The Challenge of Hot Deserts – MARK SCHEME

Question 1

Choose one of the following environments:

Hot desert environment ☐

Cold environment ☐

Tick the box to show which environment you have chosen.

Using a case study, to what extent have opportunities for economic activity been developed in your chosen environment?

- Level 3 (7-9 Marks) (detailed) responses will be developed. Examination of the opportunities for economic activity in the context of a case study of a hot desert/cold environment, with evaluation of the extent of development.

Indicative content for hot deserts

- The command “to what extent” means that responses may state the degree to which economic development has occurred. Eg the statement may be completely untrue, true to some extent (partly but not completely true), to a great extent, or completely true. Extent of development may be considerable, significant, partial, limited, slight etc.
- Understanding of the opportunities for economic activity.
  Opportunities include: resources, farming, tourism, energy eg solar, wind. Economic development comes from taking advantage of these opportunities: jobs, income, trade, taxes, improved infrastructure, spending in the local economy, multiplier effect. May explain links to economy eg deep canyons provide beautiful scenery which attracts tourists who create a demand for employment in hotels leading to a multiplier effect.
- Support for answers may be based in poorer or richer parts of the world. In HICs, south west US may be used. Economic activity may focus on water supply and how it is managed, commercial farming, mining, industrial development, supplying water, renewable and non-renewable energy, development of tourism on a large scale, building areas for retirement.

- In LICs, areas such as the Thar Desert may be cited. Economic activities include subsistence farming, including nomadic farming, and hunter-gathering. Commercial farming supported by irrigation may be emphasised. Resources such as limestone and gypsum are found in this desert, valuable for the building industry. Hydroelectric power is supplied. Tourism is a growing industry. Credit specific case study details.
- Degree of development may be determined by availability of water, physical terrain, extremes of temperature, technology, population size and migration, money available, access and transport, and value of resources. As the desert ecosystem is fragile, development may not be sustainable.
- Evaluation eg although there is much economic potential, the extent of development is partial, limited by physical factors, environmental issues, technology and other factors.

Indicative content for cold environments.

- The command “to what extent” means that responses may state the degree to which development has occurred. Eg the statement may be completely untrue, true to some extent (partly but not completely true), to a great extent, or completely true.
- Answers should focus on the nature of economic opportunities, and the scale of development
- Understanding of the opportunities for economic activity. Opportunities include: resources, farming, fishing, tourism, energy eg solar, wind. Economic development comes from taking advantage of these opportunities with resulting jobs, income, trade, taxes, improved infrastructure, spending in the local economy, multiplier effect. May explain links to economy eg high, steep mountains provide beautiful scenery which attracts tourists who create a demand for employment in hotels leading to a multiplier effect.
- Credit answers that focus on Arctic or Antarctic regions. Allow reference to tundra as well as polar areas. Support for answers may be based on Northern Canada and/or Alaska. Eg drilling and mining activities occur, hydroelectric power is developed, large parts of the coastline offer wind and geothermal energy possibilities and the region has a large fishing industry.
- Degree of development depends partly on fragility of environment and ease of damage to tundra vegetation by human activities, including drilling for oil, commercial fishing, tourism, building roads, housing and mineral exploitation.

- Extent of development may also depend on international agreements. Eg Antarctic Treaty. Protected Areas have been set up. The treaty banned mining for at least 50 years. Seal hunting is strictly regulated. Fishing boats have quotas. Tourist numbers/activities are limited under agreement by IAATO and all tours must be guided and not enter environmentally sensitive areas. Only smaller ships can visit the area.
- Evaluation of extent of economic development. Eg the tundra/polar environment is among the least disturbed ecosystems in the world. However, that is changing with the discovery of large reserves of raw materials. Although there is much economic potential, the extent of development is partial, limited by physical factors, environmental issues, international agreements, technology, access and other factors.
- An answer that lacks consideration of the extent of development is limited to Level 2.
- A purely generic answer without clear exemplification is limited to Level 2.

