logging

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (c) (i)** Study Resource C4. Explain the relationship between groundwater extraction and land-subsidence. [1 mark]

Point marked

Award 1 mark for:

- More groundwater extraction leads to more land subsidence

Accept any other relevant answer.

- (ii)** Study Resource C4. Explain which scenario is likely to be the **most sustainable** scenario for the Vietnamese Mekong Delta. [2 marks]

Point marked

Award 2 marks for each chosen scenario which is well explained.

Suggested answers:

- M3 is most sustainable due to fewer land subsidence and less ground water extraction
- M1 is most sustainable as the Delta is already facing problems related to drought, and sediment loss, and for agriculture in the Delta to survive, farmers need to continue to extract groundwater, but it needs to be stabilized

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (iii) Study Resource C4. Explain which scenario is likely to be the **most realistic** scenario for the Vietnamese Mekong Delta. [2 marks]
Point marked

Award 2 marks for each chosen scenario which is well explained.

Suggested answers:

- B1 is probably most realistic, due to population growth and increased agricultural output
- M1 is most realistic as the government is trying to stabilize land subsidence in the Delta through agricultural reforms for instance
- M1 is most realistic as the Delta is already facing problems related to drought, and sediment loss, and for agriculture in the Delta to survive, farmers need to continue to extract groundwater, but it needs to be stabilized

Maximum of 2 marks to be awarded. Accept any other relevant answer.

Note: if students chose M1 for c(ii) as well, their answers can be repeated and given marks accordingly.

- (d) Study Resource C5. Choose **two** solutions shown in Resource C5 and explain how **each of them** could help the Vietnamese Mekong Delta be sustainable. [4 marks]

Point marked

Award maximum of 2 marks for each chosen solution which is well explained.

Suggested answers:

- Higher value forms of agriculture so farmers can produce less for more profit and not put too much pressure on the land
- Agribusinesses to focus on industrialisation to reduce dependence on agriculture in the delta. River also gets more "room".
- Combining rice and aquaculture to diversify farm activities and increase yields of both rice and aquaculture
- Brackish water aquaculture as a source of seaweed, shellfish etc for human food and production

Maximum of 4 marks to be awarded. Accept any other relevant answer.

Section D: Wildfires, sinking cities and sustainable development

Resource D1 shows the top 20 largest wildfires in California, USA. Resource D2 shows the distribution of population density growth projections and fire hazards in California. Resource D3 shows the risk to selected Asian cities due to rising sea levels and flooding by 2030. Resource D4 shows the Sustainable Development Goals as part of the 2030 Agenda for Sustainable Development.

- (a) Study Resource D1. Explain how wildfires can be caused by both human and natural factors. [4 marks]

Point marked

Award 2 marks for each well-explained factor. Students **must explain both** human and natural factors to be awarded 4 marks.

Suggested answers:

- Lightning
- Power lines
- Human-related like arson, accidental fires
- Windy and dry weather

Maximum of 4 marks to be awarded. Accept any other relevant answer.

- (b) Study Resource D2. Compare the distributions of population density growth projections and fire hazards in California. [2 marks]

Point marked

Award 1 mark for each of the following:

- High wildfire hazard leads to very low population growth
- Southern California: areas surrounding Los Angeles are high hazard areas but still attract population.

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (c) (i) Study Resource D3. Describe the severity of risks to the selected Asian cities due to rising sea levels and flooding. [2 marks]

Point marked

Award 1 mark each for any 2 of the following:

- Across the 7 Asian cities shown in Fig. 1, rising sea levels and flooding will impact up to 15.27 million people.
- Cities in Southeast Asia such as Bangkok in Thailand will be most severely at risk, with 10.45 million population likely affected, while cities such as Jakarta in Indonesia and Manila in Philippines will see 1.8 million and 1.54 million of the population affected.
- Cities in East Asia such as Hong Kong in China and Seoul in South Korea registering lower population numbers at risk, at 0.09 million and 0.13 million people respectively.
- The impact on economy because of rising sea levels and flooding is also evident as the cities' economy performance in the form of GDP (Gross Domestic Product) is expected to contract between 0.4% to 96%.
- Similarly, cities in Southeast Asia such as Bangkok and Manila are expected to suffer the worst economic impacts of GDP contracting by 96% and 87 % respectively.
- Economic impacts on East Asia cities' GDPs are less severe, as observed in Hong Kong and Seoul, whereby the GDP contractions are projected at 0.4% and 1% respectively

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (ii) Study Resource D3. Choose a city in Resource D3 and explain **two** strategies it can adopt to increase overcome the risk of flooding.

