

91429R



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

Level 3 Geography, 2018

91429 Demonstrate understanding of a given environment(s) through selection and application of geographic concepts and skills

9.30 a.m. Friday 23 November 2018

Credits: Four

RESOURCE BOOKLET

Refer to this booklet to answer the questions for Geography 91429.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

RELEVANT GEOGRAPHIC CONCEPTS

Environments

May be natural and / or cultural. They have particular characteristics and features which can be the result of natural and / or cultural processes. The particular characteristics of an environment may be similar to and / or different from another. A cultural environment includes people and / or the built environment.

Perspectives

Ways of seeing the world that help explain differences in decisions about, responses to, and interactions with, environments. Perspectives are bodies of thought, theories, or world views that shape people's values and have built up over time. They involve people's perceptions (how they view and interpret environments) and viewpoints (what they think) about geographic issues. Perceptions and viewpoints are influenced by people's values (deeply held beliefs about what is important or desirable).

Processes

A sequence of actions, natural and / or cultural, that shape and change environments, places, and societies. Some examples of geographic processes include erosion, migration, desertification, and globalisation.

Patterns

May be spatial (the arrangement of features on the Earth's surface) or temporal (how characteristics differ over time in a recognisable way).

Interaction

Elements of an environment affecting each other and being linked together. Interaction incorporates movement, flows, connections, links, and interrelationships which work together and may be one- or two-way interactions. Landscapes are the visible outcome of interactions. Interaction can bring about environmental change.

Change

Any alteration to the natural or cultural environment. Change can be spatial and / or temporal. Change is a normal process in both natural and cultural environments. It occurs at varying rates, at different times and in different places. Some changes are predictable, recurrent, or cyclic, while others are unpredictable or erratic. Change can bring about further change.

Sustainability

Adopting ways of thinking and behaving that allow individuals, groups, and societies to meet their needs and aspirations without preventing future generations from meeting theirs. Sustainable interaction with the environment may be achieved by preventing, limiting, minimising, or correcting environmental damage to water, air, and soil, as well as considering ecosystems and problems related to waste, noise, and visual pollution.

GREENLAND'S NATURAL ENVIRONMENT

RESOURCE A: Location

Greenland, the world's largest island (land area of 2 166 086 square kilometres), lies in the North Atlantic Ocean. Greenland is separated from Canada's Ellesmere Island to the north by only 26 km. The nearest European country is Iceland, lying about 320 km across the Denmark Strait to the southeast.



The areas that have not yet been explored are thought to have more resource potential, but the ice sheet and harsh climate have long limited possible exploitation. However, as the sea ice melts, locations for oil and natural gas exploration have become more accessible, and more areas of land for the mining of minerals such as gold and uranium have also opened up.



Figure 2: Greenland and Arctic sea ice in 2015



Contours show elevations of the ice sheet surface.