Question 2

'Plants and animals adapt in order to survive in a hostile environment.'
Explain this statement.
Use either Figure 9 or Figure 10 and your own understanding.

- **Level 3 (detailed) (5-6 Marks**) responses will be developed. Appropriate use of **Figure 9 or 10** (direct or inferred) and specific own understanding.

Indicative content

- The command word "explain" is used, which means to provide a reasoned account of the ways that animals and plants adapt to either a hot desert or cold environment.

Hot desert environment (based on Figure 9)

- Understanding of hot desert as a hostile environment. Rainfall less than 250mm per year, high daytime temperatures (up to 50 o C) but cool at night. Plants and animals have developed adaptations which allow them to survive in hot and dry conditions. Very little biodiversity in hot deserts because of the harsh climate.
- Understanding of plant adaptations. These include:
    - No leaves or small seasonal leaves that only grow after it rains - this helps reduce water loss during photosynthesis.
    - Many plants have long root systems – these spread out wide or go deep into the ground to absorb water.
    - Short life cycles - some plants germinate in response to rain, grow, flower, produce new seeds and die over a short period.
    - Leaves with hair - these help shade the plant, reducing water loss. Other plants have leaves that turn throughout the day to expose a minimum surface area to the heat.
    - Waxy coating on stems and leaves - this helps to reduce water loss.
    - Many plants are slower growing – this requires less energy. The plants don't have to make as much food and therefore do not lose as much water.
- Use of Figure 9.
  Cacti are well adapted for survival in the desert. They have:
    - Stems that can store water.
    - Spines instead of leaves. These minimise the surface area and so reduce water loss. The spines may also protect the cacti from animals that might eat them.
    - Thick waxy skin to reduce water loss through pores.
- General density of vegetation is low. Plants are spread out across the landscape so they can draw in water without competition from other plants. Photo shows thorny shrubs with few leaves. Prickly pear cactus in background, storing water in its pads.

- Understanding of animal adaptations. Animals may have large ears to give off heat (e.g. Fennec fox), produce little urine to save water, are active only at night to avoid heat (e.g. cottontail rabbit).
- Use of Figure 9
  Camels are well adapted and can cope with wind-blown sand and cold at night. They have:
  - Thick fur on the top of the body for shade, and thin fur elsewhere to allow easy heat loss.
  - Large surface area which maximises heat loss.
  - Large, flat feet to spread their weight on the sand.
  - Ability to go for a long time without water – they lose very little through urination and sweating.
  - A fatty hump which provides energy in times of food shortages.
  - Ability to tolerate body temperatures up to 42°C.
  - Slit-like nostrils and two rows of eyelashes to help keep the sand out of their eyes.

Cold environments (based on Figure 10)

- Understanding of cold hostile environments. Credit reference to polar and/or tundra landscapes. These ecosystems have long cold winters and short cool summers. The tundra has low precipitation (less than 200 mm per year) and dry winds. These conditions make the Arctic tundra a desert- like climate. Ground consists of permafrost, with thin active layer in summer. Very short growing season.
- Understanding of plant adaptations. Plants in the tundra have adapted in a variety of ways; Plants grow close together, low to the ground and they remain small. Soils are often waterlogged because of the permafrost underneath, so only hardy plants like moss can cope with seasonal drought and waterlogging. Some plants have a waxy, hairy coating which helps to shield them from the cold and the wind, and protects plant seeds. They have small leaves, which helps the plants to retain moisture. Only the top layer of soil thaws out, therefore plants have very shallow root systems.
- Plants like lichens and moss can survive on bare rock with a bit of moisture. Most plants don’t die off in the winter; they have long life cycles to help with the short growing season. This means photosynthesis can begin immediately once the sunlight is strong enough as plants don’t need to regrow leaves.