[2 marks]

Point marked

Award 1 mark for each well-explained strategy which is related to the city of choice.

Suggested answers:

Hard-engineering strategies: building sea walls, reclaim land, build levees/flood walls, build dams, weirs, pumping stations etc

Soft engineering strategies: floodplain zoning, river restoration, land-use planning, reforestation efforts etc

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (d) Study Resource D4. In your opinion, are wildfires or floods more damaging towards a city's pursuit of sustainable development? Explain your choice.

[5 marks]

Point and levels marked

Reserve and award 1 mark for the definition of sustainable development or sustainable urban development.

This means that a **5 marks answer will include the definition of sustainable development or sustainable urban development AND meets the criteria to be awarded 4 marks as seen below.**

If students do not define the term, answer will receive a maximum of 4 marks.

Award 4 marks if answer shows understanding of how both wildfires and floods can affect sustainable development but presents argument on how one of them is more damaging than the other. This could be terms of long- or short-term impacts, scale of impacts etc, costs of the hazard etc. Answer refers either to the 3 key pillars of sustainable development (i.e. social, economic and environmental) OR the 17 SDGs in the Resource.

Award 3 marks if answer shows slight understanding of how both wildfires and floods can affect sustainable development but argument on how one of them is more damaging than the other is weak. Answer does not refer either to the 3 key pillars of sustainable development (i.e. social, economic and environmental) OR the 17 SDGs in the Resource.

Award 2 marks if answer only focuses on wildfires or floods. Answer might refer to the 3 pillars of sustainable development or the SDGs.

Award 1 mark if answer is descriptive of what floods and wildfires are and shows little explanation of how they affect a city's pursuit of sustainable development.

Award 0 marks if answer does not answer the question.

Suggested points:

- Definition of sustainable development (SD): development that meets the needs of the present without compromising the ability of future generations to meet their own needs

For wildfires:

- Large wildfires can cause poverty and hunger for those who depend on the forests for their livelihoods
- Smoke from wildfires cause air pollution and harms health
- Wildfires can cause displacement and anguish to people who must flee them
- The poor might not be able to escape or be protected from air pollution using air purifiers and good quality pollution masks

- Particulates and black carbon from wildfires are carried in the air and enter water bodies which can affect aquatic ecosystems
- Wildfires release carbon dioxide and other greenhouse gases into atmosphere and contribute to global warming

For floods:

- Negative effect on wildlife, causing drowning, disease proliferation and habitat destruction
- Alters the landscape (e.g. eroding riverbanks and causing collapse). Results in sedimentation which can degrade water quality and destroy aquatic habitats.
- Floodwater can be contaminated with pollutants such as agricultural pesticides, industrial chemicals and sewage. Contaminated floodwater can enter ocean and affect water quality and disrupt delicate ecosystems like coral reefs.
- Floods can spread waterborne diseases like cholera and allows mosquitoes to breed (i.e. spread malaria).
- However, floods might have some benefits:
 - o Floods transport vital nutrients to the surrounding land and leaves sediment and nutrients on the floodplains
 - o Floods can replenish groundwater
 - o Floods can trigger breeding events, migrations and dispersal in some species
 - o Floods can boost fish stock. Sediment deposited on riverbeds during floods can provide a nursery site for small fish. Nutrients carried by floodwater can support aquatic food webs by boosting productivity.
 - o Floods bring life to wetlands by bringing water during dry seasons.

Accept any other relevant answer.

Section E: Green Revolution and Population Development

Resource E1 shows the global change in population development, cereal production, cereal yield and land use from 1961 to 2021. Resource E2 shows contemporary farming occurring in Bangladesh.

