



GEO.PH5 Cold Environments

AQA 8035 · Calculator allowed · about 65 minutes

Total Marks

Name: _____ Date: ____ / ____ / ____

Answer ALL questions. Show all your working.

1 This question is about the characteristics of cold environments.

(a) State ONE characteristic of a polar climate (such as the Antarctic or the Arctic Ocean). (1)

(b) State ONE characteristic of a tundra climate. (1)

(c) Name one region of the world that has a tundra climate. (1)

(Total for Question 1 is 3 marks)

2 Explain what is meant by permafrost, and describe how it affects tundra vegetation.

(Total for Question 2 is 4 marks)

3 This question is about how organisms are adapted to survive in cold environments.

(a) Describe TWO ways plants are adapted to survive in a tundra environment. **(4)**

(b) Describe TWO ways animals are adapted to survive in a cold environment. **(4)**

(Total for Question 3 is 8 marks)

4 Explain why cold environment ecosystems are described as fragile.

(Total for Question 4 is 3 marks)

5 This question is about the opportunities cold environments provide for economic development.

(a) Describe one opportunity for mineral or energy extraction in a cold environment. **(2)**

(b) Describe one opportunity for tourism in a cold environment. **(2)**

(c) Describe one opportunity for scientific research in a cold environment. **(2)**

(Total for Question 5 is 6 marks)

6 Explain TWO challenges of developing cold environments.

(Total for Question 6 is 4 marks)

7 Explain why permafrost thaw is a particular engineering challenge for buildings and roads in cold environments.

(Total for Question 7 is 3 marks)

8 Table 1 shows illustrative, hypothetical figures for a cold-environment territory's land area and population. These figures are for practice only.

Territory	Land area (square kilometres)	Population
Territory X	62,000	2,600

(a) Calculate the population density of Territory X, in people per square kilometre. (2)
Give your answer to two decimal places.

(b) Suggest one reason why the population density calculated in part (a) is so low. (2)

(Total for Question 8 is 4 marks)

9 This question is about a named cold environment you have studied.

(a) Name a cold environment you have studied, and state its location. (2)

(b) Describe TWO ways Svalbard's economy has developed. (4)

(Total for Question 9 is 6 marks)

10 Using the same cold environment named in your answer to Question 9, explain TWO strategies used to protect its fragile environment while still allowing some development.

(Total for Question 10 is 5 marks)

11 Explain why an oil spill would take much longer to break down (biodegrade) in a cold environment than in a warmer climate.

(Total for Question 11 is 3 marks)

12 Use the case study of Svalbard (or another named cold environment you have studied) to answer this question.

'The challenges of developing cold environments are greater than the opportunities.' Assess the extent to which you agree with this statement.

(Total for Question 12 is 8 marks)

Mark scheme · GEO.PH5 Cold Environments

Question 1

- (a) **B1** any valid characteristic, e.g. extremely low temperatures all year, often well below 0 degrees C, oe
- (a) **Answer: For example, extremely low temperatures all year, often well below 0 degrees C.**
- (b) **B1** any valid characteristic, e.g. very cold winters and short, cool summers, with a short growing season, oe
- (b) **Answer: For example, very cold winters and short, cool summers, with a short growing season.**
- (c) **B1** any correctly named tundra region, e.g. northern Alaska, northern Canada, northern Russia (Siberia), or Svalbard, oe
- (c) **Answer: For example, northern Alaska.**

Question 2

- **B1** permafrost is ground that stays permanently frozen throughout the year, oe
- **B1** only a thin surface layer, the active layer, thaws in summer, oe
- **B1** because the ground beneath stays frozen and solid, plant roots cannot grow deep, oe
- **B1** so tundra vegetation is limited to shallow-rooted plants such as mosses, lichens and small, low-growing shrubs, oe
- **Answer: Permafrost is ground that stays permanently frozen throughout the year; only a thin surface layer, the active layer, thaws in summer. Because the frozen ground beneath prevents roots growing deep, tundra vegetation is limited to shallow-rooted plants such as mosses, lichens and small, low-growing shrubs.**