- Use of Figure 10
  Harsh environment means that very little vegetation grows. Some plants like arctic poppy flower quickly, even whilst the snow is still melting. They also have cup shaped flowers that face the sun to capture as much sunlight as possible. They appear to grow in clumps in stony soil that absorbs the sun's heat and provide shelter for the roots.
- Understanding of animal adaptations. Animals need shelter and insulation in tundra and polar regions. They tend to have thicker and warmer feathers and fur. Many of them have larger bodies and shorter arms, legs and tails which helps them retain their heat better and prevent heat loss. Many birds have two coats of feathers to help keep them warm. Animals often have feet lined with fur to help keep them warm. Many also migrate to warmer climates during the harsh winter months. Some animals (bears, marmot, arctic squirrels) hibernate for the winter and others will burrow (lemmings, ermine). Many insects spend entire life buried in the soil, rocks or plants which acts as a shelter.
- Use of Figure 10
  Polar bears have thick fur, an insulating layer of fat, with a black nose and footpads to absorb sunshine. Front feet are large, flat and oar-like, making them excellent swimmers. Sharp claws and teeth are ideal for catching and
  eating prey, and small ears reduce heat losses.
- Credit idea of adaptation to climate change – forcing some animals to migrate longer distances, to forage more widely eg polar bears and arctic foxes.

Question 3

Either
To what extent is human activity the cause of desertification in areas on the fringes of hot deserts?
or
To what extent are cold environments at risk from economic development and therefore in need of protection?

Hot deserts

- **Level 3 (detailed) (7-9 Marks)** responses will be well developed. Reasoned examination of a range of causes of desertification with some evaluation of extent to which human activity is responsible.

Indicative content for hot deserts

- The command “to what extent” means that responses may state the degree to which human activity causes desertification, with some support for the view expressed. E.g. The statement may be completely untrue, true to some extent (partly but not completely true), to a great extent, or completely true.
- Knowledge of areas affected by the process. 20% of the world’s population, in over 60 countries, have to cope with the threat of desertification. For instance, the Sahara has advanced over 250km southwards in the past 100 years.
- Understanding of how desertification occurs – the process of fertile land changing into desert typically as a result of deforestation, drought, or improper/inappropriate agriculture.

Causes which link to human activity include:

- Population growth – more people needing more food which puts pressure on the land.
- Migration- leads to greater population pressure. Drought and desertification in one region will displace people to another fragile environment.
- Overgrazing – too many goats, sheep, cattle can destroy the vegetation.
  Nomadic groups are now restricted in movement and this places more pressure on land resources. The soil may turn to dust and become infertile.
- Overcultivation – growing too much without allowing the soil to recover means it becomes exhausted.
- Deforestation – trees are cut down for fuel and building. The loss of roots makes the soils more fragile. They are exposed to wind and the rain, leading to gully erosion.
- War – many sub-Saharan countries have suffered for years from civil war, where crops and animals have been destroyed, leading to famine. Millions of people have been forced to move into desert fringe areas by armed conflicts. Some become refugees. The resources in and around the cities and camps where these people settle come under severe pressure.
- Enhanced greenhouse effect, partially caused by human activity globally, may contribute to increased risks of drought and higher temperatures in areas on fringe of hot deserts.

- Other threats include extraction of mineral resources and fossil fuels and high impact tourism in vulnerable areas such as the edge of the Thar desert and in East Africa.
- Understanding of natural factors leading to desertification. Less rainfall, higher temperatures which lead to increased evaporation/drought, or rainfall becoming more irregular, which means that vegetation dies and soils dry out and are removed by soil erosion. Climate is changing; this is part of a natural cycle of climate change as ocean currents and patterns of winds change. Human and physical factors may be linked.
- Credit examples of desertification e.g. In Kenya, nomadic Masai farmers have been forced onto marginal land. Traditional migration patterns have been affected and they have been forced to use smaller areas of land for their cattle. Overgrazing has resulted from this, leading to soil erosion by wind and water.
- Evaluation of extent to which human activities pose a risk. E.g. although climate change, as part of a natural cycle, may contribute to desertification, there is little doubt that human misuse of the land poses a major threat. Desertification is a huge environmental problem affecting many countries on the edge of hot deserts, which to a great extent is driven by human factors.