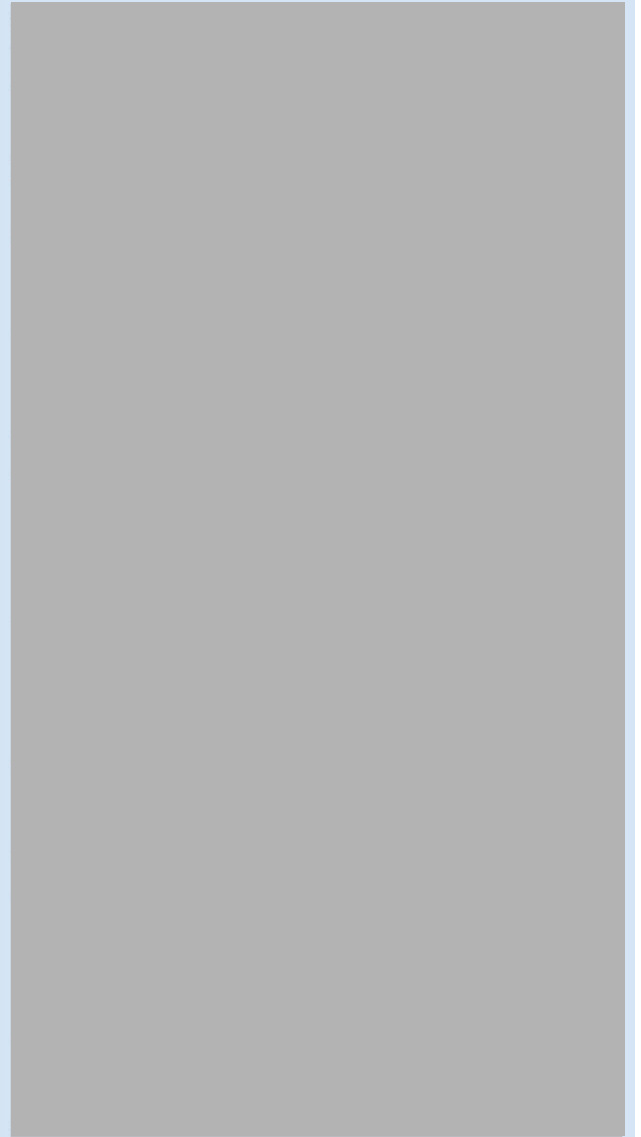


Figure 3: Greenland, showing the surface elevations of the ice sheet, and the Arctic Circle

RESOURCE B: Climate

The climate of Greenland is classified as Arctic. Large areas of the island are classified as Arctic deserts due to their limited precipitation.

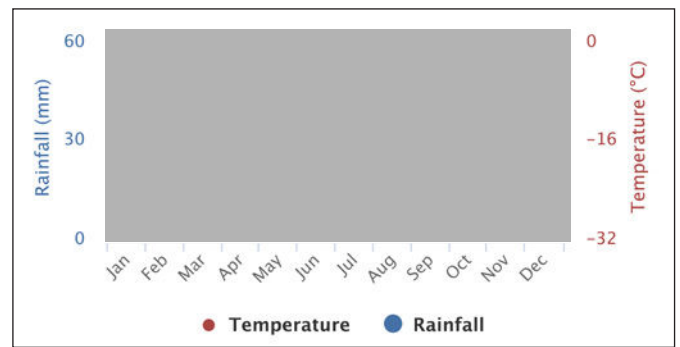


Figure 4: Average monthly temperature and rainfall for Greenland, 1901–2015

RESOURCE C: Permafrost

Permafrost is where moisture in the underlying ground and soil is frozen. In the coldest, most northerly parts of Greenland, continuous thick permafrost cover is present where there is no ice sheet. As temperatures begin to approach and fluctuate around 0°C, as distance from the North Pole increases, permafrost cover becomes discontinuous and eventually sporadic in cover.

Continuous permafrost is where ground consists of 100 per cent permafrost (except under deep lakes), found mainly within the Arctic Circle where average annual temperatures are below -5°C and winter temperatures may plummet to as low as -50°C. In the coldest parts, permafrost reaches depths in excess of 500 m, even up to 1500 m deep in parts of Greenland.

Discontinuous permafrost has patches of unfrozen ground, usually under south facing slopes and warmer water bodies, and is found where mean temperatures lie between -5°C and -1°C. Coverage of permafrost is not as thick, and is patchier than that in colder zones.



Figure 5: Zones of permafrost in the Northern Hemisphere

RESOURCE D: Mass loss of the Greenland Ice Sheet, 2002 to 2017

The Arctic region is warming twice as fast as the rest of the world. The global rises in temperature are, in part, responsible for changes to the Greenland Ice Sheet, with an estimated 1 trillion (10^{12}) tonnes of ice lost between 2011 and 2014 alone.

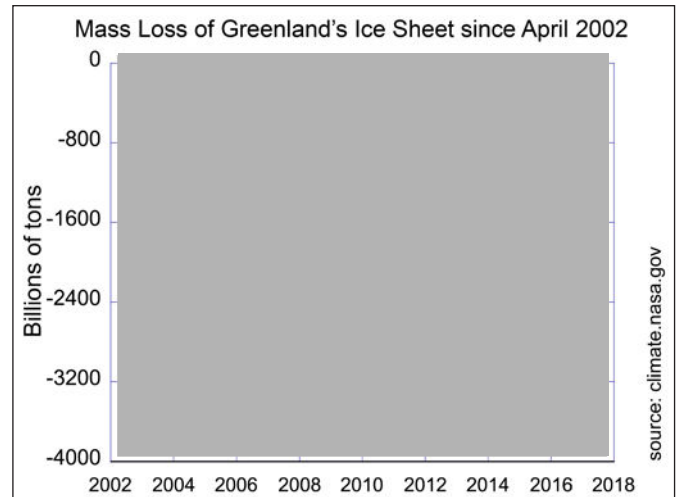


Figure 6



Figure 7: Comparison of the melt extent of the Greenland Ice Sheet in 1992 and 2005