Question 3

- (a) **B1** adaptation 1 named, e.g. shallow roots, oe
- (a) **B1** linked function, e.g. permafrost prevents roots growing deep, so plants must spread roots sideways near the surface, oe
- (a) **B1** adaptation 2 named, e.g. low, compact growth (e.g. cushion-shaped plants), oe
- (a) **B1** linked function, e.g. growing close to the ground reduces exposure to strong, cold winds and helps retain heat, oe
- (a) **Answer: For example: shallow roots, since permafrost prevents roots growing deep, so plants spread sideways near the surface; and low, compact (cushion-shaped) growth, which reduces exposure to strong, cold winds and helps retain heat.**
- (b) **B1** adaptation 1 named, e.g. a thick layer of fat (blubber) or fur, oe
- (b) **B1** linked function, e.g. this insulates the animal, reducing heat loss in extreme cold, oe
- (b) **B1** adaptation 2 named, e.g. small ears/short limbs, or white fur, oe
- (b) **B1** linked function, e.g. small extremities reduce the surface area from which heat can be lost, and white fur provides camouflage against snow, oe
- (b) **Answer: For example: a thick layer of fat (blubber) or fur, which insulates the animal and reduces heat loss; and small ears or short limbs, which reduce the surface area from which heat can be lost, while white fur provides camouflage against snow.**

Question 4

- **B1** the extreme cold means growth and decomposition happen very slowly, oe
- **B1** so plants and animals affected by damage (e.g. pollution, vehicle tracks, an oil spill) take a very long time to recover, if they recover at all, oe
- **B1** food webs are also relatively simple, with few species, so the loss of even one species can have a large knock-on effect on others, oe
- **Answer: The extreme cold means growth and decomposition happen very slowly, so damage such as pollution or vehicle tracks takes a very long time to recover from; food webs are also relatively simple, with few species, so losing even one species can have a large knock-on effect.**

Question 5

- (a) **B1** opportunity named, e.g. oil and gas extraction, oe
- (a) **B1** linked detail, e.g. large reserves have been found beneath the Arctic and its surrounding land, which can be extracted and piped to markets, oe
- (a) **Answer: For example, oil and gas extraction; large reserves have been found beneath the Arctic and its surrounding land, which can be extracted and piped to markets.**
- (b) **B1** tourists are attracted by the distinctive landscape and wildlife, e.g. glaciers, polar bears, or the Northern Lights, oe
- (b) **B1** this can create jobs and income for local people, e.g. as tour guides, or through hotels and cruise ships, oe
- (b) **Answer: The distinctive landscape and wildlife, such as glaciers, polar bears or the Northern Lights, attract tourists, creating jobs and income for local people as guides or through hotels and cruise ships.**
- (c) **B1** cold environments provide a unique setting to study climate change, ice, and species found nowhere else, oe
- (c) **B1** international research stations are built to carry out this research, bringing scientists, jobs and funding to the area, oe
- (c) **Answer: Cold environments provide a unique setting to study climate change, ice and species found nowhere else, so international research stations are built there, bringing scientists, jobs and funding to the area.**

Question 6

- **B1** challenge 1, e.g. extreme cold and long, dark winters make outdoor construction and daily life difficult, oe
- **B1** challenge 2, e.g. remoteness, since cold environments are often far from major population centres, with few roads, making transport of goods, workers and equipment slow and expensive, oe
- **B1** challenge 3, e.g. permafrost can thaw beneath heated buildings and roads, causing the ground to become unstable and structures to subside or crack, oe
- **B1** any further valid, distinct challenge, e.g. the fragile ecosystem means development must be carefully managed to avoid long-lasting environmental damage, oe
- **Answer: For example: extreme cold and long, dark winters make outdoor construction and daily life difficult; and remoteness, with few roads, makes transporting goods, workers and equipment slow and expensive.**

Question 7

- **B1** heat from a heated building, or from a road absorbing sunlight, can transfer into the ground beneath it, oe
- **B1** this can cause the permafrost immediately below to thaw, even though the surrounding ground stays frozen, oe
- **B1** as the thawed ground loses its strength and can subside unevenly, the building or road above can crack, tilt or become structurally unsafe, oe
- **Answer: Heat from a building, or a dark road surface absorbing sunlight, can transfer into the ground beneath it, thawing the permafrost immediately below even though the surrounding ground stays frozen; the thawed ground loses strength and can subside unevenly, causing the structure above to crack, tilt or become unsafe.**

Question 8

- (a) **M1** 2600 / 62000 seen, oe
- (a) **A1** 0.04 people per square kilometre cao
- (a) **Answer: 0.04 people per square kilometre.**
- (b) **B1** extreme cold and a harsh, fragile environment make permanent settlement difficult, oe
- (b) **B1** limited economic opportunities outside mining, research and tourism mean few people are drawn to live there long-term, oe
- (b) **Answer: The extreme cold and harsh, fragile environment make permanent settlement difficult, and with limited economic opportunities outside mining, research and tourism, few people are drawn to live there long-term.**