Cold environments

- **Level 3 (detailed)(7-9 Marks)** responses will be well developed. Reasoned examination of a range of causes of desertification with some evaluation of extent to which human activity is responsible.

Indicative content for cold environments.

- The command “to what extent” means that responses may state the degree to which human activity poses a risk to cold environments. E.g. the statement may be completely untrue, true to some extent (partly but not completely true), to a great extent, or completely true.
- Cold environments are fragile and they can be easily damaged by human activities. Tundra vegetation takes a very long time to grow. Relatively minor developments such as constructing a footpath can have serious long-term effects. Tyre tracks can be seen for many years after they were made. When the Sun hits the ruts it causes the permafrost to melt; this causes erosion and the ruts get bigger, and eventually the ruts turn into gullies.
- Mining - mines have opened up resources, such as gold and diamonds, under the land in tundra regions, e.g. Arctic Canada. Roads, housing and supply bases are built. This increases the number of vehicles in the tundra creating noise and air pollution.
- Pollution from mining and oil drilling has contaminated the air, lakes and rivers. Burst pipes have spilt hundreds of thousands of gallons of crude oil in Alaska and Siberia. Oil spills have caused serious water pollution.
  Some animals' movements to traditional feeding and nesting grounds have been disrupted by oil pipelines. E.g. Alaska- Prudhoe Bay to Valdez raised pipeline.
- Natural gas is extracted from gas fields e.g. in western Siberia. Natural gas is pumped from beneath the permafrost and piped across the tundra. Risk of rupture to pipelines and pollution.
- Pesticides have been used to control the masses of insects. Migrating birds feed on the insects and are poisoned or die due to their food source being removed.
- Problems with melting of permafrost where buildings and roads not constructed properly.
- Illegal hunting and fishing is threatening the numbers of certain species, e.g. whales. Species of animals such as polar bears are highly specialised so find it difficult to adapt to change.
- Tourism impacts are increasing – the rise in visitor numbers threatens animal breeding patterns and passenger boats affect the marine environment.

- Threats to environment resulting from human induced climate change. Polar ice caps are melting because of an increase in global warming. As the tundra melts, the plant matter decomposes and returns carbon dioxide to the atmosphere, causing further warming. Rising sea levels, increased risks of flooding in some low-lying coastal areas.
- Understanding the need for protection of fragile cold environments. Reasons for protection: indigenous people live traditional lives, depending on wildlife; many species of birds and animals are threatened; areas are important for scientific research; snow reflects sunlight and helps regulate temperatures; permafrost contains methane, which if released could worsen global warming. Role of sustainable management, appropriate technology, international agreements, conservation strategies to protect cold environments.
- Evaluation of risk to environment from human activity. The tundra environment is among the least disturbed ecosystems in the world. However, that is changing with the discovery of large reserves of raw materials. Any damage to the tundra landscape is slow to recover. The greatest threat may be the impact of human-induced climate change.

Question 4

Outline one way that plants are adapted to the climate in either hot deserts or cold environments.

Hot deserts

Plant roots may be extremely long (1) to reach deep water supplies (d) (1).
Roots may be spread out very wide near the surface (1) to catch as much water as possible when it rains (d) (1).
Many plants, (eg cacti) are succulents (1). They have large, fleshy tems for storing water (d) (1) and thick waxy skin to reduce water loss (d) (1).
Some plants have small leaves (1) reducing water loss (d)(1).
The seeds of some plants only germinate when it rains (1)
which means they only grow when there's enough water to survive (d)(1).

Cold environments

Most plants become dormant (1) to survive the cold, dark winters (d) (1).
Plants are small/round-shaped (1) to provide protection from the wind (d) (1).
Most plants have shallow roots (1) because of the layer of permafrost/ice beneath the soil layer (d) (1).
Leaves are generally small (1) to limit the amount of moisture lost (d) (1).
Many plants use underground runners or bulbs instead of seeds (1) because the growing season is so short (d) (1).