GREENLAND'S CULTURAL ENVIRONMENT

RESOURCE E: Government, People, and Economy

Government

While Greenland officially remains a part of the Kingdom of Denmark, it was granted home rule in 1979, which meant Denmark kept control of the island's constitutional affairs, foreign relations, and defence, but allowed Greenland to take control of its economic development, taxes, education, and social welfare system.

People

The Greenlandic people are primarily of Inuit or Eskimo descent and account for almost 90% of the 56 000 people who live there. The Inuit are long-established fishers and hunters. As people from Greenland hold Danish citizenship, they are easily able to move to Denmark, which is the more prosperous of the two countries, and has a higher standard of living, with more job opportunities.

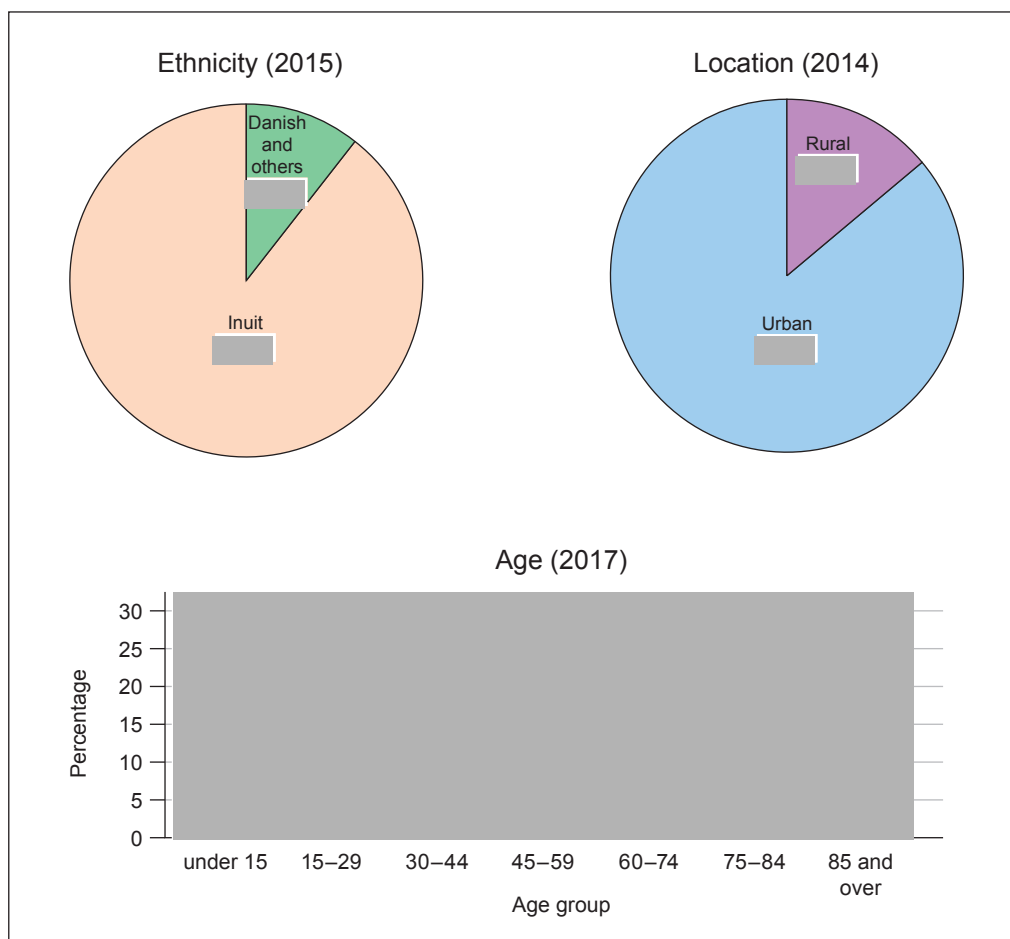


Figure 8: Demographic information on Greenland's population

Economy

Greenland's economy has long been based on fishing, which accounts for 90% of its exports. The fishing industry is susceptible to problems of overfishing and fluctuating prices, so Greenland attempted to diversify its economy, and began developing the tourist industry in the 1990s.