Question 9

- (a) **B1** Svalbard
- (a) **B1** an archipelago (group of islands) in the Arctic Ocean, part of Norway
- **(a) Answer: Svalbard, an archipelago in the Arctic Ocean, part of Norway.**
- (b) **B1** names Svalbard consistently
- (b) **B1** way 1, e.g. coal mining historically supported the main settlement of Longyearbyen, oe
- (b) **B1** way 2, e.g. tourism (e.g. cruise ships, wildlife and glacier tours) has grown as an alternative source of income and jobs, oe
- (b) **B1** way 3, e.g. scientific research is a major activity, including at the international research settlement of Ny-Alesund, oe
- **(b) Answer: In Svalbard: coal mining historically supported the main settlement, Longyearbyen; tourism (e.g. cruise ships, wildlife and glacier tours) has grown as an alternative source of income and jobs; and scientific research is a major activity, including at the international research settlement of Ny-Alesund.**

Question 10

- **B1** names the same location consistently
- **B1** strategy 1, e.g. large protected areas/nature reserves cover much of Svalbard, restricting building and vehicle access in the most sensitive zones, oe
- **B1** linked detail, e.g. this protects habitats for species such as polar bears, oe
- **B1** strategy 2, e.g. strict rules govern tourism and research activity, such as required safety/environmental guidance and limits on where visitors can travel, oe
- **B1** linked detail, e.g. this reduces the risk of pollution, disturbance to wildlife, and damage to the slow-recovering ecosystem, oe
- **Answer: In Svalbard: large protected areas and nature reserves cover much of the archipelago, restricting building and vehicle access to protect habitats for species such as polar bears; and strict rules govern tourism and research activity, limiting where visitors can travel to reduce pollution, disturbance to wildlife and damage to the slow-recovering ecosystem.**

Question 11

- **B1** the bacteria that naturally break down oil work more slowly in very cold temperatures, oe
- **B1** oil itself also becomes thicker and more viscous in the cold, making it harder for these processes to act on it, oe
- **B1** as a result, spilled oil can persist in the cold environment for a very long time, causing prolonged damage to the fragile ecosystem, oe
- **Answer: The bacteria that naturally break down oil work more slowly in very cold temperatures, and the oil itself becomes thicker and more viscous in the cold, so spilled oil can persist for a very long time, causing prolonged damage to the fragile ecosystem.**

Question 12

- **Level 4** (7-8): A detailed, well-balanced assessment that uses accurate, detailed reference to a named cold environment; weighs specific opportunities against specific challenges and reaches a clear, justified conclusion about the extent of agreement.
- **Level 3** (5-6): A clear assessment that uses accurate reference to a named cold environment; both opportunities and challenges are considered, and a conclusion is reached, though the weighing of one against the other may be less developed.
- **Level 2** (3-4): Some relevant opportunities and/or challenges are described, with limited or generalised use of a named example; a simple conclusion is given with little justification.
- **Level 1** (1-2): One or two isolated relevant points about cold environment development are made, with little or no use of a named example.
- **Level 0** (0): No relevant content.
- **Indicative content:**
 - Opportunities in Svalbard include: coal mining historically supporting Longyearbyen; a growing tourism industry (cruises, wildlife, glaciers); and significant scientific research activity, including the international research settlement of Ny-Alesund.
 - Challenges in Svalbard include: extreme cold and long, dark winters making construction and daily life difficult; remoteness raising transport costs; permafrost thaw threatening buildings and infrastructure; and a fragile ecosystem that is slow to recover from any damage, such as an oil spill.
 - Agrees with the statement: the extreme physical conditions (cold, remoteness, permafrost) and the fragility of the ecosystem mean that development is costly, difficult and risks lasting environmental harm, limiting how much can realistically be developed compared with a less extreme environment.
 - Disagrees with the statement: the growth of tourism and research in Svalbard shows that, with careful management (protected areas, strict activity rules), meaningful economic activity can be sustained without needing large-scale, high-risk industrial development such as extensive mining.
 - A balanced answer recognises that the balance may depend on the TYPE of development considered, e.g. low-impact tourism and research being more viable than large-scale resource extraction in such a fragile environment.
 - A well-supported conclusion should state a clear judgement on the extent of agreement, backed by specific evidence from the named case study.