Credit valid points about one environment only.

Max 1 mark for two separate points.

No credit for reference to animal adaptation.

Question 5

Assess the importance of inaccessibility and extreme temperatures as challenges to development in one of the following environments.

Hot desert environment **Cold environment**

Use a case study and your own understanding.

<u>Mark Scheme – Hot desert environment</u>

- **Level 3 (5-6)(detailed)** responses will be well developed and make accurate use of geographical terms. Reasoned evaluation of challenges to development in hot deserts with clear case study support.

Indicative content - Hot desert environment

- The command “assess the importance” means that responses may state the degree to which one or more challenges affect economic development, with some support for the view expressed. Eg the statement may be completely untrue, true to some extent (partly but not completely true), to a great extent, or completely true.
- Understanding of challenges to development:
  Extreme temperatures. Due to the lack of cloud cover, daily temperatures can range from over 40 °C during the day to below freezing at night. Exposure to high temperatures can cause illness or death, and healthcare may be a long distance away.
  Inaccessibility. Some hot deserts are huge – people and materials have to travel long distances, often by air, which is expensive. It’s difficult to
  provide services, eg medical care, to remote regions, making it hard for
  them to develop. Expensive pipelines have to be built to transport oil and gas from remote areas.
- Case study support eg Thar Desert. Extreme temperatures – temperatures in the Thar Desert can exceed 50°C in the summer months. It is hard for people to farm, work in mines or as tourist guides during these months as it is simply too hot. This makes development difficult.
- Inaccessibility – the desert covers a huge area of 200 000 sq km. Most of the desert is inaccessible due to the extreme environmental conditions and poor infrastructure. Beyond the city of Jaisalmer, development is limited. This has created a honeypot site for tourists in Jaisalmer but not beyond. Inaccessibility to many parts of the desert has led to greater differences between rich and poor.
- Evaluation should consider the importance of one or more factors in
  limiting development.

Mark Scheme – Cold environment

- **Level 3 (5-6)(detailed)** responses will be well developed and accurate use of geographical terms. Reasoned evaluation of challenges to development in cold environments with clear case study support.
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Indicative content - Cold environment

- The command “assess the importance” means that responses may state the degree to which one or more challenges affect economic development, with some support for the view expressed. Eg the statement may be completely untrue, true to some extent (partly but not completely true), to a great extent, or completely true.
- Understanding of challenges to development:
  Extreme temperatures. Mean annual temps are well below freezing.
  Extreme weather such as snow and strong winds are common. Exposure to the extreme cold can cause injury or death, and healthcare may be a long distance away. Cold environments are subject to extremes in the amount of daylight – in winter, it can be dark nearly all the time. In the summer, when the active layer thaws, buildings can subside and transport routes become damaged.
  Inaccessibility. Some areas are extremely remote, and the mountainous
  land makes access difficult and expensive. In winter, the only way to get to some towns is via air or dangerous ice roads. In summer, there are no roads to some towns because the ground is too soft. People in small towns may be a long way from employment opportunities or services.
- Case study support eg Svalbard temperatures can fall below –30 °C.
  Extreme temperatures make it dangerous to work outside, with a serious risk of frostbite.
- Accessibility. Svalbard is located in a remote part of Europe and can only be reached by plane or ship. The islands themselves are inaccessible and almost all transport systems are restricted to the immediate area around Longyearbyen. There is one airport close to Longyearbyen capable of handling international flights. There is 50 km of road in Longyearbyen. No roads serve the other outlying communities. Most people use snowmobiles, particularly in the winter.
- Evaluation should consider the importance of one or more factors in
  limiting development. Expect a range of views. Extreme cold may be
  considered as the most significant factor. There is virtually no settled
  population in many cold environments.