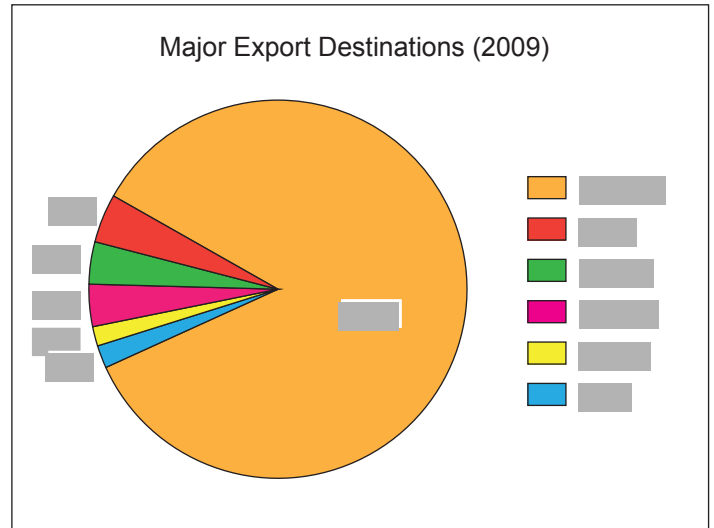


Figure 9

Nearly half the work force is employed in the public sector. Agriculture is only possible on about 1% of Greenland's total area, in the southern ice-free regions.

RESOURCE F: Employment and unemployment in Greenland

	2008	2009	2010	2011	2012	2013	2014	2015
Fishing, hunting & agriculture								
Mining & quarrying								
Manufacturing								
Electricity & water supply								
Construction								
Hotels & restaurants								
Transportation								
Wholesale & Business activities								
Public administration & service								
Other industries								
Total employed								

Figure 10: Employment statistics for selected industries in Greenland, 2008–2015

Year	Number
2010	
2011	
2012	
2013	
2014	
2015	

Figure 11: Unemployment in Greenland (permanent residents aged 18–64 years), 2010–2015

MINING POTENTIAL AND THE FUTURE OF GREENLAND

RESOURCE G: Potential for changes

Due to the rise of temperatures and subsequent melting of the ice sheet and glaciers, the available area for the extraction of minerals and natural resources in Greenland is rapidly increasing. This is leading to the arrival of small scale mining companies and exploration wells.



RESOURCE H: Minerals and potential mining areas in Greenland



Au	Gold	Cu	Copper
Fe	Iron	Mo	Molybdenum
Nb	Niobium	Ni	Nickle
Pb	Lead	Ta	Tantalum
U	Uranium	Zn	Zinc
Zr	Zirconium	PGE	Platinum Group Elements