- (a)** Define the 'Green Revolution'. [2 marks]

Point marked

Award 1m for:

- A concept/technique applied in agriculture, which led to shift from "traditional" to "industrial" practice, based on using advanced modern technologies in farming to increase crop (food) production/yield

Award 1m for mentioning at least 3 of the following characteristics:

- These technologies include using chemical inputs (fertilizers, pesticides), heavy farm mechanization/machinery (tractors etc.), managed irrigation technologies, soil management, crop disease control, high varieties of yielding, multiple cropping (different seeds: rice, wheat, maize), crop rotation

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (b)** Study Resource E1. Describe the trends observed. [2 marks]

Point marked

Award 0.5 marks for each of the following:

- During the 60-year period global population has grown – it has more than doubled.
- Global cereal production and cereal yield increased even more - by over 200%, they grew at a much faster rate than population over the same period.
- At the same time land use (total land area) for cereal production has increased marginally (for only about 20%)
- Fast and significant population growth reduced the land availability per person to live on and grow crops (food). This means using less land per person today than 60 years ago.

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (c) (i)** Using your own knowledge, outline Thomas Malthus' theory on the concept of "population-resources" relationship. [2 marks]

Point marked

Award 1 mark each for at least 2 of the following:

- he postulated pessimistic hypothesis on the effect of technological changes in food production
- population growth will grow at an exponential rate while food supply will increase at a linear rate
- the size and growth of the population depend on the food supply and agricultural methods (when food is not sufficient for everyone, the excess population will die)
- with the growth of global population available agricultural spaces will be limited
- the inevitable outcomes (OR positive and negative checks) of population-food production unbalance are food shortage, famine, war and epidemics

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (ii) Using your own knowledge, outline Ester Boserup's theory on the concept of "population-resources" relationship. [2 marks]

Point marked

Award 1 mark each for at least 2 of the following:

- she postulated optimistic hypothesis concerning the relationship between population growth and agricultural production
- she suggested that at higher population densities, more labour-intensive systems are adopted only because these offers higher total level of food production rather than higher returns to the individual farmers involved
- her theory seems to support the correlation between Green Revolution (GR) and population growth - increased population pressure led to the development of GR technologies (inventions)

Maximum of 2 marks to be awarded. Accept any other relevant answer.

- (d) Study Resource E2. Suggest **three** ways in which farmers in Bangladesh have benefitted differently from the Green Revolution. [3 marks]

Point marked

Award 1 mark each for any 3 of the following:

- only rich(er) farmers in Bangladesh benefited from GR because they could afford the inputs required for the cultivation of seeds.
- many small (marginal) and poor farmers could not afford to buy the seeds, fertilizers or machinery necessary to start them off
- some farmers took loans for necessary farming equipment and ended up in large debts
- due to loss of soil fertility because of increased use of fertilizers and pesticides and continuous use of groundwater for irrigation purposes

resulting in reducing the water table below the ground (water stress) some farmers with time could not continue with GR farming concept

- due to many floods poor farmers became even more poorer

Maximum of 3 marks to be awarded. Accept any other relevant answer.

- (e) Using your own knowledge, explain **two** ways in which agricultural practices can be improved to allow countries to benefit more.

[4 marks]

Point marked

Award 2 marks for each well-explained measure. Award only 1 mark if answer is not explained enough. Award zero marks if answer simply states the measure without any explanation.

Suggested answers:

- due to climate change effects, energy scarcity and water paucity many countries should reorient their existing agricultural systems toward highly sustainable modes of production
- application of ecology-based science and the latest technological inputs in design and management of sustainable agriculture
- adoption of modern farming methods
- application of remote sensing and spatial mapping technologies for better targeting and monitoring agricultural investment
- application of modern communication technologies (e.g. cell/smart phones) can contribute to smarter application of water, fertilizers etc.
- global food price crisis must stimulate new food security policies and significant investment in agricultural systems in developing countries
- introduction of organic cultivation and agriculture production
- use of high yielding varieties of seeds
- use of biofuel and modern farm machinery
- where lacking, introduction of appropriate institution(s) that would take care of necessary policy application and proper investment in agriculture
- where possible to integrate smallholders (small farmers) into value chains, to maintain their competitiveness

Maximum of 4 marks to be awarded. Accept any other relevant answer.