Figure 12: Minerals found in Greenland

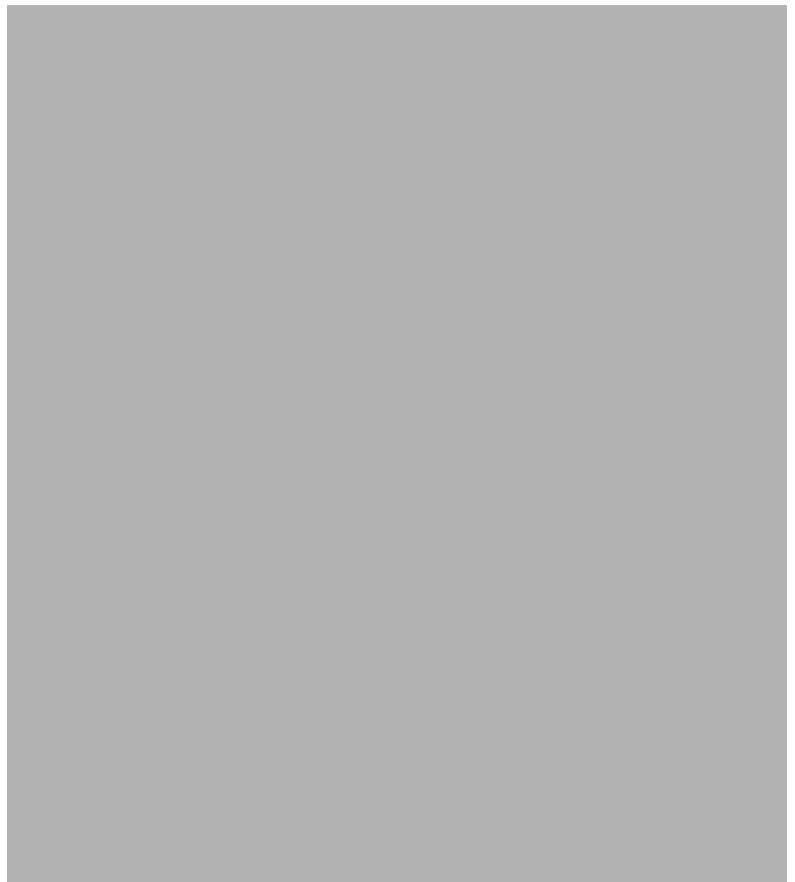




Figure 13: Mining areas and mining companies in Greenland

RESOURCE I: Uranium mining in Greenland

In October 2014, Greenland's first female prime minister, Aleqa Hammond, pushed legislation through Parliament to overturn a 25-year-old ban on the extraction of radioactive materials, including uranium. The vote was narrowly won by 15 votes to 14. At the time she stated "I simply refuse to be the victimised people of climate change" in an interview with *Business Week*. "This time we have other options than just hunting. We have the right now to our own underground." Many non-governmental organisations urged Greenland to rethink this decision, due to concerns about the management of such a toxic substance as uranium.



Narsaq has a population of approximately 1500 people, which has decreased by 10% over the last ten years. This area suffers the highest unemployment rate in Greenland. Like much of Greenland, it has traditionally made its living from fishing and hunting, and also more recently farming for lamb. Many of the locals believe that this area is in a downward spiral due to the lack of employment opportunities and residents moving to larger cities in search of a better lifestyle. When its largest employer, a shrimp processing plant, closed a few years ago after the shrimp population fled to cooler northern waters, the town lost over 80 jobs.




Figure 14: Narsaq in Greenland

RESOURCE J: The battle to mine uranium – a country divided

NOAH Friends of the Earth Denmark

A protest organised by Friends of the Earth was held in 2014 in Greenland's capital of Nuuk and attended by approximately 500 people after the uranium mining ban was overturned. There are concerns that radioactive waste from the mining process would endanger fisheries and farmland in the region, both of which are vital for local communities.



Figure 15: Friends of the Earth march in Copenhagen

Greenland Minerals and Energy (GME)

GME is an Australian-owned company which has spent nearly US\$80 million making plans for an open pit rare earth minerals and uranium mine in Kvanefjeld, near Narsaq. GME is promoting this mine as a positive step towards creating a new global green economy.



Figure 16: A GME work camp on Kvanefjeld

Greenland government

Currently the Greenland government relies on a Danish subsidy to make up half of its budget to spend on social welfare, education, and healthcare. Fishing is the main industry but supply and demand are unreliable, which is problematic. As the population ages over the next 20 years, Greenland faces steadily increasing social welfare costs. In 2013, Parliament voted to remove the ban on mining uranium in Greenland, opening the door to many more mining projects and helping it to gain more economic independence from Denmark.

Local people of Narsaq


In the areas surrounding Narsaq, there are enough green fields to make sheep farming profitable. Local couple Klaus Frederiksen and Avaiaja Lennert have 600 sheep on 70 acres of land. There are concerns that radioactive dust will fall on neighbouring settlements and

farmland, as occurred in Norway after the fallout from Chernobyl in Ukraine.



RESOURCE K: Climate change and Greenland's future

Currently the ice sheet covers 80% of Greenland's land area. As it melts, it allows Greenland to become a more viable travel destination. With its unique landscape, remote location, and growing global awareness as a symbol of climate change, tourism is growing in this part of the Arctic. It is predicted that by 2027, the number of tourists visiting Greenland each year could reach 90 000, doubling the amount that arrived in 2016. This figure does not include cruise-ship passengers, which accounted for an additional 24 000 tourists in 2016. However, tourism remains extremely seasonal within Greenland with the high summer season (mid June to early September) suffering from problems of too many tourists and a lack of infrastructure available to support them.



But tourism might be just the thing to get the world to take global warming seriously, says Milfeldt. "If people come to Greenland and see how much the glaciers have been retreating and realise it's for real, and change the way they use energy, then maybe the net benefit will be for the globe, for the climate." In that case, the real question isn't whether people should travel, but how they should live when they get back home.

Acknowledgements

Material from the following sources has been adapted for use in this examination:

Resource A

Text:

- <https://www.britannica.com/place/Greenland>
- https://www.cia.gov/Library/publications/the-world-factbook/geos/print_gl.html

Figure 1: <https://www.britannica.com/place/Greenland>

Figure 2: <https://svs.gsfc.nasa.gov/4592>

Figure 3: <https://static1.squarespace.com/static/53109b11e4b05040160f0a8f/t/55f80ec0e4b0a209351742ad/1442320064559/Glacial+Environments.pdf>

Resource B

Figure 4: http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCCode=GRL

Resource C

Geography Factsheet 340: Periglacial Environments Part 1 – An Introduction. Curriculum Press GEA-FSPI-340

Resource D

Text and Figure 6: <http://nsidc.org/greenland-today/2017/09/late-summer-melting-spike/>

Figure 7: www.giss.nasa.gov/research/briefs/legrande_02/figure-1.jpg

Resource E

Text: <https://www.britannica.com/place/Greenland>

Resource F

Figure 10: www.stat.gl/publ/en/GF/2017/pdf/Greenland%20in%20Figures%202017.pdf

Figure 11: http://bank.stat.gl/pxweb/en/Greenland/Greenland__AR__AR40/ARXLED3.px/table/tableViewLayout1/?rxid=ARXLED322-08-2018%2006:44:28

Resource H

Figure 12: <http://www.nature.com/news/cold-truths-at-the-top-of-the-world-1.19760>

Figure 13: www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/greenlands-resource-map/article9753424/

Resource I

Text:

- <http://www.world-nuclear.org/information-library/nuclear-fuel-cycle/introduction/what-is-uranium-how-does-it-work.aspx>
- <http://www.world-nuclear.org/our-association/publications/pocket-guides/pocket-guide-uranium.aspx>
- <https://www.theguardian.com/commentisfree/2008/dec/05/nuclear-greenpolitics>
- <http://www.bbc.com/news/magazine-25421967>
- <https://www.theguardian.com/commentisfree/2014/may/15/australian-uranium-mining-in-greenland-is-tearing-the-country-in-half>
- <http://www.ecocouncil.dk/en/releases-3/109-economy-and-politics/2121-rare-earth-elements-can-be-extracted-in-greenland-without-uranium>

Figure 14: <https://www.theguardian.com/environment/2017/jan/28/greenland-narsaq-uranium-mine-dividing-town>

Resource J

Text:

- <http://www.foeeurope.org/saving-greenlands-pristine-environment-uranium-mining-010814>
- <https://www.brookings.edu/wp-content/uploads/2016/06/24-greenland-energy-mineral-resources-boersma-foley-pdf-2.pdf>
- <https://www.theguardian.com/environment/2017/jan/28/greenland-narsaq-uranium-mine-dividing-town>

Figure 16: http://gme.gl/sites/default/files/IMG_0201.JPG

Resource K

Text:

- <https://www.smithsonianmag.com/travel/climate-change-tourism-in-greenland-74303453/>
- <https://www.arcticnow.com/business/2017/01/10/as-tourism-to-greenland-grows-the-country-looks-to-grow-tourism-infrastructure-to-match/>
- <https://www.slideshare.net/BTOEducational/visit-greenland-tourism-strategy-2016-2